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ARCHITECTURAL RESEARCH *Current Studies and Future Trends*

Editor: Assoc. Prof. Dr. Semra ARSLAN SELÇUK

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ARCHITECTURAL RESEARCH Current Studies and Future Trends

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FOREWORD

Today, rapidly developing technologies, interdisciplinary and transdisciplinary research carried out in every field directly affecting the design and production processes in the discipline of architecture. This book has been designed with the theme of the present and future of research in the field of architecture and was created with contributions from the disciplines of architecture, planning, landscape architecture and interior architecture.

The chapters in the book show that one of the most fundamental research areas of the architectural discipline today is "sustainability" and the methods and technologies used for this purpose. It is clear that decreasing resources, increasing population and environmental problems are the main agenda of today's architectural researches as well as the focus of future studies.

We would like to thank the authors who have contributed to this book for their valuable chapters and the staff of Livre de Lyon Publishing House for their support in the publication process.

Semra ARSLAN SELÇUK
Güneş MUTLU AVİNÇ
Ayşenur COŞKUN

CONTENTS

CHAPTER 1

THE USE OF INFORMATION TECHNOLOGIES IN CONSTRUCTION INDUSTRY AND FUTURE TRENDS

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1. Introduction

The business environment is changing rapidly as the consequence of advancing information technologies. For the last decades, information technologies are shaping the way of doing business for almost every sector. Adapting and adopting these systems is getting more and more important for organisations that are striving for success.

In parallel, structure of the construction industry is changing as well. Projects are getting larger and they are becoming harder to manage. Moreover, construction organisations are being forced to perform many projects simultaneously to compete and survive in the sector. Therefore, they need to cooperate the managemental issues more efficiently. Another thing is, as the projects are getting larger, the number of project participants are increasing and more information is produced by different stakeholders in different phase and processes. Consequently, this situation is resulting to a multi directional information flow as it can be seen in Figure 1.

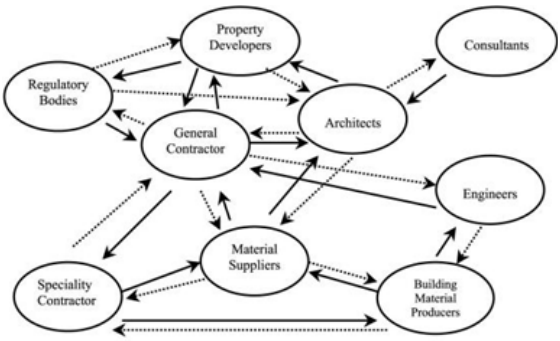

Figure 1. Information flow in a construction project

Construction industry has its own dynamics and production methods. Construction projects generate large amounts of information in the process of each unique production. Although, many companies of the construction industry, unlike the other economically leading sectors, do not generally follow the changes and advances in technology; the use of information technologies in the construction sector provides major advantages in efficiency, collaboration, coordination and information exchange between stakeholders for the ones who use it.

The aim of this study is to emphasize the importance of using information technologies in construction industry and to explore future trends. The study builds on literature review. Firstly, information, information technology (IT) and information system (IS) terms are explained. Next, the use of information technologies in construction industry is investigated. Then, potential advantages of using IT and appropriate application areas are explored. Finally, the future of information technologies in construction industry is discussed.

2. Information, Information Technology (IT) and Information System (IS)

Information can be described as data that is interpreted in a meaningful context or knowledge that is derived from data (Kroenke, 2007). Information systems (IS) and information technologies (IT) play important part in the success of organisations. Although, definitions of both are related and used interchangeably in practice, in fact they have some differences that separate each other.

IT is related to the products, methods, inventions, and standards that are used for the purpose of producing information (Kroenke, 2007). IT can be defined as the preparation, collection, transport, retrieval, storage, access, presentation, and transformation of information in all its forms like voice, graphic, text, video, and image. Information movement can take place between humans, humans and machines, and/or between machines (Kornkaew, 2012).

IS is consisted of information technology infrastructure, application systems and personnel who employ information technology to deliver information and communications services for transaction processing/operations and administration/management of an organisation (Baskerville, Stage and DeGross, 2000). Therefore, IS is the set of interacted components to produce information. As seen in Figure 2, IS includes hardware, software, data, procedures and people. Information system means a system of communication between people and information technology (as hardware and software) is one significant component in an information system (Kornkaew, 2012). As Marchand (2000) summed up, IT is primarily concerned with the infrastructure and IS focuses on the application of the technology.

Figure 2. Main components of an information system

Information systems impact all the aspects of an organisation. These impacts would be positive or negative, intended or unintended, individual or collective. The success highly depends how well the system is aligned with organisation and how well it is designed and executed. The impacts of implementing an information system on an organization can be summarized as (Kornkaew, 2012; Lucey, 2005; Chan, 2000; Rikhardsson and Kraemmergaard, 2006; Davies, 2009; Gurbaxani and Whang, 1991):

- Modifies the skills requirements for individuals and changes job descriptions and the way of doing operations as a result.
- Adjusts relationships between individuals and divisions, as well as between organisations in a supply chain.
- Leads to organizational transformation in terms of structure.
- Leads to managemental transformation.
- Reduces communication and coordination costs by enhancing the quality and speed of information and decision making process
- Increases data quality, flexibility, integration, work monitoring, coordination and management of knowledge.
- Decreases the level of individual and social interactions between workers.

3. The Use of Information Technologies in Construction Industry

Construction industry generates large amounts of information in the processes of each unique production. In a construction life-cycle, many information is produced and consumed by the stakeholders that come together for the specific project. The most of these information are uniquely tied to a temporary project This information include design drawings, reports, technical documents, communication documents like e-mails, specifications, cost analysis, schedules, site surveys, legal papers, etc. Information is produced and gathered in all stages from the very beginning until the end of the project. So, coordination and management of produced information is very important, also is a real hard

task, for the success of the project. Yet, construction sector is very cautious and distant to information technologies and slow in adaptation of technological innovations. Therefore, construction industry lags behind other sectors when it comes to digitalization as it can be seen on Figure 3.

Figure 3. Industry Digitization Index (Agarwal *et al.,* 2016)

Although, many companies of the construction industry, unlike the other economically leading sectors, do not generally follow the changes and advances in technology; IT usage in the construction sector provides major advantages for the ones who use it. Even so, construction industry generally lags behind other technology-intense sectors in terms of information technologies (Matheu, 2005). But, projects are getting bigger and getting more complex. Construction practices are changing and skilled craftsmanship is decreasing in construction industry as it is having difficulty to compete with other sectors. Therefore, all these emerging challenges are forcing construction industry to implement new ways of doing business and to embrace information technologies to compete with other sectors.

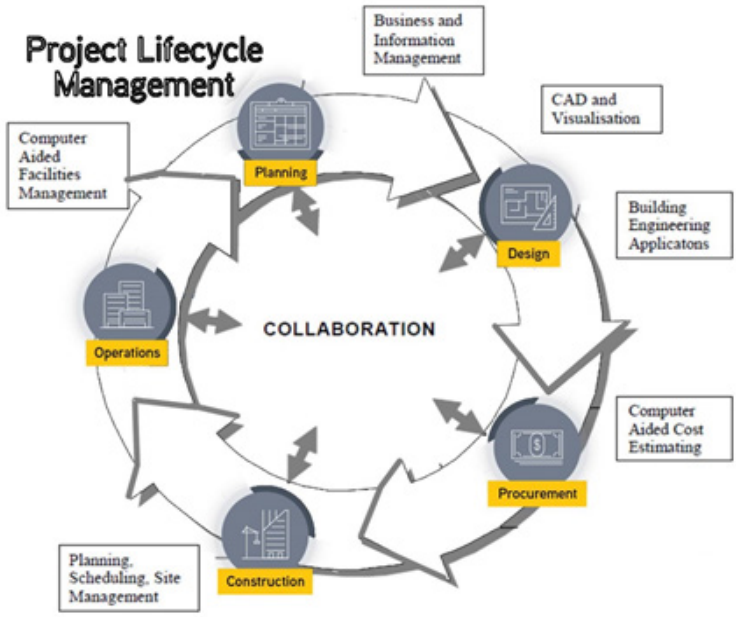

Figure 4. Construction phases and IT applications

Although, each of them have the potential of offering important assets to different phases of the construction life-cycle as it can be seen on Figure 4, recent information technologies that are used in construction projects are mostly solution-specific (one major exception is building information modelling softwares) and they can be grouped as:

- Computer aided design and visualization softwares, which are widely known as CAD and widely used by design professionals mainly in design phase of a project. They are basically used for drawing the project documents digitally.
- Building engineering softwares, which are used to deal with environmental comfort factors like lighting, heating, acoustics, structural, etc. by calculating and simulating them just in the design phase.
- Computer aided cost estimation softwares, which are used to deal with one of the fundamental requirements of a building project life-cycle which is the cost estimation.
- Planning, scheduling and site management softwares, which are used for management of the project by planning the work, evaluating the process and coordinating the resources.

- Computer aided facilities management softwares, which are used for facility management in terms of operation and maintenance and as well as monitoring the impact of the building operations on the life cycle costs.
- Business and information management softwares, which are used to gather the produced data together and providing coordination by giving stakeholders easy access to these data.
- Building information modelling softwares, which can do more than one specific task. Most of the aforementioned softwares are designed to provide solution to specific tasks in the construction life-cycle, they have different capabilities and produce unique information to its own. Therefore, integration becomes one of the key priorities for the projects. Building information modelling (BIM) software's offer solution to this problem by doing more than one specific task. They can be used for computer aided design, visualization, engineering, estimation and the most importantly the integration of the data and collaboration of the project by bringing the most of the information produced together for the stakeholders to easily access and work together.

4. The Future of Information Technologies in Construction Industry

According to Agarwal et al. (2016), five trending IT ideas are distinguishing from others in construction industry as they will shape the future of construction:

- Higher definition surveying and geolocation, means rapid digital mapping and estimating.
- 5D building information modelling, means design platform for the future.
- Digital collaboration and mobility, means moving to paperless projects.
- The internet of things and advanced analytics, means intelligent asset management and decision making.
- Future-proof design and construction, means designing with materials and methods of the future.

Among all, digital collaboration and mobility can be labelled as the most emerging issue for the construction industry. This statement is backed by the study that was carried out by Ilyas et al. (2013) using a survey consists of 100 respondents who are project managers from EMEA (Europe, Middle East, Africa) region; collaboration and mobilization of data is highlighted as the top priority.

As it is stated by Zambare and Dhawale (2017), project activities are generally split into different disciplines as architects, engineers, contractors, etc. and performed independently which each of them have their own agenda of optimizing their own value resulting communication and coordination issues effecting the project performance in total. Another thing is, the size and complexity of projects are increasing and many organisations are struggling to make sense of increasing volumes of produced data.

Although, the coordination and continuous flow of information is getting harder to control manually as the production of different data is increasing and information webs are expanding; construction industry still relies on paper intensely for many of its processes and deliverables. According to KPMG's Global Construction Survey 2016, less than one-third of respondents say their organizations use real-time data integration on projects routinely (Armstrong and Gilge, 2016). Consequently, productivity issues, quality failures and ineffective decision-making arise due to the lack of digitization, delayed information exchange and interrupted coordination (Zambare and Dhawale, 2017). So, work flows are needed to move away from papers to real-time sharing platforms in order to provide better collaboration and overcome productivity issues. As it is stated by Tracy (2017), the key element of a successful project control is to choose the best methods to manage the flow and storage of information. According to Agarwal et al. (2016), the most important real-time information collaboration should be done in the following topics:

- Design management
  - Visualizing drawings and 3D models in real time
  - Updating blueprints in the field with mark-ups, annotations and hyperlinks
- Scheduling
  - Creating, assigning and prioritizing tasks in real time
  - Tracking progress uninterruptible
  - Immediately pushing work plan and schedule to all
  - Issuing real time notifications to all
- Materials management
  - Identifying, tracking and locating materials and equipment across the entire supply chain
- Crew tracking
  - Providing real-time status updates on total crew deployed across work fronts, number of active working hours, etc.

- Quality control
  - Offering remote site inspections
  - Updating and tracking live punch lists
- Contract management
  - Updating and tracking contract compliance checklists
  - Maintaining communication active all the time
  - Providing access to up to date records of all communication for stakeholders
- Performance management
  - Monitoring progress and performance continually
  - Providing automated statistical data dashboards
- Document management
  - Uploading and distributing all the documents continually for effective decision-making
  - Allowing universal project search across any phase

Some of the mobile technologies used in construction industry can be grouped as: 1. Mobile CAD applications, 2. Data capturing applications and 3. Project management information systems. Among all, Project Management Information Systems (PMIS) stand out in terms of collaboration and organisation of information. PMIS is defined in Project Management Body of Knowledge (PMBOK) (2017) as "an information system consisting of the tools and techniques used to gather, integrate and disseminate the outputs of project management processes.". A PMIS could be an important asset for organisations as it ensures effective information flow across stakeholders to create common understanding. That way, mistakes caused by communication problems are minimized. In PMIS, information is gathered only once and then shared among the stakeholders, that's why it's effective way of information flow when compared to a scenario that all the stakeholders create and use their own information network independently. Sarkar and Jadhav (2016) summarises essential capabilities of PMIS as:

- Supporting the project charter, schedule and budget,
- Facilitating communication and feedback,
- Monitoring project activities,
- Controlling project changes,
- Analysing and forecasting project performance,
- Circulating project status to relevant stakeholders,
- Providing real-time information.

According to Craig and Sommerville (2006), a successful implementation of management information systems has benefits on human (H), project (P) and organisation (O) These benefits are:

- Reducing need for bureaucracy and hierarchy (H, P, O).
- Facilitating on building teams and overcoming barriers (H, P, O).
- Encouraging flexible communication and eliminating redundant or non-value added activities (H, P, O).
- Saving time and increasing productivity of stakeholders as a result of minimising errors (H, P, O).
- Increasing the quality and speed of work allowing faster simpler access to common data (H, P, O).
- Reducing paper based issues such as printing and distributing (O).
- Improving project processes (H, P, O).
- Improving project management processes (H, P, O).
- Standardization of project tools (O).
- Promoting and supporting quality assurance (O).

There are many major players in PMIS market and popular commercial softwares are available. Each PMIS has different capabilities according to differentiated needs of organisations and scope of the project. So it's vital to carefully specify what are needed. Internal dynamics of organisation should be ready for adaptation, requirements should be well-defined and the system should be flexible, compatible, portable and user-friendly not to fail in implementation (Sarkar and Jadhav, 2016; Agarwal *et al.,* 2016).

5. Conclusion

Even if the construction industry is lagged behind other technology-intense sectors in terms of information technologies, many information technologies applications, as the best example is CAD softwares are like sector-standard, are used by the companies and many information are created digitally. But, all of the information channels like legal papers, office documents, change orders, budgets, surveys, documents, organisational registers, personnel info, etc. are taken into consideration; it can be implied that management of information is generally problematic in construction life-cycle at whole.

In project-driven sectors, as construction, numerous stakeholders get together in different stages like design, construction, maintenance, etc. and

excessive information is produced. Therefore, a continuous information flow and collaborative document environments should be the one of the first topics to concern about for the project success.

Although effective information management and interrupted information flow is very important for the project success, information technologies have not progressed well enough in construction industry yet. With the help of information technologies, followed by mobilization of these technologies as well, project success could be enhanced and construction life-cycle could benefit significantly in areas like scheduling, time tracking, coordination, information exchange, productivity, etc. by integrating issues instantly to the project. Moreover, facilitating an appropriate management information system could improve the organization by:

- Accessing to project information is possible from anywhere and anytime desired.
- Improving team communication, collaboration and decision-making.
- Increasing transparency.
- Making data management more cost effective.
- Reducing errors and delays.
- Improving project management process by making up to date information available and shared to all whole the time.
- Improving the quality and accuracy of data to rely on decision-making process.
- Providing historical database of organization's projects to use as an example and improve the processes.

Last but not the least thing to consider is, the future's world is shaping around rapidly changing and highly nimble business environment as the speed and accessibility become number one priority. As the examples of other information technology-intense sectors shows, the pioneers who become the first ones that adapt to technological advancements get important competitive advantages. So, organisations of construction industry should build their future on innovation, digitalisation and mobilisation to get the advantage and lead the industry.

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CHAPTER 2

USER EXPERIENCE IN THE VIRTUAL MUSEUM: VIRTUAL ONLINE MUSEUM OF ART/VOMA & THE DALÍ THEATRE-MUSEUM

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1. Introduction

Museums as instituions, which gather information, investigate, authenticate, exhibit and provide training, present whole development process of human beings from past to present by means of objects (Atagök, 2006). Museums got institutionalized in ancient Greece and Rome. Museums, the centre of cultural background, make life experiences sustainable by dedicating this richness to community (Kervankiran, 2004). Museums that can be designed for a lot of interests make a great contribution to scientific, artistic, and social development of society. These areas, which contain many experiences and treasures bearing witness to history, are spaces which reflect customs, traditions, mentality in the geography where they are founded (Sürme & Atılgan, 2020). Museums have in recent years entered into the process of digitalization under the effect of COVID-19. Current opportunities of technology have exerted an influence on experiencing museums through virtual spaces. Özirli (2021) states that virtual museums, which have carried out their activities in online media for a long time, are no longer a preference because they have become compulsory as a consequence of intensifying global diseases.

Virtual platforms are undefined, unlimited, flexible, ever-changing, and have an autonomous ground rather than traditional one. The platforms are recreated as a projection of the real world in space where the rules of physics do not exist. Since virtual platforms emulated from physical world are composed of intangible materials; boundries, textures, colors, and other unlimited indicators that are downloaded constantly change and the change provides an experimental

area (Güngör, 2019). According to the dictionary of Britannica, virtual museums are defined as a collection with images, sound files, texts, other historical information, scientific or cultural attention, which are accessed through electronic media and recorded digitally (URL-1). The idea of virtual museum was for the first time shared by Andre Malraux in 1947. He describes a concept of visionary museum with neither walls nor spatial boundries, where contents and information of objects are shared, and which can be visited from any part of the globe (Styliani et al., 2009). Virtual museums generate a cultural inheritance and art platform at an international level, which enables intercultural codes to be introduced around the world (Özirli, 2021). Today's digitalized conditions have been manifesting themselves by way of relating the manners of visual arts and modern museology to architecture discipline. In addition to physiological formation of architectural tectonics, clarification of stylistic manifestation is based on users' subjective judgments. Evaluations related to virtual environment are progressing in accordance with interactions formed with environment and shared messages. Therefore, the way to enhance the qualification of spatial narratives which are intended for manifesting through advancements in today's digital design tools has been taken up.

An internet-enabled computer network and a standart internet browser are sufficient to get access to virtual museums. It is intended to get someone, who is in deed in virtual world, to feel like walking around in the actual museum founded in any part of the globe. Without travelling actual museums, individuals have been able to reach the information about collections that the museums present in a quick and easy way (Sürme & Atılgan, 2020). In the new world order obliging people to get addicted to screen, many people from different parts of the world for whom it is not possible to get access to museums have been allowed for access to the museums via virtual tours, which are timeindependent and non-spatial. Virtual museums make it possible to visit the museums by providing non-stop namely 7-24 service (Akyol, 2020). Virtualization in museums influenced by digitalization has ruled out time and spatial limitation as consequences of easy accesses to museums and easily establishing an international connection and visits. The newly generated world has no boundries, which provides its users with unlimited freedom i.e. carte blanche. For this reason, user experience in virtual museums is open to assess in many ways.

2. User Experience

Experience of space is related to space perception namely spatial perception. According to Özen (2006), space perception is associated with that person gains short or long-term experience in or around the space and accordingly recalls

there. Heidegger adopted the idea of considering spaces as interaction and experience zones rather than pure structures (Hisarlıgil, 2008). Data obtained from space through senses enables individuals to perceive and define the space while experiencing. Thus, it can be said that spaces contain multiple experiences such as physical and perceptual ones.

Integration of perception, action, motivation, sense, and cognition which exist in the dialogue established with the world by means of space, time, people, and objects brings out the concept of user experience (Hassenzahly, 2010). According to Nicolas and Aurisicchio (2011), the term "user" includes consumers and other people. As for user experience, it is not a specification of the product/artefact. It is a consequence of human-product/artefact interaction, and therefore depends on user. The phrase *"user experience"* was for the first time used by Don Norman, an American investigator and writer in the book *"The Design for Everyday Things"*. In UE, users create interactions at every point where they come across product/artefact. The interaction includes the moment of using product/artefact as of the first time it was seen and all other further processes (Akın, 2018).

UE takes shape based on users' inner conditions such as tendency, expectations, needs, motivation, mood, etc. with reference to the characteristics of designed system and the context where interaction occurs (Hassenzahl & Tractinsky, 2006). User-centered experince models describe all factors which have a role in interaction between user and an product/artefact or a system as a user-centered part of experience (Kuru, 2015). Facets with which UE is associated are shown in Figure 1.

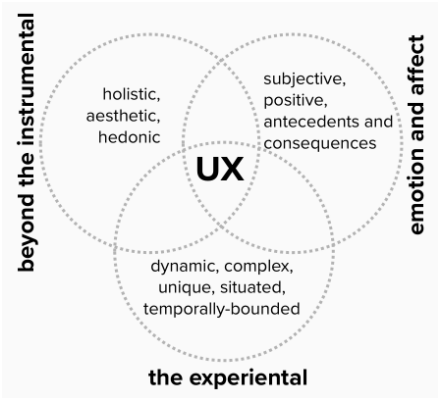

Figure 1. Facets of UX (Hassenzahl & Tractinsky, 2006)

User gets involved in a range of interactions with product/artefact. There are some qualities with different scopes and scales to comprehend and assess these interactions. Remarkable ones among them are senses, motor skills, values,

expectations, needs, personality characteristics, feelings of fun, and attention. As shown in Figure 2, UE includes four components; *user*, *product/artefact*, *context*, and *interaction*. These four components handled within the scope of UE can be summarized as follows:

- *User*, the meaning of which became popular particularly in the America as of the middle ages of the 20th century, can be defined as person for whom designs are created if we look from the viewpoint of architecture discipline, the current subjective situation of which it is considered as. The term user represents person who experiences the space. In perception of the space, user' subjective, sensual, cognitive, and holistic characteristics and processes are efficient and important.
- *Product/artefact*, points out structures such as work, object, system, space, etc., which user interacts with, and which have social and aesthetic aspects.
- *Context*, points out the conditions of space and time where/when user interacts with product/artefact. Turkish Language Association (URL-2) defines the context as "networks or linkages of events, conditions, and associatins in any facts". Context has physical, social, cultural, situational, and temporal features.
- *Interaction*, is defined as an action which a user carries out through an product/artefact that changes or affects his/her motor, perceptive, cognitive, and sensual systems. Interaction can be conducted in physical or nonphysical ways. What is important to the point is that interaction reflects a process not a purpose (Nicolas & Aurisicchio, 2011). Interaction is a consequence of the organisation and context of the system, and external interventions do not put a different complexion on it (Varela et.al., 1991).

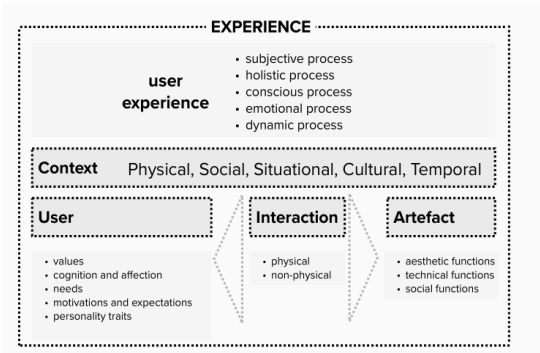

Figure 2. The Scenario of UE (Nicolas & Aurisicchio, 2011)

Each of the components is characterized by a range of subcomponents in itself. Interaction between user and product/artefact can be handled in two ways "physical" and "nonphysical". Interaction as part of UE points out relationships which connect user up to product/artefact in a context. These relationships may occur both in physically as a result of that user experiences product/artefact and in nonphysically. Interaction in both ways occurs depending on qualities such as aesthetics of product/artefact and values, cognition, needs, motivation, expectations and personality characteristics belonging to user together with technical and social functions.

UE which is lived out in accordance with product/artefact in the physical world may also take space in virtual (online) environments. The virtual world is not another world distinct from the physical world but its extension (Akın, 2018). This opinion is such as to promote that nonphysical interaction aspect of UE can be handled with regard to virtual museum.

3. Research Model

Standarts and criteria of design depend on urban dynamics, periodic tendencies and movements, and also are transformed notionally and functionally by user (Oğuz & Uzunkaya, 2021). Interaction which user forms with space where he/she is may vary depending on various parameters. Today, spaces of museums enable users to visit virtually without appearing physically in the museums. Many of spaces where actions such as visit, tour, travel are carried out have been virtualised because of the pandemia in a short time. The study conducted in this regard is intended for finding out user experiences of spaces depending on nonphysical interaction under the effects of COVID-19 pandemic.

Within the scope of the study, museums among the most common samples of space types which can be visited online namely virtually are handled. It was intended to obtain user evaluations related to *Virtual Online Art Museum /VOMA* where a space which does not exist in reality has been created virtually and *The Dalí Theatre-Museum* where a space which in reality exist can be visited online. The research model where interaction between user and product/artefact is evaluated from a "nonphysical" perspective has been fictionalized based on four components which form UE (Figure 3).

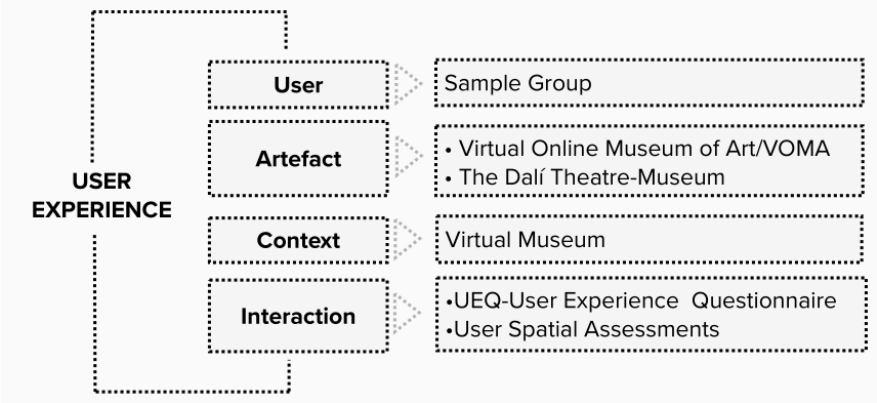

Figure 3. Research Model

The components fictionalized as part of the research model can be described as follows:

- *User;* refers to the sample group of the study consisting of 105 (62 female, 43 male) of 2nd grade students studying at the Department of Architecture, Faculty of Architecture, Karadeniz Technical University.
- *Artefact;* includes the samples of *Virtual Online Art Museum/VOMA* and *The Dalí Theatre-Museum* mentioned as a product/system within the study.
- *Context;* composes of virtual museums where user-product interaction occurs.
- *Interactions;* are handled in the light of data obtained from *User Experience Questionnaire (UEQ)* and *User Spatial Assessments*.

3.1. Artefact I: Virtual Online Art Museum/VOMA

VOMA is a virtual museum which was financed by Kickstarter in June, 2020 and opened to public in September, 2020 (Catton & Smith, 2021). VOMA is a unique opportunity to learn about life stories of artists from all corners of the world and discover their product/artefacts. It is possible for everyone who has internet connectivity to get access to the museum without any physical spatial limitations. The museum, which provides online experience, allows for cooperation with various partners via new ways. The museum also has become a real social experience where visitors' sounds can be appended to chat. VOMA cooperating with museums and collections worldwide has been introducing art objects to a large number of global audience. By this means, it can display various product/artefacts, uncover secret ones, and offer a new insight to the current (URL-3) (Figure 4).

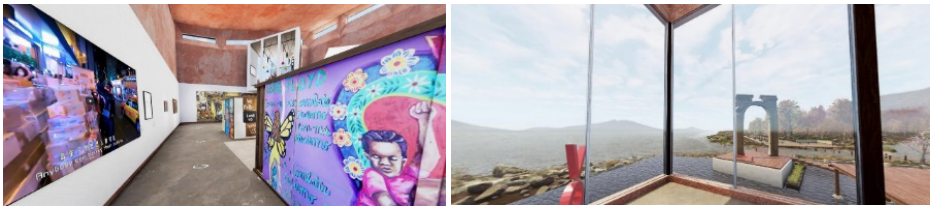

Figure 4. Virtual Online Art Museum/VOMA (URL-3)

In VOMA, where HD art objects are presented through various media and references, products are exhibited in the spaces of Gallery Zero, Gallery One and Artist Space. The museum, which has travellable areas such as Cafe and Shop, opens up the opportunity to go for a walk in the museum and nearby through marking on the map or direction keys (Kılıçaslan, 2021) (Figure 5).

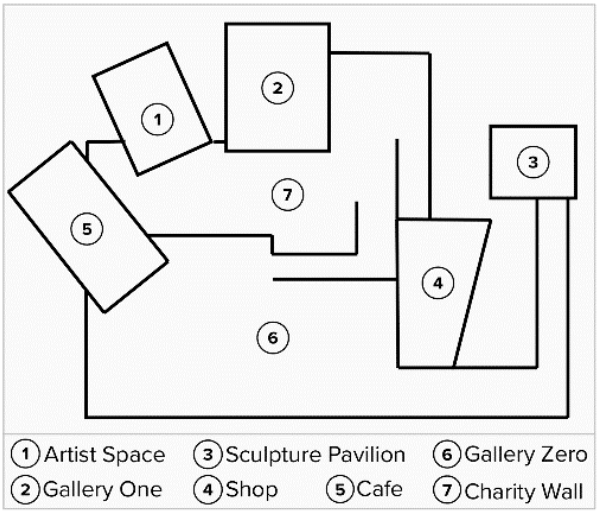

Figure 5. VOMA floor plan (Prepared by adapting from the URL-3)

The museum program touches upon the particular and universal nature of human experience by gathering different ideas and viewpoints and promoting collective imagination through collaboration. VOMA aims to be a center of discussion and conference through digital innovation by allowing for new approaches and unlimited access. It reconsiders what a museum is like, how it must operate, what it must do through collective property, innovation, and discussion (URL-3).

3.2. Artefact II: The Dalí Theatre-Museum

The Dalí Theatre-Museum, inaugurated in 1974, rises on the remains of the former Municipal Theatre of Figueres and is considered to be the last great work of Salvador Dalí. Everything in it was conceived and designed by the artist so as to offer visitors a real experience and draw them into his unique and captivating world. The museum is also the world's largest surrealist object. The Dalí Theatre-Museum's collection allows the visitors to capture the artistic journey of Salvador Dalí through a broadspectrum of works. The route around the rooms allows visitors to capture his first artistic experiences, surrealism, nuclear mysticism and his passion for science, guiding them to the works of the last part of his life (URL-4) (Figure 6).

Figure 6. The Dalí Theatre-Museum (URL-4)

The Dalí Theatre-Museum consists of two clearly differentiated museum areas offering the visitors an unguided and personal route across the various galleries: The first is the one refurbished from the old fire-damaged municipal theatre and then converted into the theatre-museum based on the criteria and design of Salvador Dalí himself (1-18 numbered rooms). This part of the museum forms a unique artistic object in which each element is an inseparable part of the whole. These galleries contain many works from the artist's legacy such as stereoscopic works, installations, and anamorphisms. The second one is the complex of the rooms (19 to 22 numbered rooms) designed so as to be the extension of the first area. In addition to these, various collections including all types of works of art such as paintings, drawings, sculptures, engravings, installations, holograms, stereoscopes, photography are on exhibition at the museum (URL-4, 2021).

On the ground floor of the museum are Lobby, Courtyard, The Cupola and The Treasure Room. The basement floor contains The Fishmongers' Room, Dalí d'Or Room, Crypt: The Tomb of Salvador Dalí and Corridor. On the first floor are Corridor, Mae West Room, Palace of The Wind Room, Poetry of America

Room, Bramante's Temple Room and Loggia. The second floor consists of a Corridor and a Masterpiece Room (Figure 7-8). The Dalí Theatre-Museum plan schemes are prepared by adapting from the URL-4).

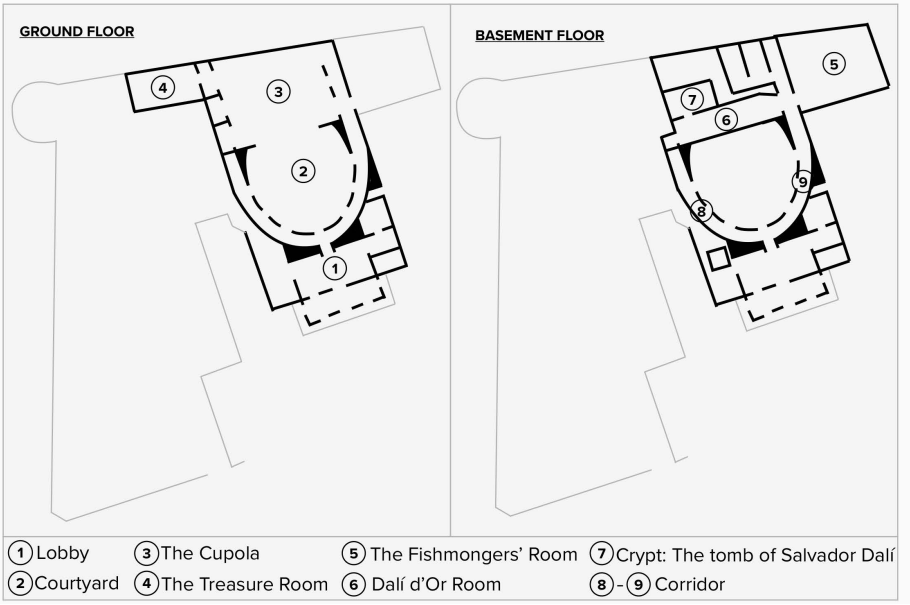

Figure 7. Ground Floor and Basement Floor Plan
(Prepared by adapting from the URL-4)

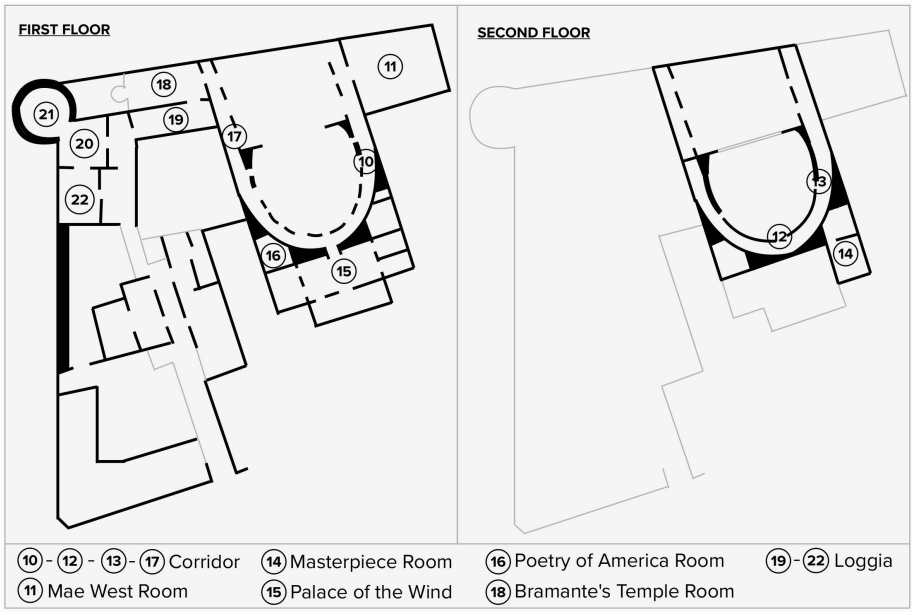

Figure 8. First Floor and Second Floor Plan
(Prepared by adapting from the URL-4)

Visiting this museum is a unique opportunity to experience and enjoy the work and thought of a genius. In the words of Dalí himself: "It's obvious that other worlds exist, that's certain; but, as I've already said in many other occasions, these other worlds are inside ours, they reside on earth and are precisely at the centre of the dome of the Dalí Museum, which contains the new, unsuspected and hallucinatory world of Surrealism". (URL-4).

The set of works the artist created expressly to be on permanent exhibition at the museum, works that range from paintings and sculptures to complex and monumental installations do also exist (URL-4). That The Dalí Theatre-Museum is virtually open to visit offers users new experiences. That the museum provides online service on a surrealistic platform can be considered as an example for virtual/nonphysical aspect of spatial experience (Sağlam, 2020).

3.3 Data Collection Tool I: User Experience Questionnaire (UEQ)

UEQ contains 26 pairs with opposite terms which can be associated with product/artefact (Schrepp, 2019). Each of these pairs should be rated on a 7-point Likert scale and the impressions related to the product/artefact is presented by carrying out a single marking for each of the terms.

The aforesaid pairs are as follows: annoying/enjoyable, bad/good, unlikable/pleasing, unpleasant/pleasant, unattractive/attractive, unfriendly/friendly, slow/fast, inefficient/efficient, impractical/practical, cluttered/organized, not understandable/understandable, difficult to learn/easy to learn, complicated/easy, confusing/clear, unpredictable/predictable, obstructive/supportive, not secure/secure, does not meet expectations/meets expectations, inferior/valuable, boring/exciting, not interesting/interesting, demotivating/motivating, dull/creative, conventional/inventive, usual/leading edge, conservative/innovative. UEQ consisting of 26 pairs with opposing terms contains 6 scales. The scales bracketed with the pairs with which they are associated, are presented in Figure 9.

