ARCHITECTURAL SCIENCES AND THEORY, PRACTICE AND NEW APPROACHES-II

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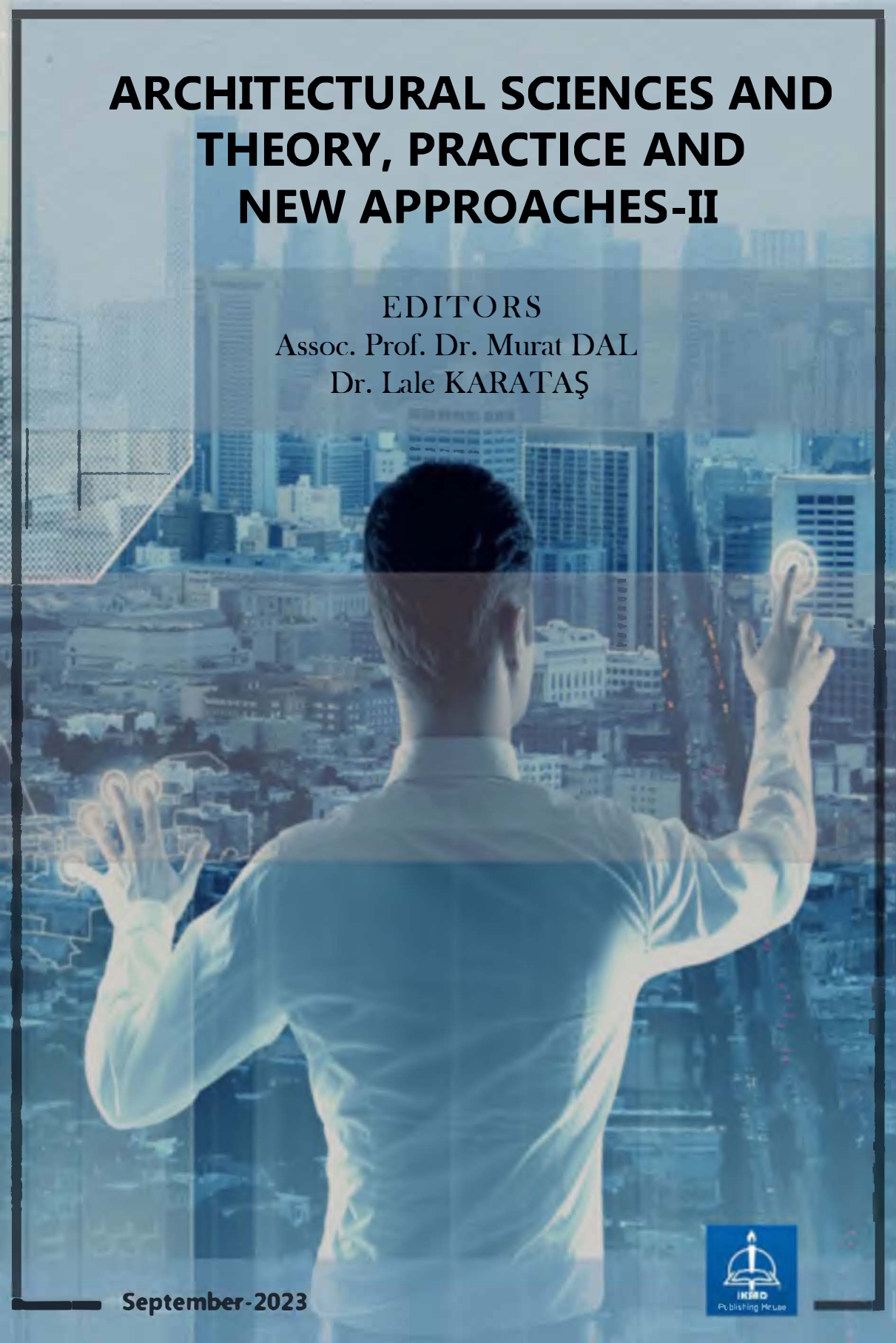

September-2023

IKSAD Publishing House

Institution of Economic Development and Social Researches

(The Licence Number of Publicator: 2014/31220)

TÜRKİYE TR: +90 342 606 06 75 USA: +1 631 685 0 853

E mail: iksadyayinevi@gmail.com

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Iksad Publications – 2023©

Architectural Sciences and Theory, Practice and New Approaches-II

ISBN: 978-625-367-256-0

Cover Design:
Dr. Lale KARATAŞ

September, 10, 2023
Ankara / Türkiye
Size = 16x24 cm

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PREFACE

The editors of this book believe that a more livable world can be created by conducting interdisciplinary studies of spatial planning and design disciplines together under the umbrella of "Architectural Sciences". In this context, the "Journal of Architectural Sciences and Applications (JASA)," which is a pioneer in the collective studies of related disciplines was published for the first time in 2016. Afterward, JASA Editors make significant contributions to the creation of various books containing original works and to bring the latest developments in the field to the reader.

This book named “ARCHITECTURAL SCIENCES and THEORY, PRACTICE and NEW APPROACHES-II” consists of ten chapters. In the book, the topics named “Shape Grammars as Architectural Design Methodology: A Chronological Reading ”, “Management of Sustainability and Environmental Impacts in Healthcare Facility Projects”, “From Mouldiness Manifesto to Ecological Architecture ”, “Healthy Life Center Implementation Project of a District Municipality Supporting the Dissemination of Healthy Life Culture ”, “YOURban Transformation: The “Human Greed” as a Destructing Factor in City and the Loss of “Spirituality”, “Rethinking Historical Settlements; Evaluation of the Historical Texture of Ankara Castle within the Framework of Historical Urban Landscape Approach”, “Analysis of Publications

on Interior Architecture Education in Scopus Database with Biblioshiny Package Software (2000-2023)", "Impregnation Methods for the Protection of Wooden Building Elements ", "Reproduction of Spaces in Cinema: A Case Study in the Dodesukaden", "Comparison of CFRP and Steel Jacketing Methods Applications for Retrofitting an Existing Concrete Industrial Structure in Earthquake Effect" were discussed in detail. We would like to thank all those who contributed to the completion of the book, the authors, the referees of the chapters, IKSAD Publishing House, and Professor Atila GÜL, who is the General Coordinator of the Architectural Sciences book series.

We hope that our book "ARCHITECTURAL SCIENCES and THEORY, PRACTICE and NEW APPROACHES-II" will be useful to readers.

10.09.2023

EDITORS

Assoc. Prof. Dr. Murat DAL
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Shape Grammars As Architectural Design Methodology: A Chronological Reading

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Citation: Ardatürk, A. Ş. (2023). Shape Grammars As Architectural Design Methodology: A Chronological Reading**.** Dal, M. & Karataş, L. (Eds.). **Architectural Sciences and Theory, Practice and New Approaches-II.** 2023, Chapter:1, 01-22. ISBN: 978-625-367-256-0. Iksad Publications.

1. Introduction

Architectural language can only be defined and understood by understanding the rules and geometrical spatial relations that constitute it. This understanding also contributes to the discovery of new design possibilities. The shape grammars developed by Stiny and Gips in the 1970s were introduced as a way of describing and even creating architectural design languages (Stiny & Gips, 1972). Understanding the existing architectural language and comprehending the relationships between forms has been the subject of many studies not only in producing new compositions but also in architectural design education and product design at different scales (Knight, 1980; Flemming, 1990; Chiou & Krishnamurti, 1995; Rollo, 1995; Agarwal & Cagan, 1998; Knight, 1999; Gips, 1999).

As a rule-based system, shape grammars also contribute to the understanding of contemporary design practices. Actually, architects today have begun to produce a wide variety of forms, paving the way for the emergence of a wide repertoire of forms (Yasar & Gur, 2022). It is known that the ancient design problems of the architectural discipline and the identified concepts are still valid today.

Shape grammars are also closely related to the concepts of discovery and creativity. In the context of exploration, form grammars contribute to analysing, repeating and improving the design process. In the context of creativity, form grammars provide an environment for various sensory-motor experiences to become an active component of the design process.

Although shape grammars continue to be popular in academic circles, they have not gained enough place in computer-aided architectural design approaches of the 21st century. However, one of the first implementation of computation in architecture was based on the use of shape grammars, a rule-based expert system in artificial intelligence that generates geometric shapes (Tepavcevic & Stojaković, 2012).

In this study, studies on shape grammars, operations on shape, shape grammars according to the purpose of use, and shape grammars in architecture are included. The main purpose of this chronological reading is to discuss the possible contributions of shape grammars in understanding and interpreting today's architectural design approaches, as well as how effective they can be in developing creative thinking skills.

2. Material and Method

In this study, which discusses the contributions of shape grammars to the design process, deep literature on the subject has been read and studies in the field of architecture from past to present have been analysed, and how shape grammars provide an environment for productive results in architectural design has been evaluated through examples.

3. Findings and Discussion

3.1. Shape Grammars in Architectural Design

In the context of architectural drawing, shape is used to signify ideas and represent design elements. Shapes are rarely static in a constantly evolving design; instead, they are constantly open to transformation (Oxman, 1990). Compositions of shapes are formed by the arrangement or combination of certain spatial elements according to some system of rules (Stiny, 1976).

At this point, shape grammars have been developed to define and understand the existing shape language of different design disciplines, especially architecture.

According to Knight, two important ideas underlie these studies. The first is the analysis or explanation of contemporary or historical design styles, and the second is the synthesis or creation new and original design styles (Knight, 1992).

Shape grammars can be simply defined as two- and three-dimensional shape languages. Shape grammars are transformational rule systems that explain the design of a shape. Most work on the application of shape grammars is analytical when describing a particular style of structure (Verkerk, 2014).

The knowledge obtained by shape grammar is related to the production of design. It also constitutes one of the most important classes of design knowledge. For example, Palladian Grammars is one of the best-known shape formulations (Oxman, 1990). In this sense, shape grammars are used not only to explain what exists, but also to produce it.

It is possible to create design shapes or to analyse existing shapes with shape grammars created by a set of sequential rules. Particularly a shape grammar is a rule-based, algorithmic system used to define, describe, derive or create design languages.

Shape grammars are an accepted paradigm in shape and composition studies and have given their greatest production in the field of architectural design (Aksoy, 2001). Shape grammars, proposed as possible support appliances for architectural designers, support designers both in

developing grammar and in predicting the types of shapes that can be produced using grammar (McKay et al., 2012).

The first theory behind shape grammars was put forward by George Stiny and James Gips in their 1972 article "Shape Grammars and The Generative Specification of Painting and Sculpture". In this article, Stiny and Gips associated shape grammars with the idea of designing with visual rules (Wortmann, 2013), aimed to reveal the components of art objects and also developed generative techniques to produce successful art objects (Figure 1).

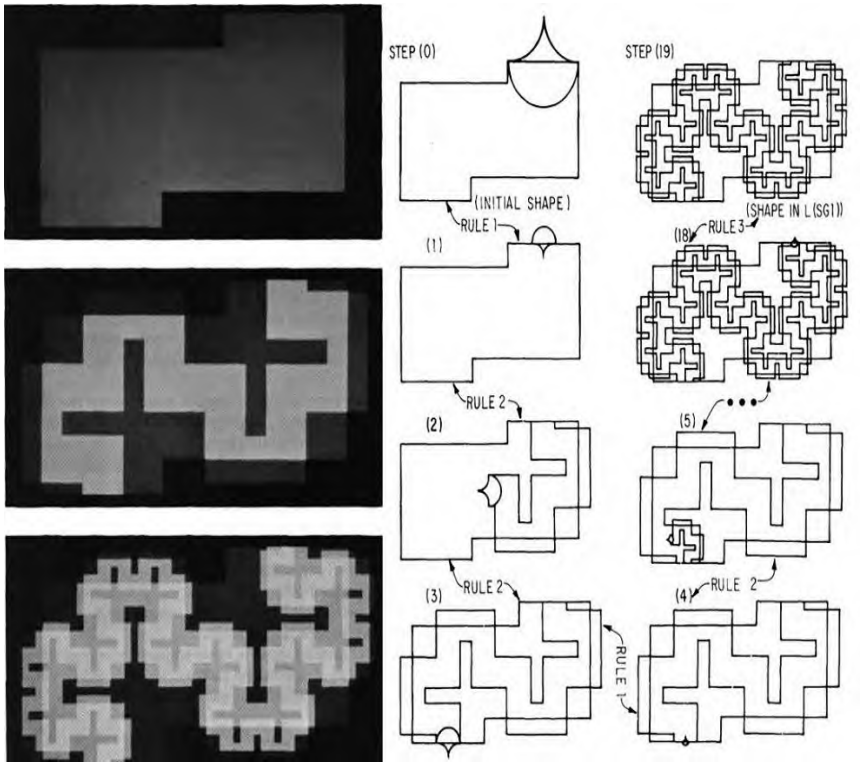

Figure 1. Generation of a Shape Using (Stiny & Gips, 1972).

Later, Stiny published his article Ice-ray: A Note on The Generation of Chinese Lattice Designs in 1977, based on previous work. In this article, Stiny argued that most of the decorative window and grid lattice designs can be produced in a simple way with simple shape grammars, and that they have a clearly observable, periodic or regular structure (Figure 2).

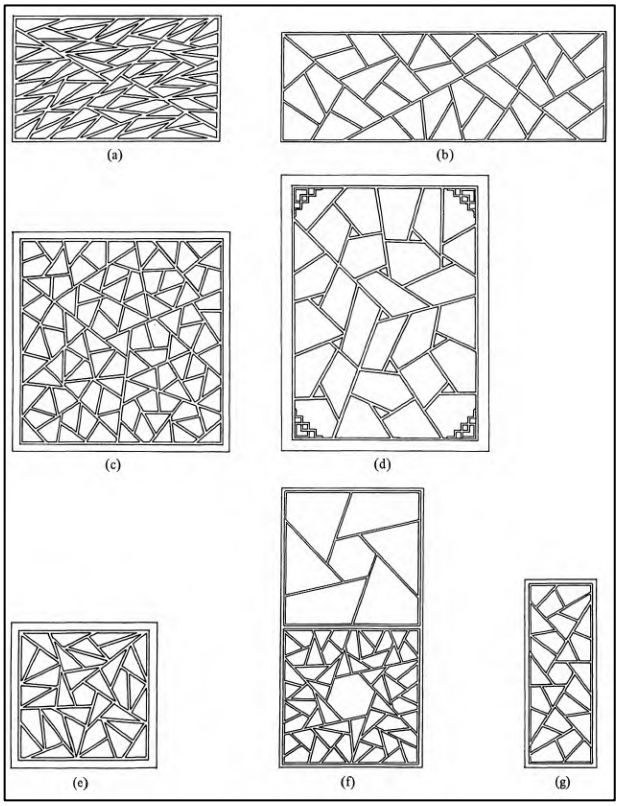

Figure 2. Ice-ray Lattice Designs (Stiny, 1977).

Shape grammars are related to the designer's process of discovering design elements and principles (Asojo, 2000) and the perception of shapes operates at the concept level, which is a high cognitive level (Arnheim, 2012). A shape grammar consists of a set of rules and an initial form. In

the shape grammar, derivations are obtained by applying the rules to the design. Derivations then guide the definition of designs, as well as supply the link between form and meaning (Figure 3).

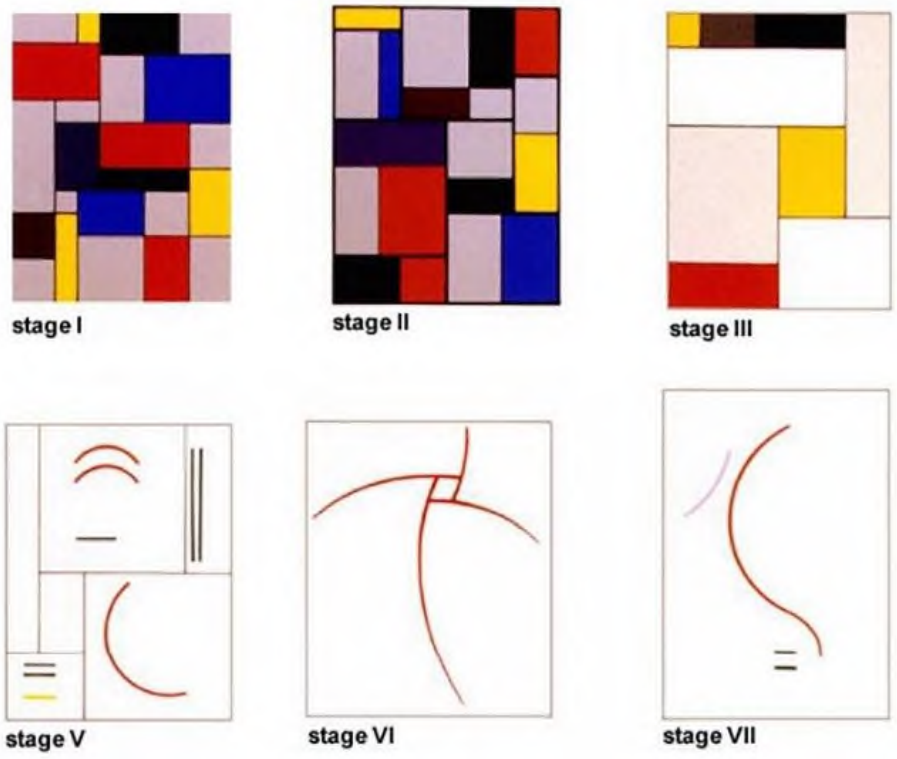

Figure 3. De Stijl Painting Grammar (Knight, 2000).

There are two types of format grammars, Standard and Parametric. In the standard shape grammar, each rule is defined by a pair of shapes separated by an arrow. The left side of the arrow specifies the shape to which the rule applies, and the right side specifies the shape that returns this part when the rule is applied. In parametric grammars, on the other hand, there are rule schemas and rules are implicitly defined. These allow the lengths of

lines and the angles between lines to vary in shapes. Values are assigned to variables in these rule schemes to produce specific rules (Stiny, 1985). Standard shape grammars are, in general, a system for producing compositions based on spatial relationships between shapes. As mentioned earlier, it consists of rules and an initial form. In standard shape grammars, spatial transformations can be performed by Euclidean transformations, translation, rotation, reflection, scale or Boolean operations such as union, intersection, subtraction (Figure 4), (Knight, 2020).

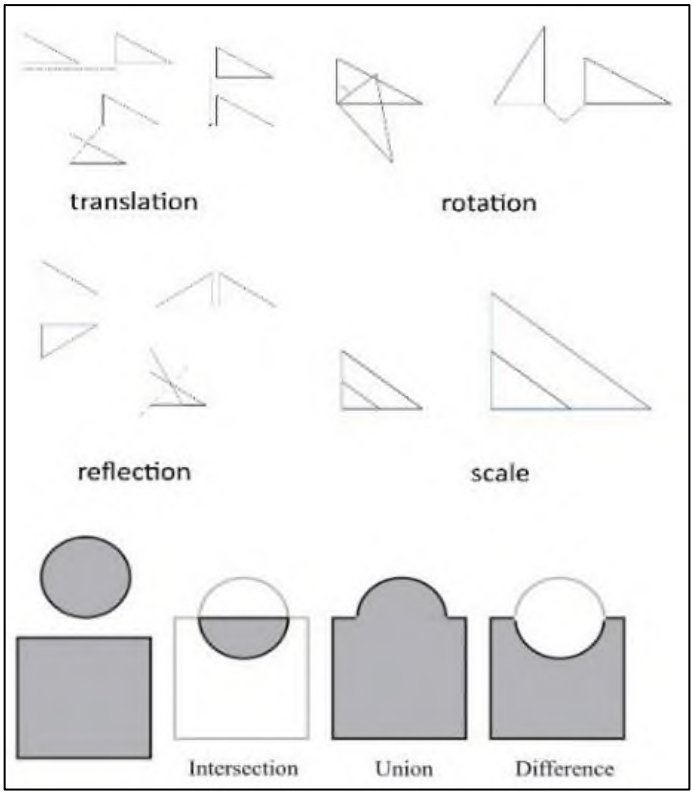

Figure 4. Spatial Transformations and Boolean Operations (Knight, 2000 & Jowers, 2019).

Parametric shape grammars, on the other hand, have rule schemes unlike standard shape grammars. In rule schemas, the lengths of the lines forming the forms and the angles between the lines are changeable. Values are given to variables in these schemas to create specific rules. In parametric shape grammars, unlike fixed shape grammars, spatial relations can be variable (Figure 5).

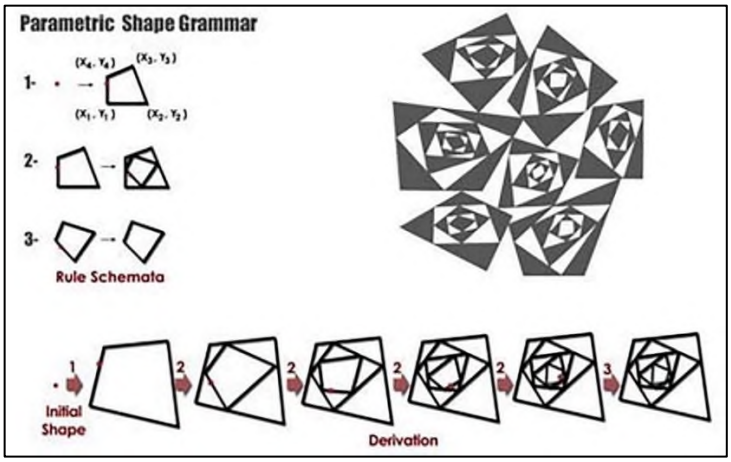

Figure 5. Parametric Shape Grammar (Mohamed, 2005).

Undoubtedly, each shape composition contains some principles within itself and thus creates a design language. At this point, shape grammars can be used in analysing an existing design language as well as in the production of new design languages.

An existing design can be analysed and deciphered with analysis grammars used for the purpose of analysing architectural language. The first shape grammar studies came to life as the analysis of existing design languages. Later, generative shape grammar studies were carried out and, in this way, new designs were realised through known design languages.

With analysis grammars, the formation rules of a building, style or an architectural language can be revealed. Shape grammars can also explain the relationship between form and function (Yasar & Heinz, 2021), which exist as phenomena that create/complement each other. These rules can be expressed parametrically and when desired, they can be transferred to the computer environment and almost unlimited design alternatives can be produced.

As mentioned above, shape grammars are also used to create new design languages. One of the best examples of original grammars is Stiny's work with Froebel's building blocks. Frederick Froebel designed wooden blocks for kindergarten children, and in 1980 Stiny published "Kindergarten Grammars: Designing with Froebel's Building Gifts" (Figure 6) (Stiny, 1980).

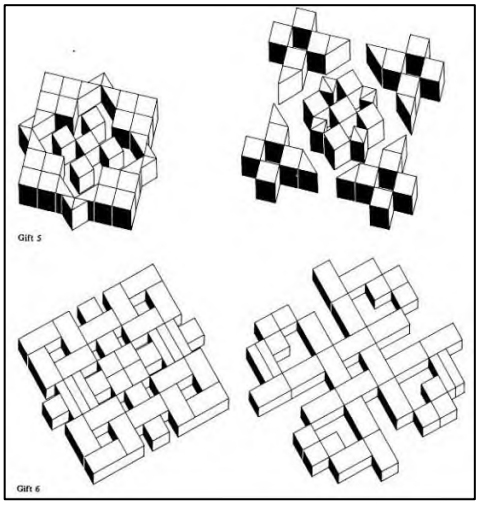

Figure 6. Stiny's Shape Grammar Study with Froebel Blocks (Stiny, 1980).

3.2. Studies on the Shape Grammar: A Chronological Reading

The first modern study on the analysis of shape was put forward by Colin Rowe in 1947 with the study titled "The Mathematics of the Ideal Villa". In this study, Rowe analysed and compared the villa designs of Palladio and Le Corbusier and also discussed the architectural vocabulary of the 19th century, Neoclassicism, Modern and Utopian architecture (Rowe, 1947). This work was later developed by design theorists such as Eisenman and these efforts collectively began to form a dictionary of formal relationships in architecture (Oxman & Oxman, 1990).

In 1977, Stiny analysed Chinese window lattice systems with his form grammar and with this form grammar, which contains for rules, he also enabled the derivation of new designs.

Another of the first shape grammar studies (also a grammar of analysis) in the field of architecture was conducted by Stiny and Mitchell on Palladian villas in 1978. In this study, Stiny and Mitchell developed an eight-stage form grammar based on the ground floor plans of Palladian villas (Figure 7). The eight stages, each of which is defined, are as follows:

1. Grid Definition
2. Exterior-wall Definition
3. Room Layout
4. Interior-wall Realignment
5. Principal Entrances - Porticos and Exterior-wall Inflections
6. Exterior Ornamentation—Columns
7. Doors and Windows
8. Termination (Stiny & Mitchell, 1978).

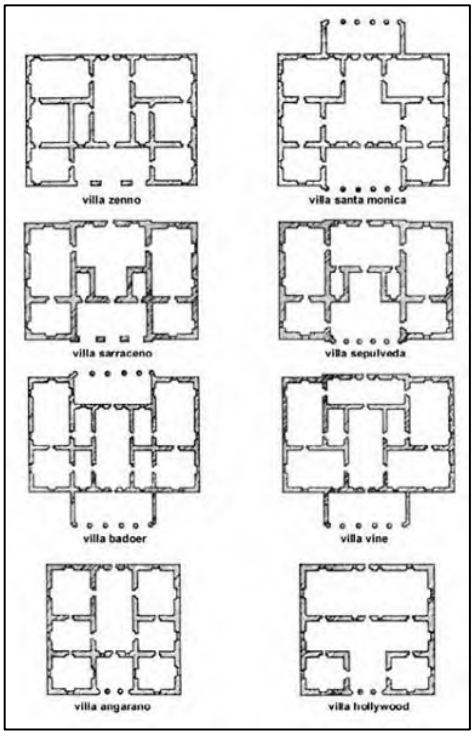

Figure 7. Palladian Villa Grammar (Knight, 2000).

The first three-dimensional analysis study conducted with shape grammars in the field of architecture is Frank Lloyd Wright's cottages by Koning and Eizenberg in 1981. In this study, Koning and Eizenberg analysed 11 cottages designed by Wright and developed a parametric shape grammar that defines the language of cottage-style houses (Figure 8). The parametric shape grammars form the compositional shapes and define the functional zones of Frank Lloyd Wright's cottage style. Here, Wright's cottages are generally defined as cruciform or butterfly-shaped in plan, and the installation of a fireplace is identified as the key to the definition of a country-style house (Koning & Eizenberg, 1981).

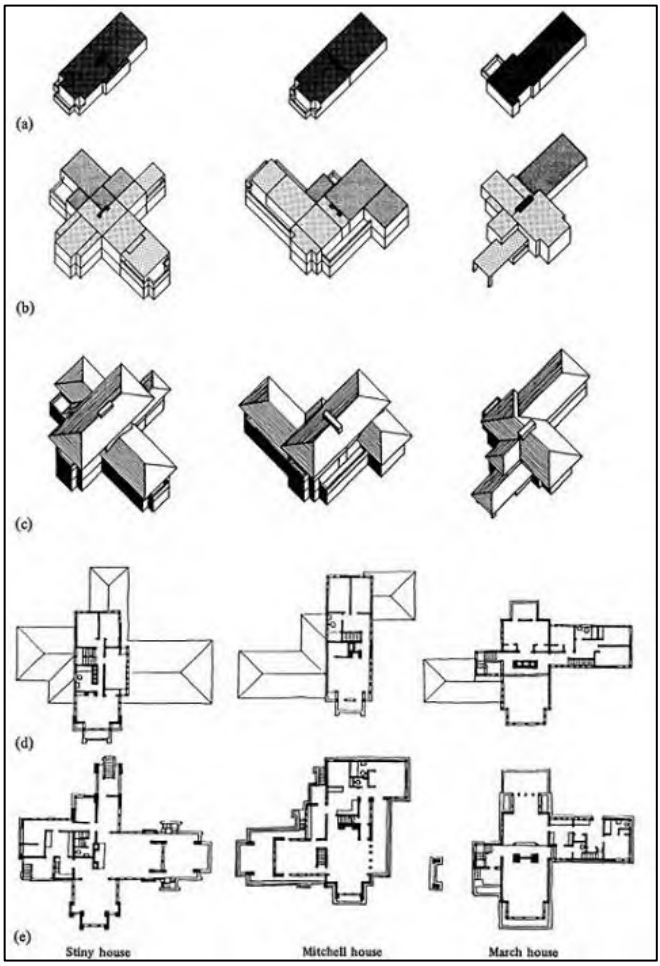

Figure 8. Three New Designs as Generated by The Grammar (Koning & Eizenberg, 1981).

Another example of three-dimensional shape grammars is Ulrich Fleming's analysis of the Queen Anne houses in America, built in the second half of the 19th century for the middle and upper-middle class (Figure 9). In his analysis, Fleming first examined their spatial

organisation in two dimensions, separated from external articulations, and then dealt with their three-dimensional configurations (Flemming, 1987).

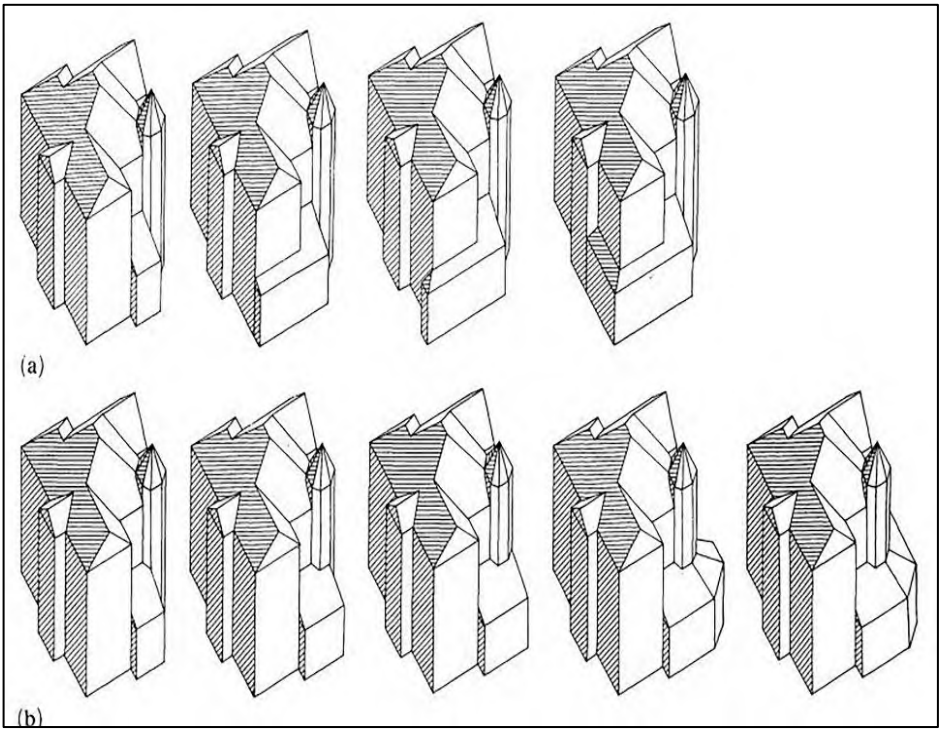

Figure 9. Examples of Growing Porches of Queen Anne Houses (Fleming, 1987).

Another shape grammar study is Duarte's 2001 study of Alvaro Siza's Malagueria houses in both two and three dimensions. In his study, Duarte wanted to show that the architect can clearly externalise his own design process through form grammars. He also aimed to code a computer programme that could generate solutions within Siza's design language (Figure 10), (Duarte, 2001).

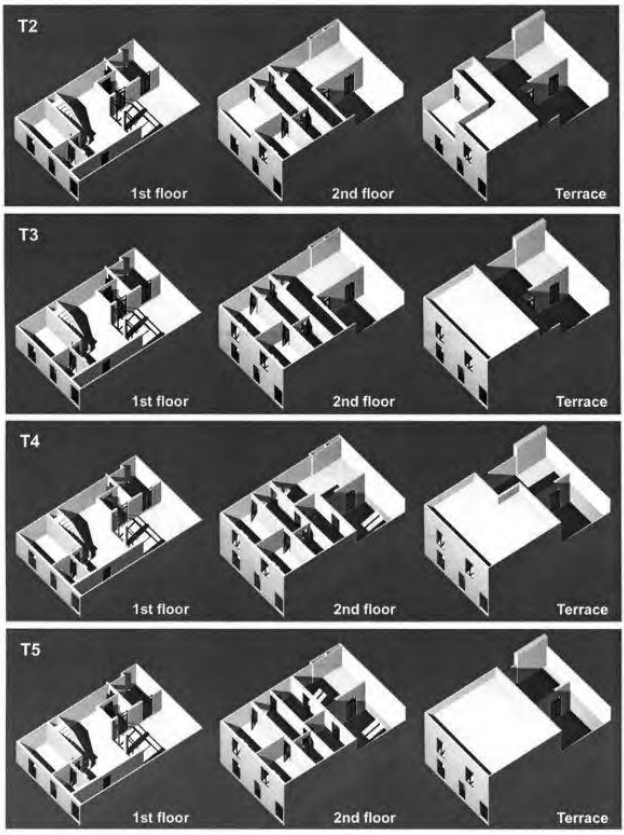

Figure 10. Digital Model of The New Malagueira Design Designed By Duarte (Duarte, 2021).