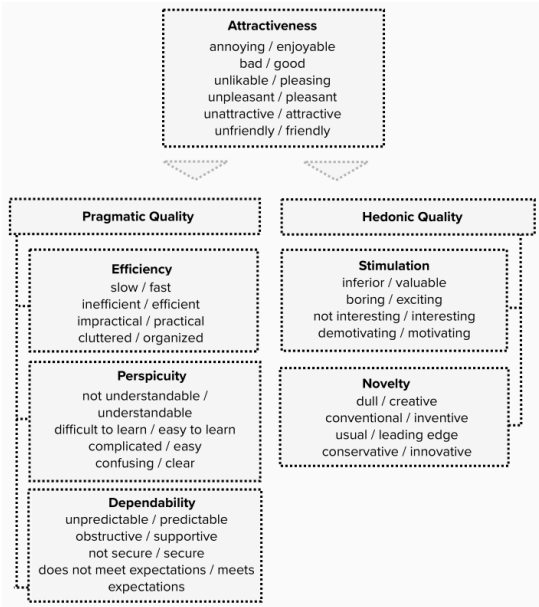

Figure 9. Assumed Scale Structure of the UEQ (Schrepp, 2019)

Attractiveness, points out the overall impression of the product and enquires whether users like the product or not. Attractiveness differs from the other scale groups so as to comprise all. Two different instincts, *pragmatic* and *hedonic*, which influence individual experiences or preferences could be mentioned.

That individuals experience the product/artefact and its tangible an functional properties (size, weight, price, etc.) in accordance with objective criteria is a consequence of their pragmatic instincts (Odabaşı & Barış, 2013). The scales of perspicuity, efficiency, and dependability are pragmatic quality aspects. *Perspicuity* corresponds to whether it is easy to get familiar with and to learn how to use the product or not. *Efficiency* is related to whether users can solve their tasks without unnecessary effort or not. *Dependability* verbalizes whether or not the user feels in control of the interaction.

That experiences become reality being influenced by pleasure, enjoyment, dream, and aesthetic features is a consequence of hedonic instincts (Odabaşı & Barış, 2013). Hedonic quality contains principles such as stimulation, fun, innovation, emotions, and aesthetic (Hinderks et.al., 2019). Beside this, it points out quality aspects such as novelty, innovativeness, and so on which have no obvious relations with the main task or goals as part of the study (Hassenzahl, 2001). The hedonic quality aspects within the

scope of the questionnaire consist of the scales of stimulation and novelty. *Stimulation* clarifies whether or not using the product is exciting and motivating. *Novelty* is related to whether or not the product is innovative, creative, interesting.

3.4. Data Collection Tool II: User Spatial Assessments

The questionnaire prepared by the researchers in order to evaluate the user spatial experiences perceptively and physically is composed of 12 items. The items have the formation of a 7-point Likert scale. The items which enable to emotionally assess the experienced virtual museum considering digital features, exhibited artefacts, space organization, guidance, movement, lighting, color, and what is felt physically during the visit are presented under the title of "Interaction 2".

3.5. Interaction I: User Experience Questionnaire (UEQ)

The evaluation is supposed to be carried out so as to reflect the first impression without putting excessive emphasis on the opposite pairs. Decisions given sometimes seem to be doubtful or responses chosen may be believed to have no relation with the product. Nevertheless, at least one of the relevant gradations must be chosen. What is more to the point is user's personal idea and there is no conclusion like true or false response. The data obtained from UEQ was evaluated by means of *Data Analysis Tools.* The data of UEQ was analyzed through the means and the statistics required for the interpretation of the evaluations were calculated.

The evaluations of UEQ related to VOMA are presented in Figure 10. The obtained data indicates that the scale of *attractiveness* has a average value of 1.170, *perspicuity* 0.560, *efficiency* 0.938, *dependability* 0.781, *stimulation* 1.314, and *novelty* 1.174.

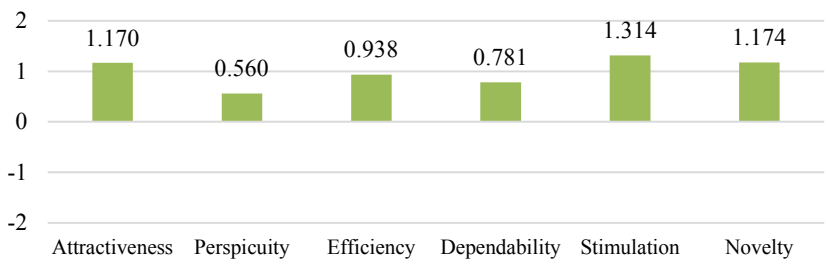

Figure 10. The Evaluation Graph of UEQ Scales Related to VOMA

If the distributions of the user assessments according to the items, it is seen that the highest average value is for the item *"inferior/valuable"* belonging to the scale of *stimulation* while the lowest one is for the item *"unpredictable/predictable"* belonging to the scale of *dependability* (Figure 11). Accordingly, it is found out that VOMA is valuable but unpredictable as product/artefact.

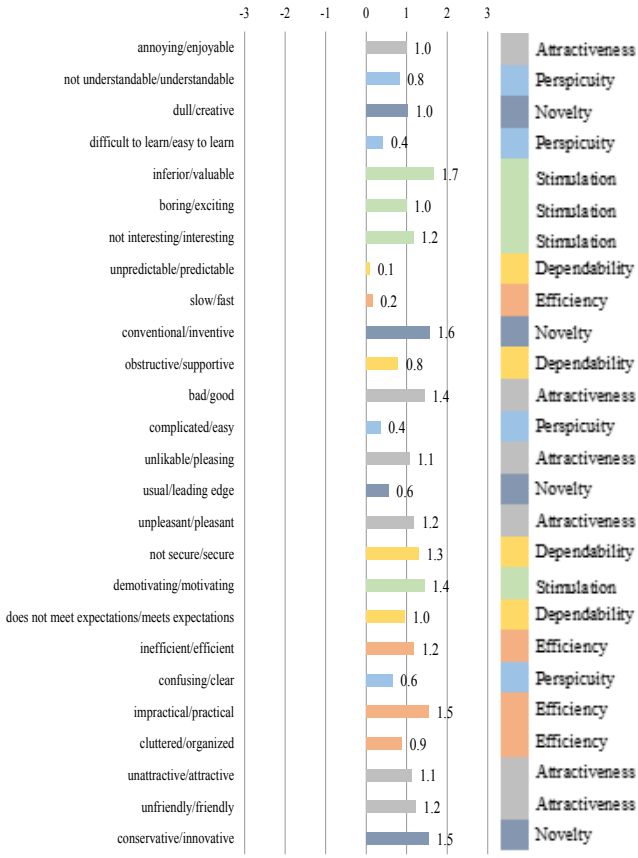

Figure 11. The Average Value Graph of the Items Related to VOMA

The comperative evaluations of average value ranges are indicated by a benchmark graph from UEQ data set (Figure 12). According the graphic data; of VOMA, the value of *novelty* is rated as "good", the value of *stimulation* is rated as "above-average", the values of *attractiveness*, *efficiency*, *dependability* are rated as "below-average", and the value of perspicuity is rated as "bad".

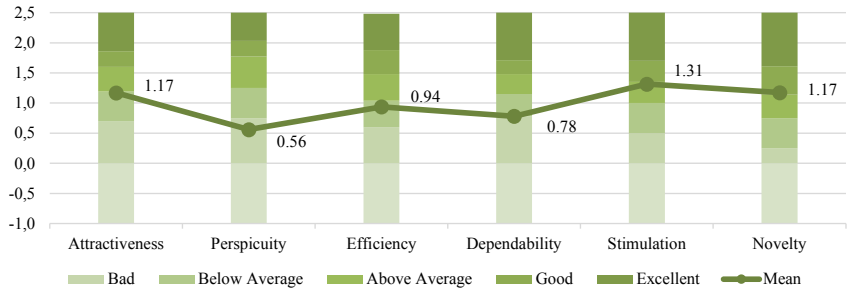

Figure 12. The Benchmark Graph of the Scales Related to VOMA

The quality evaluations for pragmatic quality groups (perspicuity, efficiency, dependability) and hedonic quality groups (stimulation, novelty) of the UEQ scales are presented in Figure 13. Accordingly, the scale of *attractiveness* has a average value of 1.17, the *pragmatic quality* scale 0.76 and the *hedonic quality* scale 1.24.

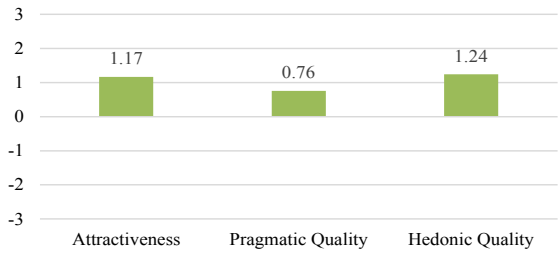

Figure 13. The Pragmatic and Hedonic Quality Evaluation Graph of VOMA

The evaluations of UEQ related to The Dalí Theatre-Museum are presented in Figure 14. The obtained data indicates that the scale of *attractiveness* has a average value of 1.140, *perspicuity* rated as 0.667, *efficiency* as 0.929, *dependability* as 0.833, *stimulation* as 1.112, and *novelty* as 0.662.

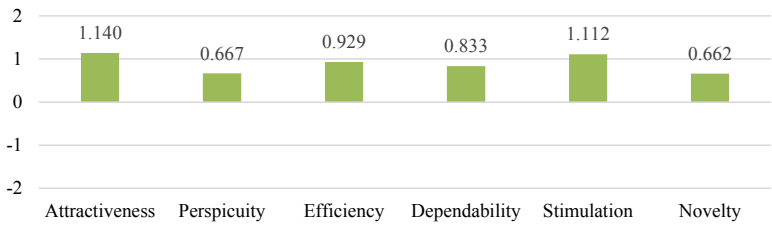

Figure 14. The Evaluation Graph of UEQ Scales
Related to The Dalí Theatre-Muesum

If the distributions of the user assessments according to the items, it is seen that the highest average value is for the item *"inferior/valuable"* belonging to the scale of *stimulation* while the lowest one is for the item *"unpredictable/predictable"* belonging to the scale of *dependability* and for the item *"complicated/easy"* belonging to *perspicuity* (Figure 15). Accordingly, it is found out that The Dalí Theatre-Museum is valuable but unpredictable as product/artefact.

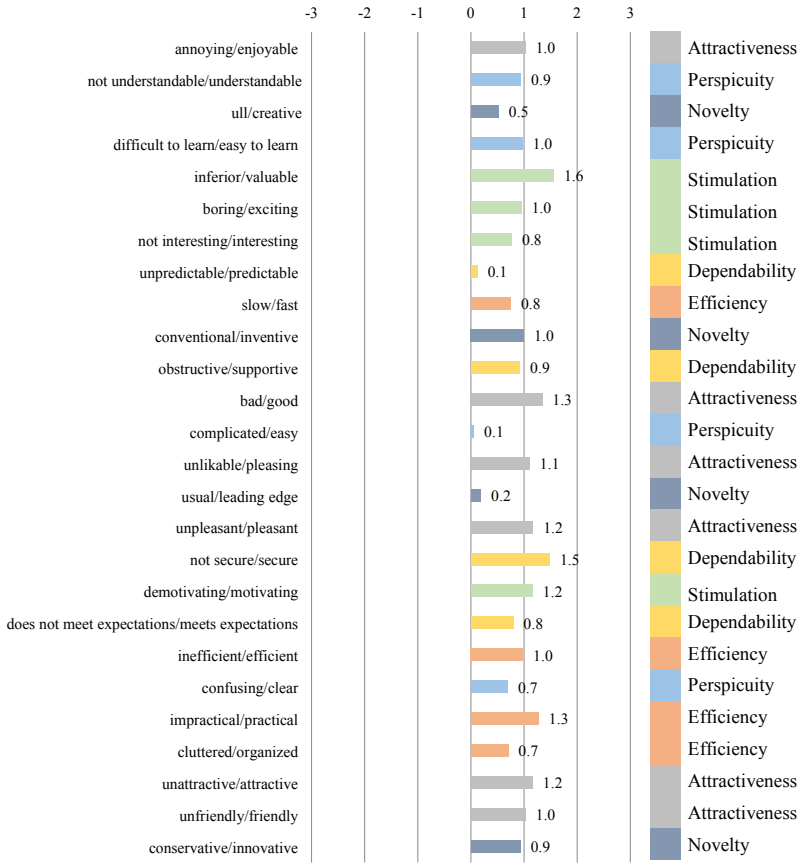

Figure 15. The average value graph of the items related to The Dalí Theatre-Museum

The comperative evaluations of average value ranges are indicated by a benchmark graph from UEQ data set (Figure 16). According to the graph data; of The Dalí Theatre-Museum, the value of *stimulation* is rated as "above-average", the values of *attractiveness*, *efficiency*, *dependability*, *novelty* are rated as "below-average" and *perspicuity* is rated as "bad".

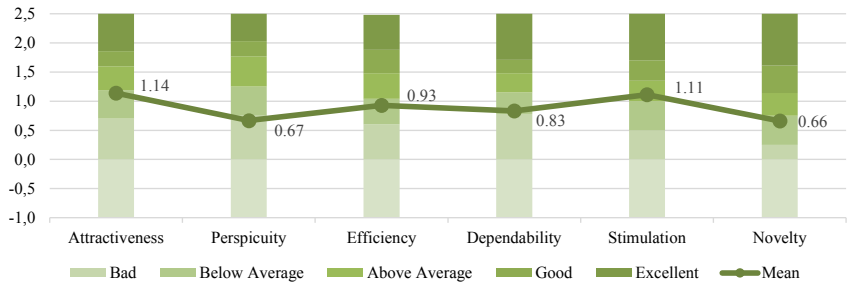

Figure 16. The Benchmark Graph of the Scales Related to The Dalí Theatre-Museum

The quality evaluations for the pragmatic quality groups (perspicuity, efficiency, dependability) and hedonic quality groups (stimulation, novelty) of the UEQ scales are presented in Figure 17. Accordingly, the scale of *attractiveness* has a average value of 1.14, the *pragmatic quality* scale 0.81, and the *hedonic quality* scale 0.89.

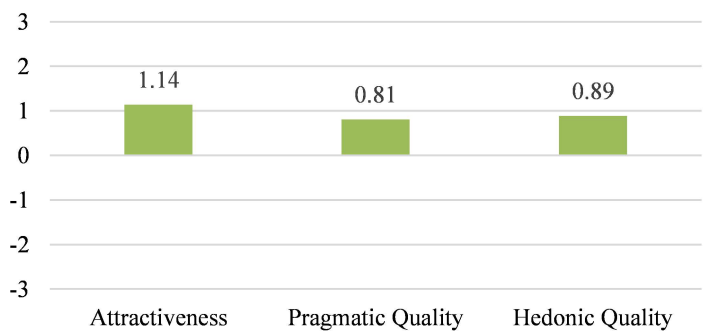

Figure 17. The Pragmatic and Hedonic Quality Evaluation Graph of The Dalí Theatre-Museum

3.6. Interaction 2: User Spatial Assessments

In this study where perceptive evaluations that are acquired as a result of experiences in virtual environment are examined, data analysis related to the 12 items was performed and the interpretation of the evaluations was conducted based on the average values. The users' spatial assessments related to both of the museums are presented in Table 1 and Figure 18.

Table 1. The Averages Related to the Spatial Assessments

		VOMA	The Dalí Theatre-Museum
Items		**Mean**	**Mean**
1	It is easy to perceive and use the user interface design belonging to the museum.	4.65	4.56
2	The information related to the exhibited artefacts is pleasing.	4.76	4.44
3	It is easy to focus on the objects on which should be elaborated.	4.79	4.09
4	The space organization is explicit and illegible.	4.87	4.60
5	The quiding arrows in the museum are sufficient for the layout to be perceived.	4.18	3.86
6	A sufficient relation can be established with the space during movement and orientation.	4.11	3.80
7	The scale and boundries of the space are perceivable.	4.90	4.66
8	A mutual interaction can be formed with the space.	4.26	4.15
9	The space is compelling and motivating.	5.13	4.93
10	The space is pleasing in terms of aesthetics.	5.24	5.50
11	The lighting level in the space is sufficient.	5.79	5.82
12	The color usage in the space is visually sufficient.	5.86	5.43

When the spatial assessments related to VOMA presented in Table 1 are examined, it is found out that the highest average value belongs to the item *"The color usage in the space is visually sufficient"* while the lowest one is of the item *"A sufficient relation can be established with the space during movement and orientation"*. Accordingly, it can be said that the color usage in the museum is found pleasing by the users but the virtual visit to the musuem fall short of establishing a relation with the space during movement and orientation. As for the spatial assessments related to The Dalí Theatre-Museum, the highest average value belongs to the item *"The lighting level in the space is sufficient"* while the lowest one is of the item *"A sufficient relation can be established with the space during movement and orientation"*. The spatial assessments related to The Dalí Theatre-Museum indicate that the lighting level is found sufficient but a relation can't be sufficiently established with the space during movement and orientation.

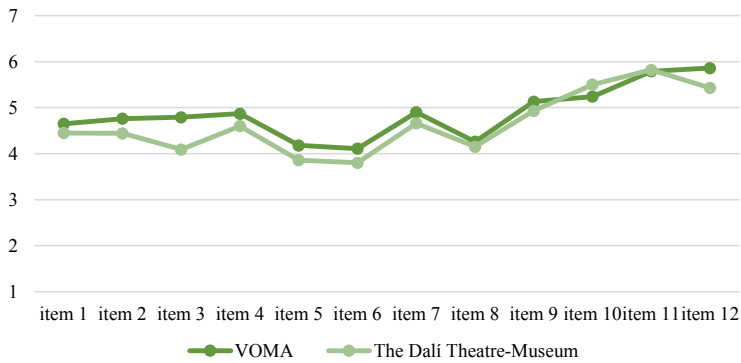

Figure 18. The Benchmark Graph of the Spatial Assessments According to the Items

When the benchmark graph attached in the Figure 18 is examined, it is noticed that the averages of the spatial assessments for both of the museums are so approximate values. However, only for the items *"The space is pleasing in terms of aesthetics"* and *"The lighting level in the space is sufficient"*, the averages of The Dalí Theatre-Museum are higher than the averages of VOMA. The other 10 items indicate that VOMA is found more favourable than The Dalí Theatre-Museum.

4. Conclusion

Virtual museums, which have emerged as a result of that innovations offered by developing and changing technology are being integrated into museums sometimes go for sometimes are independent from a physical museum. It is observed that the effect of COVID-19 pandemic as well as technology and changing human needs & habits lead to an increasing tendency particularly for virtual environments like museums. The study intended for evaluating the museums in terms of both product/artefact and space was conducted based on Virtual Online Art Museum/VOMA, which does not exist physically but has been created in virtual platform, and The Dalí Theatre-Museum, which do exist physically and can be visited virtually. As part of the research model, three out of the four components that user experience consists of namely *user*, *context*, and *interaction* are the same but the only one varying is *"product/artefact"*.

When Virtual Online Art Museum/VOMA and The Dalí Theatre-Museum, virtual museums, which can be experienced without depending on any time and physical existence are considered as a product/artefact;

- The values which are above the average according to user experience questionnaire deduce that VOMA is exciting and motivating according to the scale of *stimulation*, creative and interesting according to the scale of *novelty*. However, the above-average value only belongs to the scale of *stimulation* for The Dalí Theatre-Museum. Accordingly, VOMA is found pleasing while The Dalí Theatre-Museum is as insufficient with regard to the *hedonic quality* aspect. When the *pragmatic quality* aspect are considered, that both of the museums do not satisfy the expectation is obvious. That it has been considered as insufficent in getting familiar with the product according to the scale of *perspicuity*, offering an easy goal-directed usage according to the scale of *efficiency*, feeling in control of the interaction formed with the product according to scale of *dependability* corroborates this indication. Correspondingly, obtaining similar results in respect of the *pragmatic quality* aspect of the museums without being dependent on the differentation of the spatial content and size brings into prominence that the experience is virtual.
- That both VOMA and The Dalí Theatre-Museum are found valuable as product/artefact considering the distributions of the user assessments according to the items is a natural consequence of that museums move in beyond the physical world after being virtualized with unlimited areas of freedom. That the museums are both considered as unpredictable is caused by the fact that virtual environments create limitlessness in on line services pulling away from its physical state. Virtual places have become not only charming due to allowing for the freedom of accessibility at will but also amazing and unpredictable because of that reality turns into simulation. Beside this, it is believed that the space organization and the existence of a wide range of the exhibited artefacts are believed to have influence over the reason why The Dalí Theatre-Museum is found complicated.
- According to the user spatial assessments, both of the museums are found unfavourable in terms of the user-place interaction even though they are found favourable in terms of visual/physical features. That the lowest average value belongs to the item *"A sufficient relation can be established with the space during movement and orientation"* is a common result for both of the museums. This result indicates that the mechanism of movement and orientation which is limited for virtual place experience causes the interaction which the user forms with the place to break down.

– If the interaction between the user and the product/artefact is assessed in "nonphysical" aspect, it can be assumed that whether the museum area exists physically in terms of both its quality and perception or not leads to an obvious differentation.

Virtual world, which is not distinct from the physical world but can be accepted as its extention allows space and experience to be virtualized. In this regard, virtual world defines an unlimited and free creation area, and therefore a virtual place identity undergoes a faster process when compared to a physical place. Virtual museums as a sample of virtual places are places which undergo a change in different aspects such as identity, function, and design. These places, which are open to change offer their users different experiences. The interaction which their users form with virtual places is an open-ended process which is supposed to progress as a consequence of being requestioned, criticized, and regenerated every time a new encountering emerges. Therefore, assessments of user experience for virtual museums have become more and more significant in creating a more active and efficient virtual museum platform.

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CHAPTER 3

GENERATION OF ARCHITECTURAL DRAWINGS THROUGH GENERATIVE ADVERSARIAL NETWORKS (GANS): A CASE ON APARTMENT PLAN LAYOUTS

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1. Introduction

The discipline of architecture has been experiencing a different relationship with the digital world since the Industry 4.0 revolution, like other disciplines. By developing the first sketchpad, Ivan Shutherland was the first who made the transition to the digitalization of the traditional 2D drawing understanding of architecture in the computer world (Sutherland, 1964). Later, while the problem of whether the machine was developed to help the discipline of architecture or to replace it, Nicholas Negroponte came up with a different idea. Whereas the main problem of the designer was to deal with the problems in the dogma of the design, the way of thinking and design started to change with the understanding of computer-aided design (Negroponte, 1970). The idea that design is a designer-specific production has always led to a different quest. In the process that computer-aided design started to develop as 3D, the perception of thought that pioneered many methods tried with it was the perception of "computational design". The operation of this idea through the computer was the presentation of the basic logic of the algorithmic solution generation process to the designer through programs (Terzidis, 2004). Proposing the concept of "parametric design thinking", important architects

put the theoretical equipment of Patrik Schumacher into practice within the discipline and developed their own software in the field of application (Schumacher, 2009). In this way, designers were able to develop their original design understanding.

Many theories and technological developments have progressed in parallel from the first discovery of the traditional design concept of CAD software in the digital world to the introduction of parametric design thinking principles, many theories and technological developments have progressed in parallel (Chaillou, 2019). Architects are now able to examine, select and optimize many different factors at the same time, from design to digital production, from energy efficiency to sustainability.

The last point that 21st century architecture has reached within the framework of technological development has been to be associated with artificial intelligence, as in many other disciplines. Since while the search for solutions to the problems of architects continues, rapidly developing technology has gained the highest acceleration of recent times. Today, many researchers have carried out studies in order to direct this problematic in the right direction, and many intersections have emerged with the discipline of architecture in sub-branches of artificial intelligence such as machine learning and deep learning (Darko *et al.,* 2020; K. L. Feng, Lu, & Wang, 2019; Huang & Zheng, 2018; C. Liu, Wu, Kohli, & Furukawa, 2017; Obeso, Vázquez, Acosta, & Benois-Pineau, 2017; Sjoberg, Beorkrem, & Ellinger, 2017). In most of the researches, "computer vision, decision support systems, robotic approaches, *etc*" fields have been associated with many sub-titles from building statics to the field of construction, from the history of architecture to architectural design, from sustainability to energy efficiency.

Machine learning algorithms working with all these different disciplines, especially producing "decision support systems", have brought different perspectives to architects in order to improve and facilitate the design method of architects today. Among these approaches, many recent studies (Kelly, Guerrero, Steed, Wonka, & Mitra, 2018; Nauata, Chang, Cheng, Mori, & Furukawa, 2020; Newton, 2019; Uzun, Çolakoğlu, & Inceoğlu, 2020; Zhang, 2019) have used the working principle of GANs, which is a sub-branch of machine learning, in order to create a "decision support system" in the understanding of architectural design and to offer more alternatives each time the architectural plan layout through the machine.

In this context, generative Adversarial Neural Networks (GANs) have been extensively elaborated as a literature background. Then, current studies on the generation of spatial plan layouts, which are at the common intersection with the discipline of architecture in this field, have been discussed. Finally, it was tried to generate layouts by considering standard 4 rooms and1 saloon apartment plans working with DCGANs algorithm.

2. Generative Adversarial Neural Networks (GANs)

Artificial neural networks are based on the "perceptron" model, which Rosenblatt (1958) states that the human brain is processed by analogy with nervous cell systems. While this single cell creates the artificial neural network system, all transmitted data (input) is defined to the network. As an output, single networks provide limited outputs by taking limited inputs. Deep neural networks considered as more complex networks, are built on the ability to produce and predict different variations as output data, thanks to the definition of too much data as input (Fyfe, 2005). Computer science, which defines these multiple data as "big data" has developed the generative Adversarial Neural Networks algorithm that provides different productions do not resemble input data in the light of the defined data, in a way to produce over many visuals. However, many researchers who provide layout production of architectural plans today have tried this method from different perspectives with different algorithms.

According to the working principle of the network, these two methods, which are the learning methods of all artificial neural networks, are used as "supervised and unsupervised learning". According to the usage of supervised learning or unsupervised learning, the main methodology takes shape by focusing on the main aim. Depending on the variables, exemplary learning models may be preferred (Lee, Boubekri, & Liang, 2019). Depending on the labelization process of the data, supervised or unsupervised learning methods may be preferred. According to the main purpose of the study, main methodologies such as classification, regression, cluster analysis, and dimensional reduction can be determined. Another important process of the study is the statistical evaluation process of learning techniques and output data. The algorithm to be selected in this section changes the evaluation method of the study (Figure 2.1).

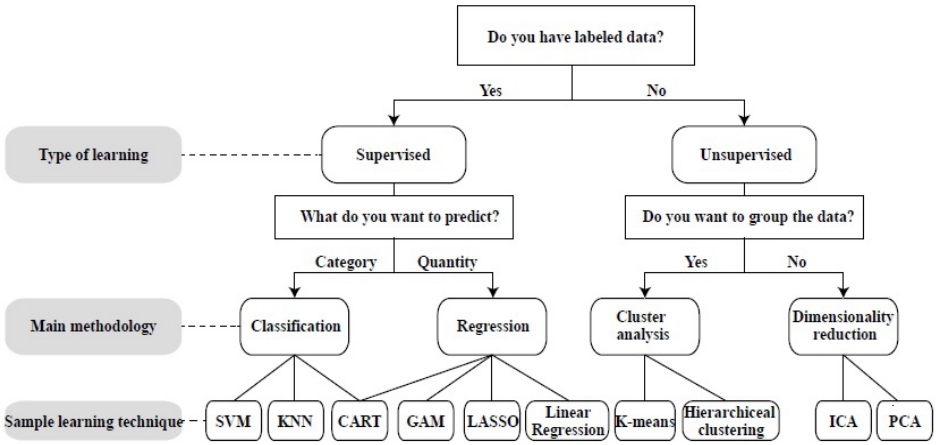


Figure 2.1. The Elements of Statistical Learning (Lee *et al.,* 2019)

The difference between deep neural networks and single neural networks is that they have more than one hidden layer. For this reason, in artificial neural networks, the weights of the input data in these separate layers are calculated together with the loss function. The outputs are optimized according to the formation status and the network is retrained (Figure 2.2) (Chollet, 2018).

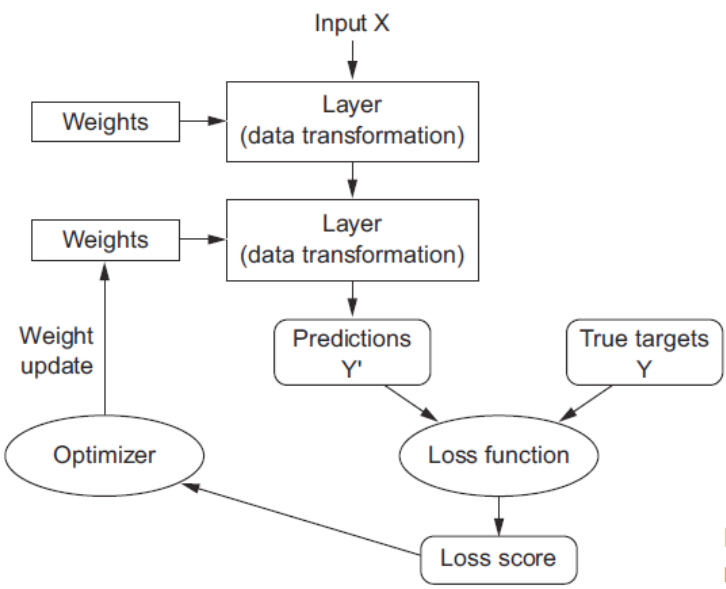


Figure 2.2. The process of calculating the layers of the network with the weights of the inputs and optimizing them again according to the loss function values (Chollet, 2018)

According to the working principle of GANs, noise is performed randomly after labeling. During this process, the generation process starts by mixing the images generated with the images in the dataset. GANs consist of two basic parts: the discriminator and the principal component classifiers known as generators (Figure 2.3).

"The generator learns to generate plausible data. The generated instances become negative training examples for the discriminator" (URL-1). "The discriminator learns to distinguish the generator's fake data from real data. The discriminator penalizes the generator for producing implausible results" (URL-1).

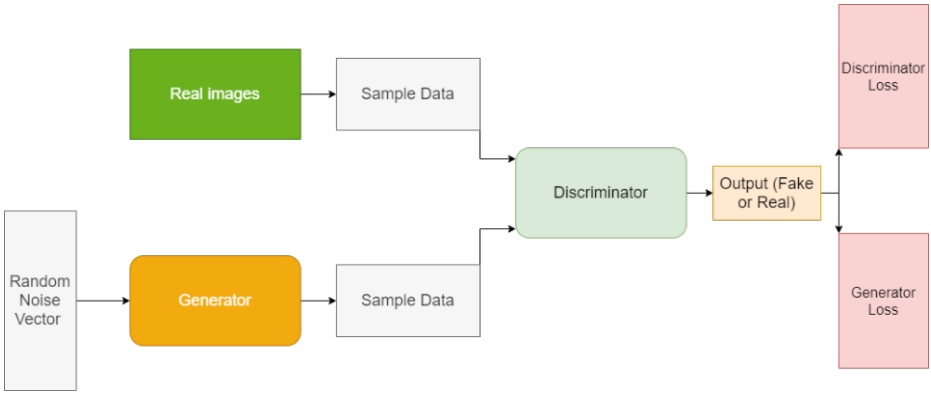


Figure 2.3. GANs working principle

The output data of the generator is directly connected to the discriminator input. Through back propagation, the classification of the separator provides a signal that the generator uses to update its weights so that the network continues to be trained until optimal generation is achieved.

Loss Function

The loss function is the main factor that optimizes the training and generation of the network. The approach of this value to 0 indicates that the outcome will be positive.

"min G max D V (D, G) = Ex~pdata(x) [log D(x)] + Ez~pz(z) [log(1 − D(G(z)))]" (Goodfellow *et al.,* 2014)

Generator Loss [D(G(z))]

"The generator tries to maximize this function. In other words, it tries to maximize the discriminator's output for its fake instances" (URL-2).

Discriminator Loss D(x) - D(G(z))

*"*The discriminator tries to maximize this function. In other words, it tries to maximize the difference between its output on real instances and its output on fake instances*"* (URL-2).

Activation Functions

In order to complicate the training process of artificial neural networks, a different algorithm than the linear regression method has been developed. The differentiability of these developed algorithms in this range gains importance in the complex structure of the network thanks to the limits it has rather than the linearity of the functions used to distinguish it. Chollet (2018) noted that "a relu (rectified linear unit) is a function meant to zero out negative values', 'whereas a sigmoid "squashes" arbitrary values into the [0, 1] interval', 'outputting something that can be interpreted as a probability". While linear and sigmoid functions are mostly used in single neural networks, ReLU (Rectified Linear Unit)-LEAKY ReLU activation functions are used in deep neural networks (Figure 2.4).

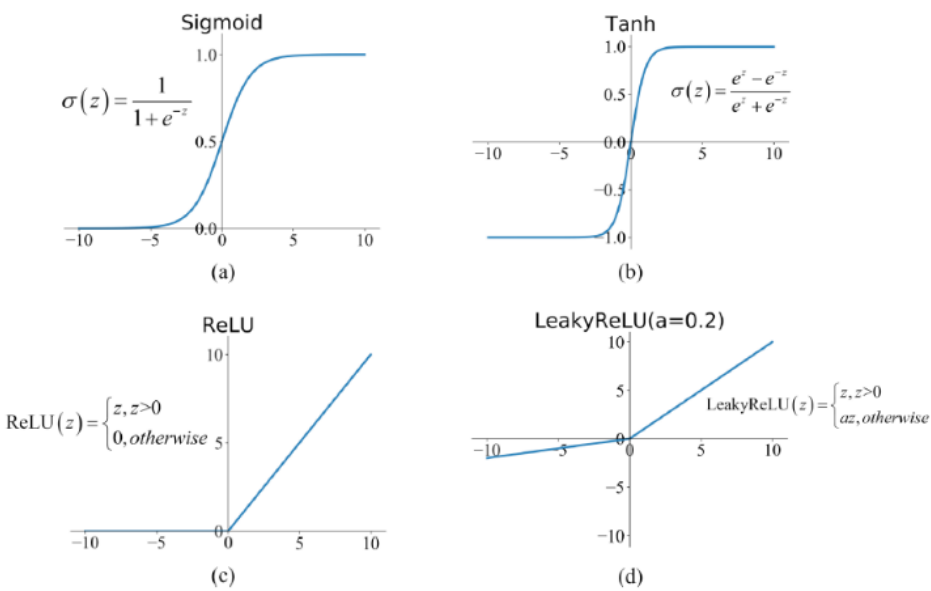


Figure 2.4. Activation Functions (D. C. Feng *et al.,* 2020).

When the GAN algorithms are evaluated, the simplest method is discussed. Since metadata sources such as the MNIST[1] dataset are not used in the study, it was preferred to use the LEAKY ReLU activation function.

3. Current Studies on GANs

One of the first studies on GANs was done by Nauata et al. (2020) providing the generation of HouseGAN. In that study 117,587 plan data sets were used. And, it was determined that in all plans, labelization was performed according to the rooms and this labelization process was generated for spatial planning with bubble diagrams (Figure 3.1). Liu et al. (2020) have generated plans to create the design of the urban scale building with the AutoALP algorithm. Architectural floor plans and urban-scale plans were trained to the network and generation was realized for the dual case, and 300 residential floor plans were used for the training dataset (Figure 3.2) (Y. Liu, Lai, Chen, Liang, & Deng, 2020). In another study, it was observed that the CNN network created with the Layout GMN algorithm created a diagram-based layout the back propagation phase during training (Patil, Li, Fisher, Savva, & Zhang, 2021) (Figure 3.3).

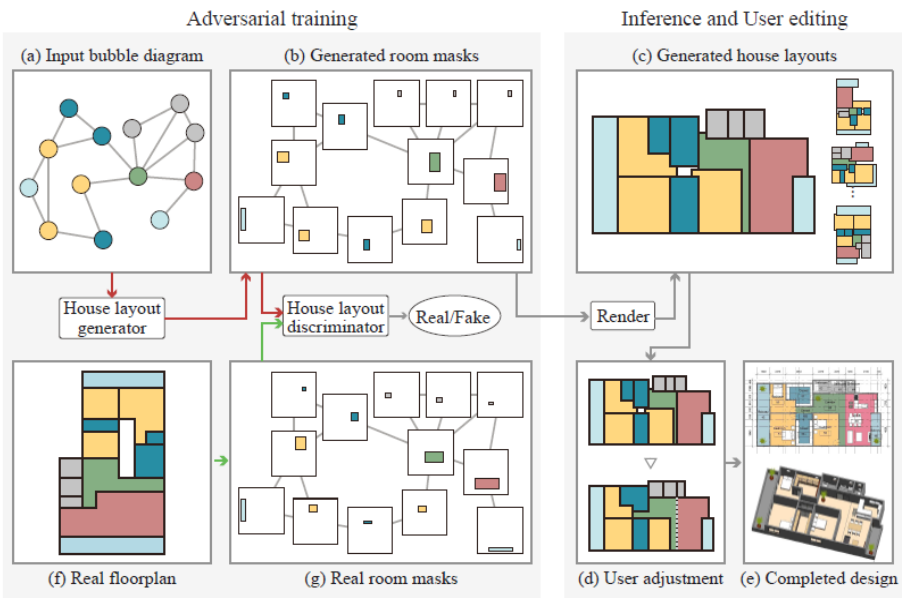


Figure 3.1. Interaction and generation of bubble diagram and plans with HouseGAN (Nauata et al., 2020)

[1] "The MNIST dataset is an acronym that stands for the Modified National Institute of Standards and Technology dataset". https://machinelearningmastery.com/how-to-develop-a-convolutional-neural-network-from-scratch-for-mnist-handwritten-digit-classification/

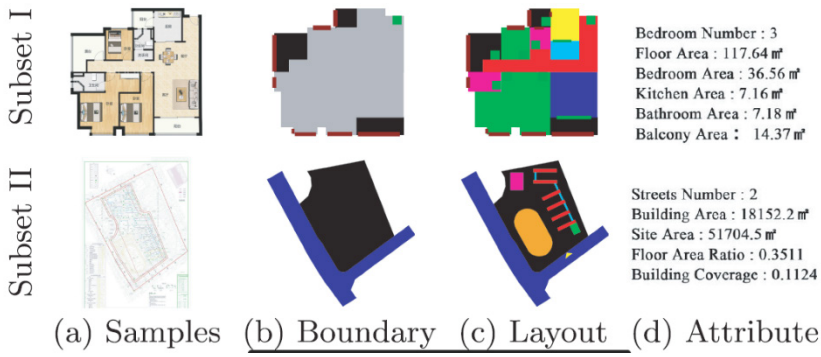


Figure 3.2. AutoALP plan and urban plan layout generation (Y. Liu *et al., 2020*)

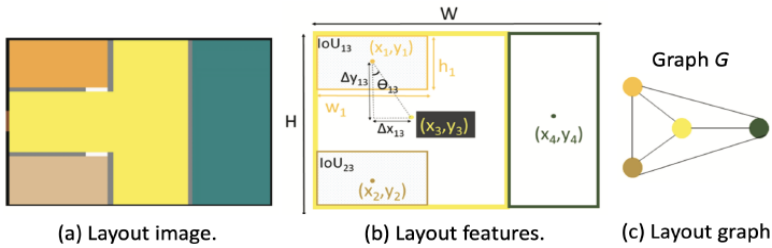


Figure 3.3. Layout image, layout feature and layout graph

A graph neural networks (GNNs) were used in the Graph2Plan study, where 80,000 layout plans were used to train deep neural networks. This dataset is known as the RPLAN dataset. The Graph2Plan algorithm was created by establishing the spatial relationship of the rooms with each other, both by training the network graphically and by training the boundaries of the plans (Figures 3.4 and 3.5) (Hu *et al.,* 2020). The processing method of this network is to use BoxRefineNet by taking the data to be trained into a bounding box.

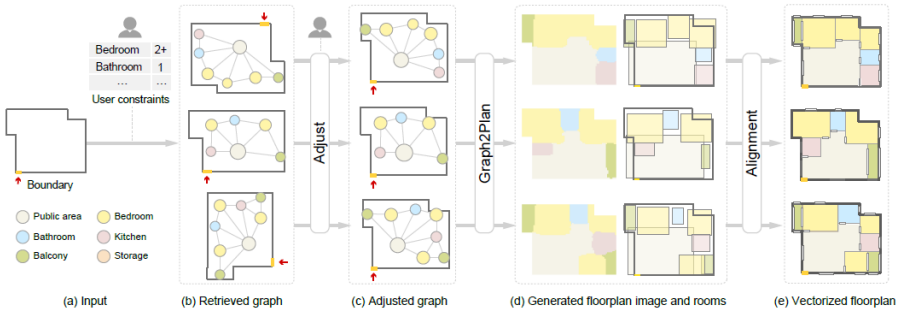


Figure 3.4. Deep neural network detecting boundaries and interaction with bubble diagrams (Hu *et al.,* 2020)

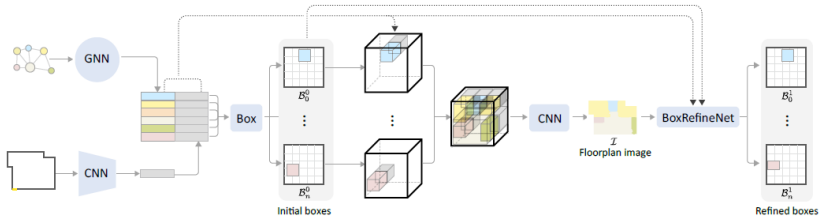


Figure 3.5. The functioning of the Graph2Plan algorithm created by combining GNN and CNN (Hu *et al.,* 2020)

In another study, plans are generated with the GPLAN algorithm, in which the linear optimization method is used (Shekhawat, Upasani, Bisht, & Jain, 2020). The difference of this study from other studies by Shekhawat et al. (2020) is that, together with the graph study in which bubble diagrams are used, they also trained the plans determined with their measurements to the network. Chang et al. (2021) also generated House-GAN in 3D, based on the functional formation diagrams of the plan and combined this generation with Voxel Grid and Graph to develop 3D generation algorithms with non-identical volumes. They named this work as Building-GAN and developed it by experimenting with HouseGAN (Chang *et al.,* 2021) (Figure 3.6).

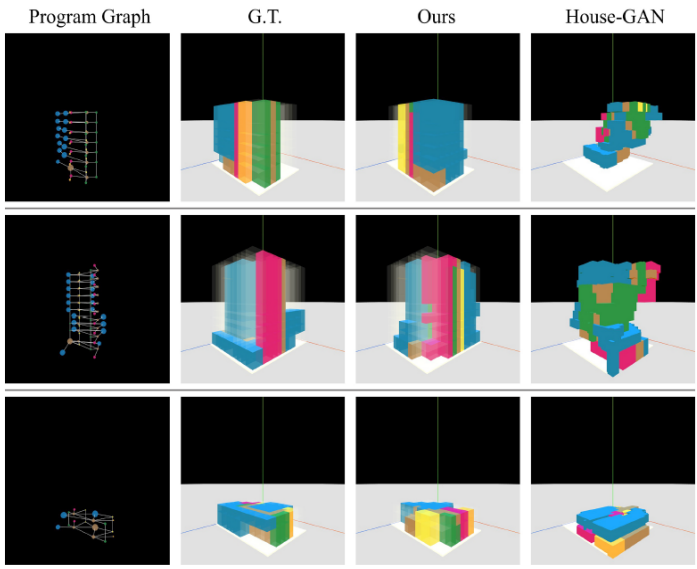


Figure 3.6. Building-GAN (Chang *et al.,* 2021)

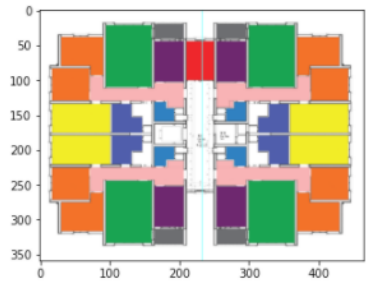
When all these studies are evaluated, it can be seen that the recent studies on spatial layout plan generation have gained momentum within two years. Almost all of these studies can work holistically with the graph planning system. The

fact that 3D generations are now similar to the 2D generation method can shed light on the further process of our work.

4. Methodology

Anaconda-Jupyter is an online web platform for working in the Python language that provides easy access to libraries for deep learning (Singh, 2020). For this reason, the Python programming language was used together with the Anaconda-Jupyter Notebook[2] software development program to carry out the study. Firstly, using Phyton's Numpy[3] library, the [numpy.array] command was used to generate the images from the picture format to numerical reduction in which the rgb (red, green, blue) values are shown with the matrix system. The main goal of this process was to convert the dataset to the .npy file format to be used as a training dataset with a GAN (Figure 4.1).

```
In [18]: plt.imshow(im)
Out[18]: <matplotlib.image.AxesImage at 0x1b823781ac0>
```




```
In [24]: room_colors = [(255/255, 0/255, 0/255), # merdiven
                        (0/255, 153/255, 0/255), # salon
                        (255/255, 255/255, 0/255), # yatak odası
                        (0/255, 128/255, 255/255), # WC
                        (0/255, 0/255, 153/255), # banyo
                        (102/255, 0/255, 102/255), # mutfak
                        (255/255, 128/255, 0/255), # oda
                        (96/255, 96/255, 96/255), # balkon
                        (255/255, 204/255, 204/255), # hol)
                       ]
```

Figure 4.1. The process of performing the numpy array operation within the specified range of values

[2] "JupyterLab is a web-based interactive development environment for Jupyter notebooks, code, and data. JupyterLab is flexible: configure and arrange the user interface to support a wide range of workflows in data science, scientific computing, and machine learning. JupyterLab is extensible and modular: write plugins that add new components and integrate with existing ones".

[3] "NumPy is a Python library used for working with arrays.It also has functions for working in domain of linear algebra, fourier transform, and matrices.NumPy was created in 2005 by Travis Oliphant. It is an open source project and you can use it freely. NumPy stands for Numerical Python". https://www.w3schools.com/python/numpy/numpy_intro.asp

After this process was performed, this file format could not be used fully for the GANs algorithm. Since this process of the study could not be realized, the process of training the plan images as a dataset in .png format was carried out. This trial process continued on the 'Google Colab[4]' platform, where we can use the GPU[5] operating system, because it is important for the computer to run faster. Thanks to Google Colab, our image data could be accessed via the drive, and data multiplication was performed beforehand. Afterwards, the method followed was to generate plans through DCGANs. This algorithm is provided by establishing a Tensorflow link. Relu activation function is used and Convolutional 2D padding method is used. These processes enabled the establishment of generator and discriminator connections that differentiate GANs algorithms from other deep neural networks. Afterwards, the dataset is defined to the network and the network is trained.

Although the epoch (cycle number) values were generated with the first 21 data, positive results could not be obtained. The epoch numbers were tried to be 50,80,150 and 500, respectively, and the saturation point of the training set was tried to be estimated (Figure 4.2). Although 499 has a very high epoch value under normal conditions, an accurate generation could not be realized with very little data. In line with this result, the network was trained again with 157 plans with the increased data set. The epoch values of this trained network were again realized as 50, 80, 150 and 500 epochs.

"min G max D V (D, G) = Ex~pdata(x) [log D(x)] + Ez~pz(z) [log(1 − D(G(z)))] (Goodfellow et al., 2014)"

Generator produces fake images together with the noise vector, allowing the images produced by the network to be distinguished from each other. Discriminator distinguishes fake or real images produced by the generator.

[4] "Colaboratory, or "Colab" for short, is a product from Google Research. Colab allows anybody to write and execute arbitrary python code through the browser, and is especially well suited to machine learning, data analysis and education. More technically, Colab is a hosted Jupyter notebook service that requires no setup to use, while providing free access to computing resources including GPUs". https://research.google.com/colaboratory/faq.html

[5] "Some of the most exciting applications for GPU technology involve AI and machine learning. Because GPUs incorporate an extraordinary amount of computational capability, they can deliver incredible acceleration in workloads that take advantage of the highly parallel nature of GPUs, such as image recognition. Many of today's deep learning technologies rely on GPUs working in conjunction with CPUs". https://www.intel.com.tr/content/www/tr/tr/products/docs/processors/what-is-a-gpu.html

According to the working mathematics of this binary function, as one increases, the other should be low.

DCGANs produced different outputs in each operating state. Visual quality and realism rates have not changed. However, as we can see in Figure 4.2, the neural network gives an image that is a little more realistic or in which the noise vector is reduced to a lesser extent with each increasing epoch value.

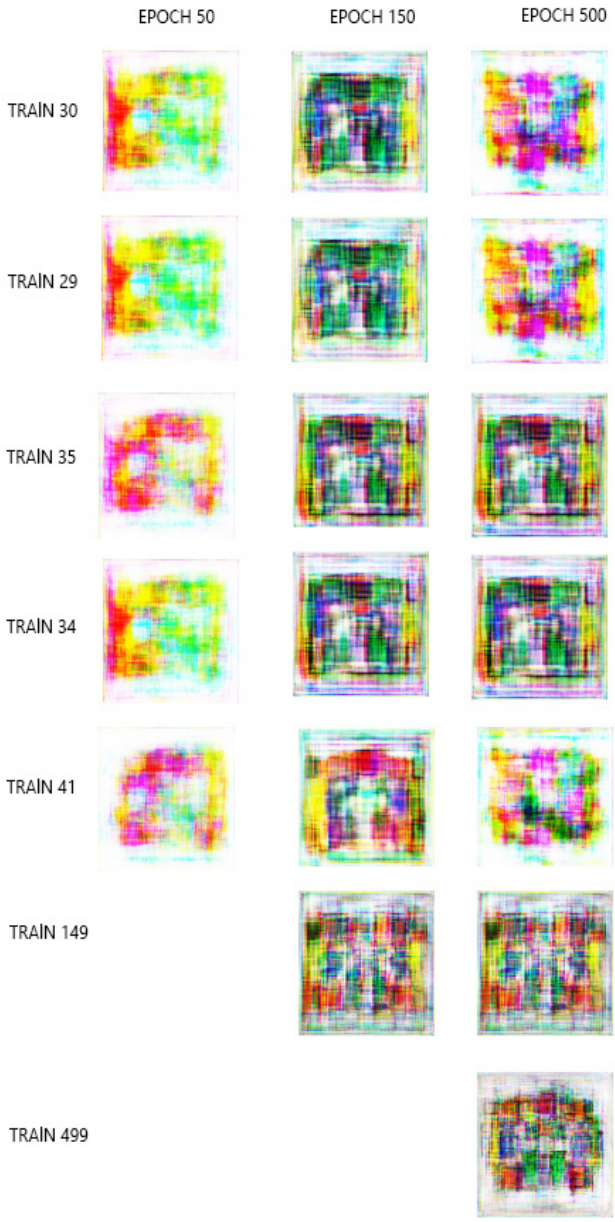


Figure 4.2. Tried generation on 21 plans

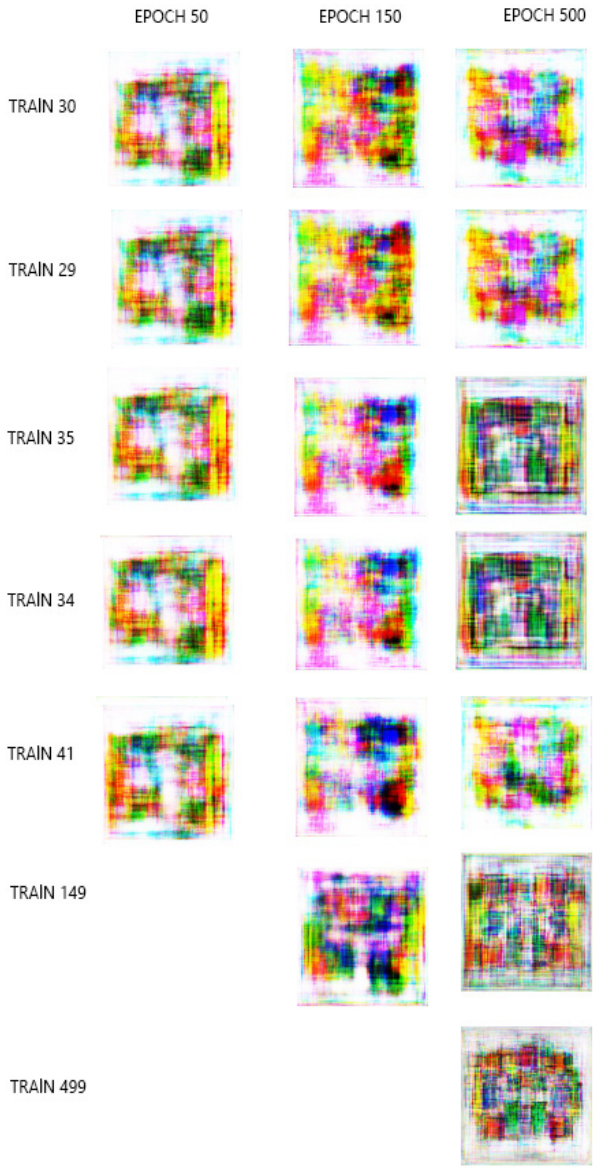


Figure 4.3. Tried generation on 157 plans

When the DCGAN algorithm was evaluated with the loss function, the values of generation loss function and discrimination loss function emerged during training. According to these values, it is known that the generation loss function values can generate real images when the values are between 0.5-2.0 under normal conditions. In our study, the loss functions in this range of values did not give very realistic images within the scope of the study. Therefore, it has

been determined that the data has insufficient resolution because the network does not reach sufficient saturation levels with low epoch values. As seen in Figure 4.3, the sharpness and resolution values of the image progressed in direct proportion with the increase in epoch values. With the determination of these values and the execution of the code, the results we obtained were plotted (Figures 4.3 and 4.4).

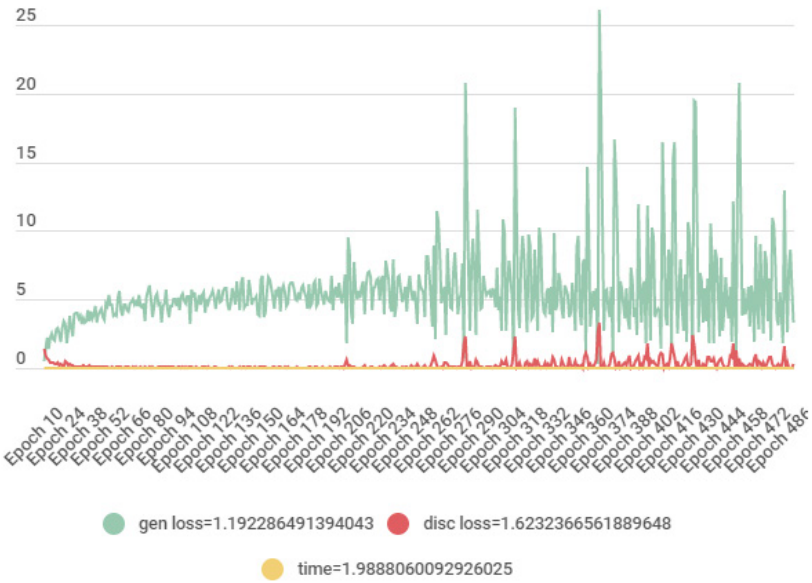


Figure 4.4. After the training process of the network with an epoch value of 500, generation loss function and discrimination loss function values

5. Conclusion

As an important algorithm of machine learning, GANs produce innovative decision support systems for the discipline of architecture, while studies in this field open new horizons for architects in their own research. In this context, it is important for architects to approach the work done in the intersection of architecture discipline and machine learning, knowing the working principle of the algorithm. For this reason, in our study, we explained the working principle of DCGANs and showed how it works with an algorithm in the generation of plan layouts. Separating the functions in the algorithm from other deep neural networks is important in terms of understanding and interfering with the mathematics of the work. For this reason, these formulas and concepts are clearly explained in the details of the study. The inference from the research study is that the images

in the epoch values where the generation loss function and discrimination loss function values are balanced are closer to the real images. However, testing the study on limited visuals (plan typologies) caused the network to produce less realistic images. Emphasizing that the "big data" concept, as mentioned at the beginning, is important for deep learning algorithms and it can be claimed that the input data obtained around 1000 will lead to a more accurate and realistic result. Looking at the current studies above, it is possible to predict that each plan scheme production works with GANs with different algorithms and that the researcher can proceed through these.

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(URL-1) https://developers.google.com/machine-learning/gan/loss last accessed:19.06.2021

CHAPTER 4

VALUE AND EVALUATION OF HOUSING: HOW AN ASSESSMENT SYSTEM CAN CONTRIBUTE TO RESIDENTIAL QUALITY*

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1. Introduction

Housing is a spatial environment which has cultural, economic, psychological, and social dimensions (Payne, 1977). The multi-storey housing blocks in Turkey provide a shelter for the people satisfying the quantity of housing but created many problems in terms of serious quality gaps which have a great impact on urban patterns (Tekeli, 2010). Due to this reason, there is an urgent need for improvement housing quality in Turkey.

There is a strong relationship between sustainability and quality. (Hatipoglu, 2017) Sustainable buildings not only have a less harmful effect on the environment, but they also improve architectural quality with a holistic approach. Bob (2012, pp.20-25) indicates that *"Architecture is sustainable when it has special design qualities, is technically up to date and is socially and functionally compatible. It is important that sustainability is understood by the architecture profession as a contribution to good architecture and not as a hindrance."*

Over the last years there it has emerged a wide range of assessment systems to measure sustainability and quality. It is a complex task to measure this complexity and find out the contribution of sustainability to the building

* This study has been derived from Phd Thesis of the author at Faculty of Architecture and Planning in Technical University of Vienna. I remember my dear supervisor Prof. William Alsop with respect and love who passed away in 2018. I would like to express my gratitude for his support and inspiration.

quality. Whether certain architectural aspects, such as quality of design can be assessed continued to remain as an open question to be answered. When addressing sustainability in building and housing, the trio of social, economic, and ecologic aspects have always been mentioned. Moreover, discussion of sustainability has transformed into the term "quality" and a lot of assessment system which is based on assessment of sustainability, give certificates to quality of buildings.

This study aims to provide an awareness of the possibility and necessity for a housing assessment system which is very crucial for socio-spatial quality and sustainability of qualified neighbourhoods. In order to achieve this goal this study focuses and elaborates upon the significance and effect of assessment of housing in terms of developing residential quality. Value and evaluation as an important aspect which improves quality widely have been implemented in many countries around the World, which is not a prominent consideration in Turkey. For this very reason, this study has presented several assessment systems including criteria influencing sustainable and qualified housing. As a result some general principles have been briefly concluded in order to define a guideline for future housing developments.

2. Good Design and Housing Quality

Housing quality is related to the definition of "good design" and "housing needs". It is important to reach set housing quality benchmarks for design quality, communicating design needs, emphasizing the importance of design to the procurement process. In the paper, "*Opportunities for Change: Sustainable Construction of DETR*" (1998), it is determined the importance of relation of progress and quality. One of the points raised is that to reach the appropriate quality, built environments should be designed durable, flexible and adaptable; another is the creation of buildings which are resource and energy efficient in their construction and whole life. These buildings should also provide efficient and pleasing atmosphere suitable for living, working etc. These features, all highlight the necessity of thinking of resource efficiency, construction quality and design quality, which contributes to human satisfaction, and to housing quality.

In order to define good design, the term "design" should be defined. We can define "design" as; a description of the main features of something. A plan is a design that shows how something should be arranged and executed.

Macmillan (2004, p.1) describes design as "*a core problem-solving activity that not only determines the quality of the built environment- the buildings, public spaces, landscape and infrastructure- but also delivers many of the instruments for implementation of an urban renaissance.*"

When this definition is reflected on architectural design it can be indicated that it is the process that lies between working with the client to identify requirements and aspirations on the one hand, and on the other putting together the components and systems to construct it. To evaluate good design, the following should be considered; functionality, whole-life costing, service enhancement and aesthetics (Treasury Task Force, 2000). This brings us to the point that building projects are like cocktails which are mix of competing factors. It can be argued that in any construction project the three most crucial aspects of the design are (Trebilcock, 2004, p.160):

- Ensuring an imaginative and visually attractive response to the brief
- Aiding the ease, reliability, safety of its construction
- Achieving maximum value and functionality with effectiveness, performance and efficiency in use.

It has now been described what 'good design' could be, and which qualities it brings with it. According to Treasury Task Force published in England (Treasury Task Force, 2000) design is described as a process of reaching efficient solutions in which intelligence and creativity have been combined. Good design is a requirement and not an optional preference. Moreover, it is not a result but also a process which responses to the required programme. Good design includes creativity, functional efficiency, structural quality, sustainability, cost and time efficiency, flexibility and the harmony with the context and programme requirements. In addition it contributes to the quality of service and provides the satisfaction of users. *Provision of these criterias also ensures wider policy objectives regarding sustainability. That means Good design improves the value by providing functionality, economical optimisation, service enhancement and socio-spatial quality with environmental benefits.*

Cabe´s emerging guides to good practice identified and described the principles of good design for building and urban design in Figure 1(CABE and DETR, 2000).

What makes a good project?	Principles of good design	What is a well-designed building?	What is a well-designed place?
• order • clarity of organisation • expression and representation • appropriateness of architectural ambition • integrity and honesty • architectural language • conformity and contrast • orientation • detailing and materials • structure, environmental services and energy use • flexibility and adaptability • sustainability • beauty	• functionality in use • build quality • efficiency and sustainability • designing in context • aesthetic quality	• appearance • context • buildability • maintenance • operation	• character • continuity and enclosure • quality of the public realm • ease of movement legibility • adaptability • diversity

Figure 1. Principles of good design at individual building and urban levels by CABE (CABE and DETR, 2000).

Another report by RIBA Future Studies Group on the value of architecture, commissioned by Worpole and Loe, put forward four principal arguments regarding the contribution that architecture and design can make at the urban level.

In order to increase the preference of residential areas by people, it is essential to create a spirit of space, where they have opportunities to feel physically and psychologically well, and find easy to use. So, the question is, what constitutes better housing quality, or what is housing quality? These questions are related with performance and functionality of residential areas.

The terms housing value and housing quality are in a significant relationship and it is meaningful to discuss these notions together. Housing value is correlated with the response of residential requirement of its inhabitants. Dwelling conditions are in relation with residential area (settlement, landscape, infrastructure) and living environment (district, neighborhood, surroundings). The housing value corresponds to the degree of accordance between residential conditions and inhabitants needs. This has an impact on activity patterns of inhabitants. Duo to the complexity of housing quality which has to response to individual needs as well as objective factors, sustainable and qualified housing cannot be reduced only

to measurable aspects, but rather it has to deal with the whole of human needs and requirements with a holistic approach and ethics.

Housing Value already contains the possibility of comparability in the sense of equivalents or as use in the material and immaterial sense. Four categories of housing values can be distinguished (Dammaschk *et.al,* 2004):

- Use value and use utility. These include practical usability, healthy dwelling, and an adequate durability.
- Emotional value - self-perception of the living situation. Aspects such as "to feel comfortable" or "to love being at one's home" are meant.
- Use for prestige - perception of others of the living situation. The owning of home serves as successful self-representation.
- Protection function and socio-spatial quality. Protection from physical impairments and interferences of privacy as well as the spatial possibilities for communication. This implies the volatility between protected privacy and casual external contact.

3. Value and Evaluation

The aim of evaluation is to determine the value of something, which is closely related to the determination of quality; the extent to which a product satisfies the specified needs and requirements. Evaluation provides recommendations which may lead to improving the quality of programming, designing, building, and management of the built environment. Besides such practical goals, scientific goals also can be targeted, such as contributing to the formation of new theories or tools (Voordt and Wegen, 2005). Evaluation of a building or the planning and design process provides understanding of a better quality. Moreover, it is possible to produce guidelines and policies from these assessments. Evaluation research teaches how to make a complex decision-making process understandable and how experiences and analysis of evaluations can be an orientation for new and future projects.

For evaluation of buildings, it is relevant to determine what to evaluate in them and their surroundings. From an architectural point of view visual or architectonic quality, which can be classified as form, function, and technology, are considered as important. Many attempts to evaluate building performance have been affected in recent years and a wide range of summaries can be found in the literature on evaluation. In each of them, indicators have been organized in different ways but have numerous common background points. Van der

Voordt and Van Wegen (2005) organize these factors into four categories which refers to the Vitruvius´traditional three-way division: Functional (utility value, future value), aesthetic (experiential value), technical, economic, and legal.

To design a building of quality is assumed to be the same as designing better buildings. Macmillan, the editor of the book "*Designing Better Buildings: Quality and Value in the Built Environment*", intended to measure and improve the quality of buildings. He says that design quality can be measured because if something cannot be measured, it means that does not exist.

There are several methods to measure quality and sustainability, such as interviews, questionnaires, observation, experiments, and the use of assessment equipment, each of which may have advantages and disadvantages. The disadvantages can be reduced to the minimum in the case that several methods are used in a balanced combination.

4. Assessment of Housing Quality

Other than assessment systems which evaluate sustainability in buildings, there are also some studies and systems which are specified only for housing quality. One of the most relevant housing quality assessment systems is the 'Wohnwert-Barometer' which evaluates 'sustainable housing quality'. This system has eleven main criteria. The Swiss housing evaluation system similarly has criteria which can rate evaluated reference projects as well as information about the buildings. Another assessment system, the "Wohnqualitätsindex", was developed in the 1980s in Austria and aimed to measure the satisfaction of tenants, renovations, and housing quality to appraise measures and subsidies for renovations. Franziska Orso and Ulrike Pitro, with their research in Wien, "Kriterien für zukunftsfähiges Stadtwohnen", have also assessed the significant criteria for housing. In this part these evaluation systems will be explained in detail including their indicators and processes:

4.1. Wohnwert Barometer(Housing Quality Barometer)

The system was developed in 2009 by the department of Design and Energy Efficient Construction at the Technische Universität Darmstadt to assess sustainable residential qualities This project was funded by the Federal Office for Building and Regional Planning for the Building and Housing Incentive Programme. The target audience are tenants, designers and planners, and operators. More than 25 international certification systems such as LEED, BREEAM, CASBEE, DGNB,

WBS, GREEN STAR were analysed to create criteria and goals of sustainable residential qualities. The determination of the housing quality is based on 43 criteria in eleven topics which are evaluated in each case with the help of various assessment aspects and divided into a four-action radius: apartment, home/environment, location, and process. The eleven main criteria are: Comfort, flexibility and multi usage, spatial and design quality, functional quality, operation, user costs, building´s resource needs, building´s overall impact, process quality, accessibility, location quality and supplies.

The issues of assessment are functional, spatial and design quality, well-being, comfort, and quality of location, as well as resource requirements and overall impact of the building.

4.2. Wohnungs-Bewertungssystem WBS – The Swiss Housing Evaluation System

WBS is an evaluation framework to plan, assess and compare residential buildings. It was first established in 1975, and in 2000 the WBS was revised to update changing housing requirements. The assessment is based on thirty-nine criteria in three main categories: flat (W1), estate (W2) and location (W3). (Figure 2) This checklist provides to the planner a systematic approach in the planning process and a clear decision-making basis. The criterion of the assessment has compliance levels 1 to 3. The sum of the weighted points is divided by the total weight of the resulting use value. The comparison of the achieved values determines the relative quality of the housing object. The quality of a project is assessed according to its respond to the requirements and its comparison with other projects

Advantages of the WBS are the rational, comprehensible assessment of all major aspects of housing quality and comparability of the quality levels of different apartment layouts, housing types and residential locations (Meyer-Meierling, 2000, p.27).

BUNDESAMT FÜR WOHNUNGSWESEN

Housing planning evaluating and comparing

Wohnungs-Bewertungs-System (Housing evaluation system-(WBS), Edition 2000

Building

Dwelling Number of rooms: Area: PHH:

Beurteilungskriterien		Points	Gewichte	Weighted points	Measured values
W1	**Wohnung**				
B 1	Net surface area		3	0,0	
B 2	Number of rooms		3	0,0	
B 3	Vielfältige Nutzbarkeit		3	0,0	
B 4	Furnishabbility of rooms		3	0,0	
B 5	Windows in rooms		2	0,0	
B 6	Placement of dining space		2	0,0	
B 7	Furnishabbiity of dining space		2	0,0	
B 8	Connection to the cooking area		2	0,0	
B 9	Windows in cooking area		1	0,0	
B 10	Equipments of sanitary		1	0,0	
B 11	Windows in sanitary		1	0,0	
B 12	Storage possibilities		4	0,0	
B 13	Flexible organisation of rooms		2	0,0	
B 14	Flexible floor plan		2	0,0	
B 15	Selectable paths		2	0,0	
B 16	Private outside area		3	0,0	
W1	Total weight		36	0,0	
	Utility Value W1	**0,00**	= total weighted points W1 / 36		
W2	**Estate**				
B 17	Range and types of flats		2	0,0	
B 18	Additional rentable housing and working spaces		3	0,0	
B 19	Flexible flat sizes		2	0,0	
B 20	Access of flats		2	0,0	
B 21	Access of the building		2	0,0	
B 22	Sanitary of the building		3	0,0	
B 23	Private storage		2	0,0	
B 24	Common storage		1	0,0	
B 25	Multipurpose and community rooms		1	0,0	
B 26	Communal open space		4	0,0	
B 27	Pedestrian and bicycle circulation		2	0,0	
B 28	Car parking		1	0,0	
B 29	Graduated esposure to the public		1	0,0	
B 30	Noise exposure and sound insulation		2	0,0	
W2	Total weight		28	0,0	
	Utility Value W2	**0,00**	= Total weighted points W2 / 28		
W3	**Location**				
B 31	Playgrounds		3	0,0	
B 32	Parks and forests		2	0,0	
B 33	Public transport stop		8	0,0	
B 34	Town or village centre		8	0,0	
B 35	Kindergarten and primary school		3	0,0	
B 36	Availability of secondary school		1	0,0	
B 37	Social facilities		1	0,0	
B 38	Nearby recreation area		3	0,0	
B 39	Regionalzentrum		7	0,0	
W3	Gesamtgewicht		36	0,0	
	Utility Value W3	**0,00**	= Total weighted points W3 / 36		
	Utility Value W1 + W2	**0,00**	= Total weighted points W1 + W2 / 64		
	Utility Value W1 + W2 + W3	**0,00**	= Total weighted points W1 + W2 + W3 / 100		

Figure 2. WBS Housing Assessment and Point System (WBS, 2000)

4.3. Kriterien für Zukunftsfähiges Stadtwohnen Wien/ Criteria for Viable and Sustainable City Housing Vienna

This research was founded in the framework of the Roland-Rainer research fellowship 2008, which was awarded by the City of Vienna and the Federal

Chamber of Architects and Consulting Engineers. It was aimed at establishing "criteria for sustainable city housing /living" and to integrate a system for the assessment of housing. In the production of housing a variety of disciplines and stakeholders are involved and affected. It is necessary to involve them in the process to further development of the project. The development of this system aims to accelerate continuous development for housing actors. This can be achieved through an enhanced processing of the objectives, as well as carrying out the weighting of the resulting criteria in expert groups.

The assessment of housing includes a range of issues which makes it necessary to create a tool that allows the setting different values in relationship to each other. This assessment framework has six target levels: city function, space quality, pluralism, ecological sustainability, economic sustainability, social sustainability. It has also six investigation (observation) levels; city structure, building development, dwellings, common spaces, open spaces, parking. A matrix from these levels which is used as assessment framework has been developed.

4.4. Kriterien für Nachhaltiges Bauten /Criteria for Sustainable Building- Aspects and Evaluation Criteria in Housing- Switzerland

The Swiss Engineers and Architects Foundation SIA demonstrated sustainability as one of its priorities in 1997. The first goal was detailed specification of sustainability for the residential sector. The coordination group sustainability of the SIA described aspects and criteria of sustainability. The aim was not creating a rating system, but a qualitative overview.

The criteria raster of SIA was published in a CD "Sustainability and Housing". The indicators of the rating system are:

- Social; well-being, utilisation, aesthetic, community
- Environment; materials, energy, landscape, infrastructure
- Economy; building stock, production costs, operating costs, flexibility

4.5. DQI (Design Quality Indicator) and HQI (Housing Quality Indicators) in the UK

4.5.1. DQI (Design Quality Indicator)

In 1999 Construction Industry Council has been established in the UK to find solutions for the weaknesses of design in buildings. This organization was supported by the Commission for Architecture and the Built Environment, the Department of Trade and Industry, the Office of Government Commerce,

Constructing Excellence, and the Strategic Forum of Construction. DQI (Design Quality Indicator) is the product of this organization in order to eliminate the poor-quality design of the buildings. The former Department of the Environment, Transport and Regions (DETR) funded the project.

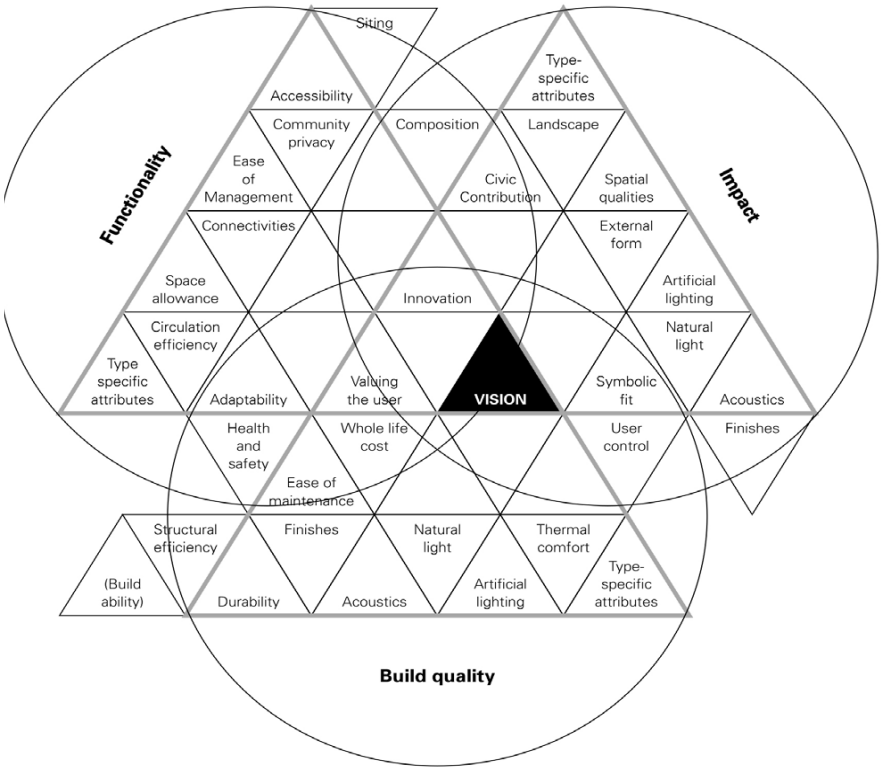

Figure 3: Overall Framework of DQI (Dickson, 2004, p.190)

The principles of this indicator were divided into three factors; functionality, build quality, and impact which had been developed from the Vitruvian principles. (Figure 3) These indicators are not used to work out in any absolute sense which is the best design in any given context, but to allow people to compare buildings. The prime aims are; to provide a framework to guide the setting of a holistic vision and intent for a building, to test the process of the design and the product, to help perform evaluations of buildings in use. Influences on the occurrence of DQIs was a framework for assessing quality prepared by Susan Francis of the Medical Architecture Research Unit(MARU) (Macmillan, 2000). The indicators for a successful design construction has been related with factors such as value life, finances, time, and resources.