Another example of recent studies analysed with the shape grammar is the study on the Early period residential buildings of Sait Bey and Semih Rüstem. In the study, firstly, the spatial organisation of the dwellings was examined in the context of the designed spaces and their relations with each other, and in the second stage, the ground floor plans and mass designs of the dwellings were analysed with the shape grammar method (Figure 11) (Saban, 2018).

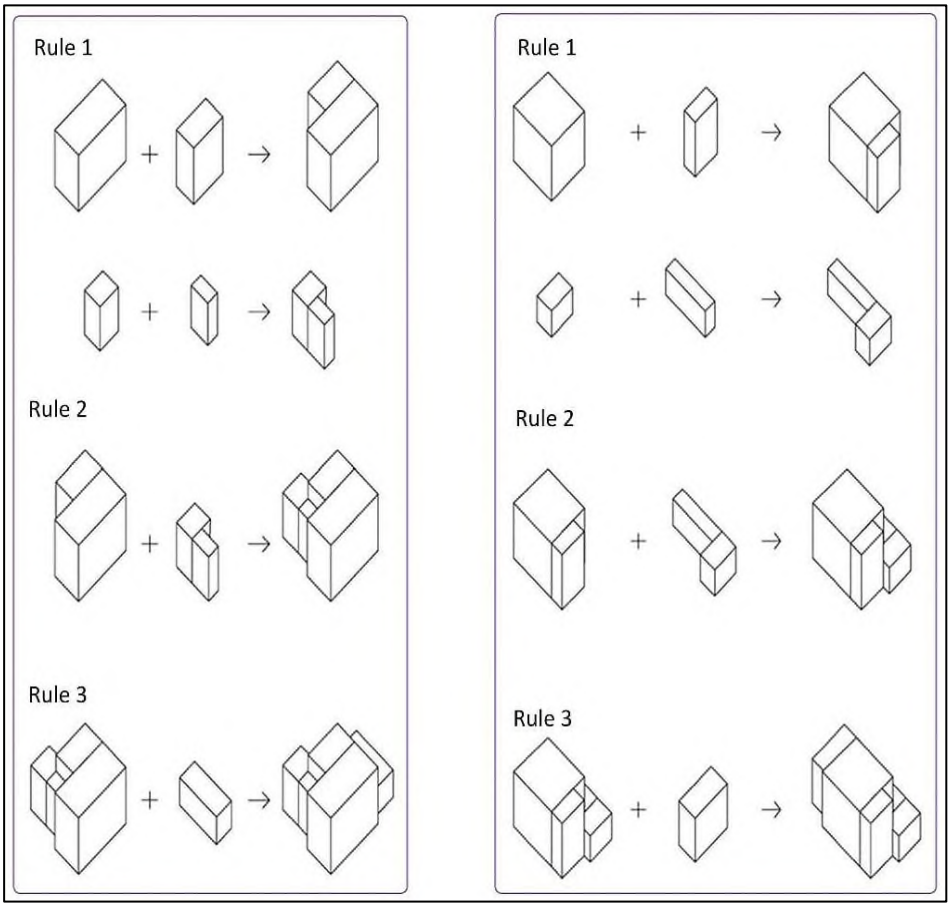

Figure 11. Mass Development Scheme of Sait Bey House (Left) and Semih Rüstem House (right) (Saban, 2018).

As a result, shape grammars, which allow an indefinite number of design solutions to a set of finite number of rules and shapes (Tepavcevic & Stojaković, 2012), are a productive approach that can be used as a synthesis tool that produces complex shapes starting from a simple shape (Fasoulaki, 2008). In this respect, shape grammars represent a philosophy

of looking at the world not through learnt or imposed parses, but through parses that have a practical meaning (Özkar & Stiny, 2009).

4. Conclusion and Suggestions

Shape grammars are an exploratory, generative design approach that feeds creative thinking processes from analysing existing buildings to designing them. Overlapping with contemporary design theories, shape grammars also play an important role in today's architectural design approaches.

Firstly, shape grammars make it possible to take a deeper look at the design approaches in different periods of architecture. With the ability of shape grammars to make various analyses in architecture, new information about the structures of different periods can be revealed. In this way, more design information can be accessed.

The potential of shape grammars for new designs can be further enhanced by integrating this approach with various software programmes. Indeed, nearly fifty years of work on shape grammars has successfully demonstrated the generative aspect of this design paradigm.

Shape grammars can also play an active role in the context of design education. As a exploration based system, shape grammars can be used as a learning model in the creativity skills that architectural design students should have.

As a result, shape grammars are important in terms of contributing to the design process and creativity thanks to their productive design techniques.

Acknowledgements and Information Note

The article complies with national and international research and publication ethics.

Ethics Committee approval was not required for the study.

Author Contribution and Conflict of Interest Declaration Information

There is no conflict of interest.

References

Agarwal, M. & Cagan, J. (1998). A blend of different tastes: the language of coffeemakers. *Environment and Planning B: Planning and Design,* 25, 205-226.

Aksoy, M. (2001). *Varolan tasarım dilleri ve yeni tasarım dilleri bağlamında biçim grameri analizi*, (Unpublished doctoral thesis) İstanbul Teknik Üniversitesi, İstanbul.

Arnheim, R. (1969). *Visual thinking*. California: University of California Press.

Asojo, A. O. (2000). Design algorithms after Le Corbusier. *Acadia Quarterly*, 19, 4, 17-24.

Chiou, S. C. & Krishnamurti, R. (1995). The grammar of Taiwanese traditional vernacular dwellings. *Environment and Planning B: Planning and Design* 22, 689-720.

Duarte, J. P. (2001). Customizing *Mass housing: A discursive grammar for Siza's Malagueira houses* (Unpublished doctoral thesis) Massachusetts Institute of Technology, MA.

Gips, J. (1999). Computer implementation of shape grammars. In *NSF/MIT workshop on shape computation*, 55, Cambridge, MA: Massachusetts Institute of Technology.

Fasoulaki, E. (2008). *Integrated design: A generative multi-performative design approach* (Unpublished doctoral thesis) Massachusetts Institute of Technology, MA.

Flemming, U. (1990). Syntactic structures in architecture. W. J. Mitchell, and P. Purcell (eds.). *The Electronic Design Studio*, 31-37. Cambridge: the MIT Press.

Knight, T. W. (1980). The generation of Hepplewhite-style chair back designs. *Environment and Planning B: Planning and Design,* 7, 227-238.

Knight, T. W. (1992). Designing with grammars. G. N. Schmitt (ed). *CAAd Futures 91*, Braunschweig/Wiesbaden: Viewag and Sohn, 33–48.

Knight, T. W. (1999). Applications in architectural design, and education and practice. *Report for the NSF/MIT Workshop on Shape Computation*.

Koning H. & Eizenberg, J. (1981). The language of the prairie: Frank Lloyd Wright's prairie houses. *Environment and Planning B Planning and Design*, 8, 295-323.

Knight, T. (2000). Introduction to shape grammars. *MIT/Miyagi Workshop: Lecture Notes February,* 7-12.

McKay, A., & Scott, C. C. & Hau, H. C. (2012). Spatial grammar implementation: from theory to useable software. *Artificial Intelligence for Engineering Design, Analysis and Manufacturing*, 26, 143-159.

Oxman, R. (1990). Prior knowledge in design: A dynamic knowledge-based model of design and creativity, *Design Studies*, 11 (1), 17-28.

Oxman, R. & Oxman, R. (1990). *The computability of architectural knowledge. in the electronic design studio: architectural knowledge and media in the computer era*. The MIT Press: CAAD Futures, 171-185.

Özkar, M., & Kotsopoulos, S. (2008). Introduction to shape grammars. In *ACM SIGGRAPH* 2008 classes, 1-175.

Rollo, J. (1995). Triangle and t-square: the windows of Frank Lloyd Wright. *Environment and Planning B: Planning and Design* 22, 75-92.

Rowe, C. (1976). The mathematics of the ideal villa. Cambridge: M.I.T. Press.

Saban, D. (2018). Farkas Molnár ve Semih Rüstem'in erken dönem konutları-Bauhaus ve kuri ilkeleri doğrultusunda bir inceleme. Megaron, 13(1), 117-131.

Stiny, G. & Gips, J. (1972). Shape grammars and the generative specification of painting and sculpture. V. Freiman (eds.). *Information processing 71*. Amsterdam: North-Holland, 1460-1465.

Stiny, G. (1976). Two exercises in formal composition. *Environment and Planning B*, 2, 187-210

Stiny, G. (1977). Ice-ray: a note on the generation of Chinese lattice designs. *Environment and Planning* B, 4, 89-98.

Stiny G. & Mitchell, W. J. (1978). The Palladian grammar. *Environment and Planning B Planning and Design*, 5, 5-18.

Stiny, G., (1980). Kindergarten grammars: designing with Froebel's building gifts. *Environment and Planning B*, 7, 409-462.

Stiny, G. N. (1985). Computing with form and meaning in architecture. *Journal of Architectural Education*, 39(1), 7-19.

Tepavčević, B., & Stojaković, V. (2012). Shape grammar in contemporary architectural theory and design. Facta Universitatis-series: Architecture and Civil Engineering, 10(2), 169-178.

Verkerk, N. M. (2014). *A general understanding of shape grammar for the application in architectural design* (Unpublished thesis master) TU Delft, Faculty of Architecture, Netherlands.

Wortmann, T. A. (2013). Representing shapes as graphs: a feasible approach for the computer implementation of parametric visual calculating. (Unpublished master thesis) Massachusetts Institute of Technology, MA.

Yasar, D. & Heinz, K. G. (2021). *İşlevin çok boyutlu yapısı ve biçime yansımaları*. Öztürk, Ö. (ed.), Mimarlık ve Kent Araştırmaları Konferansı, (p. 189-198). İstanbul: Dakam Yayınları, 189-198.

Yasar, D. & Öymen Gür, Ş. (2022). Models of diagnosis and concept in the pioneering architects in recent architecture. *ICONARP International Journal of Architecture and Planning*, 10(2), 410–427.

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Management of Sustainability and Environmental Impacts in Healthcare Facility Projects

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Citation: Geylani, Ö. (2023). Management of Sustainability and Environmental Impacts in Healthcare Facility Projects**.** Dal, M. & Karataş, L. (Eds.). **Architectural Sciences and Theory, Practice and New Approaches-II.** 2023, Chapter:2, 23-46. ISBN: 978-625-367-256-0. Iksad Publications.

1. Introduction

Hospital and healthcare facility projects play a paramount role in the delivery and enhancement of healthcare services and public health control. However, similar to other construction endeavors within the built environment, these healthcare structures exert substantial environmental impacts throughout their construction and operational phases. The involvement of human agency in the built environment entails the utilization of energy, water, and diverse resources, which, in turn, can engender adverse environmental ramifications. Simultaneously, while catering to healthcare needs, these projects may pose potential threats to human well-being, thereby necessitating a comprehensive understanding and management of their environmental implications.

Hospitals and healthcare facilities are complex structures that require the collaboration of various disciplines and the inclusion of environmental experts to address their environmental impacts (The Joint Commission. n.d., 2023).

In the context of the ongoing discourse surrounding sustainability, the primary objective is to address the needs of future generations. Hence, it becomes imperative to emphasize resource optimization, considering the adequate and appropriate utilization of resources, alongside the economic and social impacts of construction projects. Moreover, a pivotal aspect is the recognition and adherence to established standards regarding the environmental effects, thereby facilitating comprehensive discussions on sustainability on a global scale. The mitigation of environmental impacts,

enhancement of resource and energy efficiency, and implementation of effective waste management criteria during the construction of healthcare structures can be accomplished through a meticulously planned and executed project management framework throughout the project life cycle (Čongradac, et al., 2014).

In the absence of proper project management in the construction of healthcare facilities, the proliferation of environmental pollution types can occur, thereby posing potential threats to ecosystems and public health. Healthcare structures, by their nature, generate hazardous waste and contain used medical sharps within their waste streams, thereby releasing pharmaceuticals, chemicals, and infectious disease microorganisms into natural resources such as air, water, and soil. Consequently, these facilities have the capacity to directly impact human populations and natural ecosystems in a detrimental manner.

Furthermore, hospitals, as substantial energy consumers, pose a significant environmental challenge due to their reliance on fossil fuel-based energy sources. Inadequate disposal practices for chemicals, radiation, and medical procedure-generated wastewater can exert adverse effects on local ecosystems and water quality. Moreover, excessive water consumption for medical procedures, sanitation, and irrigation purposes can exert substantial pressure on local water resources, particularly in regions facing water scarcity (Healthcare Facilities Today. (n.d.)., 2023). Hence, addressing these sources of environmental pollution and embracing sustainable practices within hospital settings hold paramount importance in minimizing detrimental impacts and fostering a healthier and more

sustainable healthcare sector. This necessitates the implementation of sustainable strategies encompassing waste management, energy efficiency, water conservation, and reduced reliance on non-renewable energy sources. By undertaking such measures, healthcare facilities can effectively contribute to climate change mitigation, safeguard ecosystems, and ensure the long-term viability of healthcare services, concurrently protecting public health.

Based on the information provided above, it is evident that effective management of sustainability and environmental impacts in hospital and healthcare facility projects is crucial. With this aim in mind, this article aims to evaluate the management of sustainability and environmental impacts in hospital and healthcare facility projects from a project management perspective. It seeks to examine how project management principles and practices can effectively address the environmental implications and promote sustainability throughout the project lifecycle. The focus is on the integration of sustainability considerations into project planning, design, construction, and operation phases. Key areas of analysis include resource optimization, waste management strategies, energy efficiency measures, water conservation initiatives, and the incorporation of renewable energy sources (Stevanovic, et al., 2017).

By emphasizing the role of project management in addressing sustainability and environmental impacts, this article aims to provide valuable insights and recommendations for project managers and stakeholders involved in hospital and healthcare facility projects. The findings of this study can contribute to the development of effective project

management approaches that prioritize environmental sustainability, minimize negative impacts, and foster the creation of more sustainable healthcare facilities.

1.1. Sustainable Design and Green Hospitals

1.1.1. Sustainable design

The identification of sustainable design principles as primary considerations contributes to the effective management of environmental impacts in healthcare building construction projects by establishing them as project objectives. These objectives encompass crucial aspects such as material selection, waste control, adherence to green building standards for carbon footprint reduction, and the simultaneous integration of elements pertaining to patient comfort and occupational safety standards for the well-being and security of both patients and hospital personnel (HCO News, 2021).

Implementing such measures in the construction and operational processes of healthcare projects, particularly those with environmental responsibility, is imperative at both national and global levels. These measures should be applied throughout the project life cycle, primarily during the project design phase. For instance, incorporating design criteria such as natural lighting and ventilation systems that promote healthy airflow to ensure patient comfort are paramount. Furthermore, the selection of environmentally friendly materials for patient rooms and other functional areas within the hospital should be prioritized. These criteria should be implemented with the underlying belief that they will foster a healing environment and support patients' medication and treatment

processes. When incorporating sustainable design principles into healthcare structures and hospitals, it is crucial to consider the building regulations of the specific country and that the criteria set forth by internationally recognized certification bodies, as required by the hospital (Yildiz, 2016). These guidelines serve as essential guidance for design and administiration of the facility. While prioritizing health as the primary criterion, it is equally important to address the safety and well-being of all occupants, including healthcare staff and patients' families. This necessitates a comprehensive approach encompassing fire safety, occupational safety, security measures against potential threats originating from the building's surroundings, and the implementation of robust security measures to mitigate risks associated with the utilization of sustainable materials within the facility. By adopting such measures, potential hazards may be effectively minimized within the framework of risk management as the fundamental aspect of project management knowledge.

1.1.2.Green hospitals

A green building refers to a structure that minimizes its negative impact on the environment while maximizing resource efficiency. It is designed to be energy-efficient, cost-effective in terms of maintenance, and conducive to the health and well-being of its occupants and the surrounding community. Green buildings are considered producers, generating their own energy, increasing green spaces, and providing more benefits while causing less harm.

Leadership in Energy and Environmental Design (LEED) is a certification system that originated in 1998 and was developed by the U.S. Green Building Council (USGBC). In essence, LEED certification is intricately linked to the concept of green buildings. By obtaining LEED certification, a healthcare building not only gains valuable recognition but also showcases its dedication to implementing sustainable practices and embracing environmentally responsible design principles. LEED certification offers a set of standards and practices for incorporating green building principles into diverse an internationally recognized form of accreditation that provides guidelines for achieving sustainability in building design, construction, and operation (U.S. Green Building Council. (n.d.). LEED, 2023). When a healthcare structure meets the rigorous standards set by LEED, it distinguishes itself from conventional healthcare buildings by demonstrating a conscious commitment to environmental responsibility. Additionally, Table 1 compiles various international certifications related to green hospital certifications along with their features. One such certification is the Building Research Establishment Environmental Assessment Method (BREEAM), which was established in the UK in 1990. “BREEAM” takes into account energy performance, water usage, materials selection, and ecological impact when evaluating healthcare facilities. It employs a rating system (Pass, Good, Very Good, Excellent, Outstanding) to assess the green building performance (Building Research Establishment. (n.d.). BREEAM, 2023).

Table 1. Green Certifications Features for Healthcare Buildings

Green Certification	Features
LEED	Provides different levels of certification (Certified, Silver, Gold, Platinum)
Web:	https://www.usgbc.org/leed/ratingsystems/healthcare
Green Star	Focuses on sustainable design, construction, and operation of healthcare buildings in Australia. Considers energy efficiency, water conservation, materials selection, and indoor environmental quality. Provides rating levels (4 Stars, 5 Stars) with increasing levels of sustainability performance
Web:	https://new.gbca.org.au/rating-tools/healthcare/
BREEAM Healthcare	Assesses the sustainability of healthcare buildings in the United Kingdom. Considers energy performance, water usage, materials selection, and ecological impact. Provides ratings (Pass, Good, Very Good, Excellent, Outstanding)
Web:	https://www.breeam.com/discover-and learn/sector/in-use/healthcare/
CASBEE for Healthcare	Specifically developed for assessing the environmental performance of healthcare facilities in Japan Evaluates energy efficiency, water conservation, waste management, and indoor environmental quality. Provides ratings (S, A, B, C, D, E) based on comprehensive sustainability performance
Web:	http://www.ibec.or.jp/CASBEE/english/health.html
Green Mark for Healthcare	Considers energy efficiency, water conservation, indoor environmental quality, and sustainable materials selection. Provides ratings (Certified, Gold, Platinum) based on performance in different sustainability categories
Web:	https://www.bca.gov.sg/GreenMark/green_mark_buildings/Green_Mark_for_Healthcare.html

Another certification system specific to hospital structures is the "Green Star" certification, which originated in Australia in 2003. This certification focuses primarily on the sustainable design, construction, and operation of healthcare buildings within Australia. Areas evaluated in green design encompass energy efficiency, water conservation, materials selection, and indoor environmental quality. The Green Star certification provides rating levels (4 Stars, 5 Stars) that reflect increasing levels of sustainability performance.

"CASBEE", a green certification introduced in Japan in 2002, evaluates energy efficiency, water conservation, waste management, and indoor environmental quality in healthcare facilities. Comprehensive sustainability performance is assessed, and ratings (S, A, B, C, D, E) are assigned accordingly (Japan Sustainable Building Consortium. (n.d.). CASBEE, 2023).

Lastly, the Singaporean "Green Mark", established in 2005, considers energy efficiency, water conservation, indoor environmental quality, and sustainable materials selection when assessing healthcare facilities. It provides ratings (Certified, Gold, Platinum) based on the performance exhibited in different sustainability categories.

The positive outcomes of a green building can be summarized as follows: energy and water conservation, reduction in waste generation, improvement in indoor air quality (WBDG. n.d.,2023), utilization of eco-friendly materials, increase in green spaces, and preservation of the natural environment. Conclusively, the green building certifications and ratings

obtained by certain hospital structures worldwide and in Turkey are summarized in Table 2 and Table 3.

These outcomes contribute to sustainability and yield beneficial results for human and ecological health.

Table 2. Green Certified Hospitals on Global

Hospital Name	Country	Certification
Zulekha Hospital Sharjah	Arab Emirates	LEED Platinum
Mercy Medical Center	United States	Energy Star & LEED
Haga Hospital	Netherlands	BREEAM Excellent
Royal Jubilee Hospital	Canada	LEED Gold
King's College Hospital	United Kingdom	BREEAM Excellent
Mater Campus Hospital	Ireland	BREEAM Very Good
Sunnybrook Health Sciences Centre	Canada	Green Task
Red Cross Matsuyama Hospital	Japan	CASBEE –S

Table 3. Green Certified Top Hospitals on Turkey

Hospital Name	Country	Certification
Yozgat City Hospital	Turkey	LEED Gold
Acıbadem Maslak Hospital	Turkey	LEED Gold
Memorial Bahçelievler Hospital	Turkey	LEED Platinum
Istanbul Florence Nightingale	Turkey	TUV Hessen Green Building
Vehbi Koç Vakfı Amerikan Hospital	Turkey	LEED EBOM Platinum
Adana City Hospital	Turkey	LEED Gold

1.1.3. Environmental impacts and sustainable solutions for healthcare facilities

Designs that adhere to principles of natural systems and promote environmental sustainability are commonly referred to as "regenerative

design." This design approach enables the development of projects that support the natural environment by minimizing environmental pollutants, managing waste effectively, and fostering sustainability, rather than causing harm.

Numerous strategies can be employed to enhance the management of environmental impact in healthcare buildings within their built or natural surroundings. For instance, the design of natural light and shading control systems, as well as the consideration of design criteria related to the building's location and massing. Additionally, the concept of "biophilic interior design" becomes relevant when creating a healthy indoor environment. This concept emphasizes the integration of natural elements into indoor spaces, encouraging occupants to connect with nature. By incorporating natural and organic elements into the interiors of healthcare buildings, both visual aesthetics and psychological comfort are enhanced, thereby contributing to the well-being and productivity of patients, their families, and healthcare professionals (WBDG, n.d.., 2023).

Sustainability and environmental sensitivity should be taken into account at various scales of interior design, ranging from the selection of building elements to building materials. Certification systems, such as LEED (Leadership in Energy and Environmental Design), oversee these considerations and include policies that prioritize environmentally friendly materials, including furnishings, flooring, wall coverings, and paint, which avoid the use of harmful chemicals.

In healthcare buildings, the implementation of regular need-based control measures for patients and building users, as delineated by the LEED

environmental certification standards, encompasses a range of factors aimed at optimizing the indoor environment. These factors include ensuring good air quality, facilitating effective temperature control, managing noise levels, controlling lighting conditions, mitigating glare, regulating color rendering, and optimizing surface reflectivity.

The implementation of environmentally conscious systems in healthcare facilities not only ensures sustainable energy production but also facilitates the integration of systems that enable energy control and enhance energy effectiveness (Stevanovic, et al., 2017). The utilization of clean energy sources in energy production and the precise measurement of energy consumption values assume a paramount role in optimizing resource utilization and exerting cost control.

- Passive solar systems and passive ventilation systems are crucial criteria for achieving resource optimization in healthcare buildings as they facilitate the control of energy production and consumption.
- The use of energy-efficient lighting systems is recommended in healthcare facilities, and the economic benefits derived from appropriate façade and building envelope design that maximizes natural daylight should also be considered.
- Furthermore, ensuring that medical equipment is equipped with energy-efficient electronic systems and favoring such equipment during the procurement process can contribute to sustainability efforts.

- In healthcare settings, the use of low-flow, sensor-equipped fixtures for water control helps preserve water reserves and protect clean water sources.
- Implementing waste reduction measures and utilizing waste separation systems in hospitals are essential for effective waste management.
- Sustainable materials should be utilized in the exterior and interior design of hospital projects.

Sustainable and green design certifications are conducted under the supervision of specialized institutions in different countries, providing internationally recognized application and evaluation criteria (U.S. Department of Energy, n.d., 2023). While these certifications are utilized in various types of building projects, they particularly contribute to reducing the environmental impact of healthcare facilities and enhancing the quality of healthcare services.

- Project Management of Sustainable Green Hospitals

The international project management standards of the Project Management Institute (PMI) are defined in the guide called "A Guide to the Project Management Body of Knowledge" (PMBOK Guide, 2017). According to this, "project management is the process of effectively using resources to achieve specific goals, managing time, managing risks, ensuring communication, directing the team, and successfully completing the project." In the field of healthcare facilities, project management differs from other construction projects and becomes a complex structure.

Experts from different disciplines (medical, technical, financial, environmental, risk management, construction team) and users (doctors, healthcare professionals, patients) are involved in the project needs. Specific concepts need to be defined for project management in healthcare facilities.

Scope: Healthcare facilities and hospitals are complex projects that vary according to the relevant service area, and the size of the hospital project depends on the diversity of services provided. The scope of the project may increase or decrease based on the content of the healthcare services provided and the resources and manpower listed in the requirements. The hospital's sustainability and being an environmentally friendly green hospital will differentiate the scope and the tasks to be performed. This situation leads to a more detailed breakdown of work structure, selective resource procurement, and increased costs. In such a project, the number of experts and consultants requiring project management and communication will also increase, resulting in diverse project stakeholders.

Experience, Skills, Knowledge: Architects, engineers, project managers, medical doctors as hospital founders, healthcare service financiers, and various other project stakeholders who have been involved in designing healthcare facilities and managing construction processes may possess valuable expertise that can provide an advantage in similar hospital construction projects. Another crucial area of experience is in green hospital design and implementation, which entails the necessary knowledge to obtain green building certification throughout the project

lifecycle, with the aim of effectively managing sustainability and mitigating environmental impacts.

2. Material and Method

The primary objective of this study is to provide recommendations for the implementation of sustainability and environmental considerations in healthcare facility projects from a project management perspective. In order to achieve this aim, a comprehensive literature review was conducted, employing various search terms such as "sustainable healthcare facilities," "environmental impact management," and "project management in healthcare."

To effectively communicate the research findings, the recommendations are presented in a structured manner, employing tables and diagrams. sustainability and environmental performance of such facilities. The extracted information was then organized and synthesized to form the basis for the recommendations presented in this study.

3. Findings and Discussion

In the context of this study, the focus lies on the exploration of sustainability, green hospitals, the environmental implications of healthcare buildings, and the perspective of project management in healthcare facility design. Recommendations have been compiled, encompassing the entire life cycle of a healthcare facility, which entails the design, construction, and facility management processes. The findings of this study are presented in Table 4, wherein a comprehensive proposal framework is provided, incorporating project management processes.

Table 4. Requirements and Project Management Process

Requirements	Sustainability	Environmental	Project Management Process
Building Design and Construction	Defining Green hospital principles and goals	Minimization of carbon footprint	Hiring the sustainable design consultants
			Following the green building standarts
	Applying sustainable construction practices	Reduction of resource consumption	Implementation of efficient construction techniques
Energy Efficiency and Renewable Energy	Implementation of energy-efficient systems	Reduction of energy consumption	Conduct energy autdits, install energy-efficient equipment and renewable energy systems
	Utilization of renewable energy sources	Reduction of the dependence on fossil fuels	Installation of energy-efficient equipment
			Implementation of renewable energy systems
Water Conservation	Utilization water-saving fixtures	Minimization of water usage	Installation of water-saving systems
			Installation of recycling systems
	Implementation water recycling systems	Promoting the water conservation	Monitoring water usage
Waste Management	Implementation recycling programs	Reduce waste generation	Implementation of conservation measures
			Training the staff on waste separation
	Implementation of waste reduction programs	Applying proper disposal practices	Training the staff on recycling methods
Indoor Environmental Quality	Taking promoting actions for good air quality	Minimization of indoor air pollutants	Implemention of ventilation systems
			Usage of low-emission materials
	Providing adequate natural lighting	Improving occupant comfort	Ensuring proper lighting design
Environmental Certification	Implementation of LEED or other green building certifications (Table 1.)	Obtain certifications such as LEED or Green Globes	Pursuing envrionmental certifications, follow certification requirements and guidelines

4. Conclusion and Suggestions

The management of hospitals and healthcare facilities, approached from a project management perspective, plays a vital role in achieving an effective equilibrium between sustainability and environmental impacts. This approach entails ensuring the preservation of the environment while concurrently delivering successful healthcare services.

Project management plays a significant role as a tool in projects with complex scopes and actions, such as healthcare facilities, encompassing design, construction, and operation processes. When considering resource demands, energy consumption, waste generation, and health concerns, sustainability, green building design, waste management, and energy efficiency should be implemented in conjunction with project management. Failing to do so would entail compromising the goals of a healthy building and environment.

Within the scope of this study, project management-based, environmentally-friendly, sustainable, and energy-efficient recommendations have been provided for the design and operation of healthcare facilities, considering the aforementioned criteria. Therefore, the following recommendations are believed to be guiding principles to consider:

- Incorporating the sustainable materials and practices into hospital and healthcare facility projects starting from the design stage.
- Prioritization of the implementation of relevant green building certification criteria in project and facility management practices

to enhance indoor environmental quality for patients, healthcare professionals, and visitors.

- Embracing the sustainability principles throughout the entire lifecycle of hospital and healthcare facility projects, including design, construction, and facility management.
- Integrating the energy-efficient systems to address water, electricity, and resource consumption, leading to cost reduction and resource optimization.
- Taking corrective actions and mitigate risks based on the measurement of energy and water consumption, waste generation, and greenhouse gas emissions when improvements are required.
- In the architectural planning of healthcare structures, the integration of environmental considerations, such as landscaping, the strategic placement of trees and plants, and the incorporation of shading elements and facade design, plays a pivotal role. These design elements not only contribute to cost reduction by minimizing the need for mechanical cooling systems but also facilitate natural airflow and circulation.
- The adoption of continuous monitoring and improvement strategies for energy efficiency, and evaluate sustainability performance using appropriate metrics.
- Applying the resource optimization through the application of project management principles, including water consumption control, waste management, recycling programs, and sustainable

procurement practices, with the aim of minimizing the environmental impact of healthcare facilities.

- Incorporate sustainable design principles in the design of healthcare facilities, encompassing passive design, utilization of renewable energy, and seamless integration with other building systems.
- Provide necessary training and raise awareness among all project stakeholders involved throughout the project lifecycle to actively engage them in sustainability, energy efficiency, and environmentally conscious strategies.
- Encourage and implement supportive services and promotional campaigns that foster environmental sensitivity among patients, their families, and healthcare professionals within healthcare facilities.

The implementation of the aforementioned recommendations covers the entire project lifecycle and aims to enhance the efficiency of healthcare service delivery. By effectively managing sustainability and environmental impacts in healthcare facilities, their positive contribution to the built and natural environment can be realized. The integration of project management strategies into the planning, execution, monitoring, and control processes becomes crucial in this regard. Elevating environmental consciousness in both healthcare facilities and other construction projects will not only benefit the environment and public health but also provide promising solutions for resource preservation, healthcare advancements, and economic prosperity.

Acknowledgements and Information Note

The article complies with national and international research and publication ethics.

Ethics Committee approval was not required for the study.

Author Contribution and Conflict of Interest Declaration Information

There is no conflict of interest.

References

Acıbadem Healthcare Group. (n.d.). Maslak Hospital. Access Address (22.06.2023): https://www.acibadem.com.tr/en/hospital/maslak-hospital/

Adana Şehir Hastanesi. (n.d.). Access Address (22.06.2023): https://adanasehir.saglik.gov.tr/?_Dil=2

Amerikan Hastanesi. (n.d.). Vehbi Koç Vakfı Sağlık Kuruluşları ve Yönetim Kurulu. Access Address (22.06.2023): https://www.amerikanhastanesi.org/vkvsk-ve-yonetim-kurulu

Aspen. (n.d.). The World's First LEED Platinum Certified Hospital: Memorial Bahçelievler. Access Address (22.06.2023): https://www.aspen.com.tr/en/blog/the-worlds-first-leed-platinum-certified-hospital-memorial-bahcelievler/

BREEAM. (n.d.). King's College Hospital. Access Address (22.06.2023): https://tools.breeam.com/projects/explore/buildings.jsp?

Building Research Establishment. (n.d.). BREEAM International Overview. Access Address (22.06.2023): https://www.breeam.com/about/

Čongradac, V., Prebiračević, B., & Petrovački, N. (2014). Methods for assessing energy savings in hospitals using various control techniques. Energy and Buildings, 69, 85-92.

Healthcare Facilities Today. (n.d.). Water Conservation Strategies for Healthcare Facilities. Access Address (22.06.2023): https://www.healthcarefacilitiestoday.com/posts/Water-Conservation-Strategies-for-Healthcare-Facilities--27052.

HCO News. (2021). Sustainability Checklist: 8 Key Areas of Focus for Healthcare Construction. Access Address (22.06.2023): https://hconews.com/2021/07/15/sustainability-checklist-8-key-areas-of-focus-for-healthcare-construction/.