The overlapping features of delight, function, and sustainability (resources) have been described: delight is related to subjective preferences and perception of the user regarding spatial conditions; function is related to health care, satisfaction and ease of use, sustainability is related to social, economic, and environmental performance.

The goal of DQI have been to evaluate quality in different phases; inception, design, construction, use and process. Because of the brevity, clarity, and practical usage of the system it can be used by every person. It is essential to construct a framework for the judgment of a design, relating subjective indicators with objective indicators. The assessment tool includes three main parts: a conceptual framework, a data gathering tool, and a weighting mechanism.

4.5.2. HQI (Housing Quality Indicator)

The Housing Quality Indicator (HQI) was developed as a measurement and assessment system in the UK, by DEGW on behalf of the Department for the Environment, Transport and the Regions, and the Housing Corporation. This program incorporated design standards for affordable housing providers who want to receive funding. The first version of the HQI system was offered in 1999. The motivation of the UK Government has been that our homes have a crucial effect on social life regarding well-being, sense of worth, family relationship and sense of community (DTLR, 2000). The aim has been to ensure that housing quality today and, in the future, contributes positively to the goal. The HQI system offers an evaluation of housing quality through key features of housing projects; location, design, and performance. The HQI system was developed with ease of use in mind. The analysis is based on plans and other information. There are ten quality indicators and these are: Location, visual impact, site, layout/landscaping, open space, routes and movement, unit size, unit layout, unit noise control light quality services, accessibility, sustainability related with economic and environmental aspects and functionality.

For each indicator there are questions to be completed by an assessor. In pilot trials, the research team visited each development to make an independent quality judgement before the assessments were completed. These perceptions were recorded, together with photographs of various features contributing to the judgement, and questionnaires asking a wide range of questions about residents´ perceptions of quality. It can be concluded that the correlation between researchers´ perceptions of scheme quality and the survey result was high. The development of the HQI system provide a success about the challenge in ensuring quality of housing and the built environment (Wheeler, 2004, pp.210-214).

5. Conclusion

After the demonstration of the importance of value and evaluation and research of the asessment systems in detail it can be indicated that the assessment systems have contributed to housing quality, livability and sustainability of the countries in which they have been developed. On the other side, the construction industry in Turkey is booming, especially in the housing sector, and most housing projects lack a clear vision and are designed by chaotic mass architectural production. Since housing is the main element of urban development, most of the urban problems can be minimised by focusing to the residential quality and its improvement which also contributes to the sustainability due to the correlation between quality and sustainability. This reveals the importance of developing a housing quality assesment system in Turkey which can contribute to residential quality.

Since there is a tendency of settlements in the form of mass production which is called "site" in Turkish, the housing quality in Turkey should be considered with the environment of buildings with a holistic approach. Thus, some general practical aspects can be briefly introduced in residential areas with their their surrounding which make them more usable and livable environments. All these practical benefits which will be introduced, should be considered in an organised classification while developing an assessment framework.

Firstly, residential areas must not be designed as gated communities which isolate people as ghettos in the community (there are a lot of these examples in Turkey). They must provide security and visual privacy against the street, but also prevent the distinction between people in and outside a housing complex. Especially in city life, they have to offer enough green spaces for inhabitants, encourage social cohesion and communication between them with common rooms, and provide playing areas for children. A clear distinction between pedestrians-cycle and car paths is important for secure circulation.

The apartments of housing complexes must have good sound insulation between each unit and to outside noise, also good heat insulation against summer and winter which provides energy efficiency. It is important to have sufficient storage for prams, bicycles and private stuffs. Accessibility for all is an important issue that must be taken into consideration.

Housing developments should ensure a variety of different living conditions in terms of size and types of dwellings, such as small-large dwellings, flats and marionettes, with gardens and terraces. This is a way to ensure living preferences for people with diverse requirements and provide a community with different ages and backgrounds. On an urban scale, they must have good transportation

possibilities and public services near the complex. This helps discourage private car usage which reduces air pollution and traffic.

As a result, this study highlights the importance and need of housing quality assessment and conduct a research about the indicators and progress of several experiences of different countries on evaluation of housing. Moreover, the study which also acts as a guideline for housing development, has provided a base for establishment of a housing assessment system for Turkey which was developed by authors following this study.

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CHAPTER 5

GREEN BUILDINGS AND SUSTAINABLE BUILDING MATERIALS

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1. Introduction

Buildings have incredible effects on the environment. They are using natural resources, consuming electricity and potable water, and the waste generated by them is disposed of in landfills. Massive amounts of damaging productions, including the introduction of greenhouse gasses, are involved in construction operations. It is not just the environment that is affected by harmful buildings and materials, but also the bad quality of indoor environmental affects the health of employees in office buildings. Residential buildings, where people spend most of their indoor time, are risky for their health, happiness, productivity, etc., if the materials which surround them are harmful. From the environmental impact perspective, the building sector has a significant effect on the environment in general, which is crucial for mankind. Selections of materials and layouts are essential for sustainability since residential and office buildings signify a huge percentage of the built environment. Producing sustainable construction materials is one of the best methods to accomplish the goal of the green world. Green buildings are supposed to use environmentally accepted materials which go along with nature and have a positive impact on the surrounding and health of living beings. The research community around the world has launched important initiatives to find alternative sustainable building materials and low-tech methods, resulting in more sustainable and

affordable construction in line with today's comfort standards. Selection of materials is one of the first steps that construction professionals are supposed to approach carefully, thus sustainable construction materials that have minimum environmental burdens need to be evaluated.

This study aims to focus on green buildings and emphasize the importance of building materials for sustainability. A literature review has been performed. The concept of green buildings, which is important for sustainability to be recognized by society, is defined and analyzed in the beginning. Principles for design, advantages and goals for green buildings are explained. Following, a number of sustainable construction materials and their properties are reviewed. For this, the importance of the life cycle, and the advantages of the cradle to grave approach are emphasized. Characteristics of sustainable materials and the importance of interior design are also described. The final section focuses on the materials. Properties of some of the materials are listed and substitute materials are evaluated.

In Section 2, the concept of green buildings is defined and analyzed, which has importance for sustainability to be recognized by society. In Section 3, sustainable construction materials and their properties are reviewed. The 4th section focuses on green materials and their impact on the environment.

2. Green Buildings

The main goal of sustainable architecture is to create buildings with reduced damaging effects on the environment and with increased positive effects on human beings' health. Green buildings and their construction are designed in a way to eliminate their negative impact on their surroundings, their users, and the earth.

Areas that can be focused on during the design are site selection, structural design efficiency, energy consumption, water use, sustainable materials, indoor environmental quality, operations and maintenance optimization, and reduction of waste and toxins.

2.1. The principles of green building design

The primary step for designing a green building is to examine and analyze the site. In addition to the positive and negative properties of the site, the ecological features need to be evaluated properly for designing a building harmonical to nature. These features include exposure to sunlight, air quality, and water elements. According to Elshimy (2015), design considerations are planning for

a reduced site disturbance, wastewater management, stormwater management, landscape and exterior design to reduce heat islands, light pollution reduction, reducing car dependence through limiting car parks.

2.2. Advantages of green buildings

Designing green buildings has some advantages, a number of which are important. According to Elshimy (2015), some of these advantages are environmental advantages, health and safety advantages, community advantages, economic advantages, and productivity advantages (Figure 1). Environment, regarding the present and future human existence on earth, is one of the most important of these.

Figure 1. The benefits of designing green buildings (BharatGoGreen, 2021)

Considering the environment while making a design, leads us to reduce the operational energy, the water requirement, volume of wastewater produced, which results in less water pollution, material usage, longer building life, and lower maintenance cost. Health and safety advantages, however, enhance occupant comfort and health. Community advantages minimize strain on local infrastructures and improve quality of life. Regarding the economic advantages, the integrated design allows high benefit at low cost by achieving synergies between disciplines and technologies, reduces operating costs, lowers utility costs significantly, and optimizes life-cycle economic performance. Productivity advantages improve occupant performance. A considerable loss in national productivity may be avoided by improving employee satisfaction providing a healthy workplace via daylight use and thus increasing retail sales.

2.3. Goals of green buildings

Green buildings introduce advantages for both the occupants and the environment. Since buildings must provide livable, comfortable, and productive spaces, the most used sources are energy and water, both of which can be transformed and reused (Figure 2). Lighting, heating, electrical appliances, etc. which are required for occupant comfort and satisfaction increase the need for energy.

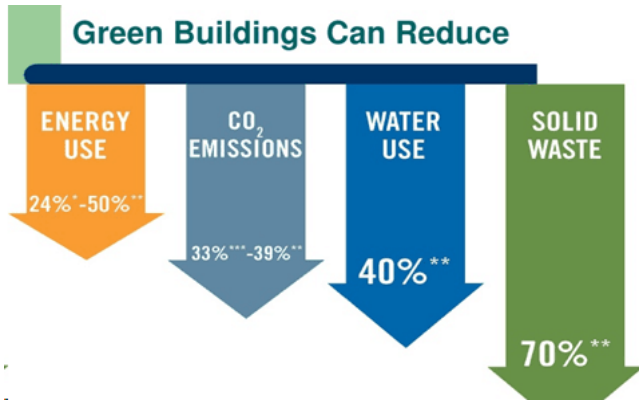

Figure 2. The percentage of reducing the most used sources with Green Buildings (Garg, 2019)

Architecture is going through a major renovation, starting from the basics. This renovation involves an integrated process where ideas are developed through synergy. Redesigning and reusing existing buildings are also being developed during this renovation. Sustainable design is also involved during this process, which consists of review and use of green practices with the cooperation of all disciplines involved in the production of the building, for reducing the effects of the building on human health and the environment.

The main characteristic of a green building is the possibility of the resources being renewable. According to Ji (2016), the main source of energy is the sun and one of the most preferred ways for natural and non-damaging use of this source is using sunlight through passive solar, active solar, and photovoltaic panels. In addition to these, using plants and trees on green roofs and rain gardens, provides various advantages, one of the most important of which is the reduction of rainwater run-off. Many other techniques with sustainable materials are also taking their place in designing a green building. For example, instead of regular concrete, which is one of the most used materials in construction, permeable concrete, green charcoal, self-healing concrete, hemp concrete, papercrete, etc., are being preferred (Dfordesign, 2019).

The development levels of various technologies differ around the world. However, there are common aspects that need to be met in order to provide the aimed effect on human health and the environment.

Ji (2016) argues that the key steps in designing sustainable buildings are specifying green building materials from local sources, reducing loads, optimizing systems, and generating on-site renewable energy. Nevertheless, the design of the building needs to be harmonious with nature to meet aesthetic expectations and attract users to sustainable practices.

One of the main goals of green buildings is to have a positive influence on its local and global environment, human health, usage of natural resources, sustainable materials, and their renewability.

2.4. Standards / Criteria (regulation and operation)

Although designing and constructing a green building is preferred by the architect and/or user, it needs to meet some criteria to be specified green. These criteria are determined by rules and standards developed by organizations, through which green building concepts and practices are specified to accomplish the highest level of green design. There are a number of rating systems that help consumers determine the level of the environmental performance of a structure. According to these systems, there are points that are supposed to be accomplished during the design of a green building, which are used to determine the level of achievement. The most widely used systems are NABERS and Green Star in Australia, AQUA and LEED Brasil in Brazil, LEED Canada, Green Globes and Built Green Canada in Canada, GBAS in China, HQE in France, DGNB and CEPHEUS in Germany, HKBEAM in Hong Kong, Indian Green Building Council (IGBC), LEED India and GRIHA in India, Green Building Council Italia in Italy, CASBEE in Japan, Green Mark in Singapore, LEED, Green Globes, Build it Green and Energy Star in the U.S., BREEAM in the U.K., and Estidama in U.A.E. (Dunne, 2020).

3. Sustainable Building Materials and Their Components

According to Franzoni (2011), the selection of the materials for the Green Buildings consists of two stages. The first is an early stage of the design process and is a general choice, whereas the second stage takes place during the planning phase where the availability of the resources is evaluated. Both stages are important regarding their effect on the final product. However, architects and engineers need to be competent about materials for a successful practice.

Although a set definition for green buildings is not present, they are generally classified (Kubba, 2010) as environmentally friendly or environmentally responsible (Spiegel and Meadows, 1999). The lack of a general definition leads to misunderstandings and misleading about green building materials. According to Franzoni (2011), green building materials are defined with two main characteristics. First, the material's life cycle should be sustainable, which can be described as 'cradle to grave' (Figure 3). This characteristic is important for the environment in general. Second, the material shouldn't be harmful to human health, which should be evaluated for the material's negative influence on indoor air quality.

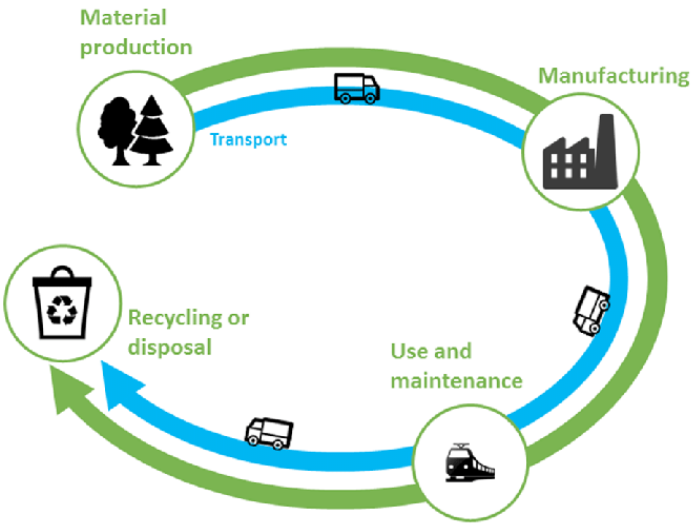

Figure 3. Cradle to Grave Approach (Hegedic, M. *et al.,* 2018)

Franzoni (2011) argues that green building materials have different levels of environmental cost for their manufacturing, transportation, or disposal, which points to the importance of the availability of a material in the market.

Similarly, Elshimy (2015) defines "Green Design" as an approach that hinders or reduces buildings' negative impact on the environment and the occupants. However, he broadens the subject into five areas namely sustainable site planning, safeguarding water, water efficiency, energy efficiency, and renewable energy. He also states that sustainable buildings express an environmentally responsible manner via maximized use of materials, minimum use of resources, and secured health and well-being of users and the related built

environment both for today and for the future. Ji (2016), regarding these, lists the advantages of using green building materials as a contribution to energy management, positive impact on health and productivity of the occupants, and flexibility in design.

3.1. Selection of sustainable building materials and their life cycle

Since the owner, the occupants, and the environment in general, are directly affected by the end product, the selection of building materials needs to be carried out carefully. The use of Life Cycle Design principles (Figure 4), which consists of three stages namely pre-building, building and post-building, guides the process for effective building materials selection (Umar *et al.,* 2012). The pre-building stage includes the tracing and extraction of the raw material, processing and manufacturing, packing and transportation to the construction site, and needs to be managed carefully since it has the biggest impact on the environment. The second stage, building, starts with the delivery of the material to the site, and consists of the site installation including the preservation and the repair processes ensuring the material to be a part of the building through its lifetime. Regarding the waste produced during the installation and the harmful effects to the occupants during the use of the building, this stage requires special attention.

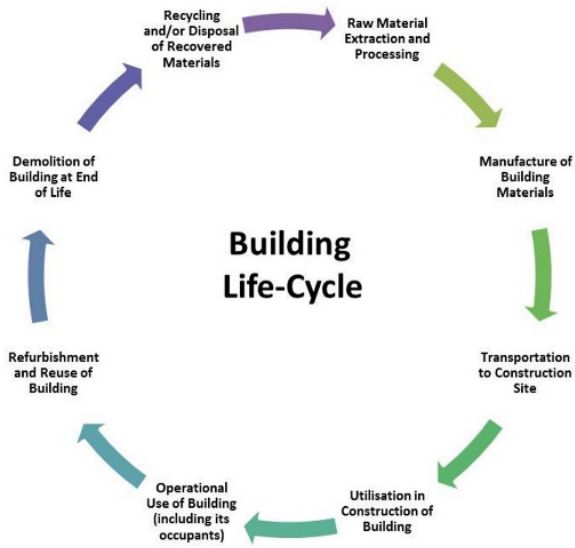

Figure 4. Methods for Building Life Cycle Design
(Shari, Z., 2017 and Phlorum, 2015)

The selection process of the building products needs to be carried out with attention because they influence clients as well as the owners, occupants, and the environment. Thus, the use of Life Cycle design principles is important for selecting the most effective building material (Umar *et al.,* 2012). The cycle consists of three stages namely, Pre-Building, Building, and Post-Building stages. The Pre-Building stage refers to the process of production and delivery of a certain material. However, it doesn't include the phase of installation. The detection, extraction, manufacturing, packaging, and transportation of the raw material from the source to the site. Having the strongest influence on the environment, this stage needs to be managed very carefully. The Building stage defines the preservation and repair of a certain building material for making sure of its lifetime as a part of the building. The most important part of this stage is the handling of the waste produced from the building materials and increasing the awareness of harmful effects that the building's occupants are exposed to. Finally, the Post-Building stage describes the management of the building materials, performance of which have finished. The demolition of a building poses considerable threats to the environment. Besides, the degrading of materials produces harmful chemicals. Nonetheless, adaptive recycling focuses on redirecting energy produced during the disposal of materials.

Ji (2016) defines the building product selection process in three steps, i.e. research, evaluation, and selection. During the research step, all technical information and environmental issues are listed. Technical information refers to information such as Material Safety Data Sheets (MSDS), Indoor Air Quality (IAQ), product warranties, environmental statements, durability information, and recycled content data. Environmental issues, on the other hand, are referred to as government regulations, building codes, building industry articles, etc. Evaluation is a step in which all technical information and environmental issues are analyzed and evaluated. This step is very important for assessing different products with the same function. During the final step, selection, the scores of various materials are listed and a selection is performed regarding the differences.

3.2. Characteristics of sustainable building materials

For a building effort to be characterized as high-performance, the building materials used need to be stable, and environmentally responsible. The selection of such materials is performed regarding the resource conservation process and collection of non-toxic materials (Ji, 2016). Since building materials have a direct influence on human health, the selection needs to be done through rigorous evaluation of

the environmental obligations of the product or material. This approach is named environmental life-cycle assessment. Additionally, the selection of the building materials has to be adapted to the requirements made by national laws, national and international standards, and local regulations (Franzoni, 2011). Those requirements should be established in terms of mechanical properties, thermal performance, acoustic performance, environmental durability, buildings' weight and dimensions limits, safety while materials have been handled and placed, aesthetic outcome, and cost. Building materials have a number of limitations, some of which are gray energy, emissions, supplying resources. For a building to be sustainable, these limitations need to be taken into account, as well as the lifespan of both the building itself and its materials need to be maximized (Umar *et al.,* 2012). Recycling or raw-material-recovery options should also be regarded for materials with a relatively short lifespan.

3.3. Sustainable building materials in interior design

Sustainable interior design and eco-friendly interiors have been increasingly used in recent years. These concepts focus on both the living quality of inhabitants and the influence on the environment. In order to produce a sustainable design, the designer needs to acknowledge the basic principles of sustainable design, such as energy sources, water supply, materials selection process, etc. Regarding the issues such as improved air quality, eliminated toxins, separated waste, etc., sustainable interior design has a direct impact on human health. The Interior designer has the role of studying and evaluating the amount of carbon dioxide that would be emitted in case of demolition and expressing the importance of renovation (Curcic *et al.,* 2019). In order to achieve sustainable interior design, designers have to recognize components, applications, and availability of sustainable products and materials within the local market. It is the designer who plays a very important role since he is the one who will choose the appropriate finishing, equipment, lighting, plumbing, and interior decor.

According to LEED and BREEAM, there are four principles of universal evaluation criteria regarding sustainable interior design, i.e. energy saving, water saving, material saving, and healthy environment. The most effective energy saving measures are the selection of energy efficient equipment and renewable energy sources. Additionally, skylights, atriums, energy efficient lighting fixtures contribute to energy saving. HVAC systems, on the other hand, have a major impact on energy use. Passive systems, such as special window and curtain approaches, may contribute to saving. Water saving may be achieved through using efficient plumbing equipment, rainwater harvest, and recycling

wastewater. Material saving involves three different measures which are flexible design, usage of eco-friendly materials, and waste reduction. Materials, which are supplied from close vicinity, durable, and easily maintained, should be preferred. Reduction of waste is achieved through the usage of recyclable materials like wood, stone, and aluminum. Healthy environment is sustained with three measures, namely increasing air quality, thermal, and acoustic comfort, and the usage of non-toxic materials (Curcic *et al.,* 2019).

Another definition of sustainable interior design involves three dimensions, i.e. global sustainable interior design, indoor environmental quality, and interior materials (Kang and Guerin, 2009, Ayalp, 2012). Regarding the sustainability of interior environments, global sustainable interior design is the most important of the three dimensions, whereas indoor environmental quality focuses on the reduction of indoor pollutants for better indoor air quality. It also aims for enhancement in thermal comfort and interior lighting. Finally, interior materials need to be recyclable for sustainability purposes. Materials, furnishings, and lighting are the most essential factors of a sustainable interior design.

Regarding the sustainability concerns, in addition to functionality, materials selection needs to be performed regarding a number of factors, e.g. extensive life, availability for recycling, reduction of toxin emissions. For furniture, on the other hand, recycling has the priority. Although wood itself is a recyclable material, the chemicals used during the production limits this process. Additionally, the waste introduced during the production process has a negative impact on the environment because of the toxic polymer-based synthetic materials. Nevertheless, the new furniture produced by recycled materials needs to meet the expectations and demand regarding functionality and aesthetic quality. In order to sustain a high level for these subjects, interdisciplinary studies need to be performed by designers and engineers.

In order to meet the occupants' needs and sustainability requirements, interior environments should be designed regarding fabrication, manufacture, installation, use and reuse, recycling, and disposal of natural resources.

4. Green Building Materials Used in Construction

A green building design needs to focus on sustainable, renewable, and environmentally accepted materials. In addition to design expertise, a certain level of know-how in fields such as physics, chemistry etc. is required for an effective green building design.

According to Kulkarni (2021), the concept of sustainability covers three aspects, i.e. economic sustainability, social sustainability, and environmental

sustainability. A green building material should introduce an advantage regarding at least one of these aspects. A traditional building material may have a smaller carbon footprint, but may be limited to a certain region, whereas a contemporary material, a few examples of which are mycelium, ferrock, solar tiles, and smart glass, may introduce a wider use, but its production may be economically impractical. Thus, the material selection process should apply different approaches to the options and perform a thorough comparison and review.

Despite being the most preferred construction material on earth, concrete is very harmful to the environment during both its production, and its use. Thus, as an example, Green Charcoal bio-bricks, which are load-bearing and can be used for structural purposes, is a sustainable building material and can be used for constructing green walls. For designing energy-efficient buildings, the designer should review the green building material options and their performance. Earthen materials, wood, bamboo, SIPs, insulated concrete elements, cordwood, straw bale, earthbags, slate/stone roofing, steel, thatch, composites, natural fiber, polyurethane, fiberglass, cellulose, cork, polystyrene, natural clay, non-VOC paints, natural fiber floorings, fiber cement, stone etc. are among the options (Elemental Green, 2019).

4.1. Characteristics of some green building materials used in construction

Earthen materials such as compacted earth, cob, and adobe have been among the most widely used building materials since ancient times, and they are still being used. With the addition of fibrous materials such as straw, the strength and durability of earthen materials increase considerably. Despite their structural limitations and maintenance needs, availability and installation properties point that earthen materials are highly advantageous in certain parts of the world. Wood, on the other hand, has been a major building material since ancient times. In order for wood to meet the contemporary structural needs, it needs to be processed into planks and boards, which means energy and chemical use, and waste production. However, wood waste can be processed into other wood materials.

Regarding its fast-growing, minimal need for processing, and decomposition after use, bamboo is one of the most sustainable building materials. Because of its high strength, it may be used as a structural element. It is also preferred for decoration because of its natural feeling and attraction. Structural insulated panel (SIP) is another contemporary sustainable building material. Introduced in relatively large sizes, it consists of two sheet layers of strand or flake, with foam filling in-between. Mostly used for walls, they support the structure of a building up to a certain limit.

Straw and straw bale are other sustainable building materials, mostly preferred for insulation purposes. Because of the air trapped in the straw fillings or bales, it functions as a thermal insulator as well as acoustic barrier. Natural fibers like cotton, wool etc. can also be used to function as insulators when used as wall fillings. Natural fibers are fast-growing, relatively easy to access, recyclable, biodegradable, lightweight, cost-effective, and recycled fibers can be used as a building material (Elemental Green, 2019).

Materials like fiberglass, reclaimed or recycled wood and metal, cork etc. are sustainable materials that are cost-effective, recyclable, and easily accessible. As thermal and sound insulation, they introduce considerable saving advantages (Pyzyk, 2018).

4.2. Sustainable Materials to Substitute Concrete

Concrete, with advantages like easy forming, superior load-bearing capacity, high fire resistance, and ease of supply, is a highly popular construction material. The amount of concrete used worldwide exceeds the total of other structural materials. However, the production of cement, which is the primary component of concrete, has destructive effects on the environment. The cement industry, in addition to high energy consumption, is one of the three industries responsible for the production of carbon dioxide gas, which is the primary greenhouse gas. Besides, the concrete dust released to the environment during the production of concrete and demolition of the buildings is a major source of hazardous air pollution. Nevertheless, the recycling of concrete is an option for reducing the environmental effects of the debris produced through the demolition of existing buildings. Concrete, which is crushed to a certain size, may be used as gravel, lining, filling for retaining walls, material for new concrete production etc.

Green Charcoal bio-brick is a sustainable construction material that may be used to substitute concrete. According to More, S. (2019), green charcoal bio-brick is produced by mixing soil, cement, charcoal, and organic luffa fibers, these bricks are lightweight, and suitable for plants to grow in. Although they are strong enough to be used in load-bearing walls, the ecologic value they introduce is higher. They support natural life during their usage phase nurturing plants, cool interior spaces down, and increase indoor air quality.

Concrete is an artificial rock obtained through a chemical reaction. It endures heavy stress loads. However, it is fragile under strain loads. Although reinforcement via steel bars limits this weakness, strains loaded through earthquakes form fissures and cracks, which limit the lifespan of the structure and may lead to breakdowns. Self-healing concrete has bacteria among the

ingredients, which produce limestone when introduced to water and fill the cracks, leaving minimal cosmetic faults.

Hemp concrete, on the other hand, being produced using hemp, is more durable than regular concrete, requires less thermal and acoustic insulation because of its ingredients, and uses CO_2 during its production process.

5. Conclusion

Designers have the highest responsibility regarding the building industry's negative impact on the environment. Although building occupants need to request healthy and environmentally sensitive buildings, it is the designers that should introduce options to users. Sustainable building materials make use of renewable resources, are less harmful both to the environment and the occupants, decrease CO_2 emissions, and require less energy for the production process. Regarding these advantages, developing countries should take measures to popularize the use of sustainable building materials. Green building rating systems cover all of the phases of a construction project and set standards for a green building. These standards may be pursued from the beginning of a project, starting with the design phase, as well as set instructions for building projects that have not started as a sustainable building.

Sustainable and green buildings are gaining popularity. Traditional and widely preferred materials such as concrete, steel, glass etc. have negative impact on the environment and occupants regarding energy efficiency, water use, air quality etc. Sustainable materials, nevertheless, reduce operational costs of buildings, as well as introducing less harm to the environment. Thus, the consciousness about sustainability and the building industry's impact on the environment and occupant wellbeing should be raised.

In order to evaluate how sustainable a material is, the life cycle of that material should be reviewed, which starts with the production of the material, and ends with the recycling or disposal. This is also called cradle to grave. Green design aims to minimize the environmental impact through the whole of this process. Since pre-building has the most of the effect on the environment, it has to be managed properly to minimize the impact. Both the impact on the environment, and the occupants need to be evaluated for material selection. Materials used in interior design have a direct impact on the occupants' health. Additionally, local and international standards and regulations need to be met. Fast-growing natural materials, materials that need minimal processing, recycled materials should have priority in order to minimize impact on the environment and occupants.

This research study aims to define sustainability measures that may be taken and list a number of sustainable materials. It is hoped that the information

introduced in this study directs attention to the environmental issues and supports future studies to be conducted by academics and professionals.

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CHAPTER 6

EVALUATING THE HOUSING MARKET DEVELOPMENT IN KAYSERI*

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1. Introduction

Real estate can be defined as land and any immovable built on and is attached to the land and which cannot be relocated. Real estate development is a multi-faceted business area involving many activities related to land development and construction (Seçkin, 1998). It is possible to divide the approaches regarding real estate in academic literature into three main groups: Neo-classical, Political Economy (Marxist), and Institutionalist. The Neo-classical approach, which was dominant until the 1970s, focused on the supply-demand balance in the real estate development process (Healey, 1991; Krabben *et al.,* 1993; Arvanitidis, 1999; Charney, 2000). Since the 1970s, another approach, the "political economy approach", has been the decisive factor in real estate research. These studies based on Marxist rhetoric have claimed that the main decisive factor in the real estate market is the process of capital accumulation (Theurillat *et al.,*2015; Van Loon, *et al.,*2017) The institutionalist approach brought a critical perspective on these approaches in the 1980s and discussed the real estate development process in the context of the institutional structure by highlighting its relationship with economic processes and social processes. Unlike the Neo-classical and Marxist approaches, this approach

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focuses on the details of the development process, and avoids generalization. It focuses rather on the actors and institutions involved in a particular project in a specific place and time (Healey & Barrett, 1990).

According to Harvey, the market is an indicator and informs buyers and sellers through price changes. Demand and supply in the market are equal only at a balanced price level. However, the balance between supply and demand is lost since the market is constantly changing. For example, the increase in real estate prices leads to a rise in demand, causing the market to deviate from the equilibrium point. The response to the rising demand will occur through construction activities, and the excess supply will drop the prices and balance the market again. On the other hand, since construction is a lengthy process, the market cannot promptly respond to the demand, therefore, there is a delay in the supply. For this reason, the market is shaped in a constantly dynamic process to reach the equilibrium point (Harvey, 2016; Harvey,2013). In the late 1980s, in the majority of the world's metropolises, there was a boom-bust cycle in the real estate market, resulting in important changes in the economic, spatial, and social structure of the cities (Beauregard, 1994). While the prices of real estate dropped rapidly in the USA, UK, and Japan, which went through this process most severely, households and companies in many sectors related to the real estate market experienced financial difficulties and went bankrupt. Due to Real Estate's currently increased global presence in financial markets as an investment tool, research on real estate as an additional financial tool has been initiated (Coakley, 1994).

In Turkey, the regulation and development of the real estate market appeared as a solution to the housing problem after the immigration wave in the 1950s-1960s. After 1980, it grew to be one of the most important urban development strategies. The real estate sector, which was shaped according to the development of its policies regarding the housing problem, came into prominence spatially and economically with modern shopping centers, multi-storey business centers, and multi-purpose entertainment and sports complexes beside many housing projects developed in the 90s. Owing to the new actors and coalitions of forces in and after the 2000s, the forms of intervention in urban space have become both diversified and effective compared to the previous period. This transformation of urban space occurs depending on the economic and political restructuring on a macro scale, the changing structure of financial capital, public interventions, and the level of development of the real estate sector. As a result, urban space is being restructured and transformed by large-scale real estate projects today.

This study focuses on explaining the relationship between the transformation of urban space and the real estatemarket. In the study, the development of the housing market in Kayseri was examined. Especially in the housing-focused analysis, the structure of the capital concentrated in the real estate development and investment process during the market restructuring were analyzed. Despite many studies on the physical transformation of large metropolises i.e. Istanbul/ Turkey, these studies are limited for cities such as Kayseri. In this context, the implications of the study for the real estate and especially the housing market, which grow more and more in cities like Kayseri, which are becoming metropolises, are gaining value.

2. The city of Kayseri and The Housing Market

2.1. Housing Development in Kayseri

Kayseri is still an important trade center with a history of approximately 6000 years. The urban texture was developed according to the decisions taken within the scope of the first plan in 1944 and was shaped with grid structure including a wide boulevard, which was the most essential reflection of the modern urban understanding of the period. Since the 1970s, it has developed in a planned manner, particularly in the city center, with a linear, compact, single-centered growth scheme. The First Master Plan prepared by Ahmet Kemal Aru in 1944 could be put into practice in the 1950s. To meet the housing demand due to the increasing population of the city, new areas had to be zoned for construction. Cumhuriyet Neighborhood was expropriated and transformed into its present form. In the plan, banks, offices, business centers, and bazaars were to be on the lower floors, and central business areas with residences were designed to be on the upper floors. Municipality Blocks were built in Sahabiye District for those whose houses were expropriated (Yılmaz Bakır ,2012; Eldek, 2014)

As a result of the industrial investments initiated in the 1950s, the Industrial Estate (Old Industry) was established with the financial credit support of the state. Kayseri Sugar Factory and Kayseri Flour Factory Facility established in 1955 are some of the important industrial investments. With the establishment of factory areas, residential areas developed in the immediate vicinity. Expropriation activities of local governments continued in Talas and Sivas Streets, Lale District, and Cami Kebir District. People living in these areas were granted land in Hürriyet Neighborhood, and flats from the blocks constructed were granted in Sahabiye and Fatih Districts. The residences constructed in Kayseri between 1950-1960 were generally located in Fevzi Çakmak and Sahabiye Districts. In residences constructed in Hürriyet, Hacıkılıç, Mevlana and Hacısaki Districts,

an average of 2-6 flats were placed on each floor. Significant changes occurred in the city in the 1960s. New economic investments began to increase in the city. The density of the service sector increased, and 3-5-storey high-rise buildings appeared in the city areas. Housing settlements were specialized for the city of Kayseri as a texture that developed after the traditional city until the 1970s. But in the early 1970s, this texture was demolished and replaced by multi-storey residential blocks (Karatepe, 1999; Kocatürk, 2004).

Table 1. Housing production process in Kayseri City

		Planning Period	**Urban pattern developed with plan**
Traditional Houses			Organic texture (open/semi-open place texture)
		Çaylak City Plan	Adjacent+ Discrete urban texture
Transition to Apartment Typology	1-2 storey	1945 Oelsner-Aru City Plan	Grid urban texture
	3-4 storey	1945 Oelsner-AruCity Plan	Adjacent+ Discrete/Gridal Urban texture, neighborhood scale, connected with street, apartments with gardens
	3-5 storey	Oelsner-Aru and 1975Taşçı City Plan (Taşçı, 1975)	Grid urban texture, Adjacent apartments without gardens
Multi-Storey Houses	Adjacent Buildings	1975 TaşçıCity Plan	Adjacent or discrete apartments
	Discrete Building	1986-Topaloğlu-Berksan City Plan (Berksan, 1986)	Point blocks-Tower blocks
Mass Housing		1986 Topaloğlu-Berksan City Plan 2006 Doğan City Plan	Adjacent buildings- Multi storeys blocks
Illegal Housing.		After 1960s Unplanned and planned areas	Adjacent or discrete apartments Point blocks-Tower blocks
Gated Community		After 2000s Topaloğlu-Berksan City Plan and Doğan City Plan	Discrete housing with garden-Low density

With the second plan made by Yavuz Tasçı in 1975, a city with high blocks and wide streets began to develop. With the effect of the zoning plan and the acceleration of the urbanization in the direction of Sivas Street, adjacent

high-rise blocks were constructed in parallel with Sivas Street, and low-rise, single-storey buildings with gardens were constructed in Argıncık and Fevzi Çakmak neighborhoods. In these areas, building parcels were formed with a grid arrangement on the building blocks between the main streets. Apartments with individual gardens were built on these parcels (see Table 1).

The target audience of most mass housing applications in Kayseri to date has been the low and middle-income groups. Therefore, it is convenient to regard them in the context of accessible housing. Mass housing areas were mostly located at the far points of the eastern and western regions based on the transportation axes (see Table 2). In the 1980s, Büyükkent Cooperative with 1640 houses was built in Belsin (1987) on Ankara road, in the west of the city, and in Kumarlı, Sivas. Beyazşehir Cooperative, founded in 1995, was also established in two separate locations (Belsin and Cırgalan). The project work of Belsin mass housing district started in 1986, and the project, which involved more than 20,000 residences, was completed and inhabited in the 1990s. On the eastern axis of the city, 4500 houses were built in the Beyazşehir Mass Housing area, 600 houses in the Kaykoop project, 2000 houses in the Ildem Cooperative in Gesi Municipality, 600 houses in the Mimarsinan Municipality Mimsin Project. A total of 25,000 houses were built with a mass housing approach (Yılmaz Bakır, 2012)

In the 2000s, under the leadership of TOKİ, a total of 5108 residences started to be built over an area of 1,126.000 m2 in the east of the city in line with the mass housing practice. This area was considered as a mass housing region completed in the shortest time along with its infrastructure, superstructure, social facilities, and parks in the city.

The development of a total of 7 housing estates included 24,373 units in the east of the city and 13,756 units in the west, a total of 38,129 residences. This also strengthened the linear structure of the city of Kayseri along the east-west direction.

Apart from Melikgazi and Kocasinan districts located in the city center, there are TOKİ buildings in Pınarbaşı, İncesu, Bünyan, Yahyalı, Yeşilhisar, Tomarza, Develi, Sarıoğlan districts also. As of 2016, a total of 6 different production models are seen in the city. Among these models are 34 applications, of which 11 are administrative housing, 6 are low-income groups, 10 are social reinforcement housing, 5 are housing for the production of infrastructure and social equipment, and 2 are agricultural villages. As a total of these projects, 10,200 completed and 3,532 residences, which are about to be completed at a level above 90%, are being built in the city by TOKİ. 3 of the 7 housing production models implemented by TOKİ were implemented in Kayseri. Out of

a total of 13,732 houses, 1,816 are low-income and poor group houses, 10,366 are middle-income houses and 240 are agricultural village houses. (TOKİ,2017; Bayraktar and Yılmaz Bakır,2019).

Table 2. Mass Housing Projects Built by the Local Government (Bayraktar and YılmazBakır, 2019)

Mass Housing		Municipality	Plan Capacity	Number of houses
Belsin		Melikgazi	19490	9500
Beyaz Şehir	Gesi	Melikgazi	3500	2160
	Belsin	Büyükşehir	6128	3000
Kaykoop		Büyükşehir	1200	600
İldem		Gesi	4000	2000
Büyükkent		Mimarsinan	1640	1000
Sinankent		Mimarsinan	1650	1650
Serkent		Mimarsinan	600	600
Şirintepe		Mimarsinan	1000	1000
Mimsin		Mimarsinan	3760	1440
Anayurt		Talas	6000	1020
Atayurt		Talas	1000	
Kocasinankent		Kocasinan	567	1000
Kıranardı		Kıranardı	600	
Total			**51135**	**25030**

2.2. Land use types in Kayseri

The total area of the province is 1,691,700 hectares, of which 671,000 hectares are agricultural land, 668,700 hectares are meadow, 108.000 hectares are forest and 244,000 hectares are other lands. The fact that the share of the total area of settlements of provinces and districts in the total area of the province is 14.42% is an important criterion in terms of explaining the development drift of the urban area (see Table 2). The primary residential areas' share in the total land assets was 3.49% and the share of secondary residential areas was 1.58%. (Kayseri Nazım Plan Report, 2013) Although there is no coastal settlement, the fact that the share of second residence areas in the total planning area is almost half of the residences used as permanent living space demonstrates the importance of vineyard houses, mountain and highland settlements in the central districts (see Table 3). Particularly the highland settlements and vineyard houses in the

immediate vicinity of the city and the height of the land whose agricultural quality will be preserved are seen as an important parameter in terms of economic development and leading the real estate market in the province.

Table 3. Kayseri City land use table (Based on Kayseri Metropolitan Municipality Transportation Plan Report, 2005)

Usage	Kayseri Metropolitan Municipality Area (ha)	%
Residential Area	8555,55	51,21
Commercial Area	185,20	1,11
Trade	47,45	0,28
Governmental Area	354,40	2,12
Green Areas	95,63	0,57
Educational facilities	41,86	0,25
Military Zones	348,13	2,08
Industrial area	911,89	5,46
Small Industrial Site	228,79	1,37
Organized industrial Zone	878,76	5,26
Sports Areas	10,63	0,06
University Areas	150,00	0,90
Forest Area	3,75	0,02
Terminals	5,00	0,03
Farms	95,93	0,57
Others	4792,77	28,69
Total	**16705,84**	**100,00**

2.3. Housing- Land Supply and Development

Examining and evaluating the existing housing stock is a primary necessity in the analysis of the housing sector and housing markets The numerical size of the existing housing stock, the population and the need for new housing, and the legal and physical conditions of the housing stock should be examined. Land and estate acquisitions are primarily for investment and project development in the city center. Moreover, it is recognized that land and estate acquisitions are generally obtained through purchase and inheritance.

When the housing stock situation in the province of Kayseri and throughout the country is analyzed in 1984 and after, it is revealed that the housing production in the province was 139,913 units and the total housing supply in Turkey was

7,096,277 units in 1984. Housing production increased continuously after 1984. At the end of 2013, the housing stock in Kayseri reached 378,519 and the housing supply throughout the country reached 20,655,946 (see Table 4).

Table 4. Development of housing production in Kayseri and Turkey (TÜİK, 2017)

Indicators	1984 Year Housing Stock	1984/2000 Period Housing Stock	2000-2010 Period Housing Stock	2010-2013 Period Housing Stock	Total Housing Stock
Kayseri	139.913	133.707	69.118	35.781	378.519
Turkey	7.096.277	9.139.553	2.618.104	1.802.012	20.655.946

According to the results of the TUIK Building Census Study, in 2000, the total number of buildings in Kayseri was 149,505, the total number of residences was 273.620, and the number of residences in urban areas (province and district centers) was 231.219. The number of buildings' share in Kayseri in the country's total is 1.84% in 2013, 1.70% in the number of residential buildings, and 1.66% in the number of residences. It is perceived that building project development and construction activities in the city are above the country average.

Examination of the housing stock data in Kayseri Province during the period from 1984 to 2013 revealed that the number of buildings increased by 92.20% and the number of residences increased by more than 100%. When the data for Kayseri and Turkey are compared, the proportion of the number of buildings in Kayseri in the country's total was 1.84% in 2013, 1.70% in the number of residential buildings, and 1.66% in the number of residences (see Table 4).

The majority of the stakeholders consider the housing presence in the province to be sufficient considering the total supply, population, and household size. The dominant opinion regarding the buyers is that they acquire housing mostly for home and investment purposes. Although the number of housing is considered sufficient, it also has been revealed that new housing projects should focus on urban depression areas and Talas District, which is close to universities. Housing acquisition transactions take place through cash or credit purchases. The buyers' most preferred type of residence is a regular apartment building due to its convenience, the second preference is an apartment complex and the third is a detached house.

It is observed that households with good economic status and difficulties in adapting to the apartment culture tend to live in detached houses with gardens and

vineyard houses. a remarkable increase in the demand for detached housing areas in the immediate vicinity of the city in recent years has been observed the increase is especially due to the short distances between the multi-storey housing estates in the city center, the services offered, the lack of open and green spaces and comfort, and overcrowding. According to the stakeholders, in house acquisition, people take into account such parameters as housing size, presence of infrastructure services, proximity to equipment areas, concentration level and living conditions of the place where the house is located, heating system, and reliability.

the general analysis of the total housing stock in the province demonstrated that the share of residences with construction permits was 59.66% in 2000, 79.82% in 2010, and 82.91% in 2013, and the number of illegal constructions has been significantly taken under control in the last 14 years with the effect of legal regulations (see Table 5). However, the same improvement rate could not be achieved in the area of residence permits. The number of residences with occupancy permits is only 56.54%. In order to meet the increasing housing demand due to the rising population of students and immigration in the province, a significant amount of illegal construction has arisen with the effect of rapid urbanization and economic conditions.

Table 5. Housing loans stock value in Kayseri and Turkey (1.000 TL) (GYODER, 2014: Han, 2012)

Indicators	2000	2006	2010	2013
Housing Units	273.620	300.948	342.738	378.519
Housing Units with Construction Licensed	163.241	183.467	273.576	313.837
Housing Units with Usage Permit	102.666	129.994	178.369	214.006

The house sales in Kayseri and throughout the country have been in a continuous upward trend after 2008, and the share of the house sales in the province in the total sales of the country varies between 2.34% and 2.69%. 8.216 of the 27,109 house sales in the province in 2013 were mortgaged house sales and the remaining 18,793 were sales realized through other methods. In the same year, it was determined that 460.112 of the total 1,157,190 house sales across the country were mortgaged sales, and 697,078 were through other methods (see Table 6).

The share of mortgaged house sales in total sales increased from 6.20% to 30.31% in Kayseri in the period of 2009-2013 and reached 39.76% from 4.09%

throughout the country in the same period. The average mortgaged housing acquisition in the province was around 25% and 31% across the country. The real estate acquisition rate by credit is lower due to the relatively high levels of the welfare of the people and acquisition through construction in return for land, in the province. On the other hand, housing purchasing behaviour and approaches also have a significant impact on the degree of utilization in the mortgaged housing idea system.

According to the stakeholders interviewed in the province, the demand for residential and non-residential buildings is in an increasing trend and the same trend will continue in the near future. The buildings are needed in order of importance in terms of total closed area and number listed as residences (such as secure sites, detached residences, and branded residences), business center, office, and hotel. It is stated that among these structures, residences should be built in Talas District, buildings such as business centres, offices and residences in Kocasinan District, hotels and other tourism facilities on Mount Erciyes and commercial investments in the city centre and especially in the close vicinity of the centre.

Since the high amount of land in the city center leads to an increase in the share of land in the housing cost, it is not likely to establish especially low-density residential areas in the transformation areas in the center. The period of holding possession of the house varies between 8-10 years, and it is observed that the mobility in the housing market is high. The desire to change the residence in a relatively short time is associated with a high tendency to acquire a larger and more comfortable house instead of a house with a small gross area or to replace the old house with a new house.

With the introduction of Law No. 5582, a new era started in the acquisition of residential and commercial real estate, however, the inability to establish a secondary market caused limited development in this area. In the period between 2008-2013 in Turkey, the volume of housing loans increased by 2.7 times and reached 408.83 billion TL. While the use of housing loans in the province was 1.36 billion TL in 2008, it reached 5.30 billion TL at the end of 2013, and 0.90% of the total housing loans in the country in 2008 and 1.30% in 2013 were used in this province. (see Table 6).

In order to meet the increasing housing demand due to the rising population of students and immigration in the province, a significant amount of illegal construction has arisen with the effect of rapid urbanization and economic conditions.This problem is a result of the works the building cooperatives established in some districts, and the contractors, build-sell, and those who build their own houses in some other districts. It has been clearly observed that the

number of main immovables that are still used as condominium servitudes and that have not been converted into condominiums even though they are about to complete their economic life, although they are settled in Kayseri as well as throughout the country.

Table 6. Comparison of housing sales in Kayseri and Turkey (TÜİK, 2017)

	Kayseri		Turkey	
Years	**Housing Sale**	**Mortgage and Other Sales**	**Housing Sale**	**Mortgage and Other Sales**
2008	10.615	-	427.105	-
2009	13.015	807	555.184	22.726
2010	15.873	5.200	607.098	246.741
2011	19.040	6.104	708.275	289.275
2012	18.581	5.634	701.621	270.136
2013	27.109	8.216	1.157.190	460.112
2014	28.375	16.971	1.165.381	623.826
2015	30.652	18.039	1.289.320	690.653
2016	30.675	19.216	1.341.453	709.767

3. Evaluation

In this study, which examines the real estate market of the city of Kayseri with a focus on housing, it has been observed that the housing production process in the city was shaped by individual housing production and cooperatives in the pre-plan period. The market, which developed with the adoption of liberal economic policies after 1950, rapid urbanization, cooperatives, condominium law, and the effect of build-and-sell, was shaped by the neo-liberal policies of the post-1980s. In accelerating the economy, housing production was considered as a sector and mass housing production was encouraged, and a uniform building order was adopted. In the continuation of this process until today;

- The process of demolishing and reconstructing expensive lands in the city,
- Gradually narrowing the boundaries of urban sites or opening them up for development,
- Slum and illegal construction,
- Neo-liberal approach in mass housing applications,

- Secure (closed) apartment complexes: There have been developments that can be described as low-rise detached houses with gardens and multi-storey sheltered houses.

In the research, the development of the housing market was primarily handled periodically, and the following findings were reached in the examinations carried out in this direction.

- First of all, the idea that land and estate acquisitions in the city are made primarily for investment and project development comes to the fore, and it is emphasized that the existence of land and estate is generally sufficient. The acquisition took place through purchase and inheritance. It is stated that land and estate acquisitions are made with cash or credit, and especially for investment purposes and for construction (in return for flat). Insufficient land availability is explained as the municipalities do not produce enough land and it is difficult to find land for sale.
- The majority of the stakeholders consider the housing presence in the province to be sufficient considering the total supply, population, and household size. The dominant opinion regarding the buyers is that they acquire housing mostly for home and investment purposes. Although the number of housing is considered sufficient, it also has been revealed that new housing projects should focus on urban depression areas and Talas District, which is close to universities.
- Housing acquisition transactions take place through cash or credit purchases. The buyers' most preferred type of residence is a regular apartment building due to its convenience, the second preference is an apartment complex and the third is a detached house.
- It is observed that households with good economic status and difficulties in adapting to the apartment culture tend to live in detached houses with gardens and vineyard houses. a remarkable increase in the demand for detached housing areas in the immediate vicinity of the city in recent years has been observed the increase is especially due to the short distances between the multi-storey housing estates in the city center, the services offered, the lack of open and green spaces and comfort, and overcrowding.
- It is perceived that building project development and construction activities in the city are above the country average.

The research also focused on the real estate market and 'developers', one of the most important actors in determining the market for the analysis of urban space, which is shaped by the influence of many different dynamics. According to the stakeholders interviewed in the province, the demand for residential and non-residential buildings is in an increasing trend and the same trend is predicted to continue in the near future. The buildings are needed in order of importance in terms of total closed area and number listed as residences (such as secure sites, detached residences, and branded residences), business center, office, and hotel. It is stated that among these structures, residences should be built in Talas District, buildings such as business centres, offices and residences in Kocasinan District, hotels and other tourism facilities on Mount Erciyes and commercial investments in the city centre and especially in the close vicinity of the centre. Similarly, in some districts and neighbourhoods in the center, transformation is deemed necessary, while in others, urban transformation and renewal works are not required.

- According to the stakeholders, while housing acquisition, people take into account parameters such as housing area, presence of infrastructure services, proximity to equipment areas, concentration level and living conditions of the place where the house is located, heating system, and reliability.
- The fact that the real estate market is more profitable than other sectors has led investors to this area.
- It has been determined that they determine their investment decisions according to the land value and supply-demand balance.
- Companies make real estate investments with their own resources. They stated that investing outside of equity is a risky situation for the company and that although the profit margin is high, the risks are just as high.
- It has been revealed as a result of the interviews that the companies do not serve a certain income group, and that they work in each region by balancing the land and demand. This situation causes the size and price of the real estate to be variable.
- It has been observed that the first criterion in the selection of land is the zoning status. In addition, the supply-demand balance emerges as an important input for land selection.
- It is concluded that the construction sector in Kayseri is progressing in parallel with Turkey.

- The process of institutionalization in many areas is valid in the real estate market of Kayseri. It has been revealed that the fact that experts do not carry out the works, that people who can provide resources but do not have knowledge about the business are in the market, the value of the real estate sector decreases for investors who want to invest, and the willingness and effectiveness of the expert teams to do business decreases.
- Specialization must be ensured so that the sector to continue at a certain level. It has been one of the most important conditions that specialization is not only for the investor but also for the local government wing.

4. Discussion and Conclusion

The physical change created by the effective real estate market in the city with the housing production results in the replacement of the traditional housing typology formed by the open and semi-open space setup with the housing typologies based on the indoor setup or with point blocks and undefined housing typologies. In particular, the transformation of low-rise (2,3,4-floor) residential areas with gardens and different building layouts into multi-storey apartments, in which the planned development of the city and the reflections of the modernist understanding are observed, creates a standardization. In particular, the transformation of slum areas into standard housing areas causes the planning to not function in a holistic structure or to be damaged by fragmented practices.

New production obtained by transformation in residential areas;

a) The process of demolishing and rebuilding: Even if this process makes the physical environment more qualified, its users are eliminated and the area is opened to a higher income group.

- The existence of rent concerns causes the transformation to affect different groups differently. While some get a share of the speculative profits, others move to the poorer parts of the city. It is the tenants who are the most affected party.
- With the improvement works on the existing slum areas, new rent increases occur, new settlements are formed that are denser and below the minimum standards required by the construction conditions, new physical environments are emerging, which are obtained by the build-sell method for flat but the infrastructure has been renewed.
- With the new zoning plan, density increases occur, and slums are turned into multi-storey blocks with the build-sell method. For this, zoning rights are

collected in the area and the transformation of slum areas is ensured with a project or with the build-sell method. With this method, the landowner and the contractor can still be profitable, but a new area may need to be sought for the tenants.

b) Standard construction, spatial separation, de-identification,
As a result of the rent-based plan changes, a standard and unidentified structuring are formed in the city, and since the spatial structure that supports the neighbourhood relations provided by the previous texture disappears, it also leads to the change of social relations. In addition, with the change of socio-economic structure, it will be possible to strengthen spatial segregation and accelerate social segregation in the long run.

c) Slum prevention zones should be seen as a positive step since they create living areas for the lower and lower-middle income groups, with the infrastructure prepared, land production, and construction according to type projects. However, as a result of lack of supervision or concessions after the implementation, these areas, which were predicted to have 1-2 floors, have created new illegal construction areas that have increased to 4 floors over time.

d) The city is losing its memory.

e) The protection of the urban site is not ensured, as well as the 20th century. There is also the loss of many buildings that can be considered as architectural heritage.

f) It results in natural and urban protected areas being under the pressure of intense construction.

As a result of the disappearance of a sense of friendship and union among the street and neighbourhood residents, social and spatial separation, the increasing homogeneity of the city, its standard appearance, and approaches that have many negative aspects, especially real estate investments are perceived as a physical space arrangement that provides rent in the city. In real estate investments and applications;

- Determining the subject with high-level policies
- Correct establishment of the planning hierarchy and holistic planning
- All stakeholders of the society can benefit from the benefit to be obtained after the investment.
- Designing investment decisions and production processes by experts, especially planners and architects, developing a multi-disciplinary approach

- It should not be forgotten that a process of participation and transparency is required.

Another important finding of this study is that unplanned development and excessive floor area construction density cause a decrease in land value.

This is a very important feature that municipalities, planners, and investors should consider when deciding on density.

The increase in the land values around the transformation areas or urban projects or transportation investments such as light rail system shows that future investments should be planned in advance due to the functional transformation potential.

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CHAPTER 7

ANALYZING THE DISTRIBUTION AND ACCESSIBILITY OF NEIGHBORHOOD PARKS: THE CASE OF ISTANBUL-MALTEPE DISTRICT

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1. Introduction

Cities are like living organisms. Time, scientific and technological developments, population movements, economic conditions and values, political decisions, and natural events cause cities to be in a dynamic and variable structure. Especially in metropolises, the change process is faster and much more intense. With rapid urbanization and increasing population density, cities are being built intensively and this process results in the decrease of open and green spaces. In our country, especially in Istanbul, there are inadequacies when open and green spaces are evaluated according to standards at all scales, from the smallest green space unit to the largest. Open and green spaces should be evaluated in terms of quality, quantity, size, access and distribution at all scales and should be improved accordingly.

In this context, the aim of the research is to examine the neighborhood-district parks, sports facilities and children's playgrounds, that constitute green spaces at the neighborhood and district level, within the scope of urban social infrastructure stratification in the sample area of Istanbul-Maltepe District in terms of accessibility/impact area distances, equitable distribution and spatial adequacy. In this framework, the current situation regarding the population data, green space sizes, distribution of parks on the basis of neighborhoods, park service areas, and accessibility of parks in the district has been determined.

1.1. Open and Green Space Hierarchy and Accessibility

Physically, cities can be defined as the whole of relations consisting of structures, open and green space systems and transportation systems that connect them with each other. However, the main element that maintains the existence of the city is the citizens. Society lives together in this urban space within the framework of social, economic, political, cultural relations and constitutional rules. This coexistence puts cities into a quite complex structure because people of different ages and genders, from various economic, social, ethnic and cultural groups live together in cities. This diversity causes both lifestyles and demands to diversify, and thus the physical environment to vary and change.

To transform this process of change into a positive one and to ensure that the urban system works well and that can offer its people a good living environment and quality; In order to establish livable cities where a high level of participation is ensured, where politicians, administrators and the public can exchange information, where a sense of belonging and human dignity exist, it is necessary to ensure the right of citizens in many issues such as housing, circulation, security, health, social justice, and equality (URL 1).

It is a fundamental right for all people to spend time safely in a clean and healthy environment, to reach inclusive open and green spaces that are accessible for everyone and are in sufficient quantity and quality, and to benefit from these open and green spaces under equal conditions regardless of age, gender, and socio-economic structure.

Public spaces that are well planned socially, ecologically and physically, have a number of benefits for all citizens and especially for disadvantaged groups. These include physical and mental health, better brain function in children, individual happiness, fresh air, less violence and even increased trust between people and local government. In this context, public spaces that are consciously planned, accessible and rich in terms of urban ecosystem play a healing role regarding public health. Providing access to all green spaces from the smallest unit to the largest, making the environment safe and inviting, offers an opportunity to encourage people to engage in physical activity and spending time in nature (URL 2).

The quality and quantity of open and green spaces, which have a crucial role in balancing the deteriorated relationship between man and nature and improving urban living conditions, and have a positive effect on people's physical and mental health, are accepted as indicators of civilization and life quality for many developed countries (Gül and Küçük, 2001).

Urban open and green spaces that provide very important ecological, economic and aesthetic services in metropolitan cities that are under the pressure of intense construction; hierarchically classified in 4 scales as housing level, elementary education unit level, neighborhood-district level and urban level (Yıldızcı, 1982). One of the basic sub-parts of the urban ecosystem and green infrastructure is green spaces at the neighborhood and district level (Öztürk, 2021). Neighborhood parks are expected to support a person's daily routines as they enhance psychological-social well-being, socialization, relaxation, security and sense of belonging (Day, 2008). Neighborhood parks are one of the green areas that can fulfill this function in the city. The quantity of neighborhood parks and their distribution in the city play an important role in provide this function. For this reason, neighborhood parks should be distributed homogeneously within the accessibility distance of the cities (Ender ve Uslu, 2016). Green spaces at this level consist of neighborhood parks, sports areas, district parks, children's playgrounds and a square. Neighborhood parks should be within 400-800 m of the houses and at least 8 decares (Yıldızcı, 1982).

1.2. Open and Green Space Standarts

There are open and green space standards concerning the hierarchical structure that determines the distribution of open and green spaces. The green space norms, which differ greatly in the world and in our country, have been determined with the "Regulation on the Amendment of the Regulation on the Principles of Making and Amending the Development Plan" numbered 23804 published on 02.09.1999, and as a result of the amendment, the green space standard, which used to be 7 m² per capita, is redetermined as 10 m². With the regulation, the distribution of this amount according to population sizes and green space types has been determined. According to this change, a total of 4 m²/person green space, including a 1.5 m²/person size playground at the level of the 5000-person primary education unit, a 2 m²/person neighborhood park at the 15000-person neighborhood unit level, and a 2 m²/person sports field was envisioned while at the level of the city unit with a population of 45,000, a total of 4.5 m²/person green area is envisaged, including a 3.5 m²/person size city park and 1 m²/person size stadium (Kart, 2008). Again, with the amendment made on 17.05.2018 and announced with Annex 2 (URL 3), the Spatial Plans Construction Regulation, which came into force after being published in the Official Gazette dated 14/06/2014 and numbered 29030, open and green space standards were redetermined as; the amount of green space per capita in the plans made within the borders of the district (children's playground, park,

square, district sports field, botanical park, promenade, recreation) is determined as 10 m^2/person, and in the plans made within the provincial borders(zoo, urban forest, area to be afforested, fair and festival area, hippodrome), 5 m^2/person is added and a total of 15 m^2 was determined.

In addition, again in the Spatial Plans Construction Regulation, accessibility distances are defined with Article 12 (URL 4), under the title of 'walking distances'. According to this;

(1) Walking distances in zoning plans; The reach of the population in the service impact area of education, health and green areas is planned by considering topography, land use, density, existing texture, natural and artificial thresholds. If the issues specified in this article are appropriate, the minimum walking distances in the second and third paragraphs are followed.

(2) In zoning plans; Kindergarten, playground, open district sports field, family health center, nursery, kindergarten and primary school functions can be planned in the service impact area that needs to be reached by walking, taking into account the distance of approximately 500 meters, secondary schools approximately 1,000 meters, and high schools approximately 2,500 meters.

The access distances which have been determined by the regulation are also very important in terms of providing just access to parks. Within the scope of social justice and just access issues, which have gained great importance all over the world in recent years, the National Recreation and Park Association (NRPA) launched a national campaign in 2019 to improve safe and fair access to quality parks and green spaces with the slogan of a 10-minute walk. With the idea that everyone should have a just and equitable opportunity to access local parks and recreational areas, this campaign aimed to provide; easy access to parks, increased physical activity, improved mental health, stronger social ties and an enhanced understanding of sustainability (URL 5).

Open and green spaces at neighborhood scale that can be accessed by walking and experienced by different individuals should be accessible within 5-10 minutes walking distance (within 800m. at most) from the users' residences. (Kearns and Parkinson, 2001; Moser et al., 2002). The location of neighborhood parks is one of the most important factors that shape individuals' habits of walking access. Due to the differences in the walking capacity of individuals (Stafford & Baldwin, 2018), location choices for parks should be determined by taking many physical and geographical features into account (such as distance, slope, streamflows, street network, traffic density and land use) (Öztürk, 2021).

These green areas, which are expected to serve the citizens of all age groups, have a crucial role in increasing the quality of urban life as well as

providing urban environmental quality, air quality, spatial justice, and social integration. (Ekkel and de Vries, 2017; Kara et al., 2011; Swyngedouw and Heynen, 2003; Williams, 2002, Öztürk 2021).

2. Material

Maltepe District of Istanbul Province was chosen as the study area. The location of the district is 40° 56’ 59.2872’’ North and 29° 10’ 26.2200’’ East GPS coordinates, with an altitude of 324 meters (URL 6). Maltepe is the 14th largest district of the city with an area of 54 km². It is adjacent to the Marmara Sea and Adalar (Prince Islands) in the south, Sancaktepe and Ataşehir in the north, Kartal in the east and Kadıköy in the west. According to the data of 2020, it has a population of 515,021 people (URL 7). There are 18 neighborhoods in total in the district. The D-100 highway (formerly E-5 or Ankara Asphalt) connecting Istanbul to Anatolia is one of the important connection roads passing through the district. Another important connection road is Bağdat Street, which stretches from Pendik to Kadıköy.

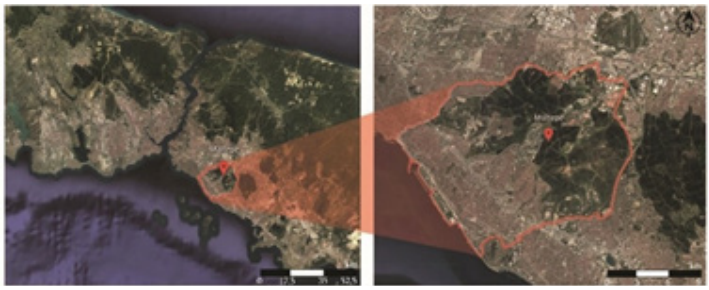

Figure 1. Location of Maltepe District (URL 8).

3. Method

In the study carried out to examine the distribution and accessibility of open and green spaces at the neighborhood and district unit level in Maltepe District, first of all, all green spaces in the district were determined on the map. The district, which has the Marmara Sea in the south, has a long coastline and coastal parks. In addition to this, the district is also rich in forests. Since these parks and recreation areas serve at the city level, they were excluded from the study.

The 18 neighborhoods in the district, and the neighborhood parks, district parks and sports fields in these neighborhoods were determined and classified according to the neighborhoods and their surface areas were calculated. Active open and green spaces’ square meters per capita were calculated for each

neighborhood. The same process was carried out to cover the whole district (total open and green space/district population).

Then, accessibility analysis was conducted for active open and green spaces which were classified according to their neighborhoods. For this analysis, 500 meters, which is given as the access to the green spaces at the elementary education level in the Spatial Plans Construction Regulation, under the title of walking distances, defined in the 2nd paragraph of Article 12 (URL 4), was taken into account and equal circles were drawn by puting the parks to the center. Thus, it has been determined whether there are residential areas in the neighborhoods that cannot access any open and green areas by walking.

The aim to be achieved in this study is the evaluation of the accessibility, adequacy and quality of open and green spaces, first in the neighborhoods and then throughout the district.

4. Findings

In the analysis, active open and green spaces at the level of neighborhood and district unit were discussed. A total of 73 neighborhood parks, 4 district parks, 5 sports fields and 1 square were identified in 18 neighborhoods. Their locations are shown on the map in Figure 2.

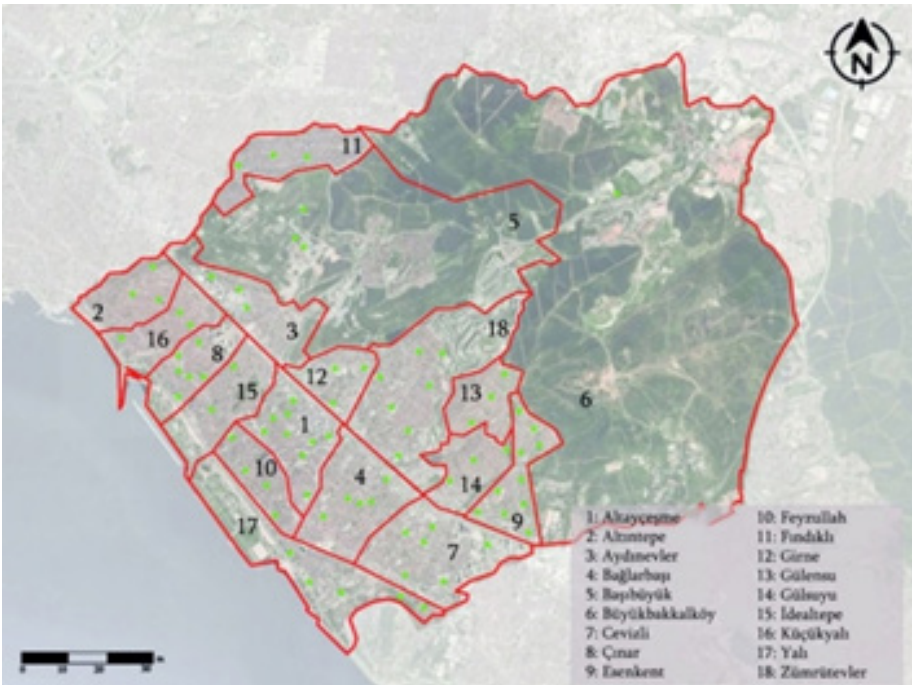

Figure 2. Locations of Maltepe open and green spaces (URL 8).

4.1. Distribution analysis

Neighborhood parks constitute the majority of active open and green spaces in the district (Table 1).

Table 1. Distribution of open and green spaces by neighborhoods

Park Name	Type	Area (m²)
1. Altayçeşme Neighborhood; It has a population of 31.550 people on an area of 1.370.000 m².		
Yasemin Park	Neighborhood Park	3838
Samanyolu Park	Neighborhood Park	871
Mopaş Park	Neighborhood Park	1159
Muhtarlık Park	Neighborhood Park	1512
Nihat Kapağan Park	Neighborhood Park	590
Altayçeşme Park	District Park	8989
Bomaç Street Park	Neighborhood Park	1134
Kırlangıç Park	Neighborhood Park	590
Uçar Sokak Park	Neighborhood Park	367
Maltepe 1453 Sports Facility	Sport Area	7351
Maltepe Square	Square	1380
Total Open and Green Area: 27,781 m². **Area of 0.88 m² per person**.		
2. Altıntepe Neighborhood; It has a population of 31,682 in an area of 1,003.000 m².		
Güvercin Street Park	Neighborhood Park	445
Selahattin Konan Park	Neighborhood Park	890
Değirmen Yolu Park	Neighborhood Park	823
Total Open and Green Space: 2.158 m². **0.06 m² area per person**.		
3. Aydınevler Neighborhood; It has a population of 19,391 people on an area of 1.391.000 m².		
Yiğit Street Park	Neighborhood Park	518
Aslanbey Park	Neighborhood Park	506
Siteler Yolu Park	Neighborhood Park	5744
Total Open and Green Space: 6.768 m². **0.34 m² area per person.**		

4. Bağlarbaşı Neighborhood; It has a population of 42,861 people on an area of 1,631,000 m².		
Şehit Mücahit Park	Neighborhood Park	594
Ümit Park	Neighborhood Park	1008
Tan Street Park	Neighborhood Park	1200
Gülyolu Park	Neighborhood Park	2100
Alaçam Park	Neighborhood Park	540
Karayolları Park	Neighborhood Park	964
Total Open and Green Space: 6.406 m². **0.14 m² area per person**.		
5. Başıbüyük Neighborhood; It has a population of 21,481 people in an area of 10,518,000 m².		
Atatürk Park	Neighborhood Park	4333
Asude Street Park	Neighborhood Park	1842
Başıbüyük Sports Facility	Sport Area	20753
Total Open and Green Space: 26,928 m². **1.24 m² area per person**.		
6. Büyükbakkalköy Neighborhood; It has a population of 10,503 people on an area of 21,905,000 m².		
Selanik Park	Neighborhood Park	725
Total Open and Green Space: 725 m². **0.06 m² area per person**.		
7. Cevizli Neighborhood; It has a population of 37,945 people in an area of 2,218,000 m².		
Orhangazi Park	Neighborhood Park	17200
Toros Park	Neighborhood Park	2635
Şehit Ayhan Akbaba Park	Neighborhood Park	2170
Şehit Alaattin Buluç Park	Neighborhood Park	943
Karakaş Street Park	Neighborhood Park	528
Pamuk Sports Center	Sport Area	14438
Total Open and Green Space: 37,914 m². **0.99 m² area per person**.		
8. Çınar Neighborhood; It has a population of 20,266 people on an area of 893,000 m².		
Adnan Kahveci Park	Neighborhood Park	1384
Aslıhan Kahveci Park	Neighborhood Park	612
Yıldız Sokak Park	Neighborhood Park	3130
Atatürk Park	Neighborhood Park	2522
Cami Yanı Park	Neighborhood Park	1072
Cami Karşısı Park	Neighborhood Park	1104
Total Open and Green Space: 9.824 m². **0.48 m² area per person**.		

9. Esenkent Neighborhood; It has a population of 20,770 people in an area of 1,203.000 m².		
2 Temmuz Park	Neighborhood Park	9675
75. Yıl Park	Neighborhood Park	2051
Derviş Street Park	Neighborhood Park	1385
Muhtarlık Park	Neighborhood Park	4512
Gül Çıkmazı Park	Neighborhood Park	1300
Yaşar Street Park	Neighborhood Park	1462
İBB Esenkent Park	District Park	8122
İBB Park	Neighborhood Park	4496
Kültür Sokak Park	Neighborhood Park	8150
Umut Street Park	Neighborhood Park	1240
İETT Çıkmazı Park	Neighborhood Park	3690
Total Open and Green Space: 46,083 m². **2.21 m² area per person**.		
10. Feyzullah Neighborhood; It has a population of 19,817 people in an area of 818,000 m².		
Barış Manço Park	Neighborhood Park	654
Gazeteci Erol Demek Park	Neighborhood Park	3992
Çetin Street Park	Neighborhood Park	865
M. Şener Abbaslıgil Park	Neighborhood Park	1997
Total Open and Green Space: 7,508 m². **0.37 m² area per person.**		
11. Fındıklı Neighborhood; It has a population of 62,130 people in an area of 1,164,000 m².		
Gökhan Göksoylu Park	Neighborhood Park	780
Halıcıoğlu Park	Neighborhood Park	476
Petrol Park	Neighborhood Park	1300
Total Open and Green Space: 2,556 m². **0.04 m² area per person**.		
12. Girne Neighborhood; It has a population of 17,864 people in an area of 767,000 m².		
Muhtarlık Park	Neighborhood Park	5064
Narlı Park	Neighborhood Park	4147
Ekşioğlu Park	Neighborhood Park	810
Total Open and Green Space: 10.021 m². **0.56 m² area per person**.		