International Hospital Federation. (2022, May 19). Japanese Red Cross Matsuyama Hospital: Gold Award Winner of the Green Hospitals Award 2022. Access Address (22.06.2023): https://ihf-fih.org/news-

insights/japanese-red-cross-matsuyama-hospital-gold-award-winner-of-the-green-hospitals-award-2022/

Island Health. (n.d.). Royal Jubilee Hospital (RJH). Access Address (22.06.2023): https://www.islandhealth.ca/our-locations/hospitals-health-centre-locations/royal-jubilee-hospital-rjh

Japan Sustainable Building Consortium. (n.d.). CASBEE. Access Address (22.06.2023): https://www.ibec.or.jp/CASBEE/english/index.html

Mater Misericordiae University Hospital. (n.d.). Access Address (22.06.2023): https://www.mater.ie/

Mercy Medical Center. (2012, June 27). Mercy Earns LEED Certification through Cancer Center. Access Address (22.06.2023): https://www.mercycare.org/news/2012/mercy-earns-leed-certification-through-cancer-center/

Project Management Institute. (2017). A guide to the Project Management Body of Knowledge (PMBOK guide) (6th ed.). Project Management Institute.

Stevanovic, M., Allacker, K., & Vermeulen, S. (2017). Hospital building sustainability: the experience in using qualitative tools and steps towards the life cycle approach. *Procedia Environmental Sciences*, 38, 445-451.

TR Hastane. (n.d.). Özel İstanbul Florence Nightingale Hastanesi. Access Address (22.06.2023): https://www.trhastane.com/ozel-istanbul-florence-nightingale-hastanesi-231.html

U.S. Department of Energy. (n.d.). Researching Energy Use in Hospitals. Access Address (22.06.2023): https://www.energy.gov/eere/buildings/researching-energy-use-hospitals.

U.S. Green Building Council. (n.d.). LEED. Access Address (22.06.2023): https://www.usgbc.org/leed

U.S. Green Building Council. (n.d.). Yozgat Şehir Hastanesi. Access Address (22.06.2023): https://www.usgbc.org/projects/yozgat-sehir-hastanesi/

WBDG. (n.d.). Enhance Indoor Environmental Quality. Whole Building Design Guide. Access Address (22.06.2023): https://www.wbdg.org/design-objectives/sustainable/enhance-indoor-environmental-quality

Yildiz, H. (2016). Sürdürülebilirlik bağlamında sağlık sektöründe inovatif uygulamalar: Yeşil hastaneler. *Kafkas Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, 7(13), 323-340.

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From Mouldiness Manifesto to Ecological Architecture

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Citation: Çeltekligil, A. & Girgin, E. (2023). From Mouldiness Manifesto to Ecological Architecture. Dal, M. & Karataş, L. (Eds.). **Architectural Sciences and Theory, Practice and New Approaches-II.** 2023, Chapter:3, 47-76. ISBN: 978-625-367-256-0. Iksad Publications.

1. Introduction

In the second half of the 20th century, the results of the great inventions made after the 18th century, the production that developed on the axis of these inventions, and the rapid consumption of resources began to be recognized as a problem. In the 20th century, the realization that natural resources are not infinite in the global world and the climate crises experienced made it necessary to bring ecological solutions to the problems experienced. In every field of production, there have been developments aimed at solving problems with micro and macro decisions. In the world where the reconstruction of cities and urbanization accelerated after the two world wars, the practice of building and architecture is one of the areas where ecological developments and innovations are experienced. Rapid construction has had a great impact on the emergence of problems such as depletion of natural resources, environmental pollution problems, destruction of biodiversity, destruction of natural vegetation, environmental problems related to soil resources, problems related to the reduction of water resources, global warming and global climate change problems, ozone depletion, rapid population growth. In the context of the rational determination of these problems and the search for solutions to these problems, the scope of Ecology, which was a sub-branch of biology until the 1970s, has also been expanded. In the 21st century, the concept of ecology has become an interdisciplinary concept that affects philosophy, economics, and politics as well as vital issues such as

alternative energy use, human-nature relations, and support for natural life (Gürpınar, 1992; Bookchin, 1996; Callenbach, 2008; Hasol, 2010).

1.1.The Concept of Ecology and Ecological Design

Introduced in 1866 by the German Ernest Haeckel, the concept of ecology is composed of the Greek words "oikos" meaning "place of residence" and "logia" meaning science or discourse (Keleş & Hamamcı, 2002). It is not possible to talk about a single definition or approach on the concept of "ecology", which is translated as "Environmental Science" by TDK. After the environmental movement in the 1970s, the concept has been expanded by different disciplines with different definitions, scopes, and practices. New concepts have also been produced with the prefix "eco": eco-cities, eco-tec cities, eco-design, etc. Hasol (2010) defines ecology as the branch of science that analyzes the relationships between living beings and their environment. Ecology examines the relations of living beings with their environment in line with the principle of holism. In this sense, when we talk about the ecology of a system, what is generally meant is the ability to think together the dynamics of each component in the system that affect each other and to evaluate this interaction in a layered manner (Bookchin, 1996; Williams & FAIA, 2007; Callenbach, 2008; Çıkırıkçı, 2021)

Awareness of ecological problems increased after the first United Nations Conference on the Human Environment in Stockholm in 1972. The concept of sustainability was defined in the Brundtland Report in 1987. In the years following these conferences, the concepts of environmental law, sustainable and ecological architecture have been developing globally

through international declarations, agreements, and decisions (Republic of Türkiye Ministry of Foreign Affairs).

The science of ecology is concerned with human-nature relations as well as the development of renewable and harmless energy sources. Especially in the 20th and 21st centuries, the damage caused to the ecosystem by human activities has made it necessary to search and research methods and ways of repairing as well as protecting the ecology. In today's world of high energy demand, the use of renewable clean energy, materials and technology is essential for the protection and restoration of the deteriorating ecosystem. In architecture, studies are carried out on ecological approaches in architectural design in order to ensure that construction activities are not against nature but in harmony with the ecosystem. Ecological approaches in architecture are addressed by different sources (design phase - production phase - use phase - post-use phase) under the main headings of resource conservation, environmental pollution control, climatic design, providing healthy conditions in interiors, structural waste management control, life cycle assessment (Tönük, 2001; Yılmaz, 2005; Williams & FAIA, 2007). In the structural sense, the concept of ecological approaches in architecture covers the size and function of the building, its relationship with the land, façade design (façade gaps and technology), material selection, and resource utilization (Güleryüz, 2013). Ecological approaches in architecture also relate to concepts such as sustainability and smart designs and come up with concepts with different practices and scopes such as "eco-building, eco-cities, eco-tec cities, eco-design, eco village, eco campus, green ecological

architecture...". In the 21st century, these design methods, which have become not only a necessity but also a trend and a marketing product, are taking their place in cities at micro and macro scales.

Ecological approaches to cities and architecture have been developed by different disciplines in response to the urban problems that emerged due to the rapid construction after World War II. One of the important examples of these early studies is the work of Austrian painter and environmental activist Friedensreich Hundertwasser. The artist intensely criticized the post-World War II urbanization and construction dominated by concrete, which developed in the context of rational architecture. The artist accused rational architecture of "cutting off man's relationship with nature, of being flat and artificial". In 1958, the artist revealed his ecological vision with the "Mouldiness Manifesto Against Rationalism In Architecture" and in the following years, he manifested his thoughts on ecological architecture with his demonstrations, speeches, models, drawings and projects.

Within the scope of this study, the ecology philosophy of Hundertwasser, who aims to protect ecology at every stage of his design (design - production - use - post-use) throughout his production life (1958-2000) and produces manifestos and architectural projects in this context, will be examined. Hundertwasser does not see ecological design as green integrated into the built environment. The artist produced with the vision that the built environment should be built together with the natural environment, not against it, and revealed his philosophy with his own methods and manifestos. In this study, Hundertwasser's ecological design

approaches and proposals, which started with the Mouldiness Manifesto in 1958 and continued until his death, will be revealed, and the projections of his ecological philosophy in today's ecological architecture will be evaluated. The environmental vision and works of the artist, who argues that ecological architecture is a physical and psychological necessity, are inspiring for today's ecological design studies. This study will discuss the reflections of the artist's eco vision on the present day and open new horizons for future studies.

2. Material and Method

The study was created by the literature review method. The main purpose of the study is to contribute to the ecological architecture literature, which is a current topic of discussion open to development, by reading the eco-philosophy of Hundertwasser, an eco-activist. The discussion within the scope of the research is important in today's world where ecological problems are increasing rapidly, yet solution proposals remain singular. In the first part of the study, Hundertwasser's ecological philosophy and ecological architectural approaches will be revealed by reading his manifestos, speeches, drawings and projects. In the second part, the reflections of the artist's philosophy in today's ecological architecture will be analyzed. Finally, the micro- and macro-scale architectural approaches to the artist's ecological philosophy will be discussed and evaluated by cross-referencing them with contemporary ecological approaches.

3. Findings and Discussion: From Mouldiness Manifesto to Ecological Architecture

3.1. Hundertwasser's Ecology Manifestos

Born in Vienna in 1928 between the two world wars, the Austrian Jewish artist Hundertwasser describes himself as a painter, doctor of architecture, ecological activist and philosopher. His life has been centered around communicating his socio-critical, creative and ecological philosophy to the world. Hundertwasser has communicated his philosophy to the world through public demonstrations, manifestos, letters, lectures, drawings, graphics, models and architectural structures he has produced and revised. (Hundertwasser Official Website)

In 1958, Hundertwasser stated in his "Mouldiness Manifesto Against Rationalism In Architecture" that the straight line is "uncreative and godless". The artist defined mould as an element that would unique the building against rationalism, liberate it, and make it intertwined with life, with expressions such as "the natural, organic reproduction and infinitely creative". According to Pierre Restany (2003: 10), for Hundertwasser, “mould” was a metaphor symbolizing the creative power of nature. Believing in the power of nature and individual creativity, Hundertwasser put forward his vision of ecology through a peace treaty with nature.

“The peace treaty must include the following points:

1. We have to learn the language of nature to be able to communicate with her.

2. To restore territories to nature which have been illegally violated and occupied by man following the principle that all what is horizontal under the sky belongs to nature, including for instance roofs and streets.

3. To tolerate spontaneous vegetation.

4. To reapproach and reunite the creativity of man and the creativity of nature which have been separated with disastrous consequences.

5. To live in harmony and according to the laws of nature.

6. We are guests of nature, and we must behave.

Man must realize that he himself is the most dangerous pest that ever devastated this earth. Man must put himself back into his environmental barriers so that the earth can regenerate.

7. We must become again a society free of waste. Only he, who honors and recycles his own waste in a waste-free society can turn death into life and has to right to continue to be present on this earth.

By respecting the cycle, he permits the resurrecion of life. (Hundertwasser, 1990; Restany, 2008: 222-234)"

The basic approach of Hundertwasser's environmental theory was to remove humans from their position as polluters and wasteful consumers of nature and reposition them within the natural cycle of nature. Humans had to learn to live in harmony with what had always been there. In this context, throughout his working life, the artist put forward various manifestos revealing his philosophy of ecology and gave speeches at global conferences (Table 1).

Table 1. Hundertwasser's Ecology Manifestos and Speeches (URL 1)

1958	**Mouldiness Manifesto Against Rationalism In Architecture**
1972	Your Window Right-Your Tree Duty
1973	Tree Tenant Letter
1975-76	Humus Toilet
1979	The Sacred Shit - The Shit Culture
1980	Tree Tenants Are The Ambassadors Of The Free Forests In The City
1982	Humus Toilet and Water Purıfıcatıon, Letter To Alex Wade
1982	Speech On Ecology
1984	Free Nature
1986	Roof Afforestation
1990	Global Environmental Necessities: Thoughts and Reflections
1999	Fragments About My Contemplatıon On Ecology

Hundertwasser developed his ecological theory, which is based on the harmonious coexistence of nature and human beings, with various ecological manifestos, especially his writings and speeches "Your Window Right-Your Tree Duty", "Tree Tenant", "Humus Toilet". According to Pierre Restany (2003), the artist complemented his ecological manifestos with a water plant purification system in which polluted water is cleaned through plants in the water (Figure 2). Hundertwasser's ecological approaches in house design are based on zero waste, recycling, and nature-human coexistence. The artist aimed to produce an ecolife where toilet waste becomes humus for green roofs and vertical gardens, rainwater provides the clean water needs of the house, and dirty water is cleaned/ filtered by plants growing in the water (Restany, 2003). The recycling of waste and the goal of zero waste were among the basic ideologies of Hundertwasser architecture (Figure 1).

Figure 1. Tree Tenant by Hundertwasser, Vienna, 1976 (URL 1)

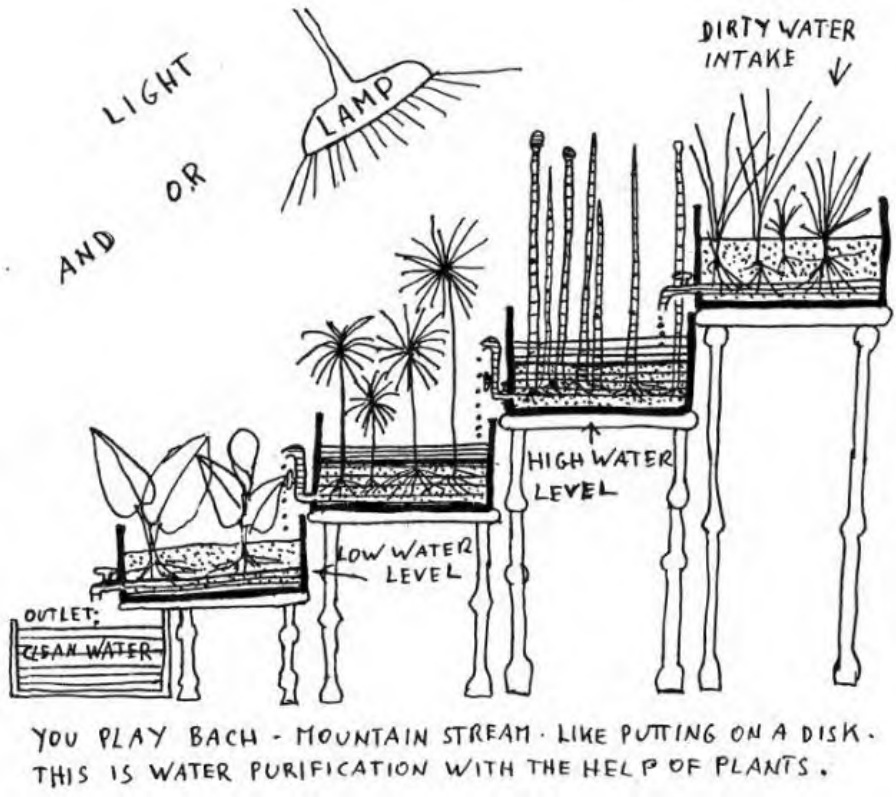

Figure 2. Hundertwasser's Water Plant Purification System, 1979 (URL 1)

In his article "Your Window Right-Your Tree Duty (1972)", Hundertwasser complains that shelter is a human right, but when nature and human beings must coexist, vertical cities disrupt the natural horizontal. And he talks about the necessity of vertical forests. Hunderwasser, who argues that the green destroyed horizontally should continue vertically, has integrated green areas consisting of grass roofs and trees into his projects at different elevations. "Tree Tenants", which

Hundertwasser defines as "trees pay rent with oxygen", can be produced in about one cubic meter of space in front of the window (Hundertwasser, 1990). In his article "Tree Tenants Are the Ambassadors Of The Free Forests In The City (1980)" the artist lists the advantages of Tree Tenants for buildings. According to Hundertwasser, Tree Tenants allow the city to maintain its moisture balance and climate. They absorb dust and CO2 from houses and streets and reduce urban noise and echo effect. Trees that screen the dwelling from the street are a shading element in the summer and shed their leaves in the winter and do not block sunlight. The coexistence of buildings with greenery leads to biodiversity in the city. There will be more space for birds and butterflies in the built environment, and this will psychologically improve people's quality of life. Hundertwasser says that tree tenants are actually a "symbol of ecological repair" of nature with the words "We are restoring to nature a small part of the huge territory that man has taken from nature." (Restany, 2008, URL 2)

Although the artist's idea of organic toilets remained in theory, he was able to realize his architectural projects in which he carried nature to the vertical with trees growing in the floor gardens and roofs and grass roofs. Hundertwasser found the opportunity to use the idea of Tree Tenants in many buildings he designed (Figure 3; Figure 4; Figure 5). The Hundertwasser-Haus social housing project, the first architectural project he designed with Peter Pelikan, is the most well-known of these buildings (Figure 3)

Figure 3. Hundertwasser-Haus Social Housing, Vienna, 1983-85 (URL 1)

Figure 4. The Forest Spiral of Darmstadt Housing, 1998-2000 (URL 1)

The ecology activist also talked about the advantages of grass roofs for ecological living. According to Hundertwasser (1990), grass roofs, like trees, produce oxygen, protect the city's air, contribute to air conditioning, collect dust and turn it into soil. The moisture balance of the city is maintained. It prevents the formation of urban heat islands as it does not reflect. In addition to sound insulation, this layer designed on the roof will also contribute to heat and radiation insulation. Soil and plants can be used to purify polluted water. The roof provides space for rainwater collection and storage. Toilet and household waste can form humus in this area. Grass roofs are suitable for organic farming and partial animal husbandry. Thanks to the grass roof, the building provides a living space not only for humans but also for organisms of different sizes. Coexistence with this green environment is psychologically therapeutic. "A house with a grass-roof is like a closed circuit. Recycling is restored and life recovers (Hundertwasser, 1990)".

Hundertwasser used grass roofs in almost all of his projects. His Thermal Village Project in Blumau, realized in collaboration with architect Peter Pelikan, is one of his most iconic buildings in which he designed green areas at different elevations and free forms of roofs that can be walked on. In this project, the architects freely applied different designs such as the forest-courtyard house, eye-slit house, rolling-hills and shifted-hills house. The project won the Austrian Environmental Award for Tourism in 1997 (URL 1) (Figure 5).

Figure 5. The Thermal Village Rogner- Bad Blumau - The Rolling Hills, 1993-1997 (URL 1)

The Austrian painter's ecological vision was not only reflected in his paintings, but also in his writings, speeches, and architectural works. In his own time, he often faced criticism that the trees he used in his buildings

would break the concrete and increase the cost of the structures he built. However, Hundertwasser's projects are accepted by the Viennese today and are still being used in a healthy way (Cesur, 2006).

3.2. Contemporary Ecological Architecture Studies and Hundertwasser's Vision of Ecology

Today, ecological problems are at a critical point. The destruction that manifests itself with the greenhouse gas effect and global warming has come to a point that requires the search for living space on different planets. In the search for solutions to ecological problems, states, scientists, and non-governmental organizations contribute to the literature with interdisciplinary studies. In the discipline of architecture, ecological approaches are developed at macro and micro scales from urbanism to interior and material design (Tönük, 2001; Yılmaz 2005; Williams & FAIA, 2007; Callenbach, 2008; Bauer et al., 2010; Tandoğan, 2018; Lessard, 2019).

"Green Building Certificates" studies, which have emerged in the last 30 years and developed interdisciplinary day by day, are important products of this effort. Certificate systems are being developed day by day in order to ensure environmental, social, and economic sustainability and to restore ecological balance. After 1990, when we analyze the evaluation criteria of the green certification systems developed by different nations, it is seen that there is a great similarity with the ecological vision of Hundertwasser between 1958 and 2000 (Table 2).

Table 2. Comparison of Green Building Certifications Rating Tools (Reed et al., 2009) and Hundertwasser's Ecological Vision (By the authors)

	U.K. 1990	**Japan 1998**	**Australia 2003**	**U.S. 2004**	**… 1958-2000**
Assessment Criteria	BREEAM	CASBEE	GreenStar	LEED	Hundertwasser's Ecological Vision
Energy	X	X	X	X	X
CO2	X				X
Ecology	X	X	X	X	X
Economy					
Health and Wellbeing	X	X	X		X
Indoor Environmental Quality	X	X	X	X	X
Innovation	X		X	X	X
Land Use	X		X	X	X
Management	X	X	X		
Metarials	X	X	X		
Pollution	X	X	X	X	X
Renewable Technologies	X		X	X	X
Transport	X		X	X	
Waste	X				X
Water	X	X	X	X	X

Within the scope of the 2030 Agenda for Sustainable Development put forward by the United Nations, 17 Sustainable Development Goals (SDGs) have been identified (Sustainable Development Official Website, 2016). The work carried out in this context is one of the important contemporary ecology movements of today. Likewise, when the United Nations Sustainable Development Goals are analyzed, it is determined that

there are parallels with Hundertwasser's discourses and studies sixty years ago (Figure 6).

Figure 6. Sustainable Development Goals (Sustainable Development Official Website)

The idea of vertical gardens and green roof systems, which Hundertwasser called tree tenants with the motto "the streets in cities will turn into green valleys where people can breathe freely again (URL 2)", are frequently encountered as an ecological approach in today's architecture. Vertical gardens, floor gardens, vertical agricultural areas are being used more and more in projects day by day. One of the most well-known residential applications with vertical gardens today is Bosco Vertical in Milan. In 2014, the ecological renovation project implemented by Boeri Studio on two residential towers of 80 and 112 meters was added to the Milan silhouette (ArchDaily, 2015) (Figure 7).

Figure 7. Vertical Garden Design Residence in Milan: Bosco Verticale, Boeri Studio, 2014 (ArchDaily, 2015)

The ACROS (Asian Crossroad Over the Sea) Center, or Fukuoka Prefectural International Hall, located in Fukuoka, Japan, was designed in 1995 by architects Emilio Ambasz and Nihon Sekkei (Figure 8). The project is located in the financial district of Fukuoka, next to the river and

Tenjin Central Park. It is designed to create a vertical garden effect in the continuation of the park. It is used for public use. In the designed project, the green area lost horizontally rises vertically along the floors. In the garden with its own ecosystem, rainwater can be collected and used for irrigation purposes. It is known that the thick grass roof layer used in the building provides thermal insulation, significantly reducing the cost of energy usage. (Belogolovsky, 2020)

Figure 8. ACROS Centre, 1995 (Belogolovsky, 2020)

Waste management and high energy use have become a major problem in cities with rapidly growing populations. Interdisciplinary studies on waste management, the use of recyclable materials and energy saving are ongoing within the scope of environmental sustainability studies. Practices are being developed in different scopes regarding waste and energy issues. Today, self-sufficient ecological system studies are carried out with macro and micro scale projects such as eco city, eco village, etc. Studies on the reuse of biodegradable and insoluble waste materials in architecture have also gained momentum in the new millennium (Tandoğan, 2018; Lessard, 2019). The Earthship Projects designed by the environmentalist architect Michael Reynolds with the motto 'reduce - reuse - recycle' can serve as an example of these projects. Since 1971, Reynolds has been putting forward and practicing ecological approaches in architecture. Earthship Projects, which are mostly made of natural, recyclable materials, can produce their own energy to a great extent. (Figure 9; Figure 10, Figure 11) Earthship Biotecture Academy was established to spread the Earthship ecological vision. Adults and students from different nationalities, professions and age groups participate in this program. Developed year by year, Earthship Projects are based on 6 design principles (URL 3) (Figure 9).

1. Building With Natural and Repurposed Materials
2. Thermal/Solar Heating and Cooling
3. Solar And Wind Electricity
4. Water Harvesting
5. Contained Sewage Treatment
6. Food Production

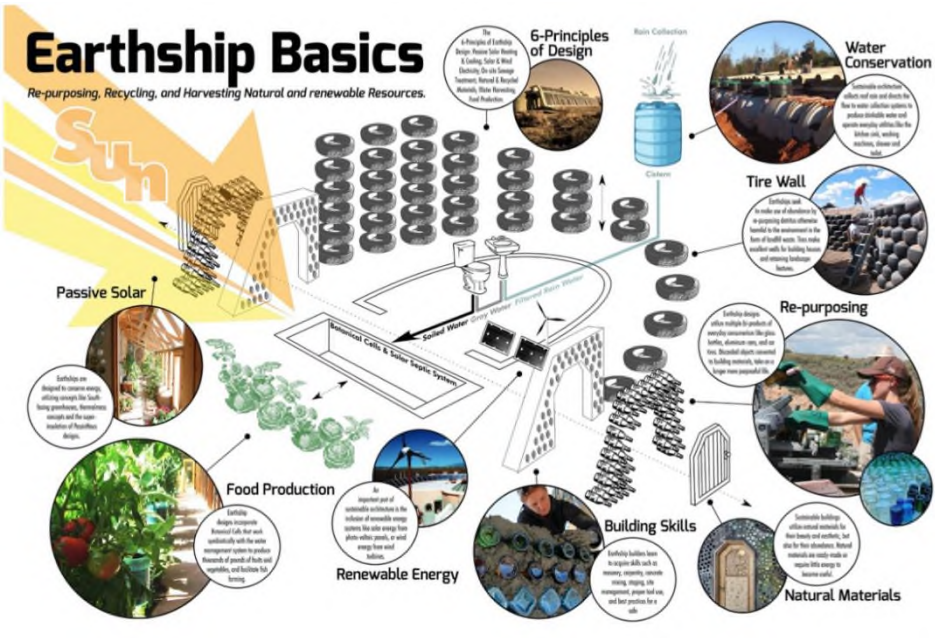

Figure 9. Earthship Design Principles (URL 3)

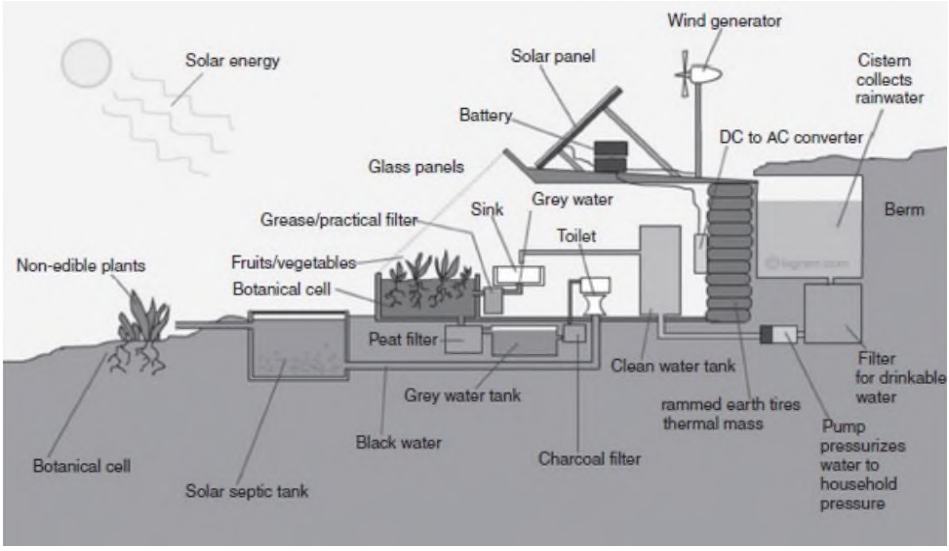

Figure 10. Earthship Systems (Lessard, 2019)

Figure 11. Earthship Projects (URL 3)

4. Conclusion and Suggestions

Winston Churchill expressed the relationship between humans and the environment as "We shape our buildings; thereafter they shape us." According to urban scientist David Harvey (2013), the question of what kind of city we want cannot be separated from questions such as who we want to be and what kind of relationship we value with nature. In this context, it would not be wrong to say that the relationship we establish with the environment starts while designing the built environment.

Hundertwasser's eco-vision put forward sixty years ago that we should "make peace with nature!" and that we should create a built environment in harmony with the ecosystem, not against nature, is exemplary in terms of environmental ethics. Looking at contemporary ecological approaches in architectural design since Hundertwassser's works, it is possible to say that although there are project-based developments, a collective ecological movement or ecological consciousness has not been fully developed/ established. Considering the extent of environmental destruction today, individual efforts are insufficient. Beyond individual efforts, developing

social, and international ecological consciousness and ecological vision is very important. The destruction of nature, which has been destroyed for centuries as if we had infinite resources, has begun to be seen as a problem in the last century. Although the recognition and acceptance of the environmental problem, the emergence of the concept of sustainability, the development of the concept not only in environmental but also in social and economic terms, the development of clean energy production with the developing technology, etc. are promising steps to ensure ecological balance, they are insufficient in the face of increasing destruction.

Hundertwasser hasn't seen ecological design as green integrated into the built environment. The artist's eco-vision is based on an ecological balance in which nature and humans interact. Looking at the activist's works "Your Window Right-Your Tree Duty, Tree Tenant, Humus Toilet, The Sacred Shit, etc.", it is seen that his ecological views such as the recycling and reuse of organic waste, energy saving, saving natural resources, food production, nature with human psychology etc. are in parallel with contemporary ecological architecture approaches. Hundertwasser's vision of building that combines ecology, aesthetics and philosophy is rich enough to open new horizons for contemporary ecological architectural design. In today's urbanization, ecological approaches are still realized as building or site-based projects. Nature is often included in projects as an aesthetic green element, sometimes as passive ventilation. However, in Hundertwasser's ecological vision, "tree tenants" existed as a sun-breaker, an oxygen producer, a reminder of vitality and an influence on mental health. When Hundertwasser's vision combining ecology, aesthetics and

philosophy is extended to all cities (to people, housing, public buildings, tourism buildings, industrial buildings, infrastructure, etc.), there may be hope for ecological recovery to be realized.

Acknowledgements and Information Note

The e-book section complies with national and international research and publication ethics. Ethics Committee approval was not required for the study.

Author Contribution and Conflict of Interest Declaration Information

There is no conflict of interest.

References

ArchDaily. (2015). Bosco Verticale / Boeri Studio. ArchDaily. Access Address (10.07.2023): https://www.archdaily.com/777498/bosco-verticale-stefano-boeri-architetti ISSN 0719- 8884

Belogolovsky, V. (2020). ACROS fukuoka prefectural ınternational hall by emilio ambasz turns 25, stir world. Access Address (10.07.2023): https://www.stirworld.com/think-columns-acros-fukuoka-prefectural-international-hall-by-emilio-ambasz-turns-25

Bauer M., Mösle P. & Schwarz M. L. (2010). *Green building: guidebook for sustainable architecture*. Berlin/ Heidelberg: Springer. ISBN-103642006345

Bookchin, M. (1996). *Ekolojik bir topluma doğru*. İstanbul: Ayrıntı.

Callenbach, E. (2008). *Ecology: A pocket guide, revised and expanded*. California: University of California Press.

Cesur, *M. G. (2006). Aykırı bir mimar olarak Friedensreich Hundertwasser.* Mimar Sinan Güzel Sanatlar Üniversitesi, Sosyal Bilimler Enstitüsü, Sanat Tarihi ABD, İstanbul. Access Address (19.07.2023): https://tez.yok.gov.tr/UlusalTezMerkezi/

Çıkırıkçı, B. (2021). *Mimari yarışmaların ekolojik söylem ve pratikleri.* Mimar Sinan Güzel Sanatlar Üniversitesi, Fen Bilimleri Enstitüsü, Mimarlık ABD, İstanbul. Access Address (05.07.2023): https://tez.yok.gov.tr/UlusalTezMerkezi/

Keleş, R. & Hamamcı, C. (2002). *Çevrebilim*, İstanbul: İmge Kitabevi Yayınları. s. 13-32. ISBN: 9789755330242

Harvey, D. (2013). *Asi şehirler: Şehir hakkından kentsel devrime doğru*. İstanbul: Metis Yayınları.

Hasol, D. (2010). *Ansiklopedik mimarlık sözlüğü.* İstanbul: Yem Yayın s.156

Hundertwasser, F. (1990). *Global environmental necessities: thoughts and reflections. Conference on Planning and Resource Management*. New Zealand Planning Institute, Access Address

(19.07.2023):https://hundertwasser.com/en/texts/gedanken_und_betrachtungen

Güleryüz, M. (2013). *Bir ütopya hareketi olarak eko-köyler: Türkiye'deki örnekler üzerine bir inceleme.* İstanbul Kültür Üniversitesi, Fen Bilimleri Enstitüsü, Mimarlık ABD, İstanbul. Access Address (07.07.2023): https://tez.yok.gov.tr/UlusalTezMerkezi/

Gürpınar, E. (1992). *Çevre sorunları*. İstanbul: Der Yayınları. s. 17

Krusche P. M., Althaus, D. & Gabriel, I. (1982). *Ökologisches Bauen,* Wiesbaden: Bauverlag.

Lessard, G. (2019). Conception De Soutenabilité De L'habitation : Étudedes Discours De 4 Organisations Promouvant Lagéonef (Earthship), *Vertigo - La Revue Électronique En Sciencesde L'environnement,* 19(3), ISSN : 1492-8442, Access Address (09.07.2023): https://journals.openedition.org/vertigo/27211

Reed, R. G., Bilos, A., Wilkinson, S. J. & Schulte, K. (2009). International Comparison of Sustainable Rating Tools, *JOSRE,* 1(1), 1-22

Republic of Türkiye Ministry of Foreign Affairs, Çevre, İklim Değişikliği ve Suya Dair Sürdürülebilir Kalkınma Hedefleri. Access Address (19.07.2023): https://www.mfa.gov.tr/surdurulebilir-kalkinma.tr.mfa

Restany, P. (2003). *Hundertwasser-the painter king with the five skins*, Köln:Taschen,

Restany, P. (2008). *Hundertwasser,* New York: Parkstone Press International.

Sustainable Development Official Website. Access Address(20.06.2023): https://sdgs.un.org

Tandoğan, O. (2018). Atık malzemelerinin mimaride kullanımı. *Ulusal Çevre Bilimleri Araştırma Dergisi*, 1(4), 189–202.

Tönük, S. (2001). *Bina tasarımında ekoloji.* İstanbul: Yıldız Teknik Üniversitesi Basım Yayın Merkezi Matbaası.