13. Gülensu Neighborhood; It has a population of 14,318 people in an area of 912.000 m².		
Telsizler Park	Neighborhood Park	645
Futbol Sahası Park	Neighborhood Park	4142
Nurettin Sözen Park	Neighborhood Park	5443
Total Open and Green Space: 10.230 m². **0.71 m² area per person**.		
14. Gülsuyu Neighborhood; It has a population of 14,627 people in an area of 916,000 m².		
Cenk Street Park	Neighborhood Park	531
Pınar Park	Neighborhood Park	4807
Muhtarlık Park	Neighborhood Park	3638
Total Open and Green Space: 9.370 m². **0.64 m² area per person**.		
15. Idealtepe Neighborhood; It has a population of 24,496 people in an area of 1,069,000 m².		
Sani Malaz Park	Neighborhood Park	1732
Fatih Tarakçı Park	Neighborhood Park	628
Total Open and Green Space: 2360 m². **0.09 m² area per person**.		
16. Küçükyalı Neighborhood; It has a population of 26,378 people in an area of 1,076,000 m².		
Şehit Anneleri Park	Neighborhood Park	4063
Barış Manço Park	Neighborhood Park	4851
Adile Naşit Park	Neighborhood Park	526
Total Open and Green Space: 9440 m². **0.35 m² area per person.**		
17. Yalı Neighborhood; It has a population of 12,627 in an area of 1,724,000 m².		
Beşçeşmeler Park	Neighborhood Park	783
Fethiye Street Park	Neighborhood Park	1245
Abdullah Horoz Park	Neighborhood Park	1602
Maltepe Sports Facilities	Sport Area	3230
Hasan Polat Stadium	Stadium	14775
Total Open and Green Space: 21.635 m². **1.71 m² area per person**.		
18. Zümrütevler Neighborhood; It has a population of 86,315 people in an area of 3.290.000 m².		
Orkide Street Park	Neighborhood Park	629
Karaca Park	Neighborhood Park	1948
Kanuni S. Süleyman Park	District Park	64394
Mercan Street Park	Neighborhood Park	3368
Zümrütevler Park	Neighborhood Park	1556
Zümrütevler Street Park	Neighborhood Park	1580
Yavuz Selim Park	District Park	23239
Total Open and Green Space: 96,714 m². **1.12 m² area per person**.		

4.2. Accessibility analysis

Accessibility analysis was conducted for active open and green spaces at the neighborhood and district level, which are classified according to neighborhoods.

Altayçeşme Neighborhood: It has a population of 31,550 on an area of 1.370.00 m². In the neighborhood, 8 neighborhood parks, 1 district park, 1 sport area, and 1 square have been identified and the total area is 27,781 m². There is 0.88 m² of open and green space per capita (Figure 3-4).

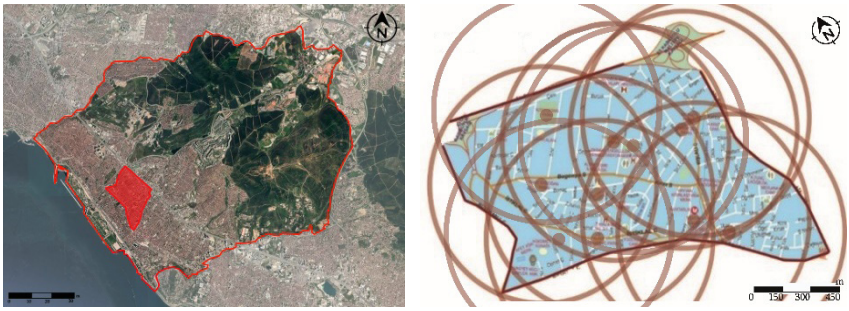

Figure 3-4. Altayçeşme Neighborhood (URL 8), Access analysis (URL 9).

Altıntepe Neighborhood: It has a population of 31,682 on an area of 1.003,000 m². 3 neighborhood parks have been identified in the neighborhood and it is 2.158 m² in total. There is 0.06 m² of green space per capita (Figure 5-6).

Figure 5-6. Altıntepe Neighborhood (URL 8), Access analysis (URL 9).

Aydınevler Neighborhood: It has a population of 19,391 people on an area of 391,000 m². 3 neighborhood parks have been identified in the neighborhood and it is 6,768 m² in total. There is 0.34 m² of green area per capita (Figure 7-8).

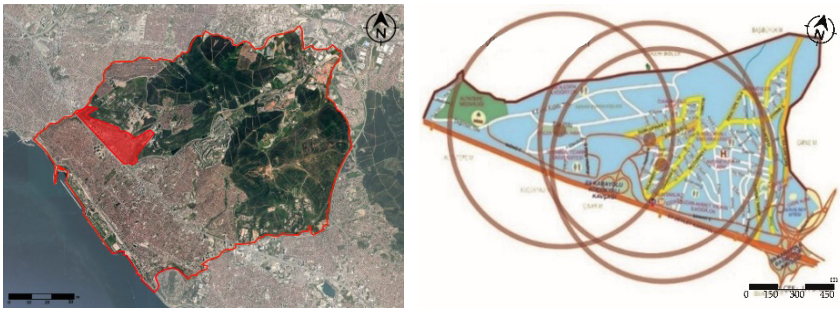

Figure 7-8. Aydınevler Neighborhood (URL 8), Access analysis (URL 9).

Bağlarbaşı Neighborhood: It has a population of 42,861 on an area of 1,631,000 m². 6 neighborhood parks have been identified in the neighborhood and it is 6.406 m² in total. There is 0.14 m² of green space per capita (Figure 9-10).

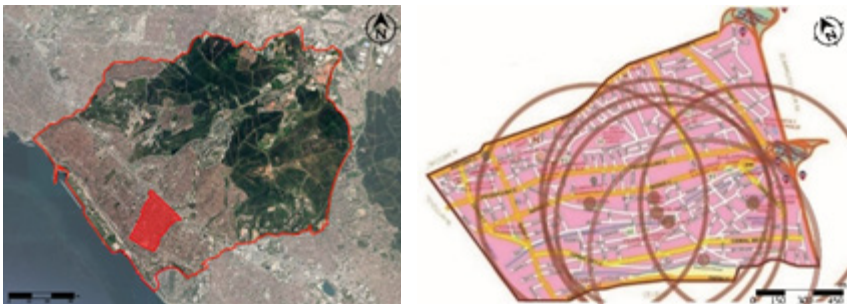

Figure 9-10. Bağlarbaşı Neighborhood(URL 8), Access analysis (URL 9).

Başıbüyük Neighborhood: It has a population of 21,481 people on an area of 10,518,000 m². In the neighborhood, 2 neighborhood parks and 1 sport area have been identified and it is 26,928 m² in total. There is 1.24 m² of open and green space per capita (Figure 11-12).

Figure11-12. Başıbüyük Neighborhood (URL 8), Access analysis (URL 9).

Büyükbakkalköy Neighborhood: It has a population of 10,503 people on an area of 21,905,000 m². There is only 1 neighborhood park in the neighborhood and it is 725 m². There is 0.06 m² of green space per capita (Figure 13-14).

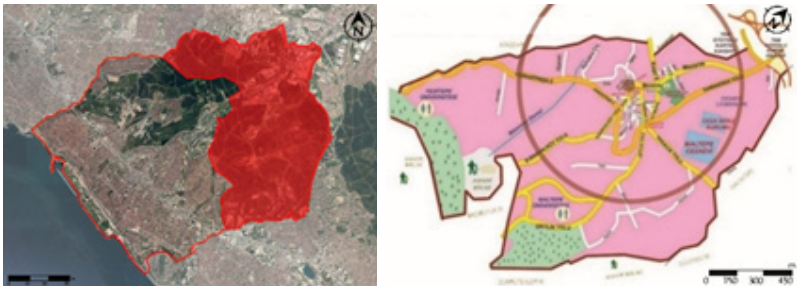

Figure 13-14. Büyükbakkalköy Neighborhood (URL 8), Access Analysis (URL 9).

Cevizli Neighborhood: It has a population of 37,945 on an area of 2,218,000 m². In the neighborhood, 5 neighborhood parks and 1 sport area have been identified and the total area is 37,914 m². There is 0.99 m² of open and green space per capita (Figure 15-16).

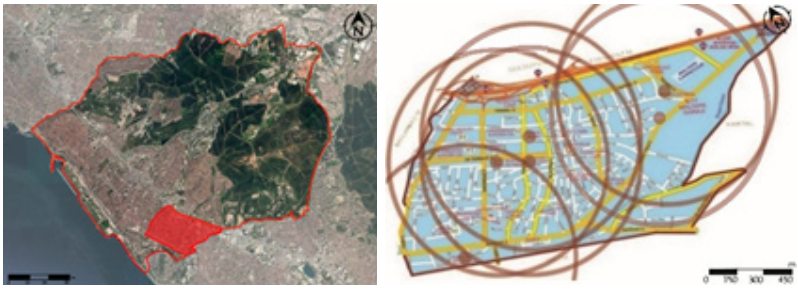

Figure 15-16. Cevizli Mahallesi (URL 8), Access Analysis (URL 9).

Çınar Neighborhood: It has a population of 20,266 on an area of 893,000 m². 6 neighborhood parks have been identified in the neighborhood and it is 9.824 m² in total. There is 0.48 m² of green area per capita (Figure 17-18).

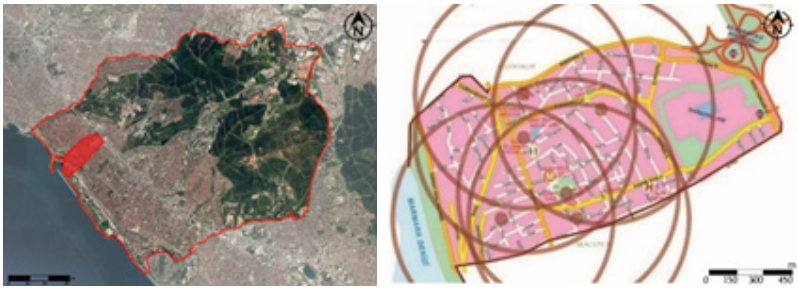

Figure 17-18. Çınar Neighborhood (URL 8), Access Analysis (URL 9).

Esenkent Neighborhood: It has a population of 20,770 people on an area of 1,203.000 m². A total of 10 neighborhood parks and 1 district park have been identified in the neighborhood and it is 46,083 m² in total. There is an area of 2.21 m² per person (Figure 19-20).

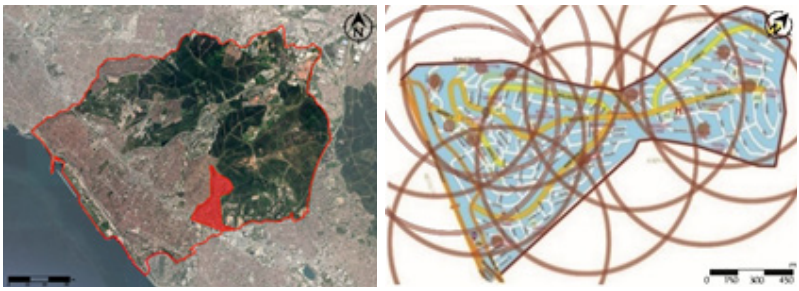

Figure 19-20. Esenkent Neighborhood (URL 8), Access Analysis (URL 9).

Feyzullah Neighborhood: It has a population of 19,817 people on an area of 818,000 m². 4 neighborhood parks have been identified in the neighborhood and it is 7,508 m² in total. There is 0.37 m² of green area per person (Figure 21-22).

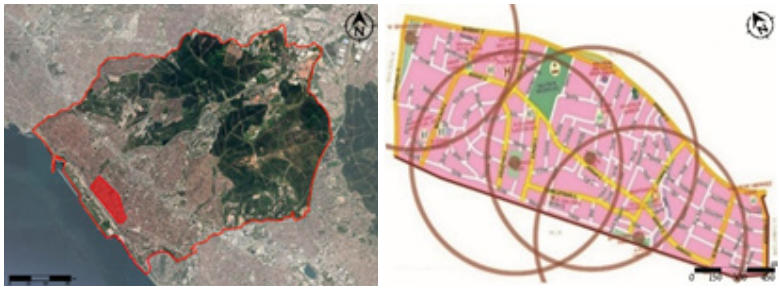

Figure 21-22. Feyzullah Neighborhood (URL 8), Access Analysis (URL 9).

Fındıklı Neighborhood: It has a population of 62,130 people on an area of 1,164,000 m². 3 neighborhood parks have been identified in the neighborhood and it is 2,556 m² in total. There is 0.04 m² of green space per capita (Figure 22-23).

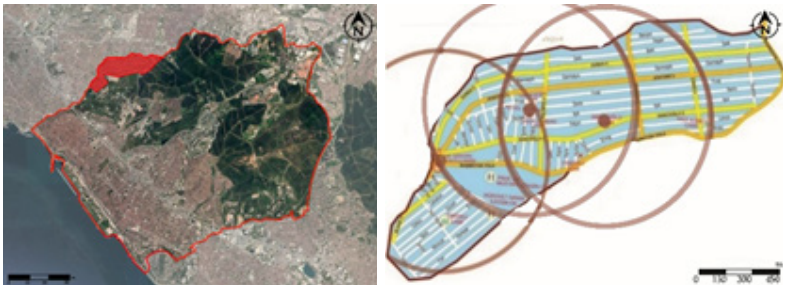

Figure 22-23. Fındıklı Neighborhood (URL 8), Access Analysis (URL 9).

Girne Neighborhood: It has a population of 17,864 people on an area of 767,000 m². 3 neighborhood parks have been identified in the neighborhood and it is 10.021 m² in total. There is 0.56 m² of green area per capita (Figure 24-25).

Figure 24-25. Girne Neighborhood (URL 8), Access Analysis (URL 9).

Gülensu Neighborhood: It has a population of 14,318 people on an area of 912.000 m². 3 neighborhood parks have been identified in the neighborhood and they are 10.230 m² in total. There is 0.71 m² of green area per capita (Figure 26-27).

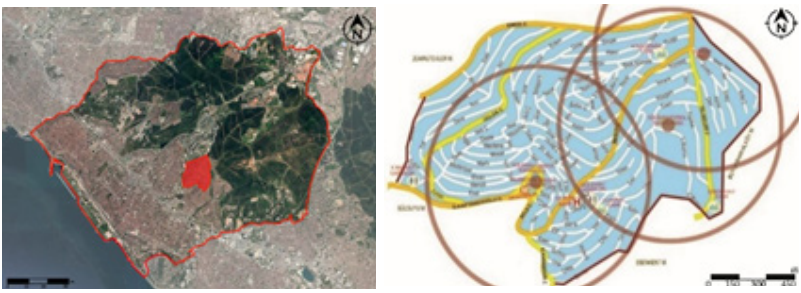

Figure 26-27.Gülensu Neighborhood (URL 8), Access Analysis (URL 9).

Gülsuyu Neighborhood: It has a population of 14,627 on an area of 916,000 m². 3 neighborhood parks have been identified in the neighborhood and they are 9,370 m² in total. There is 0.64 m² of green area per capita (Figure 28-29).

Figure 28-29. Gülsuyu Neighborhood (URL 8), Access Analysis (URL 9).

Idealtepe Neighborhood: It has a population of 24,496 people in an area of 1,069,000 m². 2 neighborhood parks have been identified in the neighborhood and it is 2.360 m² in total. There is 0.09 m² of open and green space per capita (Figure 30-31).

Figure 30-31.Idealtepe Neighborhood (URL 8), Access Analysis (URL 9).

Küçükyalı Neighborhood: It has a population of 26,378 people in an area of 1,076,000 m². 3 neighborhood parks have been identified in the neighborhood and they are 9.440 m². There is 0.35 m² of green space per capita (Figure 32-33).

Figure 32-33. Küçükyalı Neighborhood (URL 8), Access Analysis (URL 9).

Yalı Neighborhood: It has a population of 12,627 on an area of 1,724,000 m². 3 neighborhood parks, 1 sport area and 1 stadium have been identified in the neighborhood and it is 21,635 m² in total. There is 1.71 m² of open and green space per person (Figure 34-35).

Figure 34-35. Yalı Neighborhood (URL 8), Access Analysis (URL 9).

Zümrütevler Neighborhood: It has a population of 86,315 people on an area of 3.290.000 m². 5 neighborhood parks and 2 district parks have been identified in the neighborhood and the area is 96,714 m² in total. There is 1.12 m² of open and green space per capita (Figure 36-37).

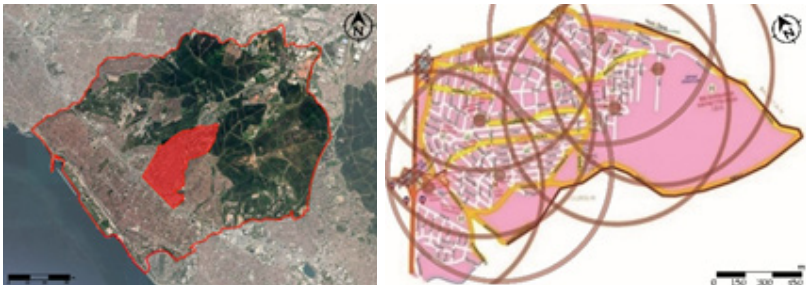

Figure 36-37. Zümrütevler Neighborhood (URL 8), Access Analysis (URL 9).

5. Conclusion

Like every other world city that is constantly growing by immigration, the greatest problem of Istanbul, which is getting more and more crowded with each passing day, is uncontrolled urbanization. In the urbanization process, where the basic need for shelter is prioritized, concrete and artificial texture generally dominates green and natural areas.

Maltepe District is one of the important districts that can be considered as an example for this. There are also forests in the north of Maltepe, which is a coastal district. However, since both these areas are defined as green spaces at the city level, they are excluded from the calculations and analyzes in this study. In the study, neighborhood parks, sports fields and squares in the district were included in the calculations.

The total area of the district is 53,868 m², the total population is 515,021 and it is divided into 18 neighborhoods. A total of 250,265 m² neighborhood parks, 104,744 m² district parks, 60.547 m² sport areas, 14,475 m² stadium, and 1,380 m² squares have been identified. A total of 0.44 m² open and green space per capita has been calculated in the district (228.983 m² / 515.021 people).

When the accessibility analyzes are examined, it has been observed that there are also residential areas that cannot reach any open and green areas by walking in Maltepe District, where accessibility is mostly provided. People who can reach into some sort of open and green space within 500 m of walking distance when they leave their homes, find themselves stuck in areas with deficient functions and insufficient green areas.

When the open and green area sizes calculated for each neighborhood are evaluated with their population, it is seen that none of the neighborhoods has the open and green space size expected per capita. It has been determined that most of the parks existing in the neighborhoods do not have the required surface area, and they are insufficient in terms of both quality and quantity.

In an ideal recreational area, hardscapes and green areas (soft scapes) are expected to be balanced and to serve in a healthy and aesthetic sense. However, in most of the parks identified, it has been observed that the majority of the area consists of hardscapes whereas a few trees or bushes can be characterized as green areas. In addition to repetitive designs, rather than being an attraction area, they can be defined as boring areas that are away from the green texture, due to their artificial identities.

For example, Muhtarlık Park, located in Gülsuyu District, is calculated as 3638 m² yet, evidently, there is little to no green space. Most of the area consists of hardscapes. The only function in this park is the children's playground, which was created using plastic equipment. Many examples such as this park, which is far from an aesthetic approach, creates an artificial image, and is insufficient in size and does not have diversity in functions, can be found in the other neighborhoods. Even though it was included in the calculations only quantitatively, not qualitatively, insufficiency was still detected (Fig. 38).

Figure 38. Gülsuyu Neighborhood, Muhtarlık Park

A similar view can be observed in Aslanbey Park, which is 506 m², as seen in Figure 39. With its ordinary and hardscape-dominated design and functional areas with similar equipment, this park also is one of the examples of inadequacy of the district in terms of both quality and quantity.

Figure 39. Aydınevler Neighborhood, Aslanbey Park

Toros Park, located in Cevizli Neighborhood, is a 2635 m² neighborhood park. However, hardscape covers the majority of the park in a non-functional way. In this park, which has an area where a more functional recreational area could be created instead of a few benches located by the roadside, there is again a single children's playground, which was created using standard equipment as in the previous examples (Figure 40).

Figure 40. Cevizli Neighborhood, Toros Park

Neighborhood parks, which are expected to serve all age groups and are used mostly by children, have standard equipment in almost all of them, regardless of the needs of children of different ages. These playgrounds, which address to a single age group, are insufficient for child psychology and development. In addition to the fact that larger areas are not provided with spaces where they can play and run, children's imaginations are limited with these simple and monotonous playgroups.

Another important user group is the parents of children. In many of the areas, sitting and resting areas are also insufficient. Major deficiencies in terms of both size and functionality were observed in almost every park identified.

Especially in 2020, the necessity of open and green spaces has clearly emerged during the pandemic process all over the world. These open and green spaces, which made their importance felt once again in terms of health in this pandemic period, when we are isolated from social life as much as possible, should be large enough and accessible to everyone. Equitable distribution throughout the city should not be overlooked, as these areas should be distributed in a balanced way and in order to meet the needs.

However, within the scope of the right to provide fair access to healthy and safe public open and green spaces, Maltepe District seems to fall short of expectations. In this context, it is necessary to re-evaluate the parks at the level of neighborhood and district unit, in terms of accessibility, quality and quantity, and with a sustainability perspective in line with today's needs, according to the district population and settlement areas and the projections of growth aspects of these areas.

It is thought that this study will contribute to the determination of the design-planning principles of the urban green space system for the future, as well as contributing to the effective and appropriate usability of the urban population's opportunities to benefit from green spaces at the neighborhood level, and to the planning searches for site selection decisions.

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CHAPTER 8

THE ROLE OF SLUM PREVENTION ZONES IN URBAN DEVELOPMENT: THE CASE OF KONYA

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1. Introduction

Cities are undergoing a rapid transformation due to rapid urbanization in line with the developments and changes in the world. Migration from rural to urban areas, which occurred as a result of the industrialization phenomenon that started in England in the mid-1800s, has led to the unhealthy development of cities, and it has become inevitable to introduce new approaches in terms of eliminating the negative effects of rapid urbanization, managing the migration movement, and eliminating the housing deficit. The planned development of cities in terms of physical and social aspects has been one of the most important issues for which scientific fields such as urban planning, architecture, urbanism, and sociology have developed solutions for nearly 200 years. The theory of Garden City developed during the period of Industrialization and the movements developed as a result of this theory have arrived at modern-day with different reflections in different countries around the world; during the Republican Period in Turkey, through German and Austrian architects and designers, the theory played an important role in the planned development of cities where industrialization was experienced rapidly, especially the capital Ankara and Istanbul. It is known that since 1950, industrialization has gained momentum in Turkey and started to affect the social and spatial structure of the cities. Konya, which has maintained its planned development since 1933, is among the first industrialized cities in Anatolia. Haluk Berksan and Yavuz Taşçı Konya Development Plan, which was a product of the first planning competition held in Turkey in 1965, constituted a turning point in the development of the city. It is thought that

the Slum Prevention Zones proposed by Konya Municipality and the planners in line with the Slum Law No. 775, which was enacted in 1966 when Konya Development Plan was approved, had a significant impact on the planned and slum-free development of the city until today. In this study, 4 slum prevention zones, which are thought to be formed by the effects of the theories emerging for the healthy growth of the city in the world, will be outlined, the findings will be revealed, and the effects of these regions on the regular and slum-free development of Konya will be discussed.

The aim of the study is to examine the development of the city of Konya, known as the city without slums in Turkey, through the slum prevention zones under the Slum Law No. 775, with the effect of the theories and suggestions put forward during the industrialization period in the world, and to investigate the effects on the development of the city by revealing the spatial and social characteristics of these regions.

It is thought that the Garden City theory, emerged in the early 1900s, and the urban practices developed under the influence of this theory, have played a significant role in the planning of the slum prevention zones, which have an important place in the development of the city of Konya, they have also impacted the development of cities with rapid industrialization in Turkey, directed the spatial setup of the slum prevention zones in the case of Konya, and the city showed a regular growth by this way. The findings, obtained from the housing environments created with limited opportunities within the planning practice between the years 1960-1980, are aimed to shed light on the planning history as well as the planned development of today's cities.

Within the scope of the study, the principles of urban development proposed by the Garden City theory will be presented, the reflections of garden city theory exhibited in different countries and Turkey will be reduced to the special case of Konya. After the establishment of the Republic, the planning process of the city of Konya, which has continued its planned development from the 1930s to the present, will be examined with its main points.

Four Slum Prevention Zones, which were implemented in different locations and successive periods in the direction of the development of the city and the neighborhood of industry and university with the Development Plan of 1966, will be examined in the urban and spatial context, the findings will be shared, and finally, the results in terms of the development of the city will be discussed. The data to be evaluated within the scope of the research will be the documents and plans obtained from archival research on the history of the research area. The studies carried on the determination of the place of the

subject in the world literature through the deduction method and the researches on the planning history of the city of Konya with the induction method will form a whole, and a consistent scientific approach will be established in the study.

2. Theoretical Framework

The slum phenomenon is a situation that emerged in Turkey in the 1950s with the rapid increase in the population of cities due to the influx of migrants from villages to cities with the effect of industrialization and the inability to produce housing that could meet the needs of this segment. It is known that it has played an important role in the transformation of the physical and social structure of cities since the beginning of its formation Karaman, 2003: 112). The migration movement, which started with the industrialization in Europe, especially in England, changed the social and spatial structure in the cities, caused the formation of unhealthy living conditions, increased rents and infrastructure costs, and the formation of slum areas (Howard, 1902). The change and transformation that started in the 1890s became the focus of the political and scientific agenda of the country and pioneered the development of many theories and proposals. The first and most influential of these theories is Ebenezer Howard's Garden City theory, which is accepted as the starting point of the development of mass housing in the housing literature. This theory, which first showed its effect in Germany after England, provided the development of cities through satellite settlements and Siedlungs to close the housing deficit (Akcan, 2009). Siedlung practices, which had an important place in the formation of housing environments in Germany during the rapid urbanization period, were introduced to Turkey by architects such as Hermann Jansen, Bruno Taut, Martin Wagner and were first established as housing cooperatives found widespread application in all cities where industrialization developed rapidly, including Ankara and Istanbul, the capital of the young Republic (Akcan, 2009).

The proposal of the cooperative method as a social model with the Slum Law No. 775 has played an important role in the rapid realization of the slum prevention zones, which constitute the main structure of the subject.

The basis of the cooperation model, which was also taken as a basis in the formation of garden cities, is based on the workers' unions established to meet the basic needs of the workers that came to the agenda in the mid-19th century. Housing cooperatives emerged in 1896 with the publication of Franz Oppenheimer's book Cooperative Settlements (Die Siedlungsgenossenschaft) (Harris, 2012).

Another approach taken as a basis in the development of slum prevention zones is the understanding of social municipalism. The movement started by Joseph Chamberlain in England in the 1870s was practiced in the city of Birmingham, when poverty caused by rapid urbanization disrupted the urban order and negatively affected urban health, and started with the transferring of urban services from private institutions to the municipality (Fraser, 1993). Improvement of living conditions, elimination of slum areas, expropriation of urban lands, and the implementation of social housing approaches will be achieved in tandem with the understanding of social municipality.

3. Overview of Urban Development in the World and Its Reflections in Turkey

The city, idealized by the garden city theory, presents a structure defined as a satellite city or unity of satellite cities, is located at a different space from the city center, is self-sufficient, has property uniformity to prevent land speculations, and are connected to the center radially through railways and public green spaces and connected to each other by road (Figure, 1) (Howard, 1902).

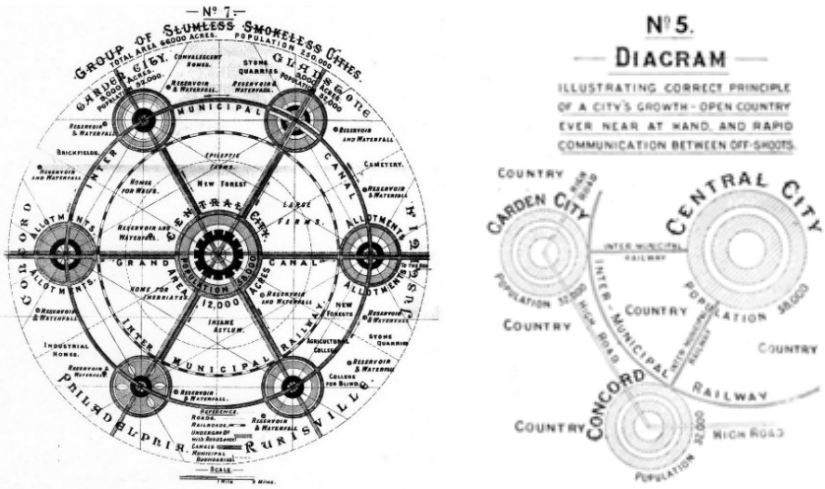

Figure 1. Garden City connection with the Center and with one another (Howard, 1902)

The settlements that are planned to be established outside the city are cities with limited growth areas, which are outside the city, with 9000 and 12000 decares of areas surrounded by public green spaces, appealing to a population of 32000 and 58000 people, and are away from the noise and pollution of the city. In the

case of the cities reaching the determined population, the formation of another city begins and the formation of another garden city is initiated (Goodall, 1987). In this way, as well as showing an autonomous structure within itself with clearly defined city boundaries, each garden city does not affect the integrity of the central city. Howard, in his book *Garden Cities of Tomorrow* (1898), in which he explained his theory in detail, made evaluations on the principles of application as well as spatial features and suggested managerial and economic models for sustainability. In this model, besides supporting the implementation of the municipality or the central administration with services such as infrastructure, roads, drainage, and sewerage, an independent management style that will enable the organization of the practices in the city is also proposed. This independent administration is obliged to provide a cooperation process that ensures that the economic values produced by the city residents during the settlement process are spent for the city. In particular, the proposal for the land to be fully in public ownership aims to prevent land speculations that may occur as a result of possible increases in value during the construction process (Howard, 1898).

The urban structure, green areas, roads and social facilities based on the neighborhood were designed as a whole, and the distances between each other were kept to a minimum and their accessibility in terms of transportation was increased. The social vitality of urban life, which forms the basis of the theory, and the healthy, calm and integrated structure of rural life are provided by integrating the proposed green areas with social facilities and commercial areas (Figure, 2). The cities of Letchworth and Welwyn, the first examples of the Garden City, were the first examples in England with these features.

Figure 2. Schemes related to the spatial setup of Garden City theory (Howard, 1898)

It is noteworthy that the theory was implemented in Germany through satellite cities and Siedlungs. While the garden city reveals an ideal with the features it defines, the concept of the satellite city, proposed by Purdom, defines a method. Purdom model has been revealed by targeting the formation of low-density cities for the city of London, and in this way, it has planned to eliminate the negativities of high-density life (Purdom, 1925). The realization of satellite cities in Germany at the end of the 1920s, with the influence of the central government and local governments, was achieved by the projects designed by architects such as Ernst May, Bruno Taut and Martin Wagner in the form of Siedlungs in Berlin and Frankfurt, and gained international acclaim (Figure, 3) (Wagner, 1925).

The New Town movement, which emerged in England with the effect of garden cities after the Second World War, also pioneered the formation of important examples in terms of the development of cities. Bilsel (2012) defines New Towns as, "*a planned urbanization model consisting of self-sufficient new settlements at a certain distance from the main city, as an alternative to the ongoing urban growth, usually in the form of oil drops, around a metropolitan city.*" It is possible to encounter these applications in many countries such as England, America, France, Australia, Pakistan, India and Brazil (Figure, 4) (Bilsel, 2012).

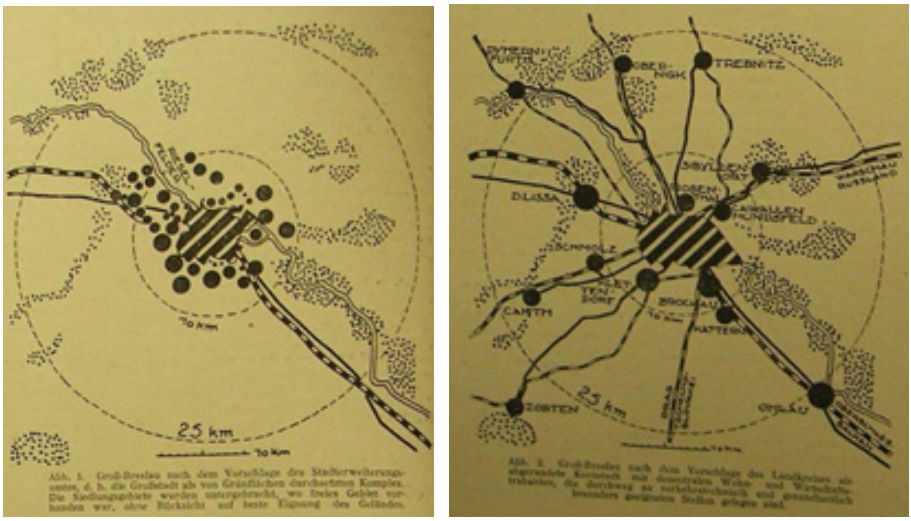

Figure 3. Satellite settlements prepared by Ernst May for the City of Breslau (Wagner, 1925)

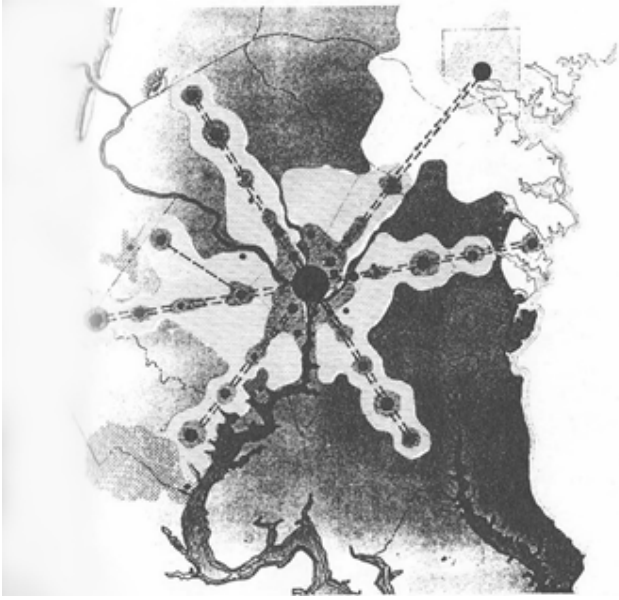

Figure 4. New city proposals around Washington (Benevolo, 1988)

These globally accepted satellite city approaches were brought to Turkey by German and Austrian architects and planners, and similar urban development examples were seen primarily in Ankara and Istanbul in Turkey. Examples such as Bahçelievler Building Cooperative, Yeni Mahalle, Batıkent in Ankara, Levent Mahallesi and Ataköy settlements in Istanbul are examples that were realized by the municipalities in areas independent of the city and planned simultaneously with the slum prevention zones in Konya. The expression of these settlements as plans, which direct the development of Istanbul, is similar to international examples in this sense (Figure, 5).

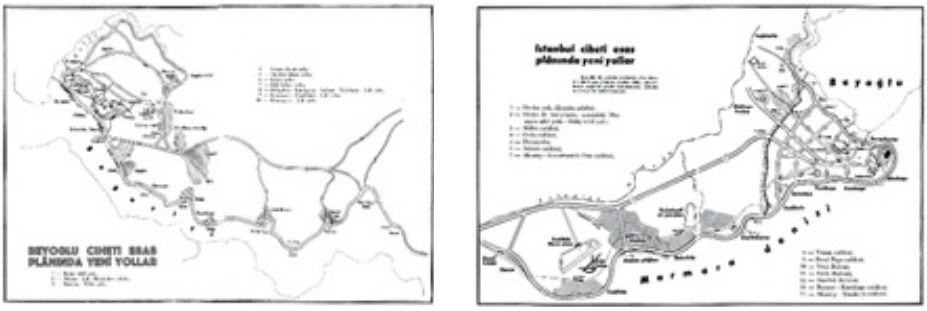

Figure 5. The first settlements of Istanbul planned outside the city (Bilsel, 2015)

4. Konya City Planning and Slum Prevention Zones

Konya, a typical Anatolian city, has continued its planning activities, which it started in 1933, regularly until today. The plans that started with the designs made by Architect Şehabettin for the city's focal points in 1933 continued with Asım Kömürcüoğlu's 1946 holistic development plan, and Leyla Baydar-Ferzan Baydar development plan in 1954. Haluk Berksan and Yavuz Taşçı Development Plan created a turning point in the development of the city. It is thought that the Slum Prevention Zones proposed by the Konya Municipality and the planners in line with the Slum Law enacted in the same years with this plan have played an important role in the development of the city without slums until today. 4 of the 5 regions proposed in the direction determined as the development direction of the city appear as residential environments that developed in successive periods and located in the neighborhood of industry and university. Slum Prevention Zone No. 1 and Slum Prevention Zone No. 2, the locations of which were proposed with the Development Plan of 1966, were designed and implemented in 1967; Slum Prevention Zone No. 4 in 1975, and Slum Prevention Zone No. 3, located in the farthest area from the city, have been planned and implemented in 1986.

It is possible to evaluate the process that the city of Konya went through after 1966 as the formation process of a planned industrial city. The biggest role in the rapid implementation of the process is the adoption of the city plan made in 1966 in the same year as the Slum Law No. 775. The law is to take measurements in this direction for the future with the improvement of the existing illegal construction. The possibilities for transferring the areas to be determined within the boundaries of the municipality, provided by the law, to the public ownership of those with treasury lands and for purchasing the privately owned lands in these areas constituted the infrastructure for the realization of the shantytowns.

In the aftermath of the Development Plan of 1966 prepared in this direction, Konya Municipality quickly determined the slum prevention zones and started the implementation of the first one in 1967. In addition, another issue that accelerates the settlement process in these regions is the decision by law to demolish the unauthorized structures in the designated areas within 2 years. In line with that, Konya Municipality started to work to implement 5 slum prevention zones. All of these regions, except for the Slum Prevention Zone No. 5, have been successfully implemented and completed (Figure, 6).

The development through cooperatives, which is essential in all slum prevention zones, enabled the participatory process to be experienced in the proposed areas and the residents to act together, and played an important role in

the rapid realization of the implementations in this direction. In addition, creating a social model by ensuring the social integration of the low-income workers and civil servants who migrated to the city and wanted to own a house, created the awareness of urbanity and belonging to a neighborhood of the residents to be resettled in the region.

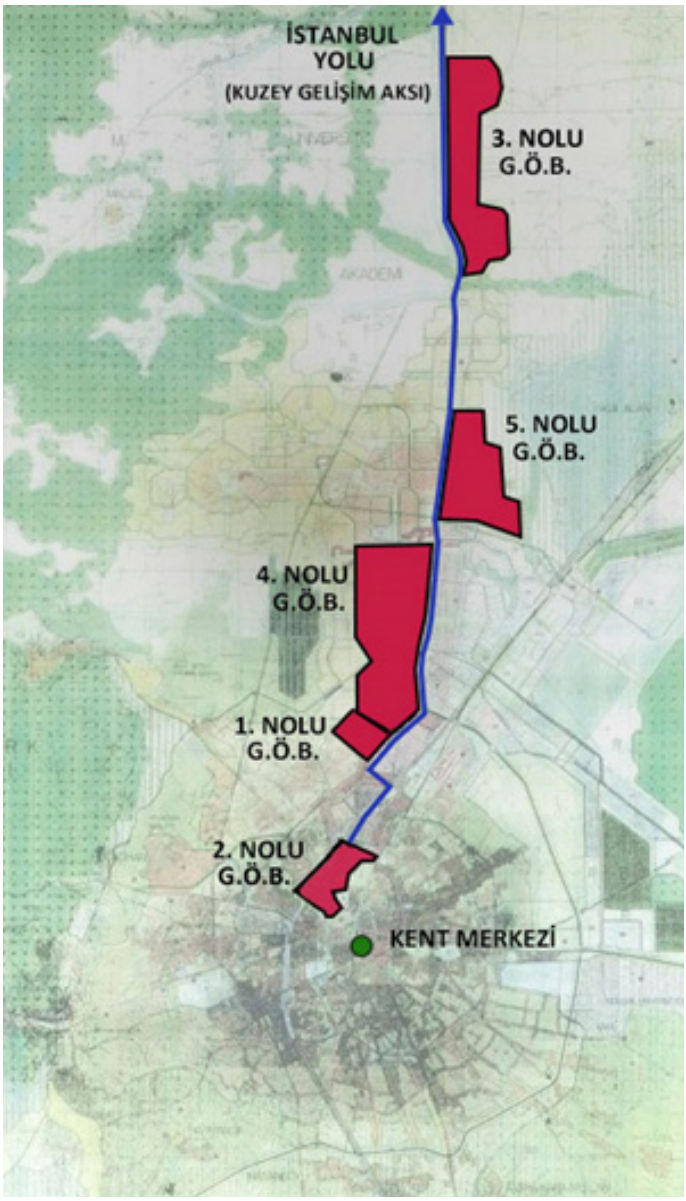

Figure 6. Slum Prevention Zones determined in the city
(Prepared by using the Konya Metropolitan Municipality Archive.)

4.1. Slum Prevention Zone No.1

"Slum Prevention Zone No.1" one of the first slum areas suggested with the Development Plan of 1966, is the first planned step of Konya's industrialization, which is planned to the north of the existing city neighboring the Organizational Industrial Zone, and it hosts the bus station, wholesale market and commercial center and is located close to the new city center.

The region, which is thought to be in an area independent from the residential areas of the city, has been designed as single-story, detached houses with gardens, except for a small center containing commercial and social facilities. The current name of the region is Aydınlıkevler District. The connection of the region with the city is provided by connecting from a single point to the 40-meter-wide Istanbul Road, which starts from the city center and continues as the main transportation artery in the north.

The transportation system and neighborhood units, which are planned in the form of a grid, are similar to the early examples of the Garden City model. It is thought that it was designed in the form of houses with gardens in order not to break the relations of the people who migrated from the countryside to the city, and to continue their agricultural activities. Implemented Architectural Projects are designed as a single type of 100 square meters and are located in parcels of 230-250 square meters (Figure, 7).

Figure 7. "Slum Prevention Zone No.1-Aydınlık Evler Neighbourhood" (Prepared by using the data of Konya Metropolitan Municipality City Information System,1975)

Each house designed in detached order has its own garden. Although it remains in the city today, the residential environment, where the urban texture is maintained, presents physical and spatial integrity, and most of them are used by their first owners or second-generation users.

4.2. Slum Prevention Zone No. 2

The Slum Prevention Zone No. 2 differs from other slum prevention zones in terms of its location close to the city center. Since the Development Plan of 1966 aimed at transforming the single-centered structure of the historical city into a linear form and suggested that the region be a commercially functional center, it enlivened the surrounding of the transportation axis with dense construction, which is proposed as a wide boulevard that could be used by vehicles, bicycles and pedestrians. While the fair area designed in the center forms the southern border of the axis, the bus station forms the northern border. Another factor that increases the importance of the region is the State Hospital (Figure, 8).

The boulevard, which was the most important attraction center of Konya in its time, was named after the mayor, Ahmet Hilmi Nalçacı, who applied the Development Plan of 1966 with the decision taken in 1970 to initiate slum prevention zones. The street, which connects the center to the bus station and whose commercial function is proposed on the ground floors of the buildings on both sides, has become the modern face of the city where national holidays are celebrated, official parades and ceremonies are held, and becomes a center where the high-income group settled with its apartments reaching 12 floors.

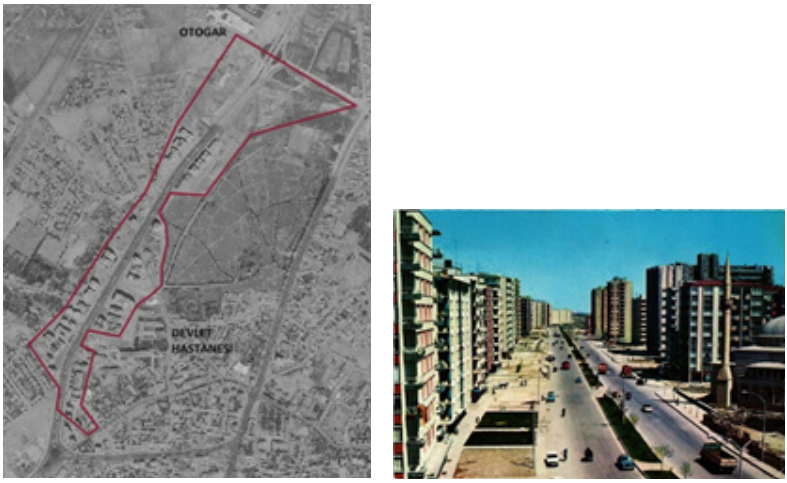

Figure 8. Slum Prevention Zone No.2-Ahmet Hilmi Nalçacı Street Status in 1975 (It was prepared by using the data of Konya Metropolitan Municipality City Information System.) and a photo of 1973 (Postcard, 1973).

The bus station area on Nalçacı Street, where the people of Konya used to go to see the modern residences of the city at the time it was built, has now turned into a 42-floor tower and shopping center, the State Hospital has been

transformed into Numune Hospital, one of the most advanced hospitals in the city, and the Fairground has been transformed into a Culture Park, and since Konya Municipality is located in this region, although it maintains its vitality, the slum prevention zone planned for the housing need of a low-income group has never been used with this feature. In terms of location selection, the region where the high-income group settled in a short time, like a decade, (Figure, 9).

Figure 9. The current situation of the Slum Prevention Zone No.2-Ahmet Hilmi Nalçacı Street (prepared by using the data of Konya Metropolitan Municipality City Information System) and the aerial photograph of 1982 (Anonymous, 1982).

4.3. Slum Prevention Zone No. 3

Although it was named Slum Prevention Zone No. 3 at the time it was planned, it was the last applied project. After the Selçuk University was founded in 1983, it was decided to be planned and implemented in 1986 due to the fact that it is located far from the city, the group it addresses is composed of workers and civil servants, as well as university employees and students. The area, which is planned approximately 20 kilometers from the city center, is located in the neighborhood of the university campus and on the axis of the Istanbul Road. According to law no. 775, it is foreseen to develop through cooperatives like other regions.

The region, which was named Bosna Hersek Neighborhood during the settlement phase, was designed as a satellite city independent from the city. The Slum Prevention Zone No. 4, which was planned on the same axis before it, provided adequate housing for the city's housing needs, and due to the limited transportation opportunities until the end of the 1980s, inadequate social facilities, and the settlement progressed slowly despite the fact that cooperatives started to be built on time. At the end of the 1980s, the light rail system planned in parallel with the Istanbul road provided transportation to Selçuk University and the Slum Prevention Zone No. 3, the completion of the resettlement in the Slum Prevention Zone No. 4, and the number of the user who preferred the region because of the housing needs of the students of the developing university, Its population increased, and then it developed rapidly and became one of the largest neighborhoods of the city (Figure, 10).

Figure 10. Slum Prevention Zone No.3-Ahmet Hilmi Nalçacı Street, today's situation in the 1990s and today (It was prepared by using the data of Konya Metropolitan Municipality City Information System.)

4.4. Slum Prevention Zone No.4

The Slum Prevention Zone No. 4, which has the largest area among the slum prevention zones with a size of approximately 450 hectares, was approximately one-fifth the size of the city in 1975, the year it was planned. In this respect, the region meets the housing needs of the workers and civil servants, and it is accepted as the most important housing move in terms of preventing slums. Today, this region is known as Cumhuriyet and Binkonut Neighborhoods. It is located on the Istanbul Road and independently from the city, as in the Slum Prevention Zones No. 1 and 3. In the southern neighborhood of the region, there is the Slum Prevention Zone No. 1, and the industrial axis, which begins

with the Organizational Industry zone in the east, continues with the industrial areas extending to the north for about 4.5 kilometers. In terms of transportation, integration with the city and providing a direct connection with industrial areas are considered (Figure, 11).

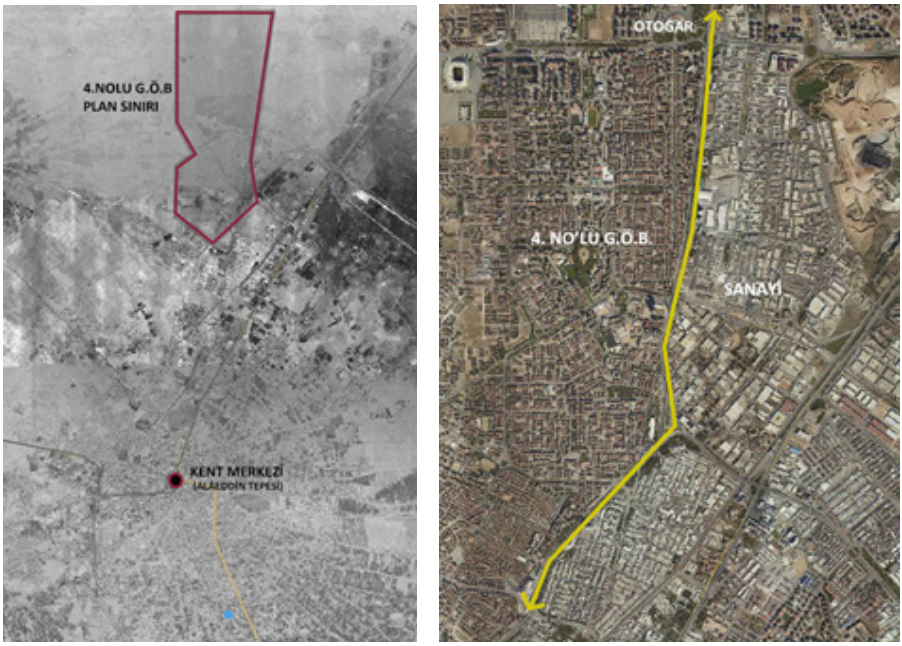

Figure 11**.** Slum Prevention Zone No. 4-Cumhuriyet and Binkonut Neighborhoods in the 1970s and today (prepared by using the data of Konya Metropolitan Municipality City Information System)

When the Slum Prevention Zone No. 4 is examined in terms of urban values, it is seen that it reflects the characteristics of the New Town movement that emerged in England with the effect of the garden city theory. As Bilsel (2012) states, cities formed by the effect of the New City movement are grid-planned, located at a certain distance from the main city, and have the characteristics of a self-sufficient city; they are planned not to exceed a certain population, urban functions are separated in accordance with the zoning principle, residential areas are designed to form neighborhood units, residential areas are designed to form neighborhood units, the green system of the city together with the transportation system form the structure of the city. Slum Prevention Zone No. 4 shows all of these features.

The grid scheme applied in the planning aims to ensure the connection of all neighborhood units with each other and with social facilities equally and

easily. The most important feature is that it is planned in the neighborhood of the industrial areas where the low-income workers work and together with the industrial areas. With this planning, the region sets a successful example in the city in terms of reaching the segment it addresses. Spatial and social features such as the implementation of a holistic urban design project in the process, a planning understanding based on the neighborhood unit, and the acceptance of the cooperative method as a social model have been the main factors in the success of the zones.

5. Conclusion

The most important common feature of three of the slum prevention zones used as a planning method in the development of the city of Konya is that they are planned as self-sufficient settlements outside the city. Each of them has its own center, sufficient commercial areas and social facilities for the needs of the planned population in this center. The Slum Prevention Zone No. 2, built between the existing center of the city and the new city center proposed by the plan, has become a center of attraction due to its central location, the housing values have increased in a short time; instead of low-income workers and civil servants, the settlement of high income groups in the area could not be prevented.

Except for the Slum Prevention Zone No. 2, in all Slum prevention zones;

- It project started to be implemented after the entire land was taken into public ownership and in this way land speculation was prevented,
- As a result of the determination of cooperatives as a social model, social integrity has been achieved and the target audience has been reached,
- Regular growth of the city was ensured and controlled through the slum prevention zones planned gradually,
- The housing deficit of the city was met thanks to these regions and the formation of slums throughout the city was prevented,
- Transportation facilities have been facilitated by planning the slum prevention zones in the direction of the city's development and on the Istanbul Road, which is the main development axis of the city.

As a result, in the city of Konya, which has developed as an industrial city in Anatolia since the 1950s and continues its planning tradition until today, it is understood that the slum prevention zones are constructed under the influence of international urban theories. The "slum prevention zones", which were

implemented with the understanding of social municipality and through the Slum Law No. 775 in Turkey in a 20-year-period between 1966-1986, became an important factor in the planned growth of the city and its development as a city without slums, and is a model that will set an example for the development of Turkish cities today.

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CHAPTER 9

FOREST THERAPY OPPORTUNITIES IN MIDDLE- EAST: A CASE STUDY IN AJLOUN

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1. Introduction

In the past, the human connection with nature was closely related. The residential places were more integrated with nature, providing food, natural resources, recreation, and even therapeutic resources (psychologically and physically). With the development and expansion of cities and the transport network, building technology has become dependent on green spaces and forests in the suburbs and on the outskirts of cities. City life has become routine, characterized by stress and tension, so people are looking for a place to change this routine and break the closed box surrounded by technology and cell phones.

The growing interest in environmental stress has been accompanied by a rapid accumulation of evidence indicating that the environment can elicit substantial stress in people living in urban environments (Ulrich *et al.,* 1991).

Furthermore, it is broadly conceived that the natural environment can enhance human health (Frumkin, 2001). Today, the use of forests has changed over time from spiritual and resource extraction sites to recognize their value in providing a variety of complex ecosystem and environmental services and social functions (Elands *et al.,* 2010). Forests have expanded from natural resources to health-promoting resources, and the number of investigations on the therapeutic effects of forests has increased (Kim *et al.,* 2021). It is recognized that new and emerging ways of encouraging people to utilize forests sustainably for human health benefits need to be embraced (Elands *et al.,* 2010).

Forests cover 31% of the global land area. Approximately half the forest area is relatively intact. More than one-third is primary forest. The total forest area is 4.06 billion hectares or approximately 5000m^2 per person, but forests are

not equally distributed around the globe (FAO and UNEP, 2020). More than half of the world's forests are found in only five countries (the Russian Federation, Brazil, Canada, the United States of America and China), and two-thirds (66 per cent) of forests are found in ten countries (Figure 1).

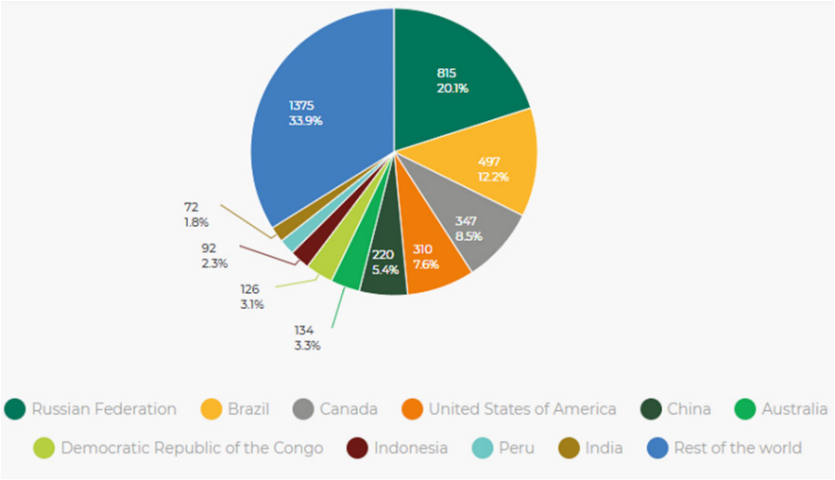

Figure 1. Global distribution of forests showing the ten countries with the largest forest area, 2020 (million hectares and % of world's forest) (FAO and UNEP, 2020)

On the other hand, the Arabian Peninsula is one of the most restricted regions in the Middle East by its forest resources, with a distribution of not even one per cent of its total area (Table 1).

Table 1. Distribution of forests in Arabian Peninsula (Worldbank, 2020)

Countries	**Land Area (sq. km)**	**Forest Area (sq. km)**	**Forest area (%)**
Bahrain	780	7	0,9
Iraq	434,128	8250	1,9
Jordan	88,780	975	1,09
Kuwait	17,820	62,5	0,35
Oman	309,500	25	0,008
Qatar	11,490	0	0
Saudi Arabia	2,149,690	9970	0,46
United Arab Emirates	71,020	3173	4,47
Yemen	527,790	5490	1,04
TOTAL	3,610,998	27,953	0,77

This study investigates forest therapy possibilities in countries with limited forest resources, such as Jordan. Although 1% of Jordan is covered with forests (FAO, 2010), Ajloun is a prominent area with its forest reserve and is selected as a study area.

It is aimed to analyze the sample area whether there are suitable forest therapy opportunities or not. General information was obtained, the biodiversity and ecotourism possibilities were examined. Source values have been tried to be presented with maps created with the help of ArcGIS.

2. Forest Bathing/Forest Therapy

However, the health and wellbeing effects of forests, in particular, have been more substantially researched in countries rich in forests or where they play a significant part in the everyday lives of locals, such as Japan or Finland (Farkic *et al.,* 2021). Forest healthcare activities such as forest bathing are primarily applied in an extensive forest far away from the urban area and large forest parks in a metropolitan area or its rural surroundings (Wu *et al.,* 2021). Forest bathing "Shinrin-Yoku" can also be defined as a new recreation type in forests that have focused more closely on forests' mental health benefits (Gürbey *et al.,* 2020).

The term Shinrin-yoku (Forest Bathing) was coined by the Japanese Ministry of Agriculture, Forestry, and Fisheries in 1982. As a research-based healing practice, forest bathing can be defined as a process intended to improve an individual's mental and physical relaxation by connectedness with the forest (Park, 2007). Forest bathing is considered the most widespread activity associated with forest and human health (Park *et al.,* 2010).

Forest bathing is a healing activity that helps maintain health and increase immunity. It reduces stress, depression, anger, fatigue, confusion, recovers cognitive functions, gastrointestinal tract, respiratory diseases, and lowers blood sugar and cardiovascular system diseases, increasing sense of relaxation and helping treat eating disorders (Park *et al.* 2021; Gürbey *et al.,* 2020).

Biodiversity is an essential component by offering different dimensions to the forest bathing participants. The therapeutic effects vary in various types of forest. Although coniferous forests which are capable of high emitting monoterpenes are preferable (Gürbey, 2020), Liu et al. (2021) stated that all three forests (mixed, deciduous and coniferous) were beneficial to lowering blood pressure and heart rate; effectively reducing negative emotions and boost positive emotions but the mixed forest had a more substantial therapeutic effect. Still, there is a lack of studies reporting the impact of canopy density; forest areas with high canopy cover should not be preferred to feel safe (Kim *et al.,* 2021; Gürbey, 2020).

3. Ajloun Forests, As an Area Eligible For Forest Therapy

All research and studies point to the importance of forest therapy, and as research progresses, this methodology can be taken seriously. In some countries, their geographical locations and vegetation cover help them develop and develop their forests, especially if these forests are rich and varied and have characteristics that make them suitable for this purpose.

The Middle East region (Especially the Arab countries) is one of the regions with a diverse climate and has distinctive characteristics. The diversity in climate has led to the variety in the natural environments that make up this region.

Jordan, being a country with a distinguished and intermediate location among the countries of the Middle East, has gained geographical, climatic and environmental importance, making its lands contain forests, pastures, plains and desert areas.

Located at the intersection of three continents with varied physical characteristics and landforms, Jordan has a rich and diverse ecosystem. It encapsulates four biogeographical regions and thirteen different vegetation types, with 2,622 vascular plant species representing 1% of the world's flora. Among which 100 are endemic, including the *Iris nigricans* & *Iris atropurpurea*, some of the few wildflowers familiar to Jordanians (Obeidat, 2019).

The forest vegetation in Jordan can be divided into natural forests composed of evergreen shrubs, pine and juniper forests, and broadleaf forests. Artificial or manufactured forests are areas afforested artificially by the Forestry Department since the 1950s. The afforested regions are found in all registered forest lands in Jordan. They are planted mainly with *Pinus halepensis* and *Acacia saligna*. The survival rate varies from 0 to 75% (NBSAP, 2020).

Jordan contains five main ecosystems (Gharaibeh, 2010):

1. The Jordan River Ecosystem: The Jordan River derives water from Lake Tiberias and drains into the Dead Sea. The Jordan River area and its extensions are considered one of the biologically significant areas. It includes a percentage of natural habitats and vital complexes threatened with extinction or weak. One of the advantages of this system is that it constitutes a global economic value in terms of forests, hunting, religious sites and tourist activities.
2. Dead Sea Ecosystem: Available information on distinctive plant and animal species.
3. Ecosystem Gulf of Aqaba: The island of Aqaba is the marine port in Jordan, where the coast extends to 27 km^2 for rare species of plants, animals and fish.

4. Highlands Ecosystem: Hovering over the average altitude of the Mediterranean Sea and extending from the northern highlands (Ajloun) down to the Petra region in the south, in which all the forests in Jordan grow from that the areas appear not to exceed 1%, rising in various species globally and locally important flora and fauna.
5. Desert Ecosystem: A display system in large areas in public spaces (80%), in public outdoor spaces (less than 20 mm/year). In this system, on sites important for bird migration, Jordan weights the bottleneck of the main migration corridors of birds. It may contain a large number of endangered plant and animal species.

3.1. Ajloun's Location and General Information

The Governorate of Ajloun is located at the northwestern corner of the Kingdom with the geographical alignment of 32°19'49.62" north latitude and 35°44'52.24" east longitude (Figure 2). Ajloun Governorate covers 412 km^2 and is considered the second smallest Jordanian Governorate after Jerash, with land characterized by agriculture, sparse forests and grassland (FAO, 2019; Al-Kheder *et al.,* 2016). The estimated population of the Governorate at the end of 2020 was 199400 (1.84% of Jordan) (Department of Statistics, 2021). There are five districts in the Greater Ajloun Municipality: Ajloun, Ain Janna, Anjara, Sakhra and Kufranjeh (Table 2).

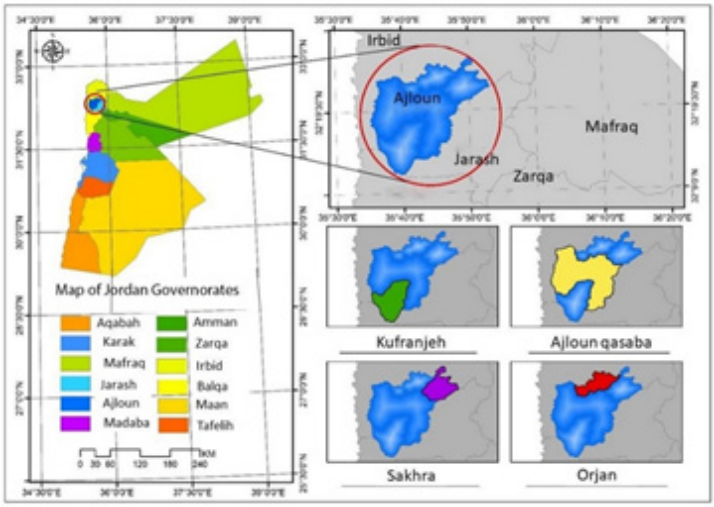

Figure 2. Ajloun's location in Jordan and other cities and the districts of Ajloun (By Ghaida A. Irmeili)

Table 2. The distance between Ajloun and other Jordanian cities (by Google map).

Name of the city	The distance (km)	Time (80 km/hour)
Irbid	32	30 min
Jarash	26	20 min
Almafraq	68	50 min
Amman	77	60 min
Zarqa	71	55 min
Madaba	105	90 min
Albalqa	73	55 min
Karak	192	2 hour and 30 min
Maan	283	3 hour and 30 min
Tafileh	256	3 hour
Aqaba	397	5 hour

Ajloun Governorate is a mountainous area of 224-1236 m and distinguished in the forests from the *Quercus calliprinos, Ceratonia siliqua, Pistacia palaestina* and *Arbutus andrachne*, beside the considerable number of springs, moderate climate and the fertilized soil (Figure 3-4) (Gharaybeh, 2015; RSCN, 2015).

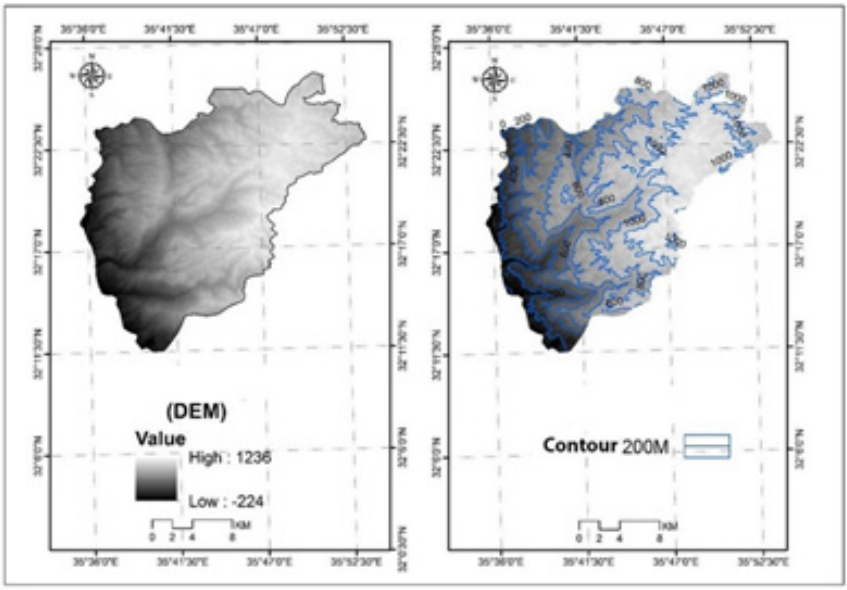

Figure 3. Digital Elevation Model (DEM) of Ajloun (By Ghaida A. Irmeili)

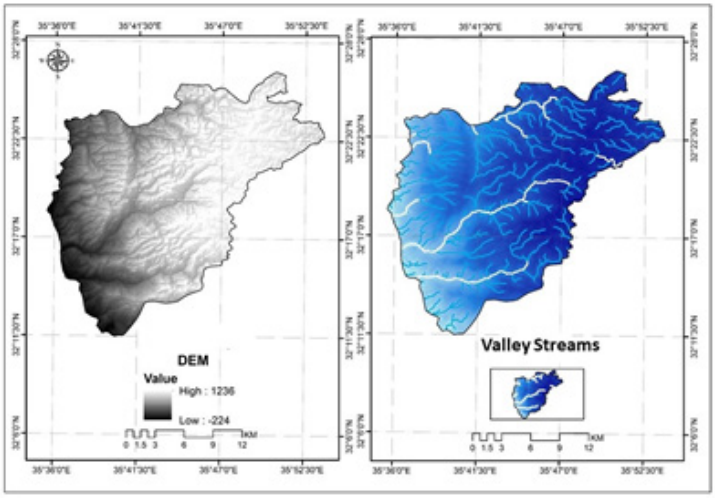

Figure 4. The streams of the valleys in Ajloun (By Ghaida A. Irmeili)

3.2. The Climate and Rainfall

Ajloun has a dry sub-humid Mediterranean climate characterized by long, hot and dry summers and short, cool and wet winters (Al-Bakri *et al.,* 2008). The average rainfall is 750 mm, the average temperature in winter is 5 C°, and the average temperature in summer is 30 C° (URL-1).

The distribution of rain and temperatures in the Ajloun governorate has shown in Figure 5.

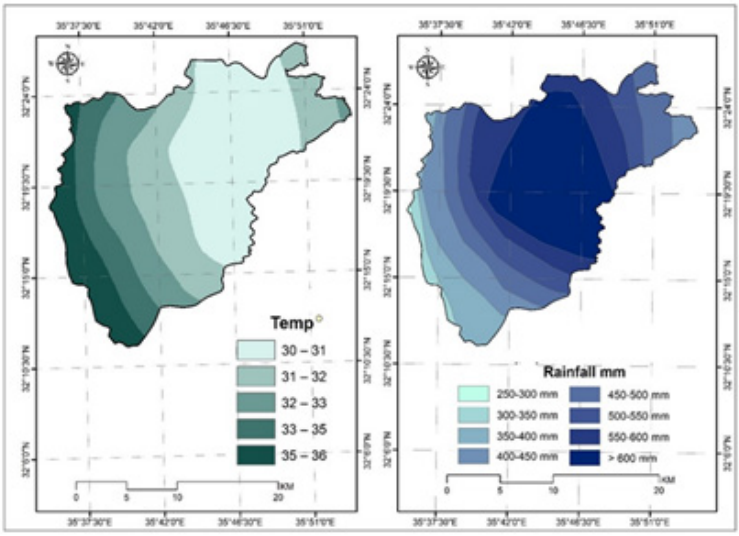

Figure 5. A GIS map shows the distribution of rain and temperature on the lands of Ajloun.

3.3. Ajloun Land Cover

The uses of lands in Ajloun vary to include: residential lands, pastures, forests, closed and open trees, rainfed and irrigated lands and fields.

The most significant land use in Ajloun is for rain-fed orchards, followed by grasslands. Forests (closed and open trees) account for 30% of the land area (Figure 6-7) (FAO, 2019).

LAND COVER CLASSES	DISTRICTS Kufranjah	Ajlun	TOTAL km²	TOTAL %
Irrigated orchards	2.04	0.50	2.53	0.6
Irrigated herbaceous crop	2.04	0.73	2.77	0.7
Rainfed herbaceous crop	2.67	6.01	8.68	2.1
Rainfed orchards	18.15	105.77	123.92	29.5
Closed trees	0.53	50.17	50.70	12.1
Open trees	6.42	61.88	68.30	16.3
Woody vegetation	0.62	0.48	1.10	0.3
Grasslands	34.42	76.91	111.33	26.5
Build-up	5.57	19.84	25.40	6.0
Bare soil	11.25	8.72	19.97	4.8
Undifferentiated bare rocks	2.37	2.39	4.76	1.1
Bare rock granite	0	0	0	0
Chert plain	0	0	0	0
Basaltic plain	0	0	0	0
Sandy areas	0	0	0	0
Saline soil	0	0	0	0
Extraction site	0.51	0.29	0.80	0.2
Saline waterbody	0	0	0	0
Natural waterbody	0	0	0	0
Artificial waterbody	0.01	0	0	0
Wetlands	0	0	0	0
Wadi	0	0	0	0
Mudflat	0	0	0	0
TOTAL LAND	86.59	333.70	420.29	100

Figure 6. Aggregated land cover statistics of the Governorate by district, source (FAO, 2019).

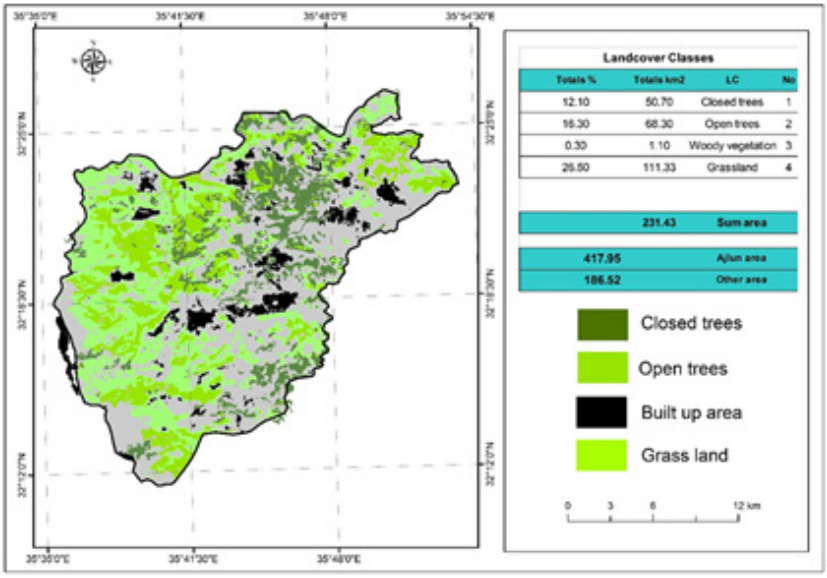

Figure 7. Map for distribution of forests with the built-up area in Ajloun, by GIS according to the satellite image from Land Cover Atlas of Jordan, 2019 prepared by FAO.

3.4. Ajloun Forest Reserve

Established in 1987, Ajloun Forest Reserve covers an area of 13 km^2 located in the Ajloun highlands north of Amman. It consists of Mediterranean-like hill country, ranging from 600 - 1100 m above sea level, with a series of small and medium winding valleys. Its ecological importance is represented by the Evergreen Oak vegetation type, which is typical of the northern highlands of Jordan. As part of the Mediterranean biogeographical region of the country, it is dominated by open woodlands that account for a significant part of Jordan's forested area, which does not exceed 1% of the country's entire land area (Figure 8-9) (RSCN, 2021a).

Ajloun contains several forest areas where tree canopy density varies from 10% to 90%, including open and closed tree areas. The most critical and densest area is the "Ajloun Forest Reserve", characterized by important biodiversity and different types of trees.

The area of closed trees, "which define as the level of tree canopy density is very high "is 51 km^2, while the area of the open trees, "which define as the level of tree canopy density is medium," is 68 km^2, with a total of 119 km^2 in the city of Ajloun, which is 30% of the land in general (Eiten, 1968).

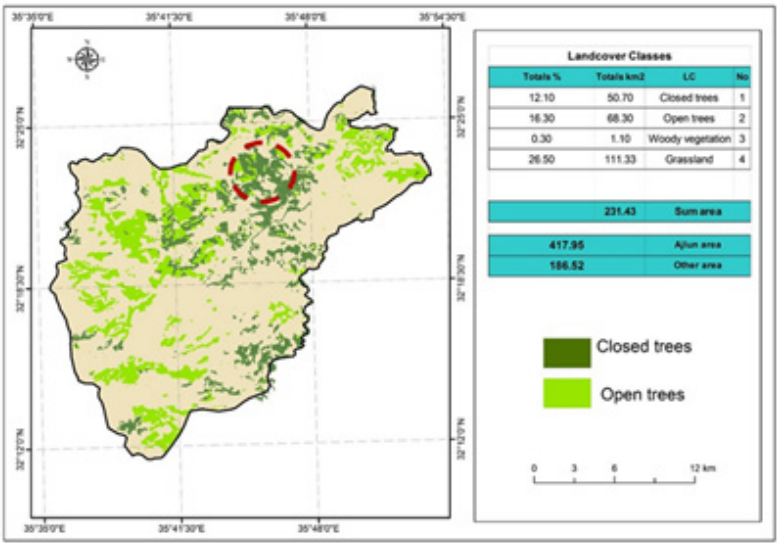

Figure 8. Map for the boundaries of protected area (Reserve), By GIS according to the satellite image from Land Cover Atlas of Jordan, 2019 prepared by FAO (Edited by Ghaida A . Irmeili)

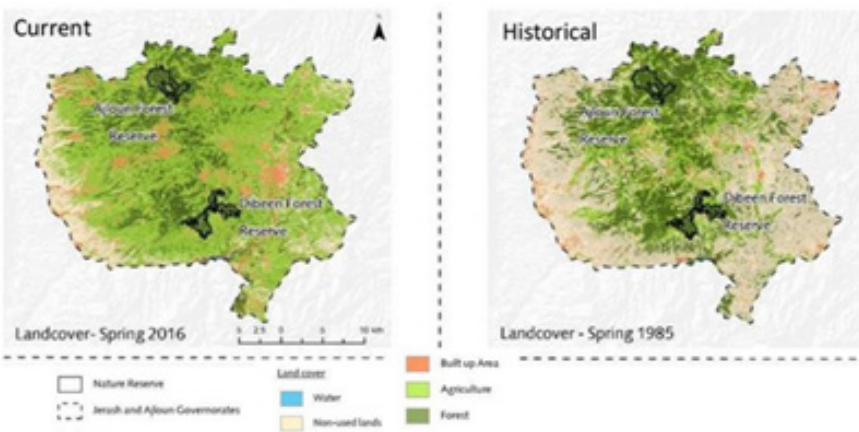

Figure 9. The location of Ajloun forest reserve and the landcover of Ajloun (RSCN, 2016)

3.5. Biodiversity in Ajloun Forest Reserve

Along with stretches of *Quercus calliprinos*, the thriving woodlands of Ajloun are dominated by *Ceratonia siliqua, Pistacia palaestina* and *Arbutus andrachne*. Throughout the years, these trees have been necessary to local people for their wood and quite often for their medicinal and nutritional value or simply as a

food source. These woodlands also support a wide range of plant and animal biodiversity. A wide variety of wildflowers thrive in the Ajloun forest, including the Black Iris, several orchids and wild tulips, several of which can be found in CITES appendices. In 2000, Ajloun Forest Reserve was announced, by BirdLife International and The Royal Society for the Conservation of Nature (RSCN), as an Important Bird Area in Jordan (RSCN, 2015). Ajloun Forest Reserve holds several faunal species, which is restricted in its distribution to the forested habitats of Jordan, such as the Stone Marten and the Persian Squirrel. Moreover, other species were recorded in Reserve, including the Wolf, Asiatic Jackal, Hyaena, Red Fox and the Indian Crested Porcupine (RSCN, 2021b).