Williams D.E. & FAIA. (2007). *Sustainable design: ecology architecture and planning.* New Jersey: John Wiley & Sons. ISBN: 978-0-471-70953-4

Yılmaz, S. (2005). *Ekolojik yaklaşımların mimari tasarım sürecine etkileri.* Gebze Yüksek Teknoloji Enstitüsü, Mimarlık ABD, Gebze.

URL 1. Hundertwasser official website, Access Address (19.07.2023): https://hundertwasser.com/en

URL 2. Tree tenants are the ambassadors of the free forests ın the cıty, hundertwasser official website, Access Address (19.07.2023): https://hundertwasser.com/en/texts/baummieter_sind_die_botschafter_des_freien_waldes_in_der_stadt

URL 3. Earthship global official website, Access Address (09.07.2023): https://www.earthshipglobal.com/home

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Healthy Life Center Implementation Project of a District Municipality Supporting the Dissemination of Healthy Life Culture

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Citation: Elmas, E. S. (2023). Healthy Life Center Implementation Project of a District Municipality Supporting the Dissemination of Healthy Life Culture. Dal, M. & Karataş, L. (Eds.)**Architectural Sciences and Theory, Practice and New Approaches-II.** 2023, Chapter:4, 77-106. ISBN: 978-625-367-256-0. Iksad Publications.

1. Introduction

Healthy living centers are facilities that include units created to strengthen primary health care services provided in family and community health centers, facilitate access to these services, protect individuals and society from health risks and promote a healthy lifestyle. The activation of healthy life centers in our country started in late 2017 and there are 216 healthy life centers across the country and 24 healthy life centers in Istanbul. Although there are healthy life centers in 19 of the 39 districts of Istanbul, there are none in 20 districts, including Sancaktepe District, which is the subject of the study (Halk Sağlığı Genel Müdürlüğü, 2023).

Factors such as gender, age, previous health experiences, culture, education level, hygiene sensitivity, mutual communication, recognition of the health personnel or institution, economic level, easy accessibility to transportation vehicles, proximity-distance or accessibility of health facilities, etc. determine the level of demand of users for health institutions (Ünüvar & Acar, 2020).

The consultancy services provided in healthy life centers are listed as follows in the Ministry of Health legislation; women, pregnant and reproductive health, nutrition and obesity, physiotherapy, psychology and mental health, preventive oral and dental health, tobacco and substance addiction, cancer early detection, screening and education, infection control services, child and adolescent health and medical services (Üstündağ, 2022).

A literature review was conducted on Healthy Life Centers. It has been observed that there are many studies in the field of health management on the subject; there is no study in which the scope and capacity data of the centers are determined by governance, and in the light of this data, the building project design and implementation processes are handled from a project management perspective. Within the scope of the field study, visits were made to the centers serving in Istanbul. It was found that the centers were opened in places deemed appropriate by the Ministry of Health; that the quantitative and qualitative preliminary work in terms of management and organization was not carried out at a sufficient level, that the targeted service level could not be reached, and that they provided services with low efficiency, especially due to spatial problems.

Since each project has its own unique characteristics, each project should be managed with its own specific management method. Accordingly, each construction project should be managed with project management that includes appropriate project methodology and project techniques (Kömürlü & Toltar, 2018).

The most fundamental and important role in the success of the construction project is that the appropriate project technique and project methodology should be determined and the design and construction work should be managed uniquely as a project (Bayır, Kasapseçkin et al., 2022). For this reason, this study aims to determine which of the services defined in the legislation will be preferred and to determine the capacity of these services with a project management discipline.

It is thought that Sancaktepe Municipality SHM Implementation Project, which is the subject of the article, has a unique value and will contribute to the sectoral practice that original, rational projects will be obtained with project management instead of rote, stereotyped approach in every project under the definition of function.

2. Material and Method

In the meetings Sancaktepe Municipality held with the public in neighborhood parks in the summer of 2021, the public in Yunus Emre, Mevlâna and Safa neighborhoods stated that it was not easy for people to access simple health services such as injections, dressings and blood pressure measurements; and requested the Municipality to build a health service point to solve the problem.

Sancaktepe Municipality requested the author, who is the deputy mayor of Sancaktepe Municipality, to prepare the design and implementation projects of a healthy life center building that will meet the demand of the public, comply with the municipality's management vision, incubate the spread of healthy life culture and set an example for neighboring districts. Upon the request of Sancaktepe Municipality, online and face-to-face meetings with the core team of project authors and contractors started in August 2021. The duties and responsibilities of the stakeholders of the project, namely the project authors, the contractor and the municipality team, were determined as described in Table 1.

Table 1. Duties and Responsibilities of Project Stakeholders

Stakeholder and Responsibilities	
Municipality	-Provision of land -Conducting zoning planning studies -Allocating workspaces for project authors -Appointment of a building control committee during the construction process
Project Author	-Architectural project design / architect (author) -Static project design / civil engineer -Mechanical project design / mechanical engineer -Electrical project design / electrical engineer -Receiving ground investigation report / geology and geophysics engineer
Contractor	-Covering the cost of construction -Appointment of the site supervisor -Giving the name of her parents to the SMM -Provision of interior furnishing

The World Health Organisation (WHO) attaches great importance to element of accessibility in its list of features required for a good health care system (Durmuş, 2022). For the SHM- for which the architectural project was designed by the author- land alternatives of suitable quantity and quality at an easily accessible point in three neighborhoods were presented to the Mayor of Sancaktepe for his selection. He preferred the land in Figure 1 in terms of ownership status, location in the city, vegetation and geographical features.

Figure 1. Orthophoto İmage of The Project Area

Yenidoğan locality Yunus Emre District 310 island/park parcel, whose orthophoto image is shown in Figure 1, is the material taken as the basis for the development of the Healthy Life Center architectural design process in the article. The land is an area in public use, which was obtained by the former Yenidoğan First Stage Municipality as an arrangement partnership share through the application of Article 18 of the zoning law. It has been determined that there is a transformer with an area of 64 m², a neighborhood headman building with an area of 330 m² and a neighborhood park on the immovable. The park parcel faces Yenidoğan Street (20.00 meters) to the north and Yeditepe Street (8.00 meters) to the south.

Between August 2021 and March 2022, a 24-month work schedule for the literature review, collection of information and documents from the field

and relevant authorities, project design and construction phases, and the project management methodology summarized in Table 2 were created. During the project design phase, SWOT analyses of the physical, social, cultural, economic, legal and administrative characteristics of the project area and its surroundings were conducted. A face-to-face survey of the local community was also analyzed in detail.

The data obtained through the analyses were presented, the information was synthesized and design decisions regarding the SHM's needs program and architectural project were developed. On 20.09.2021, the first architectural project presentation was made to the Mayor of Sancaktepe Municipality. The area allocated as administrative service area in the zoning plan was deemed insufficient for the SHM project and the municipality was requested to amend the current zoning plan. The architectural project was finalized according to the decisions taken in face-to-face and online meetings with the Municipality team between September 2021 and January 2022. The data gathered during the information gathering, analysis and synthesis stages of the project design process, which influenced the design decisions, are described in detail in the next section.

Table 2. Management Methodology Flowchart of The SHM Project

Investigation of the Project Management Process of the Healthy Service Center	
Beginning	-Identification of the functions that may be within the scope of the SHM project. -Identification of the stakeholders of the project. -Identification of project goals and objectives. -Determination of the method of obtaining construction financing.
Planning	-Planning by determining the project management methodology that includes the execution and monitoring processes during the zoning planning, building design and construction phases.
Execution	-Establishment of a project team (determination of the authors who will prepare the static project, mechanical project, electrical project, ground investigation report). -Stakeholder synchronization, alignment of the project with user expectations and periodic review of revision requirements.
Process & Control	-Monitoring the project and identifying the revisions that need to be made in the planning and the deviations and measures in the process management stages.
End	-Finalization of the project and delivery of the building to serve the users of Sancaktepe Municipality.

2.1. Analysis and Synthesis Studies

A comprehensive SWOT analysis was conducted in terms of reviewing the duties and responsibilities of stakeholders, examining the land and its environment in detail, strengths and weaknesses, opportunities and threats to the SHM Project (Sonğur, Top & Tekingündüz, 2013). The results of the SWOT analysis are presented in Table 3 and the results of the survey conducted face-to-face with the public in the field are presented in Table4. The analysis started with a holistic assessment of the project land and its surroundings. The frontage of the immovable is 52 meters, the depth is approximately 41 meters and the surface area is 2120 m2. In the 1/5000 scale Sancaktepe Master Plan dated 24.11.2009, the immovable is partly in the park area and partly in the road area as seen in the plan example shared in Figure 2. In the 1/1000 scale Sancaktepe Implementation Zoning Plan dated 15.02.2010, the immovable is partly in the park area, partly in the administrative facility area (318m2 surface area), partly in the transformer area, partly in the road area as seen in the plan example in Figure 3. The upper scale zoning plan and the lower scale implementation zoning plan are compatible with each other (Özdemir, 2011). The neighboring immovables remain in the maximum 4-storey housing legant with TAKS: 0.40 KAKS: 0.90 construction conditions. There is a height difference of approximately 12 meters between Yenidoğan Road Street and Çağlayan Street, which the immovable fronts, and the area to be built in the application zoning plan remains at the upper elevation. Yenidoğan Road Street in the north is 20 meters wide and Çağlayan Street is 8 meters wide. In the part of the immovable reserved as a park, there are planted

pine trees with an average body height of 10 meters. People socialize on the benches placed by the municipality in the area with the tree.

On the neighboring parcel on the west side, there is a residential complex with 2 blocks with a total of 6 floors, including ground + 3 normal floors and 2 floors exposed at the basement level. The immovable on the east side is in the nature of land and there is no building on the immovable.

Figure 2. Example of 1/5000 scale Sancaktepe Master Plan

Figure 3. 1/1000 Scale Sancaktepe Implementation Zoning Plan Example

It is determined that some of the buildings in the vicinity of the project area were constructed without license and supervision, and the number of occupied buildings is very low. Although there is a need for urban transformation in the region, it is aimed that the SHM can also be used as a temporary shelter and medical intervention point in possible disasters. While there is vehicular and pedestrian mobility during the day, pedestrian mobility is almost non-existent in the evening. On Yenidoğan Road Street, there are shops and economic markets to meet daily needs in the independent sections on the road level.

It is determined that the income level of the people of the region is generally at the minimum wage level, and the education level is mostly at the level of primary and secondary school graduation. There is a low-income social environment in the region, which was established a generation before by people from the Eastern Black Sea and Eastern Anatolia Regions, the majority of whom received secondary education under the age of 25, primary education between the ages of 25-40, and basic education above the age of 40. Again, it is seen that the socio-cultural and economic situation of the people of the region is reflected in the built environment in the vicinity of the project land.

Table 3. SWOT Analysis

Strong points	**Weak points**	**Opportunities**	**Threats**
Municipality's support (provision of documents and information, prompt	The legends in the current implementation zoning plan are	Easy accessibility for pedestrians due to its frontage to two roads	Yunus Emre Neighborhood Headman's Office will be located

administrative decisions and land allocation)	not suitable for the project function		within the same project
The contractor and financier for the construction of the center are identified from the beginning of the process	The small and insufficient area where the project will sit on the land	Having a sloping land topography that provides diversity in physical activities	In the headman's section, there are issues that the headman says must be there and narrowing the usage area of the healthy life center at th e road level.
The selected land is located at a point that is easily accessible to the people of the 3 neighborhoods with high demand	Adhering to the donor's stipulated construction cost	Adding a new vision to health services in the district and setting an example for neighboring districts	
The presence of a large number of mature pine trees on the project site		Sancaktepe Municipality will organize various activity areas in the wooded area	

3. Findings and Discussion

In the study area, a face-to-face survey was conducted with people living in the region. A total of 66 people, 40 women and 26 men, were included in the survey. Randomly selected citizens residing in the region for at least 3 years constituted the sample group of the study. The age range of the participants was 18-65 years; 46% had primary school education, 15% had secondary school education, 24% had high school education, and 15% had

undergraduate and graduate education. 58% said that they had lived in the region for more than 10 years. Almost all of the participants stated that they first applied to public hospitals when they got sick, adding that there was no health institution or organization nearby. Even for health support services such as injections, dressings, intravenous access, etc., they stated that they had difficulties due to the lack of a nearby center.

A 5-point Likert scale questionnaire developed by the researcher was used as a data collection tool (Chomeya, 2010). The options in the five-point Likert scale questionnaire form are listed as "Strongly Disagree (1)", "Disagree (2)", "Undecided (3)", "Agree (4)", "Strongly Agree (5)". A 10-item questionnaire was prepared to determine the content of the Healthy Life Center's needs program. The findings resulting from the analysis of the questionnaire study created for the purpose of this research are summarized in Table 4 as frequencies and percentages. The data obtained through the questionnaire were evaluated in detail together with the stakeholders of the project. It was agreed by the stakeholders that the options higher than 75% of the participants' answers to the questionnaire questions as agree or strongly agree would be guiding in determining the scope of the center's needs program. Again, by analyzing the information notes taken from face-to-face interviews, the quantitative and qualitative characteristics, capacity and interrelation of the service units to be located in the center were determined and user comfort was prioritized in the architectural design.

Table 4. Survey Results

		Strongly Disagree (1)	Disagree (2)	Undecided (3)	Agree (4)	Strongly Agree (5)
What is your opinion on the opening of an Integrated Health Service Center in Yenidoğan?	**f**		-	-	2	64
	%	-	-	-	3	97
What is your opinion on the opening of a Nutrition and Obesity Counseling Unit?	**f**	2	2	2	8	52
	%	3	3	3	12	79
What is your opinion on the opening of a Psychological Counseling Unit?	**f**	4	-	-	10	52
	%	6	-	-	15	79
What is your opinion on the opening of an Emergency Health Services (injection, dressing, simple interventions, etc.) Unit?	**f**	2	4	-	6	54
	%	3	6		9	82
In cases where you cannot reach your family physician, what is your opinion about receiving support services from a referring medical doctor?	**f**	-	-	-	8	58
	%	-	-	-	12	88
What is your opinion on the opening of an Oral and Dental Health Services Unit?	**f**	-	4	4	2	56
	%	-	6	6	3	85
What is your opinion on the opening of a Physiotherapy and Rehabilitation Counseling Unit?	**f**	2	8	2	8	46
	%	3	12	3	12	70
What is your opinion on the opening of a Pregnancy and Women's Health Counseling Unit?	**f**	2	4	-	-	60
	%	3	6	-	-	91
What is your opinion on the opening of a Child Health Counseling Unit?	**f**	2	2	-	8	54
	%	3	3	-	12	82
What is your opinion on the opening of an Inpatient Medical and Surgical Intervention Unit?	**f**	29	13	8	6	10
	%	44	20	12	9	15

3.1. Design Vision and Project Planning Process

The fact that 90% of the project land is actually woodland has been one of the important parameters in the site selection as a supportive and complementary element to the function of the center (Karaçar & Fidan, 2022). Humanity has used nature for various purposes to find health. It is possible to define parks and gardens, which are a part of nature, as valuable areas where people choose to rest, have fun, be motivated, and engage in active or passive activities (Tendü & Göktuğ, 2006). The wooded area was planned to be used as a park and garden for the local people and as a physical activity and green exercise area for the clients who would come to the center. The integrated benefits and rehabilitation of nature and exercise are conceptually covered by green exercise (Durusoy & Mutuş, 2021).

Although it is aimed to keep the parking area as large as possible, the building floor area needs to be expanded in order to accommodate the units within the scope of the healthy life center. When the building floor area and the building approach distances in the zoning status are positioned together on the land, a 1/1000 scale application zoning plan amendment as shown in Figure 4 is required for the design of the healthy life center. The planning design was approved by Sancaktepe District Council and Istanbul Metropolitan Municipality Council after receiving opinions from relevant institutions and organizations in accordance with the Spatial Plans Construction Regulation (Güneş & Uzunay, 2017). Within the scope of this amendment, the function limit of the area where the building will be

constructed has expanded from 318 m2 to 502 m2, while the park area in the project area has decreased to 81.5% of the total area.

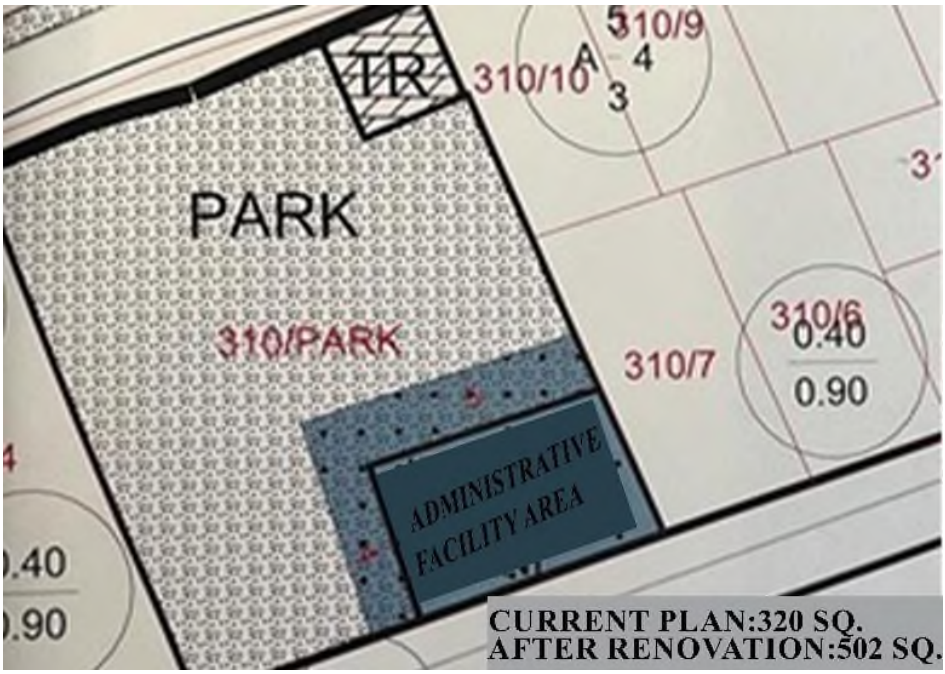

Figure 4. Comparison of The Current And Proposed 1/1000 Scale İmplementation Zoning Plan Amendment

While Yunus Emre Neighborhood Headman's Office was serving in a single-storey masonry building on the project land, the Mayor talked to the headman to vacate the site and promised to allocate a section for the headman's office in the new SHM building. While a separate building can be designed for the headman's office within the plot, a separate entrance and walkway for the headman's office is left within the main mass in order not to disrupt the integrity of the park area, allowing the two functions to be used independently under one roof. It is preferred that the SHM building

entrance is at a high elevation. At the entrance of the building, there is a windshield within the contour of the building, a two-armed staircase with an intermediate landing opposite the windshield and an elevator at the west end of the corridor provide access to the other floors.

The staircase has 18 steps, 30cm landing width and 16,67cm riser height and repeats on each floor. A space of 2.05mt*3.00mt was left for the elevator; the elevator can be used for passengers, but it can also be used as a patient stretcher elevator when necessary.

As a result of the evaluation of the findings, the units decided to be located in the center subject to the study and the relations of these units with each other have been examined in detail by the architectural author, the mayor and his team in terms of accessibility, comfort, etc. elements of the patients and clients who will receive services from the center. Thus, the design of the floor plans is shaped as follows:

The polyclinic and service units were symmetrically placed on the floor plans in the north-south direction of the floor hall and in the east-west direction of the staircase, paying attention to the lot sizes described in the legislation in force. The fact that the center of gravity and the center of mass of the building are as close to each other as possible with the symmetrical plan scheme is also welcomed by the static engineer in terms of building statics and seismicity (İdemen, 2003).

On the ground floor of the building, there are first medical intervention units, observation, dressing and injection rooms, doctor's room, consultation and breastfeeding room. On the ground floor, there is a headman service section with a separate entrance on the east side of the

entrance door of the center building. The headman area is accessed through a windbreak area outside the contour of the building. On the left side of the entrance is the neighbourhood headman's room and archive, and on the right side is the secretariat, kitchen and wc. As can be seen in Figure 5t, the area of the floor is 237m2 and 77m2 of it is reserved for Yunus Emre Neighborhood Headman.

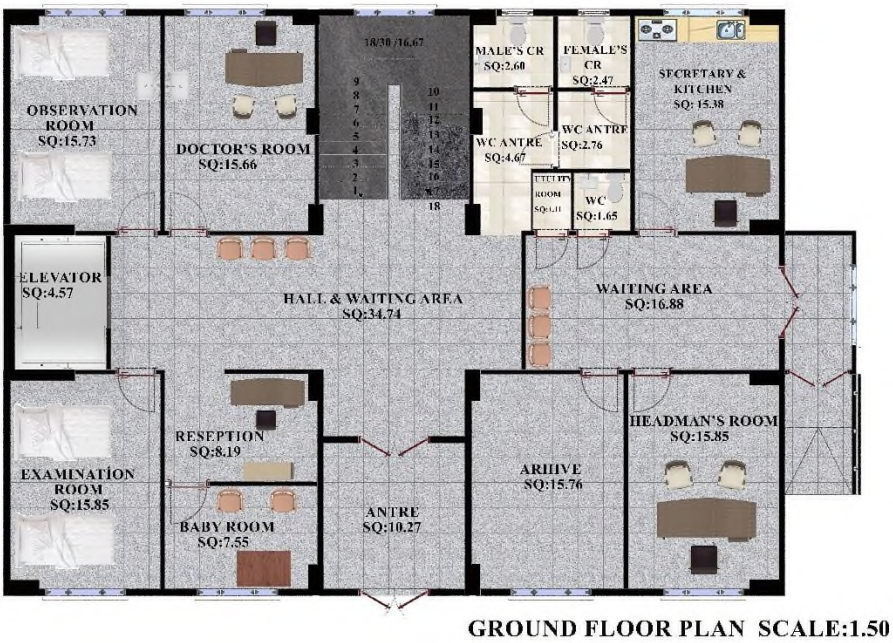

Figure 5. Ground Floor Plan

Due to the topographical features of the land, the south face of the basement floor is completely buried. Two 40m2 meeting rooms are allocated for training and information meetings to be held at the Healthy Life Center. As can be seen in Figure 6, the basement floor plan includes two psychology counseling rooms on the north side, an administrative

room on the east side, and a utility room with a door to the parking area that can be intervened from outside. As on every floor, there are male and female WCs and a cleaning room on this floor and the floor area is 228m2.

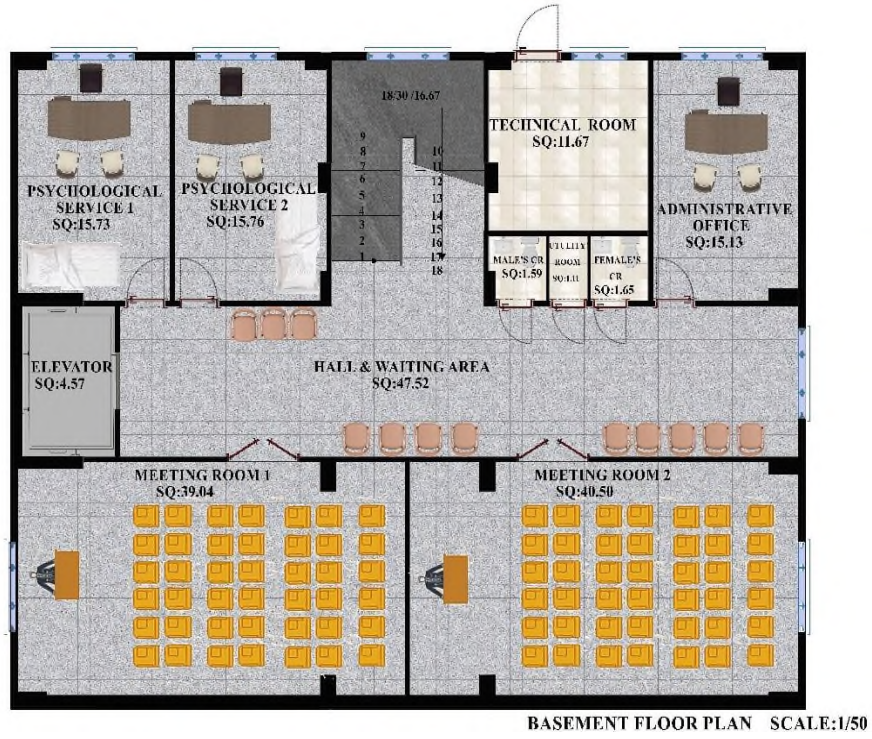

Figure 6. Basement Floor Plan

On the normal floor slab, a 1 meter overhang is used along the entrance face and a 1.50 meter overhang is used on the axis of the building entrance. There are 2 nutrition and obesity clinic rooms, general kitchen and WCs in the northern part of the normal floor plan; 2 pregnancy and women's health counseling clinic rooms, 1 child health counseling clinic room, 1 oral and dental health counseling clinic room and 1 physiotherapy

counseling clinic room in the southern part. An information desk area is left opposite the stair house for reception and guidance.

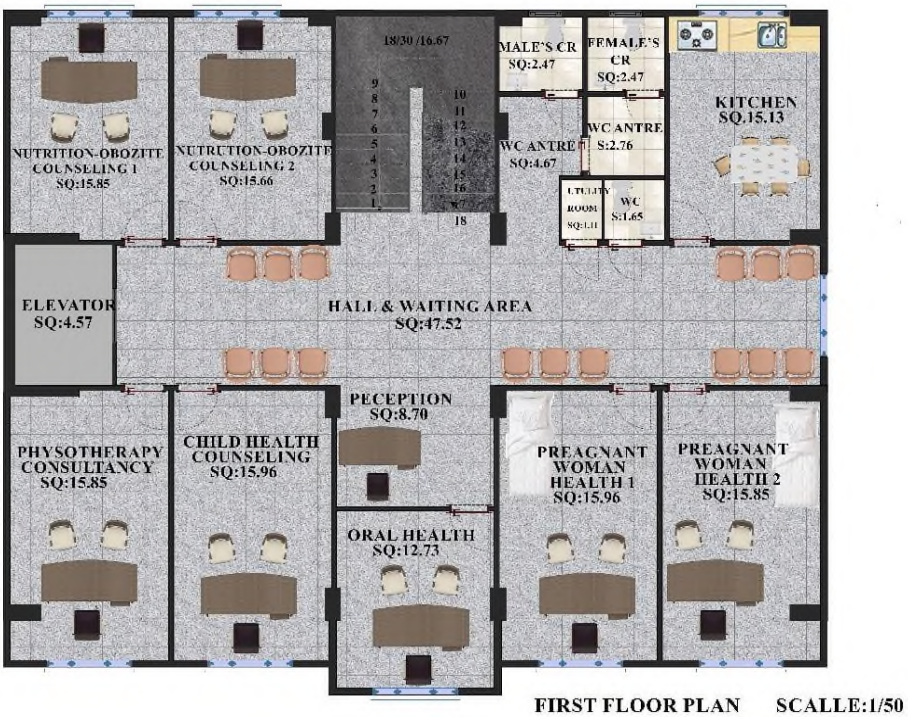

Figure 7. Normal Floor Plan

A meeting was held with the stakeholders of the project to decide on the construction technology of the wellness center. The contractor stated that he has an ongoing construction site about 2km away from the project area and that he would like to construct the building with reinforced concrete technology with a plate girder system in terms of both material and labor supply during the construction process. The contractor's proposal was considered reasonable by the project authors and the mayor. Reinforced concrete is highly preferred in Turkey because it is a construction

technology that is fast and widely known by the foremen (Özdamar Seitablaiev & Umaroğulları, 2020). With the application of correct insulation details and insulation techniques in buildings, the economic life of reinforced concrete buildings becomes even longer (Dal & Yılmaz, 2015).

The elevation difference between the two ends of the land at the building level on the high level road frontage is 0.25 meters. In determining the (+-)0.00 elevation of the building, the highest point of the building at the road level was preferred (Karadağ, 2020). The building is a 3-storey building consisting of 1 basement, ground floor and 1 normal floor. The subbasement level is 0,50 meters, the floor heights are 3,30 meters and the eave level is +7,10 meters. The slab thickness is 0.15 meters, the beams are 0.25 meters thick and 0.60 meters high.

Soil samples taken from the part where the building will sit have been examined by geological and geophysical engineers and geoscientists have reported that the building has access to solid ground at single basement level.

Figure 8. Front and Right Side Elevation of The Building

A common style was determined on each floor exposed on the facades. Repeating window ratios of 180/150 with 3 panes are used in each lot. The roof is hipped and rests on a frame made of steel tube profile. Material durability, ease of installation, thermal, water and sound insulation values are important in the choice of roofing material. Aluminium sandwich trapezoidal sheeting providing these values was preferred (Şenkal, 2004). Eaves widths are 0.60 mt and aluminum gutters and rain downpipes are left open on the facade.

3.2. Building Construction Process

The Healthy Life Center architectural project was completed in January 2022. Static, mechanical, plumbing and electrical current projects were drawn between January and April 2022. In April, the process was initiated for the issuance of the building license for the center to be built on the immovable. According to the zoning legislation, in areas where the zoning planning process has not been completed, a temporary building permit for a maximum of 10 years is granted to those who request a license until the zoning plan comes into force, provided that it is decided by the Municipal Council (Gül et al., 2020). The construction phase, which takes place after the project design and building licence approval, is defined as the construction process (Özdemir, 2023). In this way, the decision of the Municipality Council was taken on 24.05.2022 in order to start the construction of the center quickly, and the temporary building permit was issued on 02.06.2022 and the construction process started.

The land excavation, building application and the construction phase of the carrier system were completed before the end of 2022. The exterior walls are constructed of traditional brick with rough plaster and expanded polystyrene rigid foam (EPS) for thermal insulation. The faces were painted with a final layer of mineralized silicone-based paint in a dark cream tone. Polyvinyl chloride (PVC) in walnut wood color was preferred for the window joineries and aluminum based material was preferred for the entrance door. The roof structure of the building was constructed of steel and aluminum-based insulated composite panel was used as roof covering. Gypsum panel ceilings were used for easy and quick intervention in case of possible malfunctions in the installation parts, and the installation elements were hung on the floors with clips (Arısoy & Çilek, 2006). Easy-to-clean and durable granite material was preferred for the floor coverings of the center. All of the rough and fine construction works were completed in May 2023 and delivered to Sancaktepe Municipality by the contractor to be put into service.

Figure 9. Various Productions During the Construction of The SHM

Figure 10. Visualization of the SHM Building From The Road Front

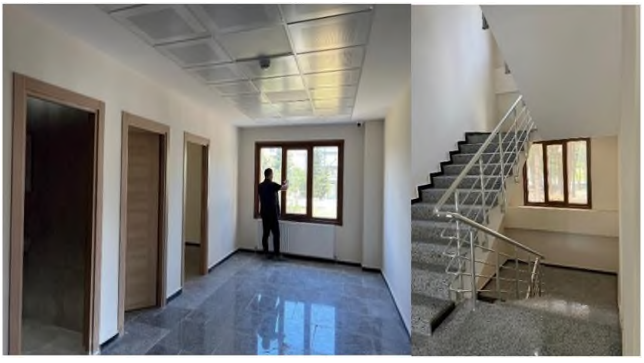

Figure 11. Interior Visuals of the SHM Building

4. Conclusion and Suggestions

This research, which aims to share the experiences gained during the process of Sancaktepe Municipality Healthy Life Center architectural design project, reveals the importance of ensuring the participation of user groups in this process. When the healthy life centers, which the Ministry of Health is trying to expand under the name of community health services, are examined, the targeted demand has not been reached in Istanbul Province. In order to ensure that the centers are used more effectively, determining the service units with user participation and designing the architectural project in the light of these decisions is targeted in this study as an important management strategy. This also involves a project management process. With a holistic approach focusing on the rapid solution of the need, the steps of initiation, planning, construction, supervision and closure are addressed. It is an implementation project that has achieved its goal by using the resources, budget and time elements required by the project management discipline (Er & Kömürlü, 2017).

For the findings obtained as a result of the study, on the one hand, an interactive, innovative approach to the architectural design process is developed, and on the other hand, important tips are presented for the new healthy life center buildings to be built within the framework of public-private partnership in our country.

Acknowledgements and Information Note

This research is based on the architectural project application of Sancaktepe Municipality Healthy Life Center, where the author is also the project author.

The article complies with national and international research and publication ethics.

Ethics Committee approval was not required for the study

Author Contribution and Conflict of Interest Declaration Information

There is only one author in the article, so it is not possible for all authors to contribute equally to the article. There is no conflict of interest.

References

Arısoy, A., & Çilek, G. (2006). Doğal havalandırma yapabilen örnek bir ofis binasında klima sistem tasarımı. *Tesisat Mühendisliği Dergisi,* 96, 5-10.

Bayır, E., Kasapseçkin, M.A., Karaçar, P., Güner, A.F., Benli, G. (2022). Ekoköyde bir sağlık yapısı örneği: Büyükkonuk aile sağlığı merkezi projesi, *Kent Akademisi Dergisi*, 15, 1, 93-108.

Chomeya, R. (2010). Quality of psychology test between likert scale 5 and 6 points. *Journal of Social Sciences*, *6*(3), 399-403.

Dal, M. & Yılmaz, D. (2015). Su-nemin yapı elemanlarına ve yapı konforuna olumsuz etkileri. *International Journal of Pure and Applied Secince*, 1 (1), 89-99.

Durmuş, A. (2022). Birinci basamak sağlık hizmetlerinin güçlendirilmesi: sağlıklı hayat merkezleri. E. Şahna & H. Akgül & Z. Selamoğlu (Ed.). *Sağlık Bilimlerinde Araştırma ve Değerlendirmeler*-I, (25-43). Ankara: Gece Kitaplığı.

Durusoy, E. & Mutuş, R. (2021). Yeşil egzersizin kronik ağrıya, fiziksel ve mental sağlığa etkileri. *İstanbul Gelişim Üniversitesi Sağlık Bilimleri Dergisi*, (14), 351-362.

Er, A. & Kömürlü, R. (2017). Rafineri projelerinde planlamanın önemi ve başarılı bir planlama için öneriler. *Kocaeli Üniversitesi, Mimarlık ve Yaşam Dergisi*, 2, 253-264, ISSN: 2564-6109.

Gül, A. & Dinç G. & Akın T. & Koçak, A. İ. (2020). Kentsel açık ve yeşil alanların mevcut yasal durumu ve uygulamadaki sorunlar. *İDEALKENT*, Kentleşme ve Ekonomi Özel Sayısı, 1281-1312.

Güneş, M. & Uzunay, M. (2017). Belediyelerde imar planlama süreci ve denetim. *Ombudsman Akademik*, (6), 161-179.

Halk Sağlığı Genel Müdürlüğü (2023). Access Address (18.07.2023): https://shm.saglik.gov.tr/shm-listesi.html,

İdemen, A. E. (2003). Bina ağırlık merkezi-rijitlik merkezi ilişkisini mimari tasarım aşamasında kuran bir uzman sistem (Yüksek Lisans Tezi). İTÜ, FBE.

Karaçar, P. & Fidan, A. (2022). Kamusal yapı olarak hastanelerde iyileştiren mimariyi etkileyen tasarım ilkelerinin değerlendirilmesi. *Gümüşhane Üniversitesi Sağlık Bilimleri Dergisi*, 11 (4), 1587-1601.

Karadağ, H. (2020). Planlı alanlar imar yönetmeliği, kentleşme ve erişilebilirlik. *Sosyal Politika Çalışmaları Dergisi*, Erişilebilirlik Özel Sayısı Cilt 1, 11-30.

Kömürlü, R. & Toltar, L. (2018). İnşaatta proje yönetimi; projenin başarısına etkisi. *Mimarlık ve Yaşam Dergisi Journal of Architecture and Life*, 3(2),249-258.

Özdamar Seitablaiev, M. & Umaroğulları, F. (2020). Dünya'da ve Türkiye'de betonarme prefabrikasyon. *Mimarlık Bilimleri ve Uygulamaları Dergisi*, 5(2), 309-320.

Özdemir, A. (2011). *İmar planlarında hiyerarşi (Yüksek Lisans Tezi), Sakarya Üniversitesi SBE.*

Özdemir, S. (2023). Mukayeseli bir inceleme: yapı denetiminde "inşaata" başlama ve yapı ruhsatında "yapıya" başlama. *Hasan Kalyoncu Üniversitesi Hukuk Fakültesi Dergisi*, 13 (25), 63-106.

Sonğur, C., Top, M. & Tekingündüz, S. (2013). Sağlık sektöründe gzft (güçlü-zayıf yönler-fırsatlar-tehditler) analizi. *Sağlıkta Performans ve Kalite Dergisi*, 5 (1), 69-99.

Şenkal Sezer, F., (2004). Metal sandviç panellerin çatı ve cephe kaplama malzemesi olarak yapıda uygulanışı ve görülen uygulama hataları. *1. Ulusal Çatı & Cephe Kaplamalarında Çağdaş Malzeme ve Teknolojiler Sempozyumu*, İstanbul, Türkiye.

T.C. Cumhurbaşkanlığı Mevzuat Bilgi Sistemi (2023). Access Address (18.07.2023): https://www.mevzuat.gov.tr/mevzuat?MevzuatNo=20507&MevzuatTur=7&MevzuatTertip=5

Tendü, Y.B. & Göktuğ, H. (2006). Sağlık bulma yönünde çevresel bir etken olarak iyileştirme bahçeler. *GOÜ. Ziraat Fakültesi Dergisi*, 23 (2), 9.

Ünüvar, B. & Acar, F. (2020). Sağlıklı hayat merkezine başvuran hastaların tercih sebeplerinin araştırılması: Karaman örneği. *Uluslararası Sağlık Yönetimi ve Stratejileri Araştırma Dergisi,* 6 (2), 317-327.

Üstündağ A. (2022) Sağlık çalışanlarının çocuk istismarı ve ihmali konusundaki farkındalığı: sağlıklı hayat merkezi örneği. *Sürekli Tıp Eğitimi Dergisi*, 31(4), 241-253.

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YOURban Transformation: The "Human Greed" as a Destructing Factor in City and the Loss of "Spirituality"

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Citation: Biçer, Ü. & Erdinç, S.Y. (2023). YOURban Transformation: The "Human Greed" as a Destructing Factor in City and the Loss of "Spirituality". Dal, M. & Karataş, L. (Eds.). **Architectural Sciences and Theory, Practice and New Approaches-II.** 2023, Chapter:5, 107-136. ISBN: 978-625-367-256-0. Iksad Publications.

1. Introduction

The modern world has embraced consumerism, which has shifted the values of society towards materialism and indulgence. This shift in values has led to a self-centred thinking where individual satisfaction is the prime focus. This has resulted in the emergence of consumption ego, which refers to the overemphasis of self-satisfaction via materialistic acquisition.

In the bustling metropolises that define our modern world, a troubling phenomenon has gradually taken hold, spreading its roots deep within the very fabric of urban life. This insidious force, known as human greed, has emerged as a potent and destructive factor that not only shapes our cities but also erodes the spiritual essence that once thrived within their confines. As towering skyscrapers reach for the heavens and the clamor of materialistic pursuits echoes through the streets, the intangible aspects of our humanity seem to fade into obscurity, leaving a void that yearns to be filled.

The relentless pursuit of wealth, possessions, and power has propelled cities into realms of unprecedented growth and prosperity. These concrete jungles, adorned with glittering facades of opulence, stand as symbols of progress and achievement. Yet, beneath the glossy veneer lies a paradoxical truth: the more we accumulate, the more we lose touch with the very essence of our existence.

The negative effects of this consumption ego can be observed in many areas, including architecture and urban planning. The human greed for wealth and power has become a major destructing factor in many fields.

Greed has influenced the decisions made for the built environment, especially related with the urban transformation process, often resulting in poorly designed buildings and public spaces. This has caused environmental damages and led to a decreased quality of life and loss of spirituality in intimate relationships for the surrounding communities.

Mankind has been in constant interaction with the natural environment since its existence. Humans, who were a part of the environment in the first periods, later became polluting it. Although many projects have been developed under the name of sustainable development/development in order to overcome the increasing environmental problems recently, it is observed that the studies are insufficient. The most important reason for this is that the regulation of human-nature relations within the market mechanism gives rise to the known contradiction in the trio of productivity-social justice-environmental protection in land use (Uysal & Akyiğit, 2012).

In this context, the primary purpose of the study is to explore and discuss the detrimental effects of physical and social corruption, as well as the loss of spirituality, within the context of urban transformation. The study aims to critically examine these issues, shedding light on the negative consequences of urban transformation on intimate relations between individuals and the overall fabric of society. By delving into these interconnected themes, it will be examined to deepen the understanding of the complex dynamics that underlie the challenges encountered in contemporary urban settings. Furthermore, this study aims to provide a comprehensive critique of these phenomena, highlighting the need for the

approaches to urban development that prioritize human well-being and foster meaningful connections between individuals.

2. Material and Method

To achieve the objectives, this study employs a multi-disciplinary approach, drawing upon various fields including architecture, urban studies and sociology. The qualitative research methods, such as visual observations and textual analysis have been employed, to gather the data. These methods enable to evaluate and interpret the experiences and perceptions of people affected by urban transformation, physical and social corruption, and the loss of spirituality. Through a critical lens, the data to identify patterns, themes, and underlying factors contributing to the identified issues will be analyzed.

By critically examining the criticism of physical and social corruption and the loss of spirituality in urban transformation and intimate relations, this study seeks to contribute to the ongoing discourse surrounding urban development. Through an analysis of the data collected, it has been aimed to touch upon the multifaceted challenges faced by individuals and societies in the contemporary urban context. Ultimately, it has been strived to foster a better understanding of these issues and provide insights that can inform more holistic and sustainable approaches to urban planning and social development.

3. Findings and Discussion

3.1. Urban Transformation: Concept, Scope and Meaning

Urban transformation / renewal / regeneration refers to the dynamic and multifaceted changes that occur within urban areas over time. It encompasses a wide range of processes and outcomes, including physical, social, economic, and environmental changes. Urban transformation can occur due to various factors such as population growth, technological advancements, economic shifts, policy interventions, and cultural dynamics. It involves the alteration of urban form, function, and character, leading to the evolution of cities and urban landscapes (Figure 1).

Figure 1. The Landscape of Fier, Albania Before the Project and After the Project, by MAU Architecture (URL 1)

Urban transformation is defined as the rehabilitation of slumped, dilapidated and unhealthy areas in urban areas, by improving them physically, socially and economically, by integrating them into the city. Accordingly, urban areas should not be seen only as physical spaces; should be considered together with its social, economic, political, legal-administrative and even cultural dimensions (Tekedar & Polat, 2020).

Donnison (1993) defined urban transformation as new ways and methods put forward to solve the problems concentrated in urban slum areas in a coordinated manner, while Roberts (2000) defined urban transformation as an integrated action trying to ensure the continuous improvement of the social, physical, economic and environmental conditions of an area.

Urban regeneration is the attempt to reverse that decline by both improving the physical structure, and, more importantly and elusively, the economy of those areas. In all regeneration programmes, public money is used as an attempt to pump prime private investment into an area (Weaver, 2001).

The scope of urban transformation is broad and covers several dimensions. Firstly, it includes the physical transformation of urban spaces, such as changes in land use patterns, the construction of buildings and infrastructure, urban expansion, and the redevelopment of existing areas. Secondly, it encompasses social transformation, including changes in demographics, lifestyles, social interactions, and community dynamics. Economic transformation is another important aspect, involving shifts in employment patterns, economic sectors, investment trends, and the development of urban economies. Lastly, urban transformation also encompasses environmental aspects, such as changes in resource

consumption, pollution levels, ecological impacts, and the sustainability of urban systems.

Urban transformation holds different meanings depending on the context and perspective. It signifies the ongoing evolution and adaptation of cities to meet the needs and aspirations of their inhabitants. Urban transformation can be seen as a response to various challenges and opportunities faced by cities, such as rapid urbanization, globalization, social inequalities, environmental degradation, and technological advancements. It involves the deliberate planning and implementation of strategies to shape the future of urban areas, aiming to create more sustainable, livable, and inclusive cities. Urban transformation also relates to the idea of urban resilience, as cities strive to effectively respond and recover from shocks and stresses while maintaining their functionality and quality of life for residents.

Urban transformation encompasses the dynamic changes that occur in urban areas, including physical, social, economic, and environmental dimensions. It involves the evolution of cities in response to various factors and challenges, aiming to create sustainable and resilient urban environments.

Hölscher and Frantzeskaki has offered three different perspectives for urban transformation which are not merely conceptual devices, they show up in cities' agendas, programmes and approaches and give guidance to practitioners. The 'transformation in cities' perspective asks practitioners to experiment with collaborative place-making approaches like urban living labs to integrate local knowledge and strengthen a sense of place

and empowerment. The ‘transformation of cities’ perspective appears as underlying integrative systems’ approach for core urban strategies such as climate change and biodiversity strategies. The ‘transformation by cities’ perspective highlights the need to invest in policy knowledge exchange between cities, for example through transnational city networks (Hölscher & Frantzeskaki, 2021).

Urban regeneration can help cities address the rising demand for land by densifying existing urban cores, particularly pockets of underused or disinvested land. Higher density is associated with economic growth and social integration. Denser, transit-friendlier cities also help lower carbon emissions, reduce pollution, and contribute to increased resilience (Wahba, Santos & Olariu, 2019).

Regeneration is not only a theme of local importance, but a global challenge that all countries must face, both developed and developing ones. Regeneration of urban areas involves not only renovations of entire streets or city blocks. Still, it is primarily about finding solutions for improving the social and economic situation of the local community The regeneration process requires in-depth analysis, comparison of case studies, and searching for good practices (ENHR, 2023).

3.2. YOURban Transformation: Negligance, Greed and Selfishness in Built Environment

Successful urban transformations, many examples of which are seen in the West, have been realized through strategic planning, collaborative and participatory planning and deliberative methods, taking into account the

local context, multi-actor and multi-sectoral coalitions, appropriate institutional organizations, and collective efforts. In Türkiye, transformation problems have been reduced to the transformation of physical space, and the social, economic and environmental dimensions of transformation have been ignored (İçli, 2011).

The primary critical approach to the state-led, property- led, transformation projects that have often been often at the forefront of the urban agenda as a reflection of neoliberal urban policies is that the projects usually haven't considered the views, expectations, and daily life of the residents of the neighborhood. Rather than solving socioeconomic problems, urban transformation projects have many times been reported to actually cause problems and lead to unjust treatment of residents (Kılıç & Göksu, 2018).

In this context, YOURban Transformation is a term proposed by the authors of this study used to describe a particular aspect of urban transformation projects, focusing on the negative influence of selfishness, greed, and ego beside the ignorance of the socio-spatial dimensions and the prioritization of physical practices during urban transformation. It refers to a phenomenon wherein these self-centered motivations drive decision-making processes, policy formulation, and resource allocation within urban development initiatives. YOURban Transformation highlights the detrimental effects that arise when individualistic interests take precedence over the collective well-being and sustainable development of urban areas.

YOURban Transformation signifies an approach where urban development projects prioritize personal gain, often at the expense of social equity, environmental sustainability, and community participation. It encompasses actions such as favoring profit-driven initiatives, neglecting the needs of marginalized groups, promoting short-term gains over long-term benefits, and disregarding the cultural, historical, and social significance of urban spaces.

This concept emphasizes the urgent need for ethical, inclusive, and participatory urban transformation processes that prioritize the common good, social justice, and environmental stewardship. By recognizing and addressing the negative impacts of selfishness, greed, and ego, urban planners, policymakers, and stakeholders can work towards fostering sustainable, equitable, and livable cities.

YOURban Transformation, is a concept that encompasses the multifaceted aspects of urban development projects characterized by the presence of selfishness, greed, and ego. It denotes a phenomenon wherein urban transformations are driven primarily by self-interest, personal gain, and the pursuit of individualistic motives, rather than prioritizing the collective well-being and sustainable development of urban communities.

In YOURban Transformation, the decision-making processes, resource allocation, and project implementation often reflect a disregard for the broader social, economic, and environmental implications of urban development. Selfishness manifests as a prioritization of personal interests and gains over the equitable distribution of resources and the enhancement of the overall urban fabric. Greed is evident in the excessive pursuit of

profit and materialistic accumulation, often at the expense of social cohesion, inclusivity, and long-term sustainability. Ego plays a role by promoting an inflated sense of self-importance and an unwillingness to engage in collaborative efforts, leading to fragmented and exclusionary urban development initiatives.

This paradigm of YOURban Transformation undermines the principles of participatory decision-making, community engagement, and the democratic governance of cities. It perpetuates inequalities, exacerbates social divisions, and undermines the potential for holistic urban development that serves the needs and aspirations of all urban dwellers.

To address the negative implications of YOURban Transformation, it is imperative to advocate for alternative approaches that prioritize collective well-being, inclusivity, and sustainable urban development. These alternative models should emphasize participatory decision-making, equitable resource allocation, and the integration of diverse perspectives to foster socially just, economically resilient, and sustainable cities.

3.2.1. Corruption in the built environment

Corruption in the built environment during urban transformation projects refers to the abuse of power, bribery, fraud, or other unethical practices that occur within the context of urban development initiatives and loss of the identity and intimacy in spatio-social structure. This type of corruption can occur at various stages of the project lifecycle, including planning, design, construction, and post-construction phases.

One of the common issues faced in urban design is the overdevelopment of land to maximize profits, resulting in the destruction of natural habitats and the displacement of local communities. In areas where greed dominates over social responsibility, the importance of sustainability and eco-friendliness is often overlooked. This disregard for the environment can lead to significant problems such as air pollution, resource depletion, and strain on infrastructure resulting in social disintegration.

Furthermore, the impact of corruption on urban design and architecture is immeasurable. Demolitions carried out under the concepts of urban renewal, transformation and revitalization since the emergence of the urbanization phenomenon show how the actions of construction and demolition are conditioned to each other: activities of demolishing existing structures in potential rent areas, architectural construction practices based on erasing traces of a certain historical period or symbolic architectural references, war and regional references, the destruction of the cities in the region as a result of the conflicts and the subsequent proposal projects (Uz & Ateş, 2020). Many contractors and politicians around the world are more interested in their personal profits than the well-being of their communities. This often leads to the building of sub-par structures or projects that are overpriced or of low-quality, with the objective of making a quick profit before leaving minimal resources behind for maintenance or improvement. In the long run, this situation can lead to structural damages and the disarray of carefully planned urban designs.

Corruption in the built environment can take various forms. For instance, officials responsible for granting permits or approvals may demand bribes

in exchange for favorable treatment or expedited processes. Contractors and suppliers may collude with officials to inflate project costs, resulting in financial loss for the government and substandard infrastructure.

The consequences of corruption in urban transformation projects are far-reaching. It can lead to poor-quality construction, delays, cost overruns, and compromised safety standards. Moreover, corruption erodes public trust in institutions and hampers sustainable urban development by diverting resources away from essential public services and infrastructure. Overall, addressing corruption in the built environment during urban transformation projects is crucial for ensuring efficient resource allocation, promoting sustainable development, and fostering trust between citizens and governing bodies.

3.2.2. Effects of human greed and consumption ego

Human greed and consumption ego have had significant destructive effects on urban transformation. Firstly, these traits often lead to unsustainable patterns of development, where short-term profit and personal gain take precedence over long-term environmental and social considerations. This results in the unchecked expansion of cities, leading to the destruction of nature, deforestation, and loss of biodiversity. Urban sprawl fueled by greed further strains resources and infrastructure, leading to increased pollution, traffic congestion, and decreased quality of life for residents.

Moreover, the pursuit of personal wealth and materialistic desires often leads to overconsumption, which puts immense pressure on resources and exacerbates environmental degradation. Increased consumption drives the demand for energy, water, and raw materials, leading to overexploitation,

pollution, and waste generation. This unsustainable consumption pattern perpetuates a vicious cycle of environmental degradation, affecting not only urban areas but also the global ecosystem.

Critically, human greed and consumption ego contribute to social and economic inequalities within cities (Figure 2). The relentless pursuit of profit often leads to the displacement of marginalized communities, as urban spaces are transformed to cater to the wealthy.

Figure 2. The Gap Between Rich and Poor is Closing! (Erdinç & Gür, 2017) (URL 2) *(English translation of the text in image: As you can see, there is no gap between the rich and the poor. The gap is closing fast!)*

Gentrification and rising property prices push out low-income residents, leading to social segregation and the loss of community cohesion. Türk states (2018) that gentrification and rising property prices push out low-income residents, leading to social segregation and the loss of community cohesion. Additionally, excessive consumption patterns create a culture of

materialism, promoting status-driven lifestyles and further widening the gap between the rich and the poor.

In conclusion, the destructive effects of human greed and consumption ego on urban transformation are evident through unsustainable development, environmental degradation, social inequality, and loss of community. Addressing these issues requires a shift towards sustainable and equitable urban planning, promoting responsible consumption, and prioritizing the well-being of both people and the environment.

3.2.3. Greedy contractors and politicians

Greedy contractors and politicians can have destructive impacts on the urban structure during the urban transformation process.

The greed of contractors and politicians bring out the damages in overall view of the cities and results as “Fikirtepe will get enough of concrete (URL 3)” (Figure 3).

Figure 3. The Fikirtepe, İstanbul Urban Transformation Project (URL 3)

Today, an 'annuity law', which is applied in spite of the public, in spite of human and vital values, is dominant in Turkey in order to expand the activities of the construction sector and open urban areas for construction. The construction capital, freed from legal obstacles, intervenes uncontrollably in places with high returns, causing irreparable damages to residential areas, forests, parks, nature, environment, intangible and tangible cultural assets (Şahin, 2015).

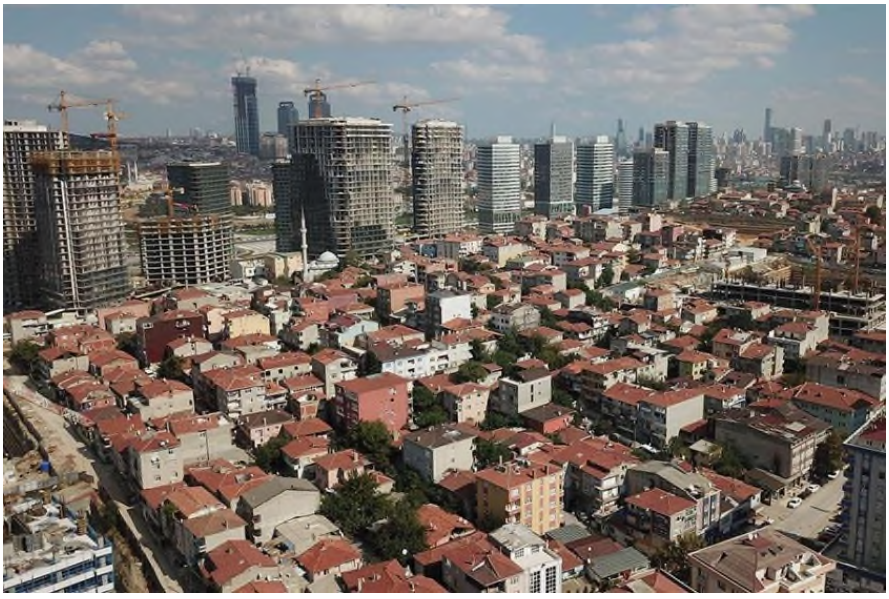

Figure 4. The Fikirtepe, İstanbul Urban Transformation Project (URL 4)

The aspects of the effect of greedy contractors and politicians can be summarized as below:

Quality Compromise: Greedy contractors focused solely on maximizing profits may compromise the quality of construction materials, techniques, and workmanship. This can result in substandard infrastructure that is

prone to premature deterioration, posing risks to public safety and requiring costly repairs or replacements.

Cost Overruns: Contractors driven by greed may engage in fraudulent practices such as inflating project costs, submitting false claims, or engaging in bid rigging. These activities can lead to significant cost overruns, burdening taxpayers and diverting funds away from other essential public services and infrastructure projects.

Time Delays: Greedy contractors may prioritize profit over timely project completion. They may intentionally extend construction timelines to prolong their involvement and maximize financial gains. These delays can disrupt urban life, inconvenience residents, and increase project costs.

Corruption and Bribery: Greedy politicians and contractors can engage in corrupt practices, to secure contracts, permits, or approvals. This undermines fair competition and transparency, distorts urban development priorities, and diverts public resources for personal gain.

Environmental Degradation: Greedy contractors may overlook environmental considerations in pursuit of profit. They may engage in unsustainable practices, such as illegal deforestation, improper waste disposal, or inadequate environmental impact assessments. These actions can lead to irreversible damage to ecosystems, biodiversity loss, and negative impacts on the overall urban environment.

Social Inequity: Greedy contractors and politicians may neglect social equity in urban development projects. They may prioritize high-profit ventures that cater to the elite, neglecting the needs of marginalized

communities. This exacerbates social inequalities, perpetuates segregation, and hampers inclusive urban development.

Lack of Long-Term Planning: Greed-driven decision-making often focuses on short-term gains rather than long-term urban planning. This can result in haphazard development, inadequate infrastructure, and an unsustainable urban structure that fails to anticipate future needs and challenges.

3.2.4.Corruption in Intimate Neighbour Relations

Corruption in intimate neighbor relations can have detrimental effects on the feeling of spirituality and community.

The sense of neighborhood among locals has always played an impactful role in shaping the built environment around us. It often leads to unique and thoughtful solutions that take into consideration the desires and needs of the individuals living in a particular area. However, the current nature of greed and corruption in society is detrimental to the development of built environments and urban design. Only by acknowledging the destructiveness of these factors can we hope to reimagine our local communities positively. In turn, this would lead to the creation of sensible urban designs and sustainable living spaces that reinforce a healthy sense of belonging and attachment to spaces.

The operations carried out in the discourse of urban transformation negatively affect the poor and unequipped segment of the society. Those living in areas intervened in the name of transformation cannot be effective in making decisions about the region they live in as a mass, and they have to comply with the decisions taken by others (İçli, 2011). This causes the

deep changes in social integrity, collectivity and lack of maintaining the urban relations, neighbourship and intimacy.

A community-driven approach, underpinned by greater accountability among contractors and politicians, could usher in a new era of architecture and urban design that balances economic gain and social welfare interests.

Lack of Trust: Corruption erodes trust among neighbors, leading to a breakdown in intimate neighbor relations. When individuals perceive their neighbors as untrustworthy, it becomes challenging to foster meaningful connections and build a sense of community. This lack of trust can hinder cooperation, collaboration, and the development of social bonds.

Selfishness and Greed: Corruption often stems from selfish motivations and a desire for personal gain. When individuals prioritize their own interests over the well-being of the community, it undermines the spirit of cooperation and collective well-being. This selfish behavior hampers the development of intimate neighbor relations and fosters an environment of individualism rather than communal support.

Loss of Reciprocity: Reciprocity involves mutual give-and-take, where neighbors support each other and contribute to the collective welfare. However, individuals may engage in exploitative practices, breaking the cycle of reciprocity and weakening the sense of community.

Diminished Social Capital: Social capital refers to the networks, norms, and trust that facilitate cooperation and collective action within a community. Corruption undermines social capital by eroding trust, weakening social norms, and reducing the willingness of individuals to

engage in civic activities. This results in a loss of shared values and a diminished sense of community spirit.

Fragmented Communities: Corruption can lead to the fragmentation of communities, where individuals become isolated and disconnected from one another. When corrupt practices prevail, individuals may withdraw from community engagement, feeling disillusioned and disheartened. This fragmentation further erodes the feeling of spirituality and the sense of belonging to a larger community.

The cultural, social and economic change that has developed with the effect of globalization and modernism causes an unsustainable natural environment to emerge with urban transformation projects of the consciousness that has turned into a consumer society. However, it transforms its new users into an "individualistic" society living in sheltered, closed, luxurious and sheltered spaces with spatial separations (Uysal & Akyiğit, 2012).

Loss of Shared Values: Culture lies at the heart of urban renewal and innovation. Creativity and cultural diversity have been the key drivers of urban success. Cultural activities can foster social inclusion and dialogue among diverse communities. Tangible and intangible heritage are integral parts of a city's identity, creating a sense of belonging and cohesion. Culture embodies the soul of a city, allowing it to progress and build a future of dignity for all (Bokova, 2016). In this sense, culture and social energy can be stated one of the most important shared values, but corruption challenges the shared values and moral principles that underpin a strong community. When corruption becomes normalized, individuals

may perceive unethical behavior as acceptable, leading to a decline in moral standards and a loss of spiritual and community-oriented values. This can create a sense of moral dissonance and contribute to a decline in the overall sense of spirituality.

3.2.5. Loss of spirituality

The statement of "loss of spirituality" has had profound implications for both the urban environment and the intimate relations between people.

In many urban settings, the emphasis on materialism, consumerism, and productivity has led to a decline in spiritual values and practices. Spirituality encompasses a wide range of beliefs, including religious and non-religious perspectives, and provides individuals with a sense of purpose, meaning, and connection to something greater than themselves. However, in urban environments driven by fast-paced lifestyles and economic pursuits, spirituality often takes a backseat, leading to a loss of inner fulfillment and a disconnection from deeper existential questions.

This loss of spirituality contributes to a number of negative consequences in urban transformation. Firstly, it leads to a disconnection from the natural world. Urbanization often involves the destruction of natural landscapes and the construction of concrete jungles, resulting in a disconnect from the rhythms of nature and the inherent spirituality found in natural environments. This separation can lead to increased stress, mental health, and a lack of connection to the broader ecological systems that sustain us. Moreover, the loss of spirituality in urban areas can contribute to a sense of isolation and disconnection between people. In a fast-paced, individualistic urban culture, there is often a lack of communal spaces and

meaningful social interactions. Spirituality often fosters a sense of interconnectedness and empathy, but its absence can result in a breakdown of intimate relations and a focus on individualistic pursuits. This can lead to feelings of loneliness, alienation, and a deterioration of social bonds, which are vital for personal well-being and community cohesion.

Critically, the loss of spirituality in urban transformation also impacts ethical considerations and moral frameworks. Spirituality often provides a moral compass and guides individuals in making decisions that prioritize the common good and ethical behavior. Without a strong spiritual foundation, urban societies may be more susceptible to unethical practices, such as corruption, exploitation, and a disregard for social and environmental justice.

In conclusion, the loss of spirituality in urban transformation has significant implications for both the urban environment and intimate relations between people. It contributes to a disconnection from nature, a breakdown of social bonds, and a weakening of ethical frameworks. Recognizing the importance of spirituality and integrating it into urban planning and design can help restore a sense of meaning, connection, and well-being in urban areas.

4. Conclusion and Suggestions

Urban transformation and the dynamics of social relationships play crucial roles in shaping our contemporary society. The transformations caused by the regeneration process bring not only epected positive consequences. They also contribute to the emergence of processes and phenomena that adversely affect the local community. Among them is a relocation of

residents who cannot afford to live in renovated tenement houses, and gentrification begins. Some local entrepreneurs close their activities. There is also a problem with the effective use of public money and the creation of new functions in the city (ENHR, 2023).

As cities evolve and expand, they often undergo significant physical changes, accompanied by shifts in social structures and interactions. However, amidst the rapid urbanization and modernization, concerns have been raised regarding the emergence of physical and social corruption, as well as the diminishing sense of spirituality within urban environments.

The current state of our built environment is a reflection of the level of corruption in our society. When contractors and planners choose to put their interests above those of the larger community or cities, they neglect the needs of the people who live in those areas. The sense of belonging to spaces, previously a significant element of community life, gets lost, and this leads to social alienation and disintegration, in addition to the negative impact on the physical environment. Promoting pluralism and tolerance is only possible through the empowerment and involvement of local communities in the decision-making process (Ndoro, 2016).

There are, however, successful urban design and architecture projects that have emerged due to the sense of belonging in neighborhoods. These projects are characterized by the integration of the traditional and modern elements of design, paying homage to the past while incorporating solutions for the present and future. With a focus on local involvement and community engagement, these undertakings encourage and foster a sense

of ownership among locals, resulting in sustainable renewal that benefits everyone.

The evaluation and criticism of the negative factors of the urban trransformation process centers around the detrimental effects they have on urban communities, public resources, and the overall built environment. It highlights the need for stricter regulations, transparent procurement processes, independent oversight, and ethical practices to curb the influence of greedy contractors and politicians. By promoting integrity, and sustainable urban development, the destructive impacts can be mitigated and a more equitable urban environment can be fostered.

It is a sad reality that human greed is often a destructive factor in many aspects of our lives, including architecture and urban design. With the rise of consumption egos and greedy contractors, politicians and individuals in social life, many neighborhoods and built environments have been struggling to maintain a sense of community and sustainability.

In addition, it can be said that the criticism of corruption in intimate neighbor relations and its impact on spirituality and community revolves around the negative consequences it has on trust, reciprocity, social capital, and shared values. It emphasizes the need for promoting transparency, integrity, and ethical behavior within communities. By fostering a culture of trust, cooperation, and shared responsibility, it is possible to restore the feeling of spirituality and strengthen intimate neighbor relations, leading to a more cohesive and harmonious community.

The corruption in social life and built environment has been a result of greedy contractors and politicians who are more interested in increasing

their part of the pie than in providing quality infrastructure. These corrupt practices have a ripple effect on society as a whole. It inhibits the development of a sense of neighbourhood and community as citizens lose faith in their government and local authorities.

However, the sense of neighbourhood can still be preserved if communities work together towards their common goals. When people come together and both politicians and contractors are held accountable, it creates a sense of trust, which is important in the development of neighbourhoods. It is through this collaboration that citizens can take an active role in shaping their community and highlighting the importance of sustainability and community development.

In conclusion, the consumption ego has driven people towards materialism and indulgence, resulting in negative effects in architecture and urban planning. There is a need for accountability and transparency to put a stop to the corrupt practices that have stalled the development of neighbourhoods. The sense of neighbourhood can be preserved by working together towards common goals and embracing sustainability and community development.

All in all, in this intellectual journey, it has been tried to peel back the layers of urban existence, exposing the hidden truths that lie beneath the surface. Together, the societies can confront the destructive forces that threaten the very essence of our cities and rekindle the flickering flame of spirituality that resides within us all.

In this sense, it is important to the profound ramifications of human greed on cities and explore the consequential loss of spirituality. By examining

the intricate interplay between materialistic aspirations and the erosion of deeper values, it has been searched to shed light on the alarming consequences that have befallen our urban landscapes. Through a multidisciplinary lens encompassing sociology, psychology, and urban studies, it has aimed to unravel the complex web of factors that contribute to this disheartening paradigm.