As cited in Tadros and Ananbeh (2018), Thomas et al. (2010) performed an inventory at Ajloun to quantify the tree biomass, quantify structure and composition. The results of their study show that *Quercus coccifera* is well-represented in all diameter classes, including the recruitment class; *Arbutus andrachne* and *Pistacia palestina* are present in far fewer numbers. Ananbeh (2010) conducted another monitoring survey_for threatened plants operated in Ajloun reserve and showed that the highest diversity of threatened plant species with four Orchid species are *Cephalanthera longifolia*, *Limodorum abortivum*, *Ophrys transhyrcana* and *Orchis anatolica*. The most abundant threatened plant species were the *Orchis tridentata*, followed by the *Cephalanthera longifolia*, which showed the higher specimens recorded during the study.

Tadros and Ananbeh (2018) registered 100 species belonging to 34 families in the Ajloun Forest Reserve. The study showed that the high-altitude vegetation cover evergreen oaks, Atlantic oaks, and maple trees, followed by shrubs, climbers and grasses. It was found that the dominant plant is the evergreen oak, followed by the Palestinian oak.

3.6. Ajloun Forest Reserve and the Green List

International Union for Conservation of Nature (IUCN) Green List is a global campaign for successful nature conservation. At its heart is the Green List Sustainability Standard that provides a global benchmark for meeting the environmental challenges of the 21st century. The IUCN Green List offers locally relevant expert guidance to help achieve fair and practical conservation results in protected and conserved areas. It can help guarantee that wildlife and ecosystems can survive, thrive and bring value to communities everywhere (IUCN, 2018).

The green list considered several aspects of the Ajloun Forest Reserve site, including natural, ecosystem service, and cultural values (Table 3).

Table 3. The site value of Ajloun reserve forest according to the GREEN LIST, IUCN, 2018)

1. NATURAL VALUES			
Monitoring of Values	Thresholds of Success	Condition of Values	Summary of Trends And Results
Ajloun Forest habitats Forest health checks and monitoring for species, habitats and coverage is carried out routinely and reported	Maintain at least 40% woody cover, and aim to achieve 50% woody cover -50% ground cover by 2020.	Forest habitats – especially evergreen oak stands – are in good condition.	Overall regeneration of the Reserve continues and feeds into management activities
Biodiversity including special, rare and endemic species Bird species, in particular, are monitored in the Reserve as well as in the surrounding landscape	Special, rare and endemic species are present and preferably in stable numbers over a five-year average period.	All values are stable, and the majority demonstrate slow increases.	Good protection and improved habitat are generally suitable for most species. Some succession issues may occur. Integration with broader landscape and Debeen PA is actively promoted
Roe Deer population Reintroduction success has been monitored regularly since the release of 26 site-bred roe deer in 2006.	The Roe deer population in the Reserve and surrounding area is viable and at least 100 individuals are identified using the Ajloun habitat.	Roe deer are well established in the Reserve but also in surrounding areas. 2018 estimate of 120 individuals.	Roe Deer is well established and viable.

Table 3 continued. The site value of Ajloun reserve forest according to the GREEN LIST, IUCN, 2018)

2. ECOSYSTEM SERVICE VALUES			
The site ecosystem services are not technically identified. Still, they are referred to in the management plan, such as the regulating services of clean air, oxygen providing, and provision of natural resources like grazing ground, medicinal plants and herbs.			New integrated monitoring plan under development for 2019.
3. CULTURAL VALUES			
Visitor education and engagement in Nature Monitor the impact of tourism on local livelihoods, culture, forest integrity, and visitor experience.			Visitors numbered over 16,000 in 2016 and 18,000 in 2017.

3.7. The Ecotourism in Ajloun Forest Reserve

The most crucial component of RSCN's solution to integrate the local communities in its conservation programs was nature-based low impact ecotourism. Ajloun Reserve covers 12 km^2 from the remaining fragile and fragmented forest patches in northern Jordan. Ecotourism infrastructure and facilities (cabins, restaurants, trails) have developed to attract users to stay overnights in the area, which only received limited numbers of day visitors before establishing the Reserve. The Reserve was linked with the surrounding historical and cultural attractions, creating benefits and alternative income to the local communities and rehabilitating local houses along the hiking trails as stop points for food and beverage. This ecotourism product depends on natural and cultural resources, low level of technology with a low negative impact on nature respecting the site carrying capacity (Figure 10, 11) (Altawalbeh, 2018).

Figure 10. Ajloun Forest Reserve (Altawalbeh, 2018).

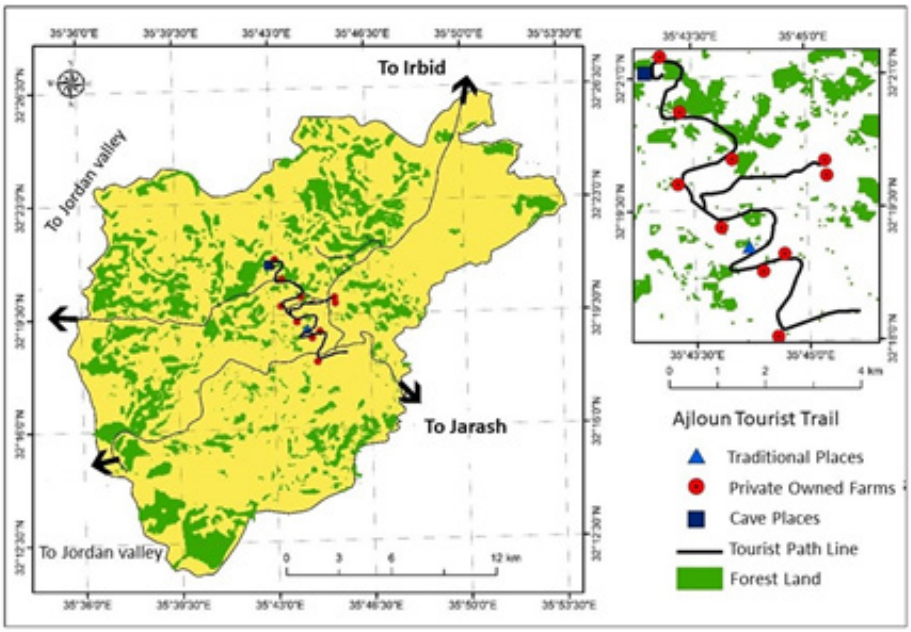

Figure 11. A GIS map of the Ajloun tourist route, the source is the tourism development of the Greater Ajloun Municipality, by Ghaida A. Irmeili.

Ajloun nature reserve has two trails (El-Harami, 2014). Both courses can be visited by guided or self-guided:

a. Easy Trail: It is a scenic viewpoint about (2 km) and takes 1-2 hours. This trail starts from the campsite and reaches the summit of a nearby hill overlooking the Reserve. The return trip goes past the breeding enclosures of the roe deer.
b. Moderate Trail: This trail consists of a Rockrose (8 km) and needs 4-5 hours to do. The visitor passes across heavily wooded valley ridges, villages and olive orchards and offers beautiful panoramic views of the West Bank and Syria.

The Reserve and the area surrounding it are dotted with ruins. The most famous is Salahidin's Ajloun Castle (1184 AD), and the most intriguing is the Mar Ilyas (Elijah) Church, one of the oldest churches in Jordan (El-Harami, 2014).

The number of visitors coming to the area increased after the opening of the tourist and visitors trails and projects, as these projects were able to prolong the stay of the visitor in the Ajloun area and the Reserve, where visitors can visit this area and walk in the tourist trails in addition to eating traditional meals.

Table 4. The number of visitors for Ajloun reserve (IUCN, 2018; Jordan Times, 2020).

The year	Number of visitors
2016	16,000
2017	18,000
2018	40,983
2019	60,000

4. Conclusions

Forest therapy or forest bathing, which has emerged as a rising trend in recent years and focuses on the healing benefits of forests, is widely practised in Far East countries with dense forest resources such as Japan, China and Korea, and more recently in Europe and America. It is accepted worldwide as a health-based concept whose effects are proven day by day with increasing scientific studies.

Being in contact with nature and benefiting from its healing effects, especially after the pandemic, made easier accessibility of forest areas with high biodiversity necessary.

Ajloun is a prominent place on a national and regional scale with its different tourism activities. The solid ecological and cultural diversity in Ajloun is pointed out the city as a central tourism region in the northern part of Jordan.

Ajloun is one of the rare and distinguished forests with its natural components, location, rare trees, a unique biodiversity system, tree density, numerous water springs and moderate climate. These features make Ajloun Forest Reserve an important area for forest therapy or forest bathing. It is also an area capable of environmental development if attention is given.

Although Jordan has limited forest resources, it has entered the IUCN greenlist with the Ajlun Forest Reserve. Ajloun Forest Reserve has also been named one of the world's top 100 sustainable destinations by Green Destinations for 2018, recognizing its responsible and sustainable tourism initiatives (RSCN, 2021).

Forest therapy is a modern concept but old in content; employing the environment in treating and correcting humans is one of the most important things that help to integrate humans with nature. Existing trails in Ajloun Forest Reserve can be used for forest therapy. The proposal of Ajloun as a forest therapy area is an appropriate opportunity to develop this concept in the Middle East because Jordan is strategically located with the rest of the countries and is the most stable and the safest country at present and is very well known for medical tourism. With projects supported by scientific studies, Ajloun may become the first forest therapy base of the Middle East in the future.

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CHAPTER 10

AN OVERVIEW OF UNUSUAL FURNITURE DESIGNS

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1. Introduction

Furniture has existed since the very beginning of human civilization. Furniture can be made by using natural materials such as rocks and tree stumps (Smardzewski, 2015). The design of furniture reflects not only the culture and aesthetics (Fitzgerald, 2018) but also the design approach, materials science and manufacturing technology (Lawson, 2013).

In this study, 20 different designs have been put forward with the thought that animals, cartoon characters, items used for different daily purposes can inspire furniture design. The aim is to examine the impact factors other than the main components in the furniture concept. In the study, the impact factor was examined by presenting examples where the imagination of the designers and the furniture design were combined.

Furniture is described as movable equipment that as make a person's office or home more suitable and comfortable for living or working. Furniture can be used for seating, storage or sleeping. The concept of furniture first was improved about 2500 B.C. The first items created for household use were made of stone, as wood was not readily available during the Neolithic time period. Dressers, cupboards and beds were the first forms of furniture (Peters, 2018).

Neolithic furniture can often say something about who the individuals were. An example of furniture design from the Neolithic period is shown in Figure 1. (bohaglass.co.uk, 2021).

Figure 1. Example of Neolithic Furniture (bohaglass.co.uk)

There is an opinion that the Doric and Ionic clothing in Rome and ancient Greece were clearly designed to resemble architectural structures. In this period, the human body was handled like a column and the design concept seen in architectural orders was also used in the design of these garments. The corrugated areas used in columns in Ancient Greece were a reference to the drape layers and cylindrical form of the 'chiton', the most popular garment of the same period. It is seen that the pointed ends of the Gothic architecture also influenced the fashion of the time. Clothes have gone beyond the limits of the human body. Hats for men and women are excessively long and pointed shoes are used (Guldur and Bayram, 2016). Today, fashion designers and architects undertake joint projects. Famous architects such as Rem Koolhaas, Tadao Ando and Frank O. Gehry, Charles Gwathmey, and fashion icons such as Ralph Lauren, Alexander McQueen, Prada, Armani, Issey Miyake state that they interpret the structures they create with the design lines of these brands while designing the buildings where their collections will be displayed (Guldur and Bayram, 2016). The works of designers in this field, influenced by buildings and various architectural styles, are quite numerous. Below is an example from Givenchy (Figure 2).

Figure 2. Examples of designs created by Givenchy in 2008, influenced by renaissance, gothic and baroque architecture (Guldur and Bayram, 2016).

In furniture making, different and many materials are shaped and decorated with various processes.

It has been a tool for designers and masters to display their creativity and skill in every period. Furniture has always been a valuable commodity. In the past, the wealthy could not limit their spending in this area. Furniture makers have had to satisfy wider consumer masses with industrialization. So they had to consider economic factors in design. Gradually, fine workmanship has been replaced by cheaper technologies, and valuable materials have been replaced by imitations. (Boyla, 2012).

From the outside perspectives, it is often diffi cult to fully understand how exterior (or site) design integrates the elements of furniture that are used for various design purposes and create a sense of place. Such an understanding can open up creative possibilities for designers of outdoor areas and enable them to shape spaces that can succeed in achieving their aims over the long term (Yücel, 2013). Also, there is growing evidence that the competitiveness of some companies is based on an innovative use of user-oriented design (Montresor and Vezzani, 2019).

Furniture is an important component of the built environment in schools that can be easily modified, given funding availability. The school-based studies

have found that children using standbiased desks expended significantly more energy than those using standard chair-height desks (Benden et al 2012, Blake et al 2012).

Similar types of relationships exist among many other branches. For example, cartoon characters have been able to inspire ceramic artists. According to zel (citing this relationship from zel, Cevik, 2018), the characters created by the cartoonists, who have great support for cartoons, met with the art of ceramics with the project "Line of Heroes on the Street" realized by VitrA Seramik Art Workshop in June 2003. With this project, he created a link between cartoons, caricature and ceramic art. Ceramic sculptures, in which the works of many important cartoonists were transformed, met with the audience on the streets of Istanbul (Cevik, 2018) (Figure 3).

Figure 3. Ceramic sculptures exhibited within the scope of the "Line Heroes on the Street" project (Cevik, 2018)

Furniture design and production process has ceased to be a phenomenon that can only appeal to a certain segment of society, with the industrial revolution and mass production. So, it has become a product accessible to everyone. The way of production of handcrafted furniture has changed. Different materials have been used and a standard product has been created. At the same time, with mass production, it has been ensured that the same part (module) can be produced in thousands of numbers in a certain size and form at one time. (Özel and Kayacan, 2020). The module is defined as the unit, the basic part, which has a structural or functional integrity in itself (Hasol, 2010).

Figure 4, shows the design in which many modules are added together to form a different unit.

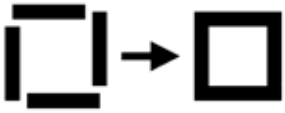

Figure 4. Part to Module (Hadi, 2013)

Figure 5, shows that by repeating a module, it creates different multiple setups/ configurations.

Figure 5. From Module to Multifiction (Hadi, 2013)

The Industrial Revolution and the resulting mechanization offered the artist a new perspective in terms of material and subject diversity; This period was a time when individual approaches were felt more in the works of artists. In this period, art, freed from the clutches of traditional patterns and predicted boundaries, was fed from many different fields and entered an evolutionary process within itself, which is still a touchstone in plastic arts. In the understanding of contemporary art, which is the beginning or result of this interdisciplinary interaction, especially established in the field of plastic arts, the emphasis on freedom and originality for the use of all kinds of materials that can strengthen the individual, emotional and fictional expression of the artist has also been at the forefront (Cevik, 2018).

2. Factors Affecting Furniture Design

Since people spend 1/3 of their life sitting, the important role of furniture in our lives is an indisputable fact. When designing furniture, in addition to aesthetics, comfort and conformity to physical dimensions are the factors that the manufacturer and designer should pay attention. Furniture in workplaces and hospitals should be made in accordance with the dimensions of the user. Furnitures used in working environments should be produced in accordance with the anthropometric measurements of men and women. Furniture selection can change employee health and working efficiency (Telli and Şenol, 2013). The feeling of the furniture in the space to the consumer is the most important issue that manufacturers should focus on (Bülbül and Erdinler, 2019).

The reflections of the modern movement at the beginning of the 20th century, as the basis of the relationship between function and form in furniture design, maintain most of their influence at the beginning of the 21st century. Today, new technology, material, production technique, design approach, ideology, lifestyle, social values, changes and transformations in these affect today's furniture. In the post-war period, space design gains importance with restructuring and there is an increase in furniture mass production (Sahinkaya, 2009). In this period until today, designers acting with the principle of pluralism have designed furniture without any particular concern (Pina, 2003).

Italy has an important place in today's furniture design. The changes experienced in Italy between 1940-50 have caused Italy to be the center of fashion trends in furniture until today. Italian designers; architecture, interior design, product design and furniture design handled with an interdisciplinary approach. They proposed innovations and different solutions both aesthetically and functionally in production and design (Fiell, 1991). Workplace furniture design and user anthropometry have become an important consideration in designing ergonomically appropriate furniture (Van Wely, 1970, Harris et al, 2005).

3. Unusual Furnitures

Exceptional furnitures are made to order to be very special and highly personalized. Each of these unique designs is thoughtfully designed and crafted with craftsmanship that represents the individual. This extraordinary piece of furniture has both presence and personality.

Some interesting furniture has emerged from the imagination of its designers. These are seen in the market as animals, cartoon characters, daily used objects, cars, etc. The designers were mostly inspired by the animals with whom we share the world. In addition, the cartoon characters watched regardless of children or adults are also among the factors that affect the imagination of the designers. On the other hand, it has influenced the interesting furniture designs of designers from objects used in daily life. In the research, these factors that affect the designers have emerged, and in this study, these factors are revealed with examples.

In this study, these interesting furniture samples were handled and their similarities with the real ones were examined. The aim here has been to reveal the furniture samples inspired by the designers and brought to life.

3.1. Affinity to animals

First, the designers were inspired by animals, the creatures we share the world with. There are bookshelves, tables, coffee tables, etc. examples of which are very common

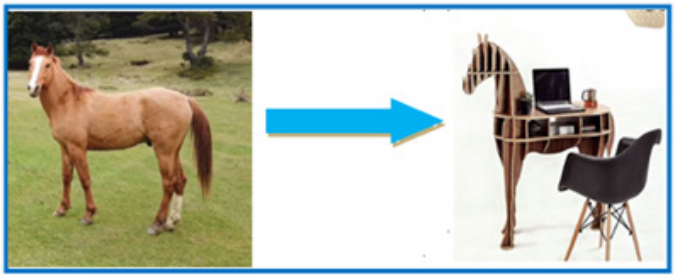

Figure 6. Horse table (dekodea.com)

Figure 6 is an example of a wooden desk in the shape of a horse, while Figure 7 is a pig-shaped bookcase made of wood. The designers who created the examples revealed the interestingness and aesthetics with this furniture they created inspired by animals.

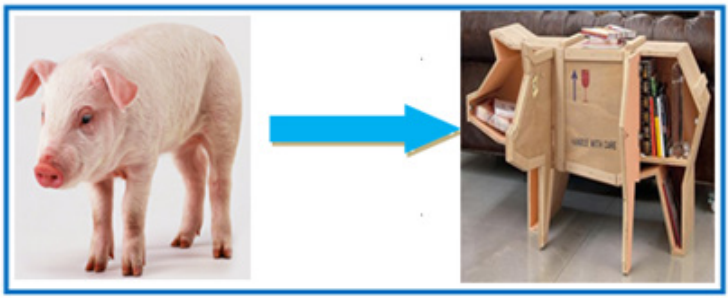

Figure 7. Pig bookcase (pinterest.com)

Figure 8. Snail table

There is a huge amount of furniture made with a combination of many different materials. There are designs in which glass, metal, wood, etc. materials are used a lot. Figure 8 was a design that the designer turned into furniture by designing wood and glass in the form of snail shells.

Figure 9. Hippopotamus chair (featureproductlist)

Leather armchairs, especially used as office furniture, are among the furniture types we see a lot. The designer revealed a different perspective than usual with the leather armchair he designed in the shape of a hippopotamus in Figure 9. In this design, it is now in the status of an office furniture brought to the market.

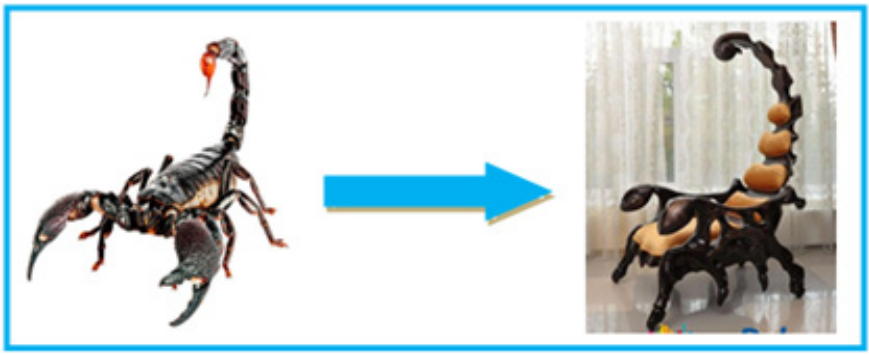

Figure 10. Scorpion seat

Another armchair shape that the designer has put forward by being inspired has been the scorpion known as tehylei. As seen in Figure 10, its legs, body, aesthetics and appearance draw attention with its similarity.

3.2. Affinity to Cartoons

Another factor affecting the designers was cartoon characters, toys and movie themes. There is a lot of interesting furniture especially inspired by Marvel and DC characters.

Figure 11. Cindy dresser (welsofthome.com)

Dolls, especially preferred by girls, have also been turned into furniture by designers. Figure 11 is designed with a shape resembling a cindy doll and has found its place within the scope of interesting furniture.

Figure 12. Flash dresser (bigumigu.com)

Figure 13. Clock cabinet (bigumigu.com)

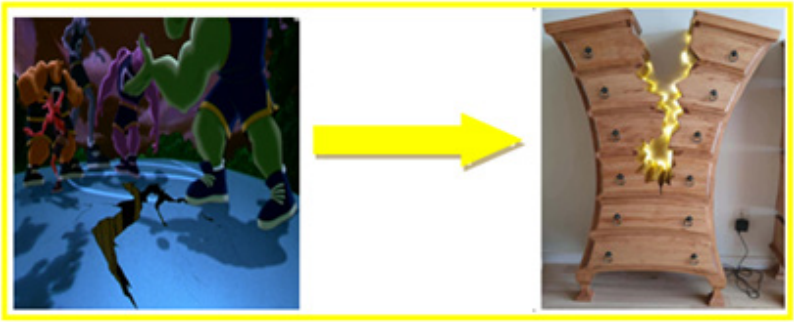

Figure 14. Broken dresser (bigumigu.com)

Cartoons live in a universe where both children and those who remain children escape from the reality of this world and find peace. It is also a source of inspiration for creative bodies. Most recently, Taku Inoue stole our hearts by transforming Tom's unfortunate moments while chasing Jerry into a statue. We have seen the effects of cartoons on the creative world in Y. Nakajima's post-apocalyptic toys and Jynwaye's illustrations on shoes. Henk Verhoeff, on the other hand, brought the cartoon universe to the real world with the furniture he designed and brought to life in Figures 12, 13 and 14.

Figure 15. Living dresser (welsofthome.com)

There are animations and movies that attract the attention of adults and children. These are the kind made by the makers of Looney Tunes, Marvel, Disneylan, DC, etc. Among the working examples, Figure 12 is the Marvel character Flash, the clock that comes to life in Figure 15 beautiful and ugly movie, Figure 14 is furniture produced by designers inspired by the broken *basketball floor in Looney Tunes Space Jam movie.*

3.3. Affinity to others

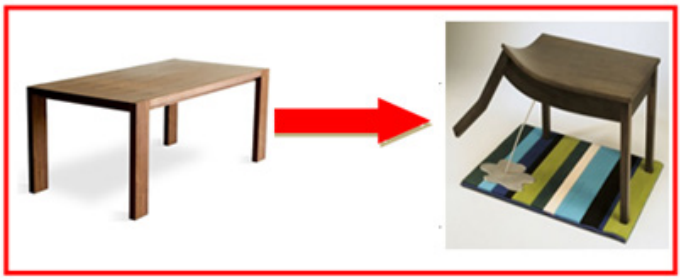

Figure 16. Interesting table (welsofthome.com)

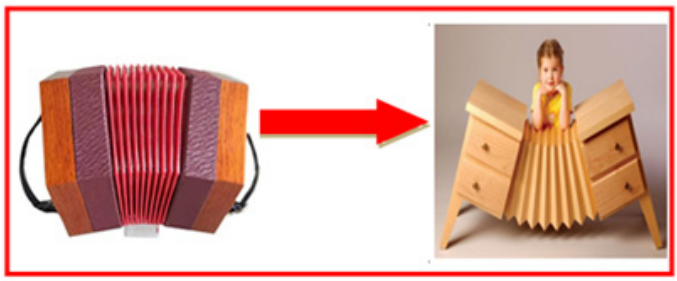

Figure 17. Accordion table (welsofthome.com)

Figure 18. Plastic interesting table set (kadinlar.tc)

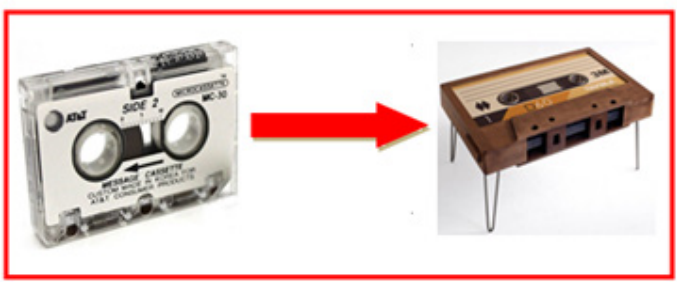

Figure 19. Cassette table (welsofthome.com)

It is the most used furniture type table in kitchens, halls, offices, etc. Designers make table designs taking into account ergonomic, aesthetic and intended use. In Figure 16 and Figure 18, the table designs available in the market, interpreted with interesting designs can be seen. There are also tables made from different objects other than those on the market. While Figure 17 is made with accordion description, Figure 19 is an interesting table with its cassette resemblance.

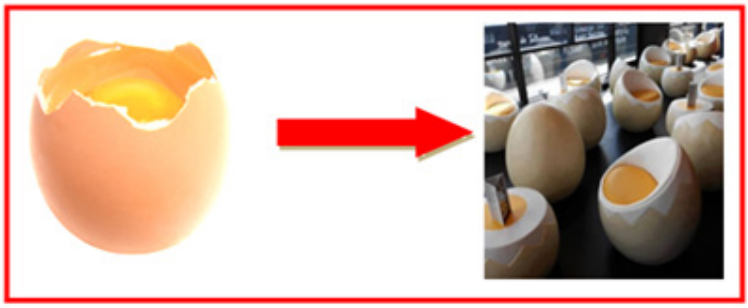

Figure 20. Egg seat (welsofthome.com)

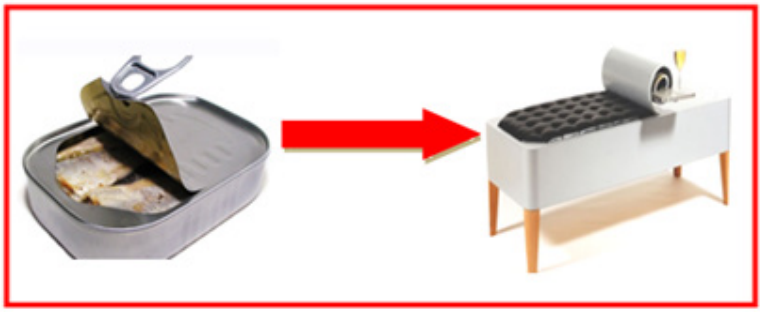

Figure 21. Canned seat (welsofthome.com)

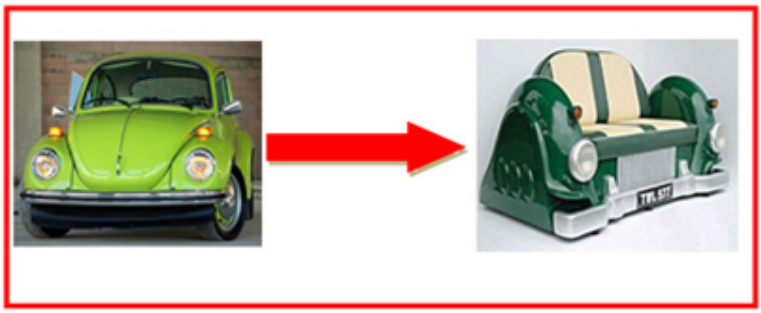

Figure 22. Vosvos seat (welsofthome.com)

Armchairs are the furniture preferred indoors and outdoors in the home, office, garden, etc. Designers have also made interesting designs in this furniture type. Figure 18 is egg-shaped, Figure 19 is canned, Figure 20 is an example of interesting sofa designs.

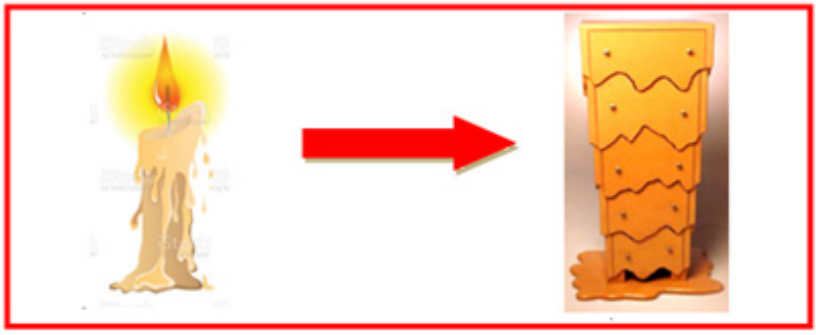

Figure 23. Melting chest of drawers (welsofthome.com)

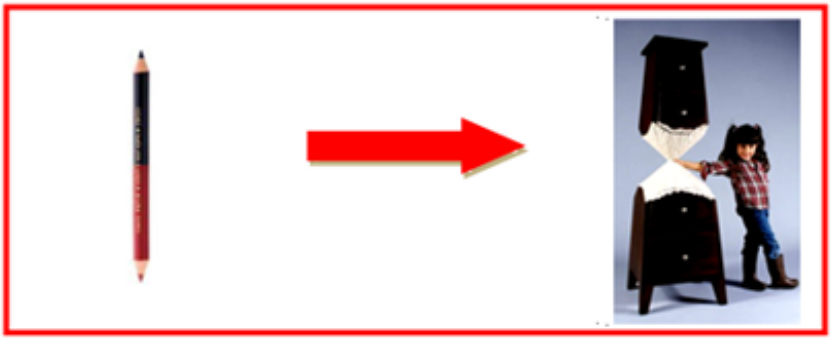

Figure 24. Pencil chest of drawers (welsofthome.com)

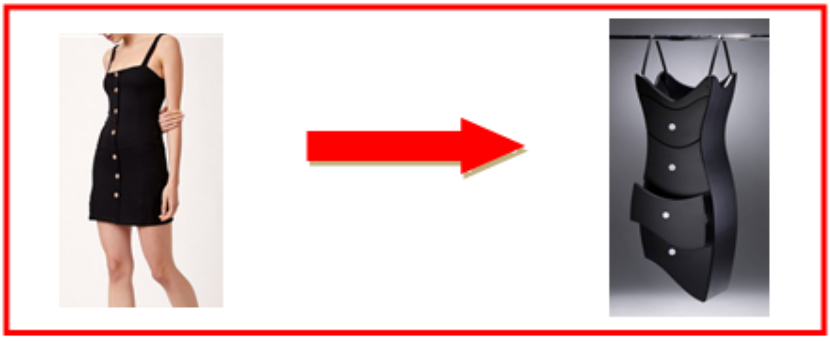

Figure 25. Dress chest of drawers (welsofthome.com)

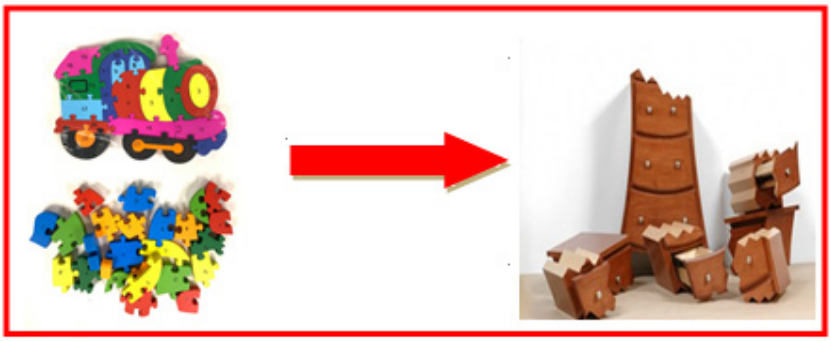

Figure 26. Puzzle chest of drawers (welsofthome.com)

The chest of drawers, which is used for indoor and outdoor storage, is another type of furniture with interesting designs. The designers made interesting designs inspired by the melting candle (Figure 23), pencil (Figure 24), dress (Figure 25), puzzle (Figure 26).

3.4. Different furniture designed with environmental awareness

Colorful and unique designs can be easily created with materials obtained from recycling. Figure 27 shows a chair design that supports recycling made of waste bottle caps. It is the Clamshell Chair from BRC Designs made from bottle caps connected by zippers. The chair frame is made from 99% recycled steel with a white powder coat finish (Simmons, 2021).

Figure 27. Soda bottle cap chair by BRC Designs (Simmons, 2021)

Different furniture can be designed with each material that is considered as waste, thus saving money. Figure 4 shows a seating group design made of waste cardboard paper.

Figure 28. Seating group design made of waste cardboard paper
(nguli-online.me, 2019)

Ecological design is to design our environment and our lifestyles to integrate harmoniously and seamlessly with the natural environment on earth. In other words, the goal in eco-design; It is the harmonious and perfect bio-integration of structures with the natural environment. If this integration is achieved, it is thought that the disasters that may befall humanity can be overcome with less damage.

4. CONCLUSION AND RECOMMENDATIONS

When looking at different furniture samples, there are many designs inspired by nature. Nowadays, designers are designing furniture that gives importance to recycling, as well as designing furniture that attracts attention. In this era, where the impact of global warming is felt, the importance of revising and using waste products rather than producing new products is increasing. Thus, functional designs that contribute to nature, rather than extraordinary designs, become the focus of attention. In order to protect our world and to use our resources efficiently, new and extraordinary furniture should be designed by evaluating the old rather than the furniture in which the design overtakes the function.

The coexistence of different disciplines can be observed, especially in the art movements and movements that emerged in the 20th century. In the art universe extending from the 20th century to the present, fields such as video, movement-dance, music, literature and painting can coexist, and new forms of artistic expression can emerge. The stretching of the borders between the branches of art and/or the fact that these borders take on a more permeable structure brings to mind the need for an arrangement in harmony with this structure in art education (Pazarlıoğlu Bingöl, 2015, p.28).

With this point of view, going one step beyond the designs with artistic purposes has been the main goal of this study. With this purpose, even with concern, the function, which is one of the most important components of furniture and therefore furniture design, has been pushed into the background and even abandoned in some designs. However, it has been seen that the image continues. In other words, the question of whether the element that is sufficient to perceive a piece of furniture as furniture is the image of the object or whether it fulfills the function it is obliged to fulfill, is opened in this way.

Trying is a situation that requires courage, and the anxiety of making mistakes can hinder creativity. Although seeking perfection in the artistic creation process may be among the goals of the artist, being stuck with it can also hinder creativity. In the creation process, the artist creates the work through a complex process with knowledge, experience, creativity and aesthetic inquiries. In order for this formation to be strong, the relationship between the two elements of the work is important. The relationship between content and form determines the artistic power, aesthetic aspect and conceptual process of the work (Gökçe, 2015, p.74-85). When the subject is approached from a similar point of view, it is seen that a similar acceptance is possible in terms of design. Freedom in design thinking can be restricted by many different factors; however, it is thought that the form-content balance is just as important. With this approach, “function”, which is one of the main components of furniture and therefore furniture design, is no longer a necessity; The primary condition in the creation process was to reflect the work taken as the starting point with an original interpretation and to establish a communication with the viewer in this way, regardless of the functional concern.

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