Acknowledgements and Information Note

The e-book section complies with national and international research and publication ethics.

Ethics Committee approval was not required for the study.

Author Contribution and Conflict of Interest Declaration Information

1st Author % 50, 2nd Author %50 contributed. There is no conflict of interest.

References

Bokovic, I. (2016). Foreword. P. Roberts & H. Sykes (Ed.). *Culture, Urban, Future: Global Report on Culture for Sustainable Urban Development*. Paris: UNESCO. Access address (31.07.2023): https://unesdoc.unesco.org/ark:/48223/pf0000246291

Donnison, D. (1993). Trickle Down on Bubble Up?. C. McConnel (Ed.). *Agenda for Future.* London Community Development Foundation.

ENHR. (2023). Annual conference 2023-urban regeneration: shines and shadows, Lodz/Polan. Access Address (12.07.2023): https://www.uni.lodz.pl/enhr2023

Erdinç, S. Y. & Gür, Ş. Ö. (2017). Rezidans kültürü üzerine bir inceleme: İstanbul örneği. *Yakın Mimarlık,* 1(1), 68--90.

Hölscher, K. & Frantzeskaki, N. (2021). Perspectives on urban transformation research: Transformations in, of, and by cities. *Urban Transform*, 3 (2).

İçli, G. (2011). Kentsel dönüşüme ilişkin sosyolojik bir değerlendirme - Denizli örneği. *Sosyal ve Beşeri Bilimler Dergisi,* 3(1), 43-57.

Kılıç, E. M. & Göksu, A. E. (2018). Bir kentsel dönüşüm deneyimi: kadifekale-uzundere ikileminde bireysel öyküler üzerine düşünmek. *Planlama,* 28(2), 201-217.

Ndoro, W. (2016). Leveraging culture for peaceful, tolerant and socially-ınclusive cities. P. Roberts & H. Sykes (Ed.). *Culture, Urban, Future: Global Report on Culture for Sustainable Urban Development*. Paris: UNESCO. Access address (30.07.2023): https://unesdoc.unesco.org/ark:/48223/pf0000246291

Roberts, P. (2000). The evolution, definition and purpose of urban regeneration. P. Roberts & H. Sykes (Ed.). *Urban Regeneration Handbook*. London: Sage Publications.

Şahin, Ç. (2015). Türkiye'de kentsel dönüşüme dayalı inşaat odaklı ekonomi modeli ve toplumsal maliyeti: en temel insan hakları, sosyal haklar, çevre hakkı ve kent hakkı açısından eleştirel bir

değerlendirme. *Istanbul Journal of Sociological Studies,* 51, 51-81.

Tekedar, B. & Polat, E. (2020). Sürdürülebilir kentsel dönüşüm çerçevesinde Isparta kent merkezinin incelemesi. *Journal of Architectural Sciences and Applications,* 5 (1), 35-49.

Türk, Ş. S (2018). Three key ıssues of urban renewal: approaches for Turkey. *Journal of Design for Resilience in Architecture & Planning,* 2(3), 206-221.

URL 1: https://www10.aeccafe.com/blogs/arch-showcase/2018/02/08/rigjanica-in-fier-albania-by-mau-architecture//

URL 2: http://www.halkhaber.org/wp-content/uploads/2015/09/zengin-yoksul.jpg

URL 3: https://www.gazetekadikoy.com.tr/gundem/fikirtepe-nasil-donusuyor

URL 4: https://www.evrensel.net/haber/345048/fikirtepede-kentsel-donusum-esnafi-da-magdur-etti

Uysal, A. F. & Akyiğit, H. (2012). Tüketim toplumlarında kentsel dönüşüm projelerinin ve çevre-toplum anlayışının sosyolojik analizi. *Türk Kültür ve Sanat Araştırmaları Dergisi,* 1(4), 545-565.

Uz, M. P. & Ateş, B (2020). Yıkarak kentleşme: yıkma odaklı kentsel müdahaleler üzerine yeniden düşünmek. *Mimarlık,* 415, 49-53.

Wahba, S., Santos, V. J. & Olariu, R. T. (2019). Urban regeneration – a catalyst for inclusive and sustainable cities. Access address (14.07.2023):https://www.theguardian.com/society/2001/mar/19/regeneration.urbanregeneration1

Weaver, M. (2001). Urban Regeneration - the issue explained. The Guardian. Access address (16.07.2023): https://www.theguardian.com/society/2001/mar/19/regeneration.urbanregeneration1

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Rethinking Historical Settlements: Evaluation of the Historical Texture of Ankara Castle within the Framework of Historical Urban Landscape Approach

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Citation: Girgin, E. & Çeltekligil, A. (2023). Rethinking Historical Settlements; Evaluation of the Historical Texture of Ankara Castle within the Framework of Historical Urban Landscape Approach. Dal, M. & Karataş, L. (Eds.). **Architectural Sciences and Theory, Practice and New Approaches-II.** 2023, Chapter:6, 137-154. ISBN: 978-625-367-256-0. Iksad Publications.

1. Introduction

A city is defined as a settlement that is more densely populated than villages, where agricultural occupation is less, where the physical, social and cultural needs of the society are met, and which is in constant development (Keleş, 1980). Urbanization, on the other hand, is defined as the increase in the number of cities and the growth of cities through the process of population accumulation in cities in parallel with industrialization and economic development (Keleş, 1980). In addition, more comprehensive definitions of urbanization have been developed by considering multidimensional aspects of the city such as dynamics, variability, diversity and fluidity. Today, along with the positive parameters attributed to urbanization, issues such as urban poverty, social segregation, depressed areas, gentrification, inadequate infrastructure, excessive building density, ecological and climatic challenges caused by rapid and uncontrolled urbanization are discussed.

The consequences of rapid and uncontrolled urbanization are also reflected in the historical textures within the city; due to problems such as investment and speculation, failure to protect cultural heritage, change in the social fabric, insufficient infrastructure, etc., the physical, social and cultural texture of historical textures is fragmented and their texture integrity is disrupted. Consequently, contemporary approaches to the conservation of historic urban heritage include more comprehensive evaluations ranging from the conservation of architectural monuments to the evaluation of the social, cultural and economic processes of the city.

1.1.Theoretical Background

In order to form the theoretical background and framework of the study, it has become necessary to select some concepts related to urban historical textures and to explain their interrelationships. The conceptualization of historic urban areas also determines the approaches to the conservation and evaluation of these textures.

Historic urban areas have a plural, dynamic and variable character, constructed by different actors in simultaneous/different processes. The physical, social, economic and cultural change of historic urban areas is closely related to the development of the city in which they are located. Considering these parameters, it is thought that historic urban areas should be protected and developed. Based on these assumptions, the concepts of "historic area/city", "spirit of place", "historic urban landscape" have been selected in relation to historic urban areas and explained in line with international regulations, recommendations and relevant literature.

In the " Recommendation Concerning the Safeguarding and Contemporary Role of Historic Areas" (UNESCO, 1976), the concept of "historic area/city" is defined as any group of buildings, structures and open spaces in the urban or rural environment that are recognized for their archaeological, architectural, prehistoric, historical, aesthetic or sociocultural integrity and value (UNESCO, 1976). Within the definition, the urban or rural environment is directly linked to historic areas/cities through spatial, social, economic and cultural ties and affects them either statically or dynamically (UNESCO, 1976).

Along with this approach, the Québec Declaration (ICOMOS, 2008) conceptualized the "spirit of place", which refers to the preservation of the intangible as well as the tangible values of the historic environment. Tangible values such as buildings, sites, landscapes, routes, objects, and intangible values such as memories, narratives, written documents, rituals, textures, smells, etc. constitute the spirit of place by adding meaning, value, emotion and mystery to the place (ICOMOS, 2008). The spirit of place has a plural and dynamic character; it is constructed simultaneously by different actors, can change over time and belong to different groups (ICOMOS, 2008). Rather than considering tangible and intangible values as separate or in opposition to each other, the declaration describes routes along which the two mutually construct each other (ICOMOS, 2008).

In recent studies, the issue of the conservation of historic sites together with their tangible and intangible values has been brought to the agenda in relation to the social, cultural and economic processes of the city. In relation to this, the "Recommendation on the Historic Urban Landscape" (UNESCO, 2011) proposes a landscape approach for the identification, conservation and management of historic sites within their wider urban context. The "historic urban landscape" approach considers all natural features of the historic fabric, such as topography, geomorphology and hydrology, as well as the entire historic and contemporary built environment, including its spatial organization and connections. All natural and physical values of the historic fabric are evaluated together with the social, cultural and economic context. In addition, the concept of historic urban landscape does not refer to an existing situation, but to a

historical process that expresses a historical layering of cultural and natural values (UNESCO, 2011). In the decision, historic urban landscapes are seen as one of the main resources for the development, economic growth and social cohesion of cities in a changing global world. Accordingly, a sustainable, comprehensive and integrated approach to identify, assess, conserve and manage historic urban landscapes within the context of upper-scale development goals is proposed (UNESCO, 2011).

2. Material and Method

The aim of this study is to investigate an effective and comprehensive approach to the protection of our tangible and intangible cultural heritage. In this context, firstly, certain concepts related to historic urban areas are selected and explained to form the theoretical background and framework of the study. In the second part of the study, the approaches of "Historic area/city", "Historic urban landscape" and "Spirit of place", which offer a contemporary and comprehensive perspective on the conservation of historic urban areas, are examined in the case of the historic fabric of Ankara Castle and its surroundings.

3. Findings and Discussion

In this study, the concepts of "historical area/city", "spirit of place", and "historical urban landscape" are discussed in the case of Ankara Castle and its surroundings. The most important factor in choosing Ankara Castle for the discussion is that Ankara Castle, which reflects the historical texture of the capital city Ankara, exhibits a dynamic structure in itself and in its relationship with the city with its social, physical and cultural accumulation from the past to the present. In this context, firstly, the

historical process of Ankara Castle and the planning studies related to the historical texture are analyzed. Possibilities for the sustainable and effective conservation of the tangible and intangible values of the historical urban area within the framework of "historical site/city", "spirit of place" and "historical urban landscape" approaches are discussed.

Ankara Castle and its surroundings are the oldest settlement texture of Ankara. During the Ottoman period, the castle and its surroundings were a residential area and had different functions such as dungeon, soldier shelter, and protection of state assets (Urak, 2002). In the 16th century, it is known that the wealthiest segments of the city lived in and around the castle. (Günel & Kılcı, 2015) (Figure 1).

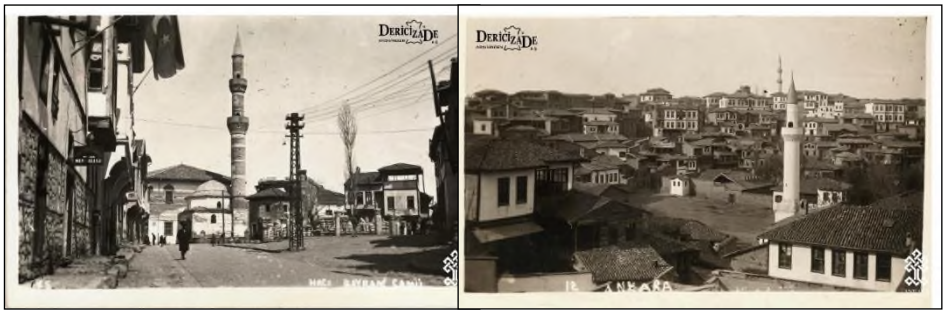

Figure 1. Old Ankara (Ankara Provincial Directorate of Culture and Tourism, 2023)

With Ankara becoming the capital in the Republican Period, Yenişehir was chosen as the new center of the city and intensive construction activities started in the city. In 1928, the first Ankara City Zoning Plan was prepared by Prof. Herman Jansen. In the plan, the castle and its surroundings were identified as a "Protocol Area" that needed to be protected and plans were made for the development of the new city. (Keleş, 2018) With this process,

the wealthy, aristocratic and bourgeois families living in and around the castle left their places and settled in the new developing areas. (Keleş, 2018) The new tenants who settled in the historical texture did not consider their places as permanent, but as temporary places that they would leave as conditions changed. (Keleş, 2018) With the population mobility in and around the castle, the economic and social fabric of the region has changed significantly (Figure 2).

Figure 2. Ulus and Yenişehir (Ankara Provincial Directorate of Culture and Tourism, 2023)

Due to the population growth in Ankara in the 1950s and the inadequacy of the current plan, the Yücel-Uybadin Plan was prepared in 1957 (T.M.M.O.B, ŞPO, 2019). In line with the plan decisions, the property texture of the historic area was fragmented and the integrity of the texture was disrupted with zoning applications such as floor increases on main streets, road expansions, etc. (T.M.M.O.B, ŞPO, 2019). In 1990, the Ulus Historic City Center Conservation Improvement Zoning Plan was approved and was canceled in 2005. Staging, financing and organizational models for the protection of the historical texture were established in the plan (T.M.M.O.B, ŞPO, 2019). In the zoning plans for the castle and its

surroundings between 2008 and 2014, it was aimed to "renew the protected areas and open them to development" (T.M.M.O.B, ŞPO, 2019). In 2014, a 1/5000 scale Master Plan for Conservation of the Ulus Historic City Center was prepared, and in 2016 it was canceled as "contrary to the principles of scientific urbanism, conservation planning techniques, national and international legal framework on conservation and public interest." (T.M.M.O.B, ŞPO, 2019) After this process, "Transitional conservation principles and terms of use" were determined(Figure 3).

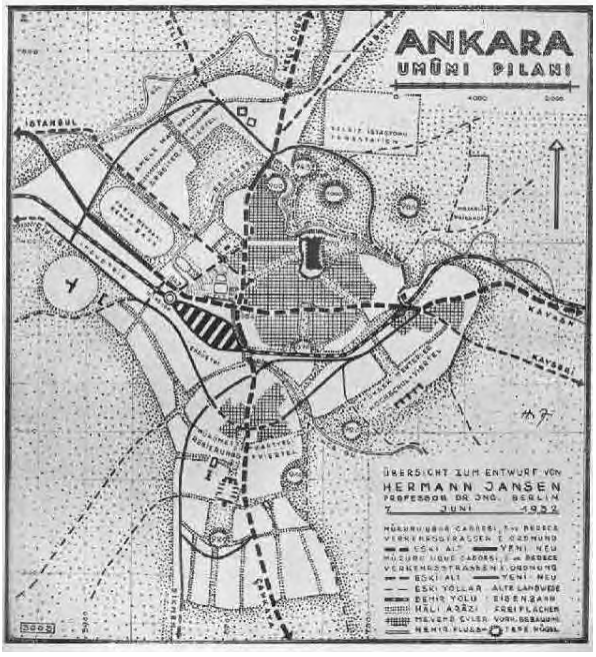

Figure 3. Ankara City Zoning Directorate, 1937, "Ankara Zoning Plan"

Today, conservation-repair works have been carried out on the inns and residences around the castle and these buildings have been given functions such as museums, commerce, hotels and restaurants. In addition, street

sanitization works have been carried out in some areas within the castle. The fact that the conservation zoning plans made for the historical texture until today have not achieved the targeted results and that new plans or revisions are constantly being made has made it necessary to put forward new insights on the conservation and development of the historical urban fabric.

Accordingly, the "Recommendation on Historic Urban Landscapes" recommends that historic areas should be defined, conserved and managed within their wider urban context, taking into account their physical, social, cultural and economic values (UNESCO, 2011). In this context, it is thought that planning studies on the historical texture of Ankara Castle have been limited to certain areas and have not established a social, economic and physical relationship with the city. The physical, social and cultural fabric of the historical texture is shaped according to the developments in the city. In turn, one of the dynamics affecting the physical, social and cultural development of the city is the developments in the historic fabric. During the Republican Period, the wealthy, aristocratic and bourgeois families living in and around the castle abandoned their homes and settled in the newly developing areas. More recently, due to urban renewal works in areas relatively close to the castle, the population in these areas has settled in the historical texture. In parallel with the development of the city, it can be said that the economic, social and physical fabric of the castle is in constant change and that there is a dynamic relationship between the castle and the city (Figure 4).


Figure 4. The Castle and The City from the Castle

From the first planning studies of the city until today, the castle and its surroundings have been considered as a tangible cultural heritage that needs to be conserved with its physical texture. However, the castle and its surroundings reflect a historical process that expresses a historical layering of physical, cultural and social values. However, it should not be forgotten that the cultural, economic and social practices from the past in the historical texture have reached the present day by multiplying, transforming and relocating, and create possibilities for future practices.

With the street sanitization works carried out in the Inner castle, it is thought that the structures, streets and open spaces that formed the physical texture of the region have been conserved, but the cultural and social values that add meaning, value, emotion and mystery to the place have not been protected (Image 4). However, it is possible to read the traces of intangible values that reflect the spirit of the place in the streets that are not street sanitized and remain in the background. The inhabitants of the castle reflect and maintain their cultural, social and economic existence by materializing spatial elements (walls, shop windows, furniture) (Picture

5,6,7,8). It should also be realized that the physical historical built environment and economic, social and cultural intangible values complement each other and that it is not possible to "separate the spirit from the space and the intangible from the tangible" (ICOMOS, 2008). It should be foreseen that areas that have been street sanitized and conserved only physically will regain their spirit through experiences. Within the scope of planning and conservation disciplines, the aim is to explore the possibilities of discovering the routes where tangible and intangible values complement and build each other and to include them as data in planning (Figure 5-7).

Figure 5. Ankara Castle, Areas of Street Sanitization

Figure 6. Ankara Castle, Back Streets

Figure 7. Ankara Castle, Back Streets

In the historical fabric of Ankara Castle, the "spirit of place" has been transmitted, reconstructed or changed over time by successive societies from the past to the present. However, today, the "spirit of place" is plural and dynamic with the presence of different users in the historic fabric.

In this context, it should be taken into consideration that the place gains its meaning, value and mystery with the awareness of all users, whether permanent, temporary, visible or invisible. The accumulation of the historical texture from the past and the diversity and mobility of users in the texture should be considered as the distinctive feature of the texture(Figure 8-10).

Figure 8. Castle, Physical, Social, Cultural Layerings

Figure 9. Castle, Physical, Social, Cultural Layerings

Figure 10. Ankara Castle, Different Users

Figure 11. Ankara Castle, Different Users

4. Conclusion and Suggestions

Depending on the results of urbanization, the physical, social and cultural texture of historical urban tissues are fragmented and their texture integrity is disrupted due to problems such as rent anxiety, failure to protect cultural heritage, change in social texture, inadequacy of existing infrastructure, etc. In this study, Ankara Castle and its surroundings, which reflect the historical texture of Ankara, are discussed in the context of the protection of historical urban areas and urbanization balance.

From the past to the present, conservation zoning plans have been made for Ankara Castle at certain intervals, but they have not achieved the targeted results. Therefore, it has become necessary to put forward new insights on the protection and development of the historical urban fabric of Ankara Castle. In this context, within the framework of the approaches of "Historic area/city", "Historic urban landscape" and "Spirit of place", which offer contemporary perspectives on the conservation of historic urban areas, the conservation studies on the historic fabric of Ankara Castle have been re-evaluated.

Accordingly, in order to ensure the sustainable conservation of this historic urban area, it is considered that all natural and physical values of the texture should be evaluated together with the social, cultural and economic context. The historic urban area is not only a tangible and stable physical environment that needs to be preserved, but like other historic urban areas, it also exhibits a dynamic structure that is in constant change with its accumulation from the past. In addition, it should be foreseen that the social, economic and physical fabric of the historic urban area is constantly

shaped depending on the developments in the city, and that the developments in the historic fabric affect the city. Based on these assumptions identified in this study, a sustainable, comprehensive and integrated approach should be taken to address, evaluate, protect and manage the historic fabric within the scope of upper-scale development goals.

Acknowledgements and Information Note

The e-book section complies with national and international research and publication ethics.

Ethics Committee approval was not required for the study.

Author Contribution and Conflict of Interest Declaration Information

All authors contributed equally to the e-book section.

There is no conflict of interest.

References

Günel, G., & Kılcı, A. (2015). Ankara şehri 1924 haritası: eski bir haritada Ankara'yı tanımak. *Ankara Araştırmaları Dergisi*, *3*(1), 78-104.

ICOMOS (2008). Québec declaration on the preservatıon of the spirit of place. Access Address (01.08.2023): https://whc.unesco.org/uploads/activities/documents/activity-646-2.pdf

Keleş, R. (1980). *Kentbilim Terimleri Sözlüğü*. Türk Dil Kurumu Yayınları, Ankara.

Keleş, R. (2018). *Eski Ankara'da bir şehir tipolojisi*. İdealkent Yayınları.

UNESCO (1976) Recommendation concerning the safeguarding and contemporary role of historic areas general conference. Access Address (01.08.2023): https://unesdoc.unesco.org/ark:/48223/pf0000114038.page=136

UNESCO (2011) Recommendatıon on the hıstorıc urban landscape, Access Address (01.08.2023): https://whc.unesco.org/uploads/activities/documents/activity-638-98.pdf

Urak, G. (2002). Kullanımda değerlendirme: Ankara Kaleiçi yenileme / işlevsel dönüşüm uygulamaları ve Ankara halkı. *Hacettepe Üniversitesi Edebiyat Fakültesi Dergisi,* 19 (1).

URL-1. Ankara İl Kültür ve Turizm Müdürlüğü (2023) Eski Ankara. Access Address (01.08.2023)https://ankara.ktb.gov.tr/TR-152389/ankara-tarihce-ve-diger-bilgiler.html

URL-2. Ankara Şehri İmar Müdürlüğü (1937) Ankara İmar Planı. Access Address(01.08.2023):https://www.academia.edu/4285200/Ankara_%C4%B0mar_Plan%C4%B1_Raporu_Prof_Hermann_Jansen_

URL-3. TMMOB, ŞPO (2023). Mekân: Ulus Ankara'da yitmekte olan kültür ve tabiat varlıkları: mekân, insan ve kentin tarihi. Access Address (01.08.2023): https://www.spo.org.tr/resimler/ekler/a97fc32b3c0b42a_ek.pdf

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Analysis of Publications on Interior Architecture Education in Scopus Database with Biblioshiny Package Software (2000-2023)

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Citation: Burkut, E. B. (2023). Analysis of Publications on Interior Architecture Education in Scopus Database with Biblioshiny Package Software (2000-2023). Dal, M. & Karataş, L. (Eds.). **Architectural Sciences and Theory, Practice and New Approaches-II.** 2023, Chapter:7, 155-176. ISBN: 978-625-367-256-0. Iksad Publications.

1. Introduction

Interior architecture; it is defined as a profession that deals with the places in terms of functionality, usability, aesthetics in order to meet the needs of individuals, and designs them in accordance with the mental and physical characteristics of the people and taxes (Saraf, 2013). The interior architecture determines the space requirements, chooses decorative elements such as color and lighting, and makes the space functional, safe and beautiful. It organizes the interior design of the buildings, functional and aesthetic. In this research, current publications on interior architecture education in the Scopus database were examined. (Hinkel, 2019; Cho & Suh, 2019; Predan, 2020; Matthews et al., 2021; Alaswad, 2022).

In this study, bibliometric analysis method was applied, and bibliometric analysis, first introduced by Pritchard, is defined as "quantitative and qualitative analysis of published academic literature to monitor the development of a particular research area over a long period of time" (Pritchard, 1969). Bibliometric analysis is a multidisciplinary baseline that provides the opportunity to look at the research from a broad perspective in order to better point the development levels of the studies done in the literature (Samiee & Chabowski, 2012). In other words, bibliometric analysis, which aims to determine the profile of studies conducted in a science or discipline, shows the systematic development of scientific knowledge production (Ruhanen et al., 2015).

When the relevant literature was reviewed, it was found that few bibliometric analysis studies were conducted in the field of interior

architecture; It has been observed that some of these studies are bibliometric studies (Yaşar, 2022). Moreover game-based learning (Çörekçi, 2023), student-customer concept (Şekerci et al., 2023), nature based patterns (Kılıç, 2023) and bibliometric and science mapping analysis (Burkut, 2023), sustainable interior design (Chou et al., 2021), creative thinking (Park & Lee, 2022), furniture design system (Zhu et all., 2023), the history of women in interior design (Turpin, 2007), health and well-being (Colenberg et al., 2021). However, no bibliometric study was found for visualization analysis using bibliometric analysis and software programs. The fact that a similar study has not been carried out and that it provides important contributions to researchers who will conduct tourist guidance studies related to communication in the future increases the importance of this study. The research questions of this study are:

1. Which publications are included in the Scopus database on "interior architecture" and "interior design education"?
2. How have the statistics of these publications changed over the years?
3. Which publication type has the most publications?
4. Which journal and institution interior architecture, what are the frequencies and percentages of the keywords or topic words of the authors in the publications?

Table 1. The Methodology of The Research All Steps

	IDENTİFİCATİON	
Assembling	**Research Question:**	1. Which publications are included in the Scopus database on interior architecture and interior design education? 2. How have the statistics of these publications changed over the years? 3. Which publication type has the most publications? 4. Which journal and institution interior architecture 5. What are the frequencies and percentages of the keywords or topic words of the authors in the publications?
	Source Quality :	Scopus® database
	Search Date	April 1, 2023-June 20, 2023
	ACQUİSİTİON	
	Search Period:	2000 to 2023
	Search Keywords:	(TITLE-ABS-KEY ("interior design education") OR TITLE-ABS-KEY ("interior design education*") OR TITLE-ABS-KEY ("interior design" AND "education") OR TITLE-ABS-KEY ("interior architecture" AND "education") OR TITLE-ABS-KEY ("interior architecture" AND "education") OR TITLE-ABS-KEY ("interior architecture studio")) AND PUBYEAR > 1999 AND PUBYEAR < 2024 .
	Total Number of Publications:	N=744
	EVALUATION	
Assessing	**Analysis Method:**	Bibliometric Analysis using Rstudio-Bibliometrix: Biblioshiny.
	Agenda Proposal Method:	Presenting the current trends of research in the field of interior architecture education and interior design education.
	REPORTING	
	Reporting Conventions:	Figures, tables, graphs, words.
	Limitations:	Data from the SCOPUS and the search was limited to the years 2000-2023.
	Source of Support:	No funding

2. Material and Method

The research methodology of this article is shown in Table 1 below. Research data were collected in the SCOPUS database between April 1, 2023 and June 20, 2023 (Url-3). In the research, publications on interior architecture education and interior design education between 2000 and 2023 were examined. A search was made in the Scopus® database with the words (TITLE-ABS-KEY ("interior design education") OR TITLE-ABS-KEY ("interior design education*") OR TITLE-ABS-KEY ("interior design" AND "education") OR TITLE-ABS-KEY ("interior architecture" AND "education") OR TITLE-ABS-KEY ("interior design studio") OR TITLE-ABS-KEY ("interior architecture studio")) AND PUBYEAR > 1999 AND PUBYEAR < 2024 .

Agenda Proposal Method: Presenting the current trends of research in the field of interior architecture education and interior design education. Analysis Method: The data of this research were analyzed with Bibliometric Analysis using Rstudio-Bibliometrix: Biblioshiny software.

3. Findings and Discussion

3.1. Analysis of all Publications on Interior Architecture Education in the Scopus Database Between 2000 to 2023

This research analysis of “interior architecture education” main information about data in this research created by Biblioshiny Package Software with Scopus Database (Table 2). According to the findings in Table 2 shows main information about data 744 document results in Scopus database between 2000 to 2023. According to the information in Table, there are 376 sources (journals, books, etc), 744 documents, Annual

Growth Rate % 4,06, Document Average Age 8, 5 and Average citations per doc 6,659 and 19579 references in the Scopus database. Also, document contents are 2811 Keywords Plus (ID) and 1593 Author's Keywords (DE). According to the information in 1439 authors and 246 Authors of single-authored docs, 310 Single-authored docs and 2, 24 Co-Authors per Doc, International co-authorships % 10, 18 in the Scopus® database with analysis R Studio – Bibliometrix: Biblioshiny software (Url-4).

Table 2. Main Information About Data in This Research Created By Biblioshiny Package Software With Scopus Database

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	2000:2023
Sources (Journals, Books, etc)	376
Documents	744
Annual Growth Rate %	4,06
Document Average Age	8,5
Average citations per doc	6,659
References	1
DOCUMENT CONTENTS	
Keywords Plus (ID)	2811
Author's Keywords (DE)	1593
AUTHORS	
Authors	1439
Authors of single-authored docs	246
AUTHORS COLLABORATION	
Single-authored docs	310
Co-Authors per Doc	2,24
International co-authorships %	10,18

DOCUMENT TYPES	
article	465
article article	3
book	14
book chapter	40
book chapter article	2
conference paper	138
conference paper article	1
conference paper conference paper	1
conference review	18
editorial	2
erratum	1
letter	4
note	5
review	37
short survey	6

Document by year there are 66 publications in 2022 with the highest number between 2000 to 2023. Then there are 63 publications in 2021, 52 publications in 2020, 49 publications in 2019, and 46 publications in 2018, 32 publications in 2017, respectively. There are 37 publications in equal numbers in 2015-2016. There are 37 publications in 2014 and 35 publications in 2013. There are 26 publications in 2012, 30 publications in 2011, 42 publications in 2010, 33 publications in 2009. There are 30 publications in equal numbers in 2007-2008. There are 16 publications in 2006, 18 publications in 2005, 9 publications in 2004, 12 publications in 2003. There are 11 publications in 2002, 8 publications in 2001, 7 publications in 2000 in the Scopus® database (Figure 1).

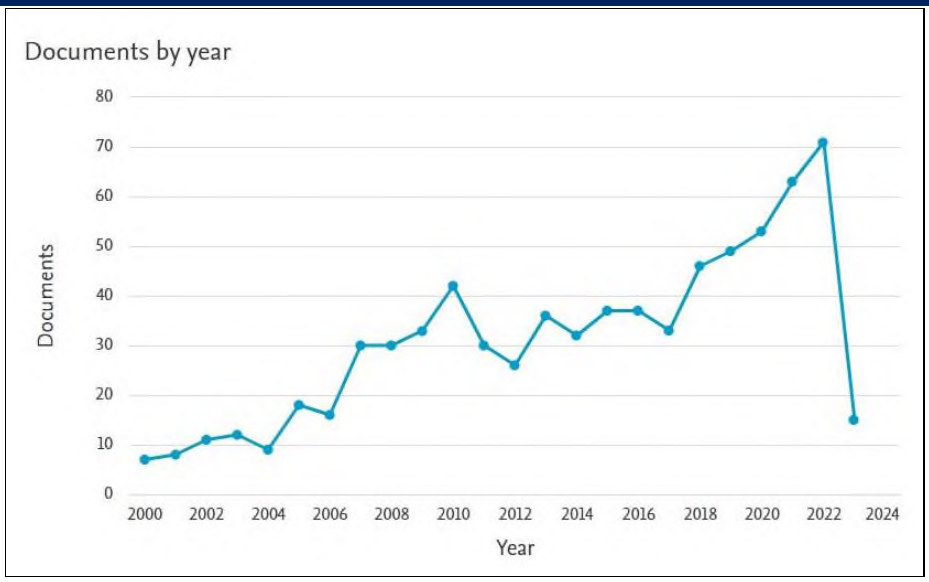

Figure 12. Document by Year (Scopus, 2023)

When the publications are examined according to the document type, there are 474 publications article types (%63.7). Also 141 publications conference paper (%19.0), 42 publications book chapter (%5.6), 37 publications review, 18 publications conference review (%2.2), book 14 publications (%1.8), short 6 publications (%0.8) and survey 6 publications equal number, note 5 (%0.7), letter 4 publications (%0.6), and editorial 2 publications (%0.3) in the Scopus database (Figure 2). Moreover, filter by sources title number of results "Journal of Interior Design" 63 publication, "International Journal of Design Education" 27 publications, "International Journal of Art and Design Education" 22 publications, "Design Principles and Practices" 22 publications.

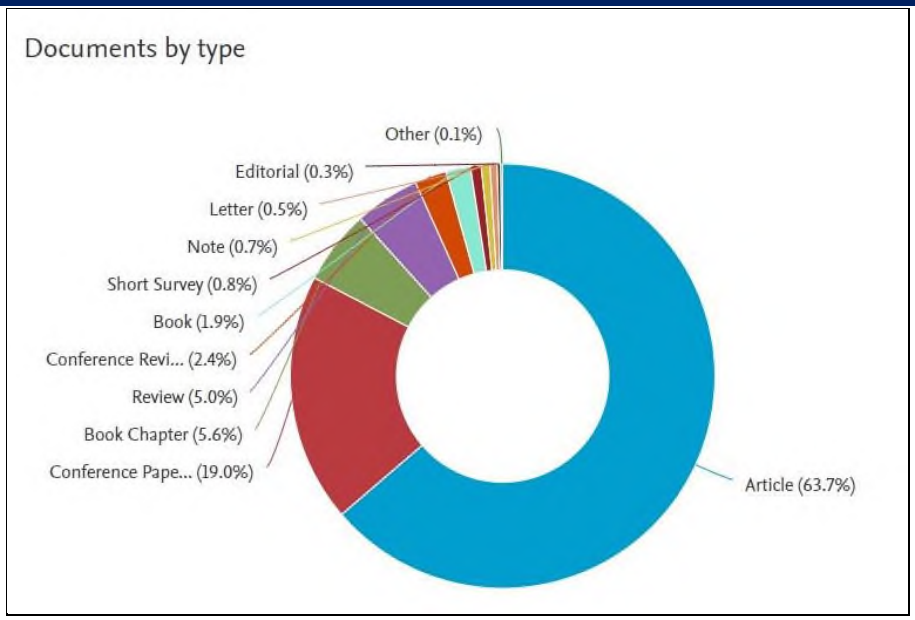

Figure 13. Document by Type (Scopus, 2023)

As seen as Figure 3 document by affiliation "Bilkent University" has 25 publications, "University of Minnesota Twin Cities" has 18 publications, "Colorado State University" has 11 publications, "Florida State University" has 8 publications and "Istanbul Technical University" has 8 publications. In addition, "Prince Sultan University" and "East Carolina University" has 7 publications, "Kyung Hee University" has 6 publications, "Arizona State University" has 6 publications and "Queensland University of Technology" has 6 publications in the Scopus database (Figure 3).

Documents by country or territory in "United States" has 276 publications, "Turkey" has 73 publications.

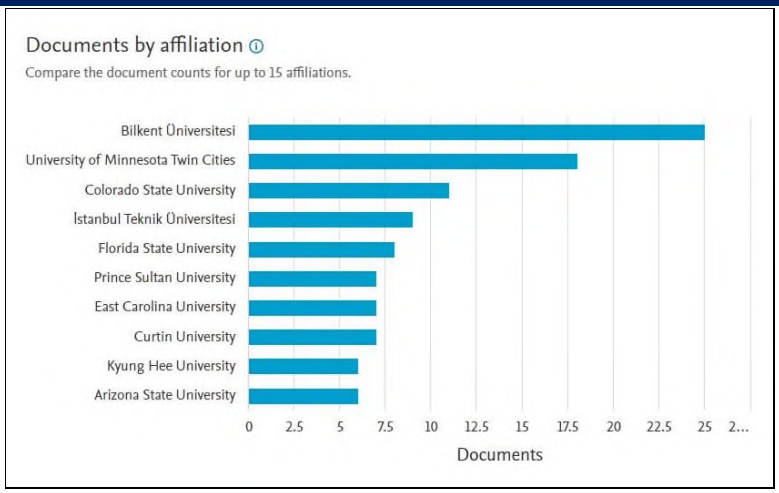

Figure 14. Document by Affiliation (Scopus, 2023)

In addition, "Australia" has 38 publications, "China" has 33 publications, 26 publications in "United Kingdom", "Canada" has 23 publications, "Saudi Arabia" has 22 publications," Poland" has 20 publications , "South Korea" has 18 publications and "Sweden" has 16 publications in Scopus database.

3.2. Bibliometric Analysis of all publications on interior architecture education with R Studio Biblioshiny Software

Moreover, filter by sources title number of results "Journal of Interior Design" 63 publications. The Journal of Interior Design has the largest number of publications. The citation list of the publications in this journal is shown in Table 3. In addition, "International Journal of Design Education" has 27 publications, "International Journal of Art and Design Education" has 22 publications, and "Design Principles and Practices" has 22 publications (Figure 4).

Tablo 3. List of most cited publications in the Journal of Interior Design

	Document titles/Article	Authors	Sources	Year	Citation
1	**"Interior design education** in the 21st century: An educational transformation"	Guerin, D.A., Thompson, J.A.A.	Journal of Interior Design, 30(2), pp. 1–12	2004	28
2	**"Interior Design** Practitioner Motivations for Specifying Sustainable Materials: Applying the Theory of Planned Behavior to Residential Design"	Lee, E., Allen, A., Kim, B.	Journal of Interior Design, 38(4), pp. 1–16	2013	25
3	"Virtual Environments for Design Research: Lessons Learned From Use of Fully Immersive Virtual Reality in **Interior Design** Research"	Kalantari, S., Neo, J.R.J.	Journal of Interior Design, 45(3), pp. 27–42	2020	24
4	"Soft Skills versus Hard Skills: Practitioners' Perspectives on **Interior Design** Interns"	Gale, A.J., Duffey, M.A.,Park-Gates, S., Peek, P.F.	Journal of Interior Design, 42(4), pp. 45–63	2017	18
5	"A Natural Balance: **Interior Design**, Humans, and Sustainability"	Sorrento, L.	Journal of Interior Design, 37(2), pp. 9–24	2012	18
6	**"Interior design's** social compact: Key to the quest for professional status"	Anderson, B.G., Honey, P.L., Dudek, M.T.	Journal of Interior Design, 33(2), pp. 5–12	2007	18
7	"Learning styles of **interior design** students as assessed by the Gregorc Style Delineator"	Watson, S.A.	Journal of Interior Design, 27(1), pp. 12–19	2001	18
8	"Understanding Spatial Ability in **Interior Design Education**: 2D-to-3D Visualization Proficiency as a Predictor of Design Performance"	Cho, J.Y., Suh, J.	Journal of Interior Design, 44(3), pp. 141–159	2019	17
9	"Diy Biophilia: Development of the Biophilic **Interior Design** Matrix as a Design Tool"	McGee, B., Park, N.-K., Portillo, M., Bosch, S., Swisher, M.	Journal of Interior Design, 44(4), pp. 201–221	2019	15
10	"Creating mature thinkers in **interior design:** Pathways of intellectual development"	Carmel-Gilfilen, C., Portillo, M.	Journal of Interior	2010	15

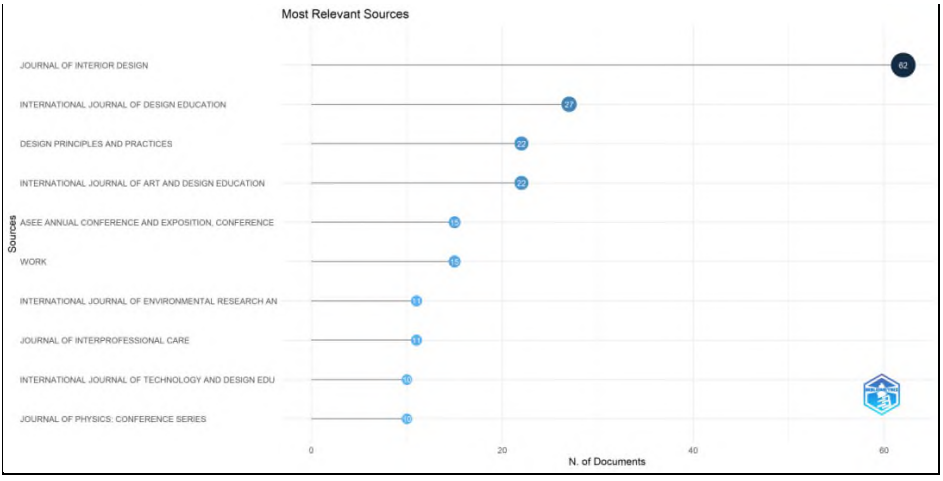

Figure 15. Most Relevant Sources

According to Figure 5 most relevant words "interior design" 121 publications (%21). The word "design education" appears in 82 publications (%14), "education" 31 publications (%5), "interior design education" 24 publications (%4), "architecture" 23 publications (%4), "design process" (%4), "sustainability" 20 publications (%3), "design" 19 publications (%3), "creativity" 18 publications (%3), "interior architecture" 16 publications (%3), "design studio" 14 publications (%2), "ergonomics" 12 publications (%2), "virtual reality" 12 publications (%2). There are an equal number of words; "collaboration" 11 publications (%2), "pedagogy" 11 publications (%2), "sustainable design" 11 publications (%2). In addition, "design thinking" obtained 9 publications (%2), "innovation" 9 publications (%2). In addition, there are an equal number

of publications. “architectural education” 8 publications (%1), “curriculum” 8 publications (%1), “design pedagogy” 8 publications (%1), “interior design studio” 8 publications (%1), “universal design” 8 publications (%1), “architectural design” 7 publications (%1), “health” 7 (%1) (Figure 5). In addition, Figure 6 shows the tree map chart of the most relevant words (Figure 6).

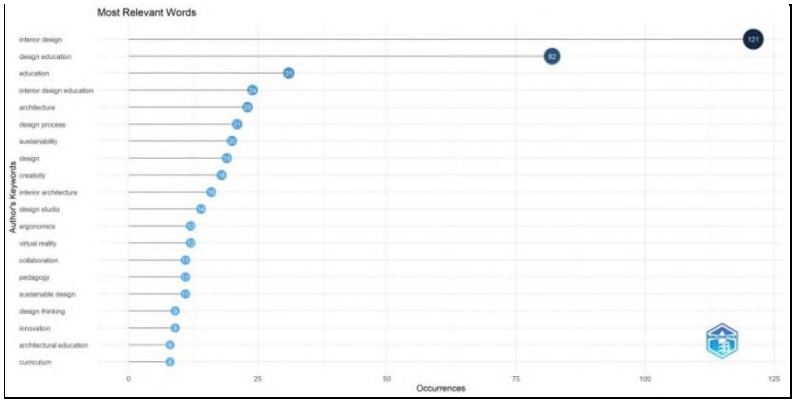

Figure 16. Most Relevant Words

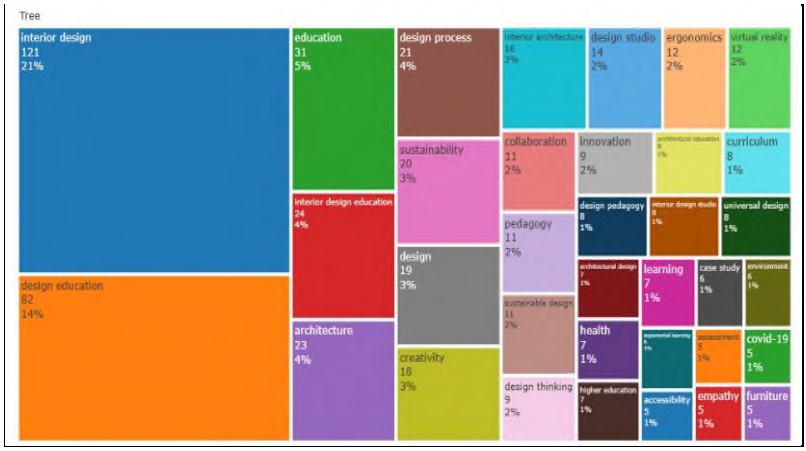

Figure 17. Tree Map Charts

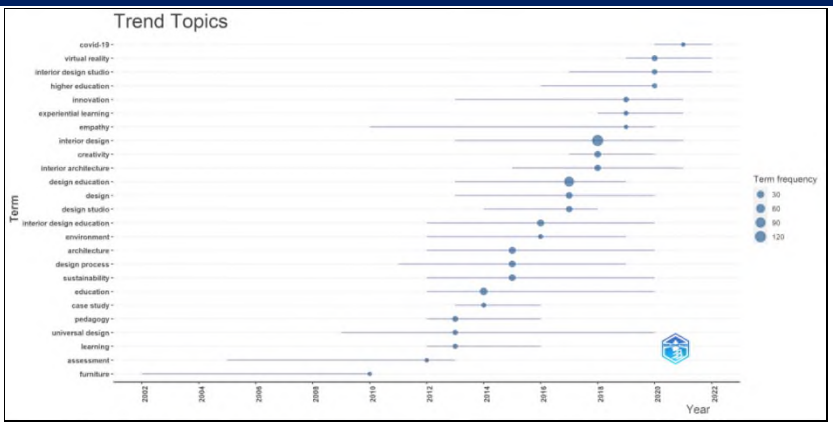

Figure 18. Trend Topic Words in Authors' Publications

(Term frequency/per year)

In Figure 7, the trend topics author keywords of the authors according to the years are seen. The size of the circles in Figure 7 shows the frequency of use of the words. On the graphic in Figure 7, the larger the circle, the higher the frequency. According to Figure 7 and Table 4 trend topics author keywords interior design 121 frequencies, design education 82 frequencies, education 31 frequencies, interior design education 24 frequencies, architecture 23, design process 21, sustainability 20. According to Table 4, interior design was most used in authors' publications between 2013 and 2021(121 frequency). Design education was most used in authors' publications between 2013 and 2019 (82 frequency). In addition, covid-19 was most used in authors' publications between 2020 and 2022 (Table 4).

Table 4. Trend Topic Words in Authors' Publications (frequency/year)

item	freq	year_q1	year_med	year_q3
furniture	5	2002	2010	2010
assessment	5	2005	2012	2013
pedagogy	11	2012	2013	2016
universal design	8	2009	2013	2020
learning	7	2012	2013	2016
education	31	2012	2014	2020
case study	6	2013	2014	2016
architecture	23	2012	2015	2020
design process	21	2011	2015	2019
sustainability	20	2012	2015	2020
interior design education	24	2012	2016	2020
environment	6	2012	2016	2019
design education	82	2013	2017	2019
design	19	2013	2017	2020
design studio	14	2014	2017	2018
interior design	121	2013	2018	2021
creativity	18	2017	2018	2020
interior architecture	16	2015	2018	2021
innovation	9	2013	2019	2021
experiential learning	6	2018	2019	2021
empathy	5	2010	2019	2020
virtual reality	12	2019	2020	2022
interior design studio	8	2017	2020	2022
higher education	7	2016	2020	2020
covid-19	5	2020	2021	2022

Figure 8. WordCloud of Keywords in Authors' Publications

4. Conclusion and Suggestions

In this research, publications related to interior architecture education were examined. Bibliometric data analysis was used in the research. The research was conducted only in the Scopus database, and all other databases were excluded. Only publications between 2000 and 2023 were included in the research. The data collection process of the research took place between April 1, 2023-June 20, 2023.

The findings of this research can give an idea to academicians, graduate students and current course contents and syllabuses doing research on interior architecture education. Future research may include publications over a larger time period. Suggestions for future research; All databases, except the Scopus database, can be searched with similar keywords, including interior architecture, interior architecture education, interior

design, interior design education, interior architecture studio, design education, and topics and keywords that can be discussed together.

In recent years, the bibliometric analysis method has been widely used in the fields of health and social sciences, but the number of publications prepared using this method in the fields of architecture and interior architecture is very few. Therefore, this research is important for interior architecture and architecture. In addition, besides the Rstudio-Bbiliyoshiny software program, analysis can be made in VOSviever, CiteSpace, ScientoPy software to contribute to the field of interior architecture. Researchers who want to specialize in this subject can create software programs in scientific research projects.

With this software, current issues such as digital design, artificial intelligence, computer-aided software can be analyzed with current interior architecture and architecture literature and contribute to the field.

Acknowledgements and Information Note

The e-book section complies with national and international research and publication ethics.

Ethics Committee approval was not required for the study.

Author Contribution and Conflict of Interest Declaration Information

The article has a single author and there is no conflict of interest.

References

Alaswad, Z. (2022). Instructional design and evaluation of a game-based learning interior design studio. *International Journal of Design Education*, 16(2).

Anderson, B. G., Honey, P. L., & Dudek, M. T. (2007). Interior design's social compact: Key to the quest for professional status. *Journal of Interior Design*, 33(2), v-xii.

Aria, M., & Cuccurullo, C. (2017). Bibliometrix: An R-tool for comprehensive science mapping analysis. *Journal of Informetrics*, 11(4), 959-975.

Burkut, E. B. (2023). Evaluation of interior architecture education research in the web of science database: bibliometric and science mapping analysis. *Journal of Architectural Sciences and Applications*, 8 (1), 385-405.

Carmel–Gilfilen, C., & Portillo, M. (2010). Creating mature thinkers in interior design: Pathways of intellectual development. *Journal of Interior Design*, 35(3), 1-20.

Cho, J. Y., & Suh, J. (2019). Understanding spatial ability in interior design education: 2D–to–3D visualization proficiency as a predictor of design performance. *Journal of Interior Design*, 44(3), 141-159.

Chou, S. F., Gunasagaran, S. & Abidin, S. N. B. Z. (2021). A systematic literature review on the sustainable interior design development in Taiwan: opportunities and challenges. *Journal of Engineering Science and Technology Special Issue on STAAUH*, 265-278.

Colenberg, S., Jylhä, T., & Arkesteijn, M. (2021). The relationship between interior office space and employee health and well-being–a literature review. *Building Research & Information*, 49(3), 352-366.

Çörekci, T. B. (2023). Game-Based learning in interior architecture education. *Design and Technology Education: An International Journal,* 28(1), 55-78.

Gale, A. J., Duffey, M. A., Park–Gates, S., & Peek, P. F. (2017). Soft Skills versus hard skills: practitioners' perspectives on interior design interns. *Journal of Interior Design*, 42(4), 45-64.

Guerin, D. A., & Thompson, J. A. A. (2004). Interior design education in the 21st century: An educational transformation. *Journal of Interior Design*, 30(2), 1-12.

Hinkel, R. U. (2019). The enduring impact of the bauhaus experiment on interior design education. *Journal of Interior Design*, 44(4), 197-199.

Kalantari, S., & Neo, J. R. J. (2020). Virtual environments for design research: Lessons learned from use of fully immersive virtual reality in interior design research. *Journal of Interior Design*, 45(3), 27-42.

Kılıç, S. (2023). The use of nature-based patterns as a tool in the interior architecture education. *Current Research in Architecture, Planning and Design*, 15.

Lee, E., Allen, A., & Kim, B. (2013). Interior design practitioner motivations for specifying sustainable materials: Applying the theory of planned behavior to residential design. *Journal of Interior Design*, 38(4), 1-16.

Matthews, C., Brown, N., & Brooks, M. (2021). Confronting lack of student diversity in interior design education. *Journal of Interior Design*, 46(4), 3-11.

McGee, B., Park, N. K., Portillo, M., Bosch, S., & Swisher, M. (2019). DIY Biophilia: development of the Biophilic Interior Design Matrix as a design tool. *Journal of Interior Design*, 44(4), 201-221.

Park, E. J., & Lee, S. (2022). Creative thinking in the architecture design studio: Bibliometric analysis and literature review. *Buildings*, 12(6), 828.

Predan, B. (2020). Circular Design in Design Education: A case study on the use of paper in interior design. *The International Journal of Design Education*, 14(4), 47.

Samiee, S.& Chabowski, B. R. (2012). Knowledge structure in international marketing: a multi-method bibliometric analysis. *Journal of the Academy of Marketing Science*, 40, 364-386.

Sorrento, L. (2012). A natural balance: Interior design, humans, and sustainability. *Journal of Interior Design*, 37(2), 9-24.

Şekerci, Y., Kahraman, M. U., & Kaya, B. E. (2023). The impact of student-customer concept on the quality of design studio courses in interior architecture education: academicians' perspective. *Online Journal of Art and Design*, 11(5).

Turpin, J. (2007). The history of women in interior design: A review of literature. *Journal of Interior Design*, 33(1), 1-15.

URL-1. Access Address (22.06.2023):
https://en.wikipedia.org/wiki/Bibliometrix

URL-2. Access Address (22.06.2023):
https://mk.gov.tr/veritabanlari/Veritabanları%20Listesi/liste

URL-3. Access Address (22.06.2023):
https://www.scopus.com/search/form.uri?display=basic#basic

URL-4. Access Address (22.06.2023):
https://www.bibliometrix.org/home/index.php/layout/biblioshiny

Watson, S. A., & Thompson, C. (2001). Learning styles of interior design students as assessed by the Gregorc Style Delineator. *Journal of Interior Design*, 27(1), 12-19.

Yaşar, D. (2022). Trends Of Research on Interiors: A bibliometric analysis of the interiors: design, architecture, culture journal. *Contemporary Issues in Architecture and Urban Planning*, 18.

Zhu, L., Yan, Y., & Lv, J. (2023). A bibliometric analysis of current knowledge structure and research progress related to sustainable furniture design systems. *Sustainability,* 15(11), 8622.

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Impregnation Methods for the Protection of Wooden Building Elements

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Citation: Bozkurt, Ö. (2023). Impregnation Methods for the Protection of Wooden Building Elements. Dal, M. & Karataş, L. (Eds.). **Architectural Sciences and Theory, Practice and New Approaches II.** 2023, Chapter:8, 177-211. ISBN: 978-625-367-256-0. Iksad Publications.

1. Introduction

Wood, being a natural material that is readily available and workable, has been one of the oldest construction materials used throughout human history. As an organic material, wood is inherently susceptible to degradation, not only due to environmental factors or usage conditions but also because of structural vulnerabilities it possesses. Biological deterioration caused by organisms, chemical degradation, thermal alterations, and moisture are the most significant factors contributing to the deterioration of wooden structures.

In traditional woodwork, preservation begins with selecting the most appropriate material based on the requirements of the intended usage location and the available resources. It continues with proper material processing and ensuring that the wood stays dry in its intended use location. Nowadays, impregnation methods have become the most commonly employed techniques for preserving wood materials and extending their service life. Some of these methods can be applied to the material before usage, while others can be carried out on-site without removing the wood from the structure.

Impregnation involves the introduction of chemical substances into wood through various methods to impart specific characteristics to the material. Impregnating agents used against organisms that utilize wood as food or shelter render the material toxic to these organisms (Zhou et al., 2023; Bozkurt, 2013). Fire-retardant impregnating agents inhibit flame spread and enhance the wood's ignition resistance (Ali et al., 2019; Aseeva et al.,

2013; Bednarek & Wietecka, 2010). Water repellent preservatives slow down the moisture changes occurring in wood. Similarly, treatment with different chemicals can impart various characteristics to wood, making it resistant not only to moisture but also to acids, alkalis, or other elements as required by the intended use (Ayanlaye et al., 2022, Jones & Brischke, 2017). This enables wood to retain its durability well beyond its normal service life.

1.1.History of Impregnation

Efforts to protect and extend the use of wood have been present throughout human history. The history of wood preservation dates back to the time when intercontinental transportation was established, around the 2nd millennium BCE. During this period, when agriculture and mining developed, wheeled vehicles became prevalent, and writing and alphabets emerged, the advancement of trade facilitated the start of overseas commerce. In other words, the construction of the first wooden ships and consequently the efforts to preserve the wood used in these ships began during this period. These preservation methods have continued for approximately 4000 years through various techniques.

The ancient Egyptians, who believed in the continuation of life after death, made efforts to preserve the bodies of both humans and animals. They constructed massive stone structures and stored bodies in wooden coffins inside pyramids. The ancient Egyptians were aware that protecting wood from moisture could preserve it for a long time. Based on this fundamental principle, they applied natural preservatives to the wooden nails used in making wooden coffins and successfully preserved these coffins for

thousands of years by keeping them inside the pyramids, isolated from soil and moisture (Graham, 1973). Although numerous preservation methods have been developed, inspired by the principles of this era, the exact nature of the protectants and preservation techniques used during that time remains uncertain even today.

In the 1000s BC, during the ancient Greek civilization, to enhance the durability of wooden structures, wooden columns were placed on stone platforms, thereby preventing their contact with water and soil. In ancient Chinese, Egyptian, Greek and Roman civilizations; vegetable, animal, and mineral oils were used to protect wood materials. For instance, olive oil and cedar oil were known to be used for wood preservation. During the 500s BC, the ancient Greeks employed a preservation technique for the wood they used in constructions. They would drill holes into the wood and then pour olive oil into these holes. Afterward, the wood was allowed to dry, which provided a form of protection and preservation (Bozkurt et al., 1993).

Throughout history, various preservation methods were experimented with for wood materials. For example, parts of the Temple of Artemis were constructed using charred and coalified wooden columns, enhancing their durability (Bozkurt, 1985). During the same period, the ancient Greeks also used a method to protect wooden structures from fire. They covered wooden towers with aluminium plates to prevent them from catching fire. This practice demonstrated the fire-resistant properties of aluminium, showing that it could act as a protective material against fire (Graham, 1973).

In 100 BC, metallic salts began to be used for protective purposes in the civilizations of Egypt and China. The wooden posts found in the ancient Roman mines in Cyprus were determined to be protected with copper (Richardson, 1993).

The first written information about wood preservation dates back to 234-149 BCE, provided by Marcus Porcius Cato. However, more comprehensive and enlightening information on wood technology and preservation was recorded by the Roman naturalist Pliny in the years 23-79 CE. Pliny, has established fundamental knowledge about wood technology and wood preservation. He noted that softwoods are more prone to decay, while certain hardwoods like cedar, cypress, and ebony can be durable even underwater. He provided information about wood-boring insects and various forms of wood decay. Additionally, Pliny compiled a list of 48 different oils that could be used for wood preservation, along with their properties and characteristics (Rackham, 1945).

The practices that can be considered as the ancestors of impregnation have been similarly employed for centuries, and there has been little significant development in terms of impregnating materials and techniques for a long time. The increase in intercontinental transportation has necessitated the need for more definitive decisions regarding wood preservation. The requirement of at least 200 wooden oars for each voyage in maritime transportation and the rapid deterioration of these oars by marine pests during the journey have brought forth this necessity. Thus, for the first time, in the years 1470-1492, an official decision was made regarding the

preservation of wooden materials used in maritime vessels (Lane, 1934). Subsequently, in 1548, paddle makers published a report stating that if the wood used in paddle construction is adequately preserved, it can withstand the demands placed upon it. Despite all these developments, the damage caused by marine pests continued to grow and persist for many countries. Finally, the complete destruction of a fleet of one hundred Spanish ships by marine pests in the West Indies in 1590 prompted more serious measures to be taken and led to an increase in research on wood preservation (Graham, 1973).

The invention of steam engines between 1630 and 1830 marked a significant milestone in industrialization. During these two centuries, the significant advancements in maritime transportation, navigation, and telegraph communication systems led to an increased demand for timber and wood materials (İlhan, 1980). Researchers and scientists focused on finding ways to preserve wood and enhance its durability during this time. In 1657, methods were developed for wood preservation involving charring the wood to turn it into charcoal, applying tar on it, and immersing it in pyroligneous acid. Over the next 150 years, various substances such as oils, adhesives, resins, rubber, salts, tar oils, and various industrial by-products were experimented with for wood impregnation (Richardson, 1993).

Starting from the 1800s, significant advancements have been made in the field of wood impregnation. In 1817, William Chapman compiled a list that included many wood impregnations still in use today, aiming to extend the service life of wood materials used in ships. However, only organic

solvent-based impregnating agents were not included in the list. In the following years, the production of iron increased worldwide, leading to the abundant production of creosote by distilling coal tar. Moreover, the development of railways, the establishment of telephone and telegraph systems, and advancements in shipbuilding brought to the forefront the need to enhance the durability of wood materials utilized in these areas. Consequently, creosote became widely used as an impregnating agent.

In 1831, Frenchman Jean Robert Breant patented a method of applying impregnation under pressure in a closed steel vessel. This can be considered the first impregnation process in the modern sense (Richardson, 1993).

In 1832, in England, Kyan used a mercuric chloride solution for the first impregnation process, effectively preserving wood used in wet environments and ropes. In 1837, Margary impregnated wood by soaking it in a solution of copper sulphate. In 1838, Burnett made a significant breakthrough in the development of basic impregnation methods by using a solution of zinc chloride under pressure. The method he developed was successfully utilized in the preservation of the Royal Navy during that era and is still known as the Burnett Method today, retaining its validity (Graham, 1973).

Afterward, Bethell developed a method for creosote impregnation, which involved first applying a vacuum and then applying pressure to achieve better penetration. This method, in which wood cells were entirely filled with creosote, became known as the "full cell method." In the following years, this method was further developed to enable its application with

different chemicals, expanding its applicability. In 1841, Payne obtained a patent for a two-stage impregnation method, in which he applied iron sulphate and then calcium sulphide.

In 1853, the Institution of Civil Engineers in London convened to create a report on wood preservation. The report covered the substances present in the structure of wood, water-temperature relationships, marine pests, fungi causing wood decay, and measures that could be taken for wood preservation (Graham, 1973).

In 1868, Clark conducted marine tests to assess the durability of wood impregnated with creosote and published the findings. He emphasized the crucial step of drying the wood prior to impregnation. The protective testing methods mentioned in Clark's report continue to be employed in similar fashion to this day. The full-cell method, which involved the application of a mixture of zinc chloride and carboxylic acid creosote, was developed by Julius Rütgers in 1870 and is still in use today.

As the 1900s approached, chemists and engineers experimented with new preservatives and methods for wood impregnation, advancing the impregnation equipment to a highly sophisticated level. Simultaneously, research was conducted on the degradation of wood caused by biological agents, and the processes of decay began to be better understood. During the early 1800s, researchers such as Benjamin Jonson and Theodore Hartig conducted studies on microorganisms that cause decay in wood. However, the development of this knowledge took time. Robert Hartig, the son of Theodore Hartig, made accurate assessments regarding the relationship between fungi and wood, which his father had noticed in 1833. He became

the first researcher to provide significant information about fungi living in wood, their habitats, and their reproductive systems. In 1878, Hartig successfully identified and determined the effects of dry rot fungi on wood (Richardson, 1993). The better recognition of biological pests that deteriorate wood has led to an improvement in the effectiveness of applied remedial methods.

In his publication titled "On the Antiseptic Treatment of Timber" in 1884, Boulton presented significant theories regarding the causes of wood deterioration. Furthermore, Boulton developed a new pressure-applying impregnation technique and enabled the impregnation of green wood material by drying it in pressurized vessels. Indeed, Boulton approached the preservation of salt metals with scepticism and instead employed oils derived from the distillation of coal tar in his applications. He conducted significant experiments on the potential usability of different substances, such as naphthalene, for wood preservation (Graham, 1973).

In 1902, more economical and practical empty cell methods were developed, which allowed only the cell walls, not the entire woody cells, to be coated with the preservative, achieving effective impregnation. The method first discovered by Wassermann was further developed by Reupping and Lowry, leading to the implementation of new and more economical empty cell methods.

The Forest Products Laboratory (USFPL) established at the University of Wisconsin in 1910 became the world's first research institute and laboratory dedicated to wood and wood preservation, accelerating research in the field of wood and wood preservation. Indeed, the institute has

provided support for the creation of significant publications in the field of wood preservation, including the renowned "Preservation of Structural Timber (Wies-1916)," which is considered a masterpiece among the publications in the area of wood preservation to this day. (Ridout, 2004). Subsequently, similar institutions and laboratories with the same objectives were established in Canada, and many other countries, and wood preservation facilities were opened. As a result, wood protection and preservation practices began to take their current form.

In 1921, in Germany, Wolman developed a method using wraps to extend the durability of wooden poles by bandaging the vulnerable parts both below and above the ground with an externally reinforced impregnation method (Bozkurt, 2009). Thus, a significant step has been taken towards the development of on-site applicable maintenance and impregnation methods.

In 1930, Shinn introduced the use of steaming and low-pressure application in the process of impregnation. In 1931, Schmittutz developed the osmosis method. In 1938, Auguste Boucherie developed the method of extracting nutrient-rich sap to facilitate the impregnation of freshly cut timber (Hunt & Garratt, 1967).

In 1946, Sten Henrikson discovered the oscillation method, which allows the impregnation of wood through variable pressure application. With hundreds of repetitions involving vacuum and pressure at each stage, Henrikson developed a new application method (Bozkurt et al., 1993). During the same years, highly effective and economical preservatives

against fungi, such as tetrachlorophenol, sodium salts, and pentachlorophenol, were developed (Becker & Theden, 1969).

In 1952, Gilward and Jonat developed the Stepped Pressure method, which allowed more effective impregnation of some hard-to-treat wood species. In 1967, Goulet introduced a method to enhance the penetration of liquids during the impregnation process by mechanically damaging the passage barriers through compression, thus facilitating the impregnation process (İlhan, 1980).

Since the 1950s, significant research and publications have been carried out in the field of wood preservation, and numerous international committees have been established. Some of these committees include the International Union of Forest Research Organizations (IUFRO), the International Research Group on Wood Preservation (IRGWP), and the European Committee for the Homologation of Wood Preservatives.

In recent years, with the introduction of biotechnology in wood preservation, advancements in the field of impregnation have accelerated. Comprehensive research has been conducted in various areas, including the characteristics of chemicals used in this field, the impregnability properties of wood, and the alterations in cellular structure after impregnation (Mai et al., 2004; Chernenko, 2017; Li et al., 2020; Aydemir et al., 2015; Park et al, 2017). Thus, in the control of biological degradation, besides traditional methods, alternative solutions can also be employed.

Furthermore, impregnation techniques are now not only applicable to solid wood but also used in the production of wood-based panels (Keskin,

2009). It is possible to produce durable panels with different properties by blending wood chips with impregnating agents and shaping them (Albano et al., 2001).

2. Material and Method

Impregnation can be applied with different techniques depending on the risk category of the application site and the type of material. In this study, impregnation techniques will be classified and discussed based on the application method as pressure methods, non-pressure methods, and on-site maintenance methods.

To enhance the effectiveness of the impregnation process, regardless of the chosen method and chemical, certain pre-treatment procedures need to be carried out accurately. In order for the protection to be permanent, the suitable environment where destructive organisms can sustain their life should be eliminated first. The preparation processes to achieve this involve cleaning the material surface, drying it, and shaping the necessary architectural details.

3. Findings and Discussion: Impregnation Methods for the Protection of Timber

3.1. Pressure Methods

Pressure methods are the most effective techniques for wood material impregnation. In facilities implementing these methods, wood material is placed inside a steel vessel, and under a certain pressure or vacuum, the impregnating agent is introduced into the cells. With this application method, the wood preservative is absorbed more effectively by the material, leading to a more homogeneous distribution and deeper

penetration into the wood. The process being conducted in completely closed vessels also enables the proper control of environmental conditions (Figure 1).

Figure 1. A Pressurized Impregnation Facility Applying The Vacuum-Pressure Method (Bozkurt, 2009).

Due to the requirement of applying pressure methods to the material before use, these methods are not applicable to old materials. Nevertheless, during restoration, they can be applied to new materials that will be used alongside the old material. For the materials to be used in contemporary wooden structures, these methods are the most suitable.

Pressure methods are generally applied based on two main principles: "full-cell" and "empty-cell" methods. In full-cell methods, the cell walls and internal voids of the material are entirely filled with the impregnating agent. Due to the high level of protection, it provides, full-cell methods are generally preferred for materials classified under high-risk categories. However, alongside its high level of protection, full-cell methods also have some drawbacks such as excessive consumption of preservatives or increasing the moisture content of the treated material. As a result, with

the continuous development of pressure methods, empty-cell methods have become increasingly preferred over time. In empty-cell methods, only the cell walls, not the entire cell interior, are saturated with the impregnating agent (Acker et al., 2023).

In pressure impregnation methods, the liquid uptake is very high until the outer surface cells become saturated. After the surface cells become saturated, the rate of liquid absorption slows down. In other words, an increase in penetration depth leads to a decrease in flow rate. The reason for this decrease is the reduction in the number of conducting vessels (tracheids) and the decrease in perpendicular pressure on the pit apertures as we go deeper. There is longitudinally applied pressure inside the cell cavities, which reduces the pressure perpendicular to the pit apertures on the outer surfaces of the cells (İlhan, 1988).

Pressure methods can be implemented using various techniques. Various applications such as low-pressure methods, oscillation, variable pressure methods, and high-pressure techniques are used in pressure methods (Zhang et al., 2020). In each of these methods, the fundamental principle is to penetrate the material with the impregnating agent using either low or high pressure. Nonetheless, they differ from each other in details, such as the type, intensity, and other application method of the chosen pressure.

3.1.1. The vacuum-pressure methods

The Vacuum-Pressure Method is one of the most effective techniques utilized in wood preservation. It is possible for the impregnating agent to penetrate deep into the wood material and distribute very effectively. Hence, the protection it provides is quite high (Archer & Lebow, 2006).

In the vacuum-pressure method, initially, low pressure is applied to the system to remove the air and moisture present in the cell voids. Afterwards, the chemical substance is transferred to the treatment tank. Following this transfer, the system is subjected to high pressure. Pressure application enables the impregnating substance to penetrate throughout the living wood. After reaching a sufficient penetration level, the impregnating substance is removed from the treatment tank, and a second vacuum process is carried out. After being conditioned for a certain period while the system remains closed, the lid of the treatment tank is opened, and the impregnation process is completed.

The amount of impregnation material transferred to the treatment tank and the quantity of impregnating agent penetrating the wood during each process can be accurately measured using scales placed on the storage tanks.

3.1.2. The double vacuum (low-pressure) methods

The double vacuum process follows the same fundamental principles as the vacuum-pressure method. However, after the double vacuum process, the remaining amount of preservative on the wood material is less. In the past, this method could only be used with solvent-based impregnating agents, but in recent years, it can also be applied with water-soluble impregnating agents (Chernenko, 2017).

In the system, an initial vacuum process, which takes about 10-15 minutes, is carried out. The vacuum process allows the removal of air and moisture from the cell voids of the wood material. However, the intensity of the low pressure applied here is not as high as in the vacuum-pressure process.

While the vacuum process continues, the treatment tank is filled with the impregnating agent, and with the help of the pressure difference between the initial vacuum and atmospheric pressure, the wood is impregnated. Afterward, the impregnating agent is taken back to the recovery tank, and the impregnation tank is emptied. The double vacuum process is completed with the final vacuum application. During the final vacuum, low pressure is applied to the material for 20-45 minutes to remove excess preservative solution. Thereafter applying low pressure for a specific duration, when the system returns to atmospheric pressure, the remaining impregnating agent on the surface is drawn into the interior of the wood, ensuring complete surface drying. While the dual vacuum method is based on the full cell principle, the lower pressure applied ensures that there is less remaining impregnating agent on the wood material's surface. The applied pressure in the dual vacuum method is typically around 2 bar, even for the most difficult-to-treat wood species (Bozkurt, 2009).

Wood materials treated with the dual vacuum method do not lose their dimensions before the process. When appropriate chemicals are chosen, the color of the material does not change following the impregnation, and biological issues are eliminated. Since the process is carried out within closed tanks under controlled conditions, it is easy to monitor and control the amount of chemical to be impregnated and the duration of the treatment.

3.2. Non-Pressure Impregnation Methods

Non-pressure impregnation methods are techniques for applying impregnating agents to wood without the use of pressure or specialized

equipment, such as vacuum pumps or closed tanks. In non-pressure impregnation methods, impregnating agents are introduced into the wood material through the cell structure's conductivity and diffusion pathways, with the assistance of hydrostatic pressure or the temperature differential effect of the applied impregnating agent.

The movement of liquids within the wood material occurs through the process of diffusion. In other words, the penetration of impregnating agents occurs through the diffusion of chemical solutions in water or oil through the cell walls. During this process, osmotic pressure is generated. In these methods, an increase in temperature and density has an enhancing effect on absorption. Moreover, the solution that wets the surface creates capillary tension, facilitating the penetration of the liquid into the wood. The force arising from capillary tension allows the flow of the chemical substance to continue vertically, against the weight of the liquid passing through the conduits, until reaching equilibrium (İlhan, 1980).

Some of the non-pressure methods can also be applied on-site to the existing material. Immersion, dipping, and Boucherie methods, on the other hand, cannot be applied on-site.

3.2.1. Boucherie methods

The fundamental principle of this method is based on the principle of displacement, where the sap present in freshly cut, unpeeled tree trunks is replaced by the impregnating agent. For the method to be successful, it should be applied within two weeks after cutting (Bozkurt et al., 1993). Due to the application principle of the method, it can only be applied to logs. Since the wood material needs to be dried before processing, this

method cannot be used even for lumbered materials. Therefore, it is not feasible to use this method during restoration projects.

3.2.2. Immersion methods

The immersion method involves immersing the wooden material in a tank containing the impregnating agent for specific periods of time. During the process, as the entire surface remains submerged in the impregnating agent, it can penetrate the wood without the need for any applied pressure. The immersion time can be applied as either short or long durations, depending on the desired penetration depth.

In the short-term immersion process, the wooden material is placed on pallets and immersed into dipping tanks. The immersion duration is adjusted based on the wood species, type of impregnating agent and solvent, geometric shape of the wood material, and its intended use. In the short-term immersion method, the absorption and penetration depth of the impregnating agent is generally lower compared to the pressure methods (Yalınkılıç, 1992). Therefore, it should be applied in usage areas with lower risk classifications. The method is applied in areas where wood constructions, such as wooden elements and exterior claddings, are used, and where there is no direct contact with the soil.

The long-term immersion method is similar in application to the short-term immersion method; however, the immersion period varies between one day and two weeks. The longer immersion period allows for greater penetration of the preservative into the wood, resulting in increased depth of impregnation (Acker et al., 2014). Wood materials impregnated with long-duration immersion can be suitable for use in high-risk environments

compared to those treated with short-duration immersion. However, the extensive application time of this method has limited its widespread use.

In general, immersion methods do not involve any pressure or temperature application to the material, making it possible to use them on old materials. The factor that limits the use of this method on old materials is its inability to be applied on-site. However, in old structures, it is possible to use this method as a more effective alternative for the impregnation of easily removable wooden elements or for the impregnation of elements removed from the surface for repair purposes compared to superficial methods.

3.2.3. Thermal impregnation methods

The method used for hard-to-treat wood species can be defined as impregnating wood under high temperature for a specific duration. The temperature can vary between 150 to 320 degrees Celsius, depending on the desired level of protection and the wood's impregnability characteristics. The effect of high temperature enables the efficient transfer of the impregnating agent into the material (Wang & Cooper, 2005).

Despite being non-pressure techniques, thermal impregnation methods share a similar application approach to the vacuum-pressure method in principle. In the thermal impregnation process, the air-dried wood material is initially immersed in a bath of hot impregnating solution. Since approximately half of the air-dried wood material's volume is filled with air, the air within the cells expands and is expelled by the heat from the hot impregnating agent. Subsequently, when the hot impregnating solution is replaced with cold impregnating agent, the air inside the cells contracts

due to cooling, creating a vacuum effect that allows the protective substance to penetrate into the cells (Bozkurt et al., 1993).

In recent years, with the increasing environmental pressure, there has been a search for alternative materials and methods for wood preservation. Studies are being conducted in Europe to develop thermal impregnation methods and apply non-toxic impregnating agents using this method as one of the alternatives. (Inari et al., 2005; Aydemir et al., 2015; Humar et al. 2020). However, the material impregnated using the thermal impregnation method, also known as Termo-wood, may undergo changes in certain properties due to the high-temperature effect.

3.3. Impregnation Techniques Applicable On-Site in Buildings

The portions of wood material that are constantly or periodically exposed to moisture and in contact with soil are considered to be the areas with the highest risk of decay and the weakest against biological activity. For instance, wooden bridge piers and beam ends used in structures are particularly vulnerable areas to risks. Nevertheless, it is not possible to dismantle and impregnate these vulnerable materials with the methods mentioned above.

The protection of these parts can be achieved by introducing concentrated impregnating salts into the material or by wrapping the material and allowing the salts to penetrate the material over time through diffusion. Alternatively, more superficial methods can be employed, such as applying or injecting impregnating agents into the material. Based on this principle, various methods have been developed.

3.3.1. Diffusion methods

Diffusion is the process of molecules of various substances in contact with each other mixing and spreading into one another due to density differences. When concentrated water-soluble salts are applied to the surface of freshly cut wood, there is a concentration gradient between the impregnating solution and the moisture inside the wood, resulting in a diffusion from the more concentrated environment to the less concentrated environment (Bozkurt et al, 1993). This fundamental principle makes it possible for the impregnating solution penetrate the depths of the material. The diffusion process occurs in two stages. In the first step, the preservative is applied to the surface using various methods. As a result, the cells present on the surface are exposed to a high concentration of the impregnating agent. In the second step, conditioning is performed to facilitate the deeper penetration of the preservative. Thus, starting from the surface cells in contact with the concentrated chemical substance, a chemical flow is initiated towards the deeper cells. High moisture content and ambient temperature increase the speed and effectiveness of diffusion (Ridout, 2004).

When diffusion methods are applied with a single salt, it is called the simple diffusion method. The double diffusion method, which involves the application of multiple salts, and osmosis methods are also considered as diffusion methods.

3.3.2. Bandage method

The bandage method, based on the principle of diffusion, has been developed to extend the service life of wooden utility poles when installed

vertically. In buried electric poles, the decay zone is located approximately 30-40 cm below and 20-30 cm above the ground-air interface. Therefore, around the poles, as seen in Figure 2, a trench is excavated at a depth of 50-60 cm. After removing any decayed parts from the pole and clearing the surrounding soil, a slurry-like impregnating agent is applied to the pole, which is then wrapped with a water-resistant covering material, and the trench is filled back in (Bozkurt et al., 1993). The slurry-like impregnating agent, moistened by the moisture of the wooden pole from the inside, diffuses into the pole through the process of diffusion. The outer cover layer prevents washing away. When the bandage is renewed approximately every five years, it is possible for the poles exposed to weather conditions to endure for many years (Bozkurt, 2009).

The bandage method can also be applied similarly to hidden columns and beams under floorings in buildings. The diffusion effect will be stronger in areas of structures that are constantly exposed to moisture, such as under roofs and wooden floorings, making the method more effectively applicable.

Figure 2. Application of the Bandage Method (Bozkurt, 2009)

3.3.3. Brushing/spraying methods

The brush application and spraying methods are the easiest but most superficial ways of using impregnating agents on wooden materials. Partial coverage of surfaces and incomplete impregnation of the live wood can lead to problems. When these methods are used, the impregnating agents penetrates the wood material through capillary action between the woody cells and the liquid applied to the surface. The longitudinal arrangement of most cells causes the longitudinal penetration of impregnating agents to always be greater than the radial penetration (Aslan, 1998). The radial penetration depth with these methods is 1-5 mm for easily and moderately treatable wood species (such as pine) and less than 1 mm for difficult and very difficult treatable species (such as larch) (İlhan, 1980). If the wood material surface is dirty or wet, the absorption amount is reduced.

The simplicity and easy accessibility of the required equipment, along with the method not requiring expertise, have made the brushing method widely used in construction projects. Most of the chemical substances used for on-site maintenance purposes in the industry are produced for application through the brushing method. However, as mentioned above, the penetration depth in the brushing method is quite low. Therefore, to increase the penetration depth, the chemical substance should be applied in two coats. The amount of protective substance absorbed by the material varies depending on different factors. These factors include the condition of the wood material surface, the anatomical structure of the wood, the

moisture content it contains, the viscosity of the impregnating substance, and surface tensions (Henriques et.al, 2010).

When it comes to impregnating large areas, such as exterior claddings of buildings, and treating roof timbers damaged by insects, the spraying method is preferred over the brush application method. Besides, the spraying process should be applied to walls affected by dry rot-causing fungi (Emerson, 2012). In this case, the sprayers to be used should have wide-mouthed spraying nozzles.

Indeed, in the spraying method, the risk of excessive chemical overspray poses potential hazards to both the applicator's health and the environment. Another important consideration is that the wood material to be impregnated with these methods should not have been previously infested by fungi and must be well-dried. This way, after the application of the protective substance, there are no cracks on the surface that could facilitate the penetration of fungi into deeper layers.

Indeed, brushing and spraying methods can be applied easily even in challenging areas where other methods might not be feasible or effective for protection. These methods have played a significant role in the widespread adoption of chemical preservation for wooden structural elements. However, due to their limited penetration depth and lower effectiveness compared to other methods, they require periodic reapplication. This situation may lead to various issues concerning the material and the environment (Furuno et al., 2003).

In the spraying method, the rough and coarse surface of the wood material increases the amount of preservative absorbed per unit area. Sawn surfaces can absorb more preservatives compared to planed surfaces.

3.3.4. Drilling/injection methods

In the drilling/injection method, holes are drilled at regular intervals perpendicular or obliquely to the fibers, and then filled with powder, liquid, or paste form of the preservative material. Once the holes are filled with the preservative material, their openings are sealed with impregnated wooden plugs. The cavity hole/injection method is particularly effective for preserving the exposed ends of beams with horizontal cuts or round wooden beams and columns that protrude outward.

The injection method also relies on the principle of injecting the preservative into the wooden material in a similar manner. In fact, this method has been known for many years and has been particularly successful in combating insects. Hickin developed practical injectors for this purpose in 1949 (Figure 3). The usage of these injectors, known as "Rentokil" and "Fetcham," is extremely easy and economical (Ridout, 2004). In the injection method, injection can be applied to existing holes such as insect tunnels or cracks on the surface of the wood material, and if necessary, minor holes can be drilled for the application. Injecting into existing insect tunnels enhances the effectiveness of the process as the chemical substance can penetrate along the channels created by the insects. The injection method is commonly used in conjunction with brushing and spraying techniques.

The cobra method is another technique that is applied using a similar principle. In areas of wood exposed to continuous outdoor conditions with a high risk of decay, the cobra method can be applied, where the impregnating agent is injected into the material with the help of a specialized tool. Using this tool, at intervals of 10 cm in the longitudinal direction and 5 cm in the transverse direction, cracks are opened to a depth of 50 mm in areas 20 cm above the ground level and 40 cm below the ground level. Then, the preservative in a slurry form is injected into these cracks (Bozkurt et al., 1993). In structures, a similar method can be applied to large-sectioned wooden elements located below and above the ground level by removing the floor covering and treating the areas accordingly. After the repair, the floor covering is reinstalled, so the holes that were opened will not be noticeable from the outside. However, this method is not suitable for historic buildings due to the deformations it creates on the applied surface.

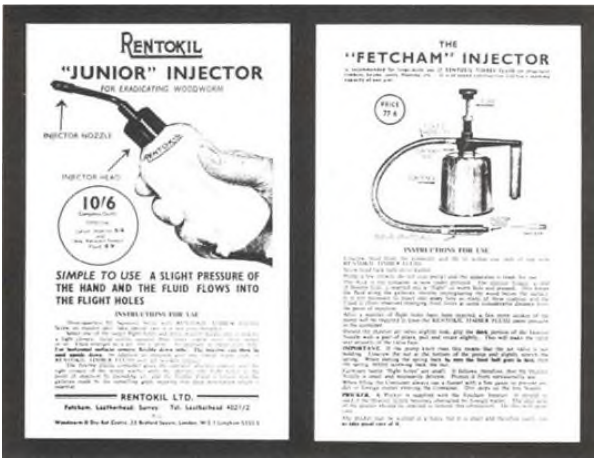

Figure 3. Rentokil - Fetcham Injectors (Ridout, 2004).

4. Conclusion and Suggestions

Wood is one of the oldest building materials in human history. Wood's unique characteristics, such as high mechanical strength relative to its lightness, good insulation properties, ease of workability, and being a natural and sustainable material, make it an exceptional building material. In our traditional building culture, the preservation of wood material is done in three main steps. These steps include selecting the most suitable wood material based on usage conditions, assembling the chosen material with the appropriate construction, and ensuring proper on-site dry maintenance. When we examine our traditional structures, we observe that these conscientiously constructed wooden buildings have stood for centuries without undergoing any chemical treatment.

In contemporary structures, the scarcity of natural resources and the demand for rapid production have led to the search for alternative materials and methods. The increased utilization of mass production methods, which involve less manual craftsmanship, has made it impractical to solely rely on traditional methods for preserving wood. Thus, the use of preservation treatments, such as impregnation processes, has become inevitable for the protection of wooden structural elements. The main reasons for using impregnation methods in wooden structures or elements can be summarized as follows:

1- Introducing wood species with low natural durability into the construction sector,
2- Extending the service life of endangered wooden elements used in historically significant structures,

3- Reducing the risk of biological infestation in new additions used in restoration projects,
4- Arresting the decay in wood elements affected by biological deterioration,
5- Providing specific properties such as water repellency or fire resistance to wood materials for specific applications,
6- Ensuring the protection of structurally designed wooden-based boards or panels against various risks.

In wooden structures, impregnation processes are applied to the building elements before construction. In other words, impregnated wood materials are used in the construction of the building. The most suitable method that can be preferred for the impregnation of these materials is the pressure impregnation method. Likewise, methods that apply pressure are the most effective in impregnating wood materials. In pressure methods, the depth of penetration of the impregnating substance is greater and more homogeneous. The process taking place within closed containers with controlled pressure and chemical amounts is also significant for environmental and human health. It ensures that the impregnating substance is absorbed more by the material, distributed more homogeneously, and penetrates deeper.

Due to the complex equipment required for pressure impregnation methods, it may not always be feasible to use this method. On the other hand, in cases where the size of the material to be treated is too small or too large, the mechanical resistance of the material is not suitable for pressurized methods, or when alternative methods with lower chemical

usage are preferred, non-pressurized preservative methods are chosen. The most commonly used non-pressurized methods include dipping, soaking, and thermal methods.

In historical structures, it may not be possible to remove the material from its place, and the old wood with low mechanical resistance may not tolerate pressure methods. Therefore, it is more appropriate to use on-site maintenance methods to avoid the risk. In restoration works, pressure methods can be used for newly added or replaced wooden elements, but for historical elements, surface application methods like brushing, spraying, injection, or diffusion methods should be preferred.

Acknowledgements and Information Note

The e-book section has produced from the doctoral thesis numbered 729, completed in 2009 at Trakya University, Institute of Natural and Applied Sciences, Department of Architecture.

The e-book section complies with national and international research and publication ethics.

Ethics Committee approval was not required for the study.

Author Contribution and Conflict of Interest Declaration Information

All authors contributed equally to the e-book section. There is no conflict of interest with the Person(s) named.

References

Acker, J.V., Bulcke, V.D., De Windt, I., Li, W. & Defoirdt, N. (2014). *Service life concept for wood products used in exterior out of ground contact conditions (p.10), Proceedings of the AWPA's 110th Annual Meeting.*

Acker, J.V., Bulcke, V.D., Forsthuber, B. & Grüll, G. (2023). Wood Preservation and Wood Finishing. Sandberg et al. (Ed.) *Handbook of Wood Science and Technology.* Springer p.793-871.

Albano, C., Ichazo, M., Gonzalez, J., Delgado, M. & Poleo, R. (2001). Effects of filler treatments on the mechanical and morphological behavior of PP+wood flour and PP+sisal fiber. *Mat Res Innovat, 4, 284-293.*

Ali, S., Hussain, S.A. & Tohir, M.Z.M. (2019). Fire test and effects of fire retardant on the natural ability of timber: a review. Pertanika Journals *Science & Technology,* 27(2), 867-895. ISSN: 0128-7680.

Archer, K. & Lebow, S.(2006). Wood preservation. In: Primary Wood Processing. Principles and Practice, Chapter 9, *297–338.* Springer, Dordrecht.

Aslan, S. (1998). *Ağaç zararlıları koruma ve emprenye teknikleri.* Ankara: KOSGEB Publishing.

Aseeva, R., Serkov, B. & Sivenkov, A. (2013). Fire protection of timber building structures and constructions. Wimmer, R. (Ed.). *Springer Series in Wood Science.* Springer (16 October 2013) (p.199-226) Print ISSN:1431-8563

Ayanleye, S., Udele, K., Nasir, V., Zhang, X. & Militz, H. (2022). Durability and protection of mass timber structures: A review. *Journal of Building Engineering.* 46, 103731 https://doi.org/10.1016/j.jobe.2021.103731

Aydemir, D. Kızıltaş, A., Kızıltaş, E.E., Gardner, D.J. & Gündüz, G. (2015). Heat treated wood-nylon 6 composites. *Composites Part-B: Engineering,*68,414-423.

Becker, G. & Theden, G. (1969). *Annual report on wood protection 1959-1960.* Berlin: Springer-Verlag.

Bednarek, Z. & Wietecka, A.K. (2010). Analysis of the fire-protection influence on wood strength. *Journal of Civil Engineering and Management,* 13(2), 79-85.

Bozkurt, Y. (1988). *Ahşap Malzemenin Korunması Semineri.* Ankara: MPM Publishing.

Bozkurt, Y. Göker, Y. & Erdin, N. (1993). *Emprenye Tekniği.* İstanbul: İstanbul University Publishing.

Bozkurt, Ö. (2009). *Tarihi yapıların restorasyonunda ahşabın biyolojik bozulmalarına karşı yerinde emprenye tekniklerinin uygulanabilirliği (Ph.D. thesis) Trakya University Institute of Natural and Applied Sciences, Edirne.*

Bozkurt, Ö. (2013). Anobium Punctatumun biyolojisi ve mücadelesinde çeşitli yöntemler. *Journal of Yapı Dünyası.* 17(210), 42-47.

Carter, R.M. (1962). Progress in wood preservation. *Journal of Forest Products.* 12(4):155-157.

Chernenko, V.A. (2017). Technology of wood impregnation by polimeric compositions. *Construction of Unique Buildings and Structures, 7(58), 32-52.*

Emerson, R.N. (2012). In Situ Repair Technique for Decayed Timber Piles. *Stuructures 2004: Building on the Past, Securing the Future.*

Furuno, T., Imamura, Y. & Kajita, H. (2003). The modification of wood by treatment with low molecular weight phenol-formaldehyde resin: a properties enhancement with neutralized phenolic-resin and resin penetration into wood cell walls. *Wood Science and Technology Journal of the International Academy of Wood Science, 1, 76-87.*

Graham, R.D. (1973). *History of wood preservation, eood deterioration and its prevention by preservative treatments*, *Vol.1*, Degradation and Protection of Wood*,* New York: Syracuse University Press

Henriques, D.F., Nunes, L. & Brito, J.D. (2010). Development of a penetration test for timber impregnation products for use in old buildings. *Construction and Building Materials,* 24(7), 1095-1100.

Humar, M., Repic, R., Krzisnik, D., Lesar, B., Korosec, R.C., Brischke, C., Emmerich, L. & Rep, G. (2020). Quality control of thermally modified timber using dynamic vapor sorption (DVS) analysis. *Journal of Forests,* 11(6), 666.

Hunt, G.M. & Garrat, G.A. (1967). *Wood Preservation.* United States: McGrav-Hill Book Co.

Inari, N.G., Petrissans, M & Gerardin, P. (2005). Chemical reactivity of heat-treated wood. *Wood Science Technology,* 39, 28-29.

İlhan, R. (1980). *Ağaç Malzemede Koruma ve Emprenye Tekniği.* Trabzon: Karadeniz University Faculty of Forestry Publishing.

Jones, D. & Brischke, C. (2017). *Performance of bio-based building materials, Woodhead publishing series in civil an structural engineering.* Sawston/Cambridge: Elsevier, 652 p.

Keskin, H. (2009). Impact of impregnation chemical on the bending strength of solid and laminated wood materials. *Materials & Design,* 30(3), 796-803.

Lane, F.C. (1934). *Venetian Ships and Shipbuilding of the Renaissance.* Baltimore: The Johns Hopkins Pres.

Li, P., Zhang, Y. Zuo, Y., Wu, Y., Yuan, G. & Lu, J. (2020). Comparison of silicate impregnation methods to reinforce Chinese fir wood. *Wood Research and Technology Holzforschung* 75(2). Online ISSN: 1437-434X

Mai, C., Kües, U. & Militz, H. (2004). Biotechnology in the wood industry. *Applied Microbiol Biotechnology,* 63, 477-494.

Park, H.J., Wen, M.Y., Kang, C.W. & Sun, Y.X. (2017). Development of physical pretreatment method for fire retardant impregnation. *BioResources,* 12(2), 3778-3789. ISSN:1930-2126

Rackam, H. (1945). *Pliny: Natural History.* Cambridge: Harvard University Press.

Richardson, B.A. (1993). *Wood Preservation.* London: E&FN Spon 2nd edition.

Ridout, B. (2004). *Timber decay in buildings: the conservation approach to treatment.* London: Spon Press.

Wang, J.Y. & Cooper, P.A. (2005). Effect of oil type, temperature and time on moisture properties of hot oil-treated wood. *Holz als Roh und Werkstoff,* 63, 417-422.

Yalınkılıç, M.K. (1992). *Daldırma ve vakum yöntemleriyle sarıçam ve doğu kayını odunlarının kreozot, imersol-WR, tanalith-CBC ve tanalith-C kullanılarak emprenyesi ve emprenye edilen örneklerin yanma özellikleri.* Trabzon: Orenko'92 1. Ulusal orman ürünleri endüstri kongresi bildiri kitabı, 1. 373-402.

Zhou, K., Li, A., Xie, L., Wang, P. & Wang, C.C. (2023). The organic-inorganic hybrid sol fort he consolidation of decayed wood in architectural heritage. *Construction and Building Materials,* 373, 130847.

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Reproduction of Spaces in Cinema: A Case Study in the Dodesukaden

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Citation: Hekimoğlu, Y. (2023). Reproduction of Spaces in Cinema: A Case Study in the Dodesukaden. Dal, M. & Karataş, L. (Eds.). **Architectural Sciences and Theory, Practice and New Approaches II.** 2023, Chapter:9, 212-227. ISBN: 978-625-367-256-0. Iksad Publications.

1. Introduction

The cinema and architecture have a long history together (Hacıömeroğlu, 2008). This togetherness is the subject of study by architects, scientists, and philosophers (Bachelard, 2013; Bruno, 2002; Merleau-Ponty, 2017; Pallasmaa, 2014; Penz, 1994; Tanyeli, 2017). In studies on the interaction of architecture and cinema, the subject is usually space. There are studies on the physical or perceptual properties of space, the experience of space, spatial images, the reproduction of the space, or the user of the space (Norberg-Schulz, 1971; Benjamin, 2018; Hekimoglu, 2021a; Morin, 2005). These studies strengthen or benefit the relationship between cinema and architecture, so studies are important for two areas.

In this study, an analysis is made on cinematic spaces. The subject is reproduced spaces, spaces reproduced in cinema (Figure 1). The study area is the reproduced spaces that emerge within the architectural spaces used in the cinema. The literature supports the conceptual work, and analyses are made on the movie Dodesukaden. These analyses discuss the production reason and process of the reproduced spaces in the film. It is seen that the reproduced spaces are not just a physical production created by the architect. Spaces imagined by the user or the person experiencing the space can also be reproduced. This study discusses the reproduced spaces imagined by the character in the selected movie. In this reproduction space, spatial elements, color, and texture change. The study's primary purpose is to show perceptual production in the

reproduction of spaces. The processes and contributions of this perceptual production are discussed.

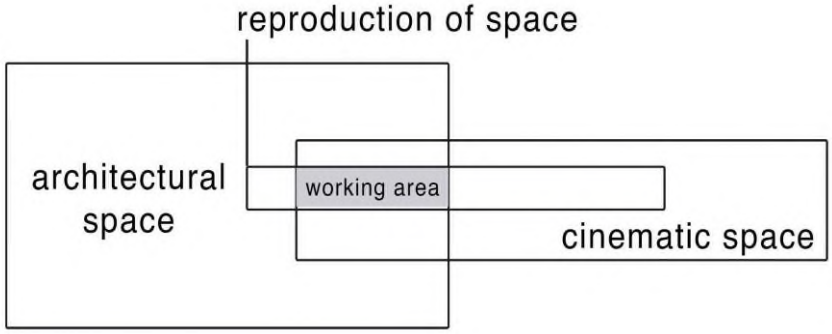

Figure 1. Conceptual Background of The Study.

1.1. Reproduction of Space

Henri Lefebvre (2014) explains the production of space as follows; Space is a concept that needs to be examined in three dimensions: perceived, conceived, and lived. Perceived space represents the spatial practice and corresponds to physical space. The conceived space represents space and describes the dominant space in society. The living space refers to the representation spaces. While images and symbols accompany the living space, it also includes the symbolic use of the objects of the physical space (Lefebvre, 2014). The three dialectical processes mentioned not only create the production of space but also explain the materials in this process. These materials are used in the production and reproduction of space.

One of the words Heidegger (2020) uses most when describing one's existence is space. It becomes spatial in case space is combined with time and body. The spatial is constantly renewing and reproducing itself.

Considering the views of Heidegger and Lefebvre, the following determination emerges: the reproduction of space does not have to be just physical production. This reproduction can be imaginary, sensory, or imaginary (Figure 2).

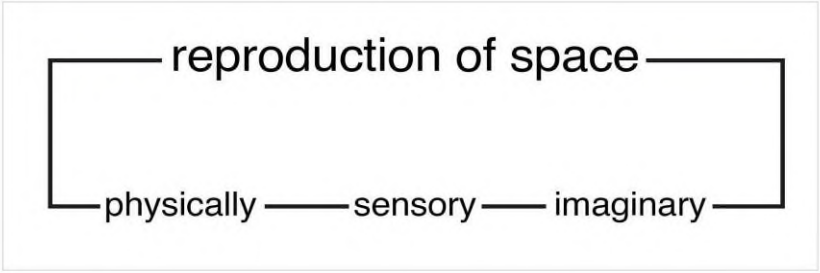

Figure 2. Reproduction of Space.

1.2. Architecture and Cinema

The architecture contains scientific and cultural values with structure and effects on the formation process. Tanyeli (2017) defines architecture as multidisciplinary, and so architecture can be seen in other fields. One of these fields is cinema because it can sometimes use space like architecture. It is seen as very close to architecture with its use of space, the perception of space, and the production process of space (Benjamin, 2018; Hekimoğlu, 2021b; Higson, 1996; Pallasmaa, 2001). Considering the physical and perceptual characteristics of space, space is seen in almost all films (Damrau, 2000, Shonfield, 2000). Looking at the motion image provides more data on the use of space in cinema (Deleuze, 2014). In addition, motion image in architecture and cinema allows the user to experience the cinematic space. However, even if the audience does not move when they look at the space in the cinema, they are mentally active

(Bruno, 2002). When viewed as a production process, the architecture uses tools such as drawings and models before producing the building, while cinema primarily expresses the space in writing. It is seen that there is a need for representation before production for both fields (Penz, 1994). In addition to this power of representation, parameters such as light, shadow, scale, texture, and camera angle used in films show the cinema's space production process (Vidler, 1993). Eisenhard, who studied architecture and is interested in cinema, argues that film spaces and architectural spaces are produced similarly regarding the production process. (Lamster, 2000).

1.3. Reproduction of Space in Cinema

The inevitability of using space in cinema and the design and arrangement of spaces strengthens its relationship with architecture, and even cinematic spaces find more free ones (Tunçok Sarıberberoğlu, 2020). The production of the space with different data increases the power of imaginary reality in the cinema and adds different dimensions to the space. The viewer reproduces this space in her/his mind by looking at the person experiencing it in a space she has not physically experienced (Hekimoğlu, 2021a). When we look at the spaces reproduced in the cinema, we see the spaces produced in the audience's mind, produced in the character's mind, or physically reproduced in the film (Figure 3).

The cinematic space experience is similar to the real-life space experiences of the person (Yücel & Ökem, 2020). For this reason, the audience can visualize the space experience of the character in her/his mind. The audience can experience and interpret the spaces that the character produces in her mind (Figure 3).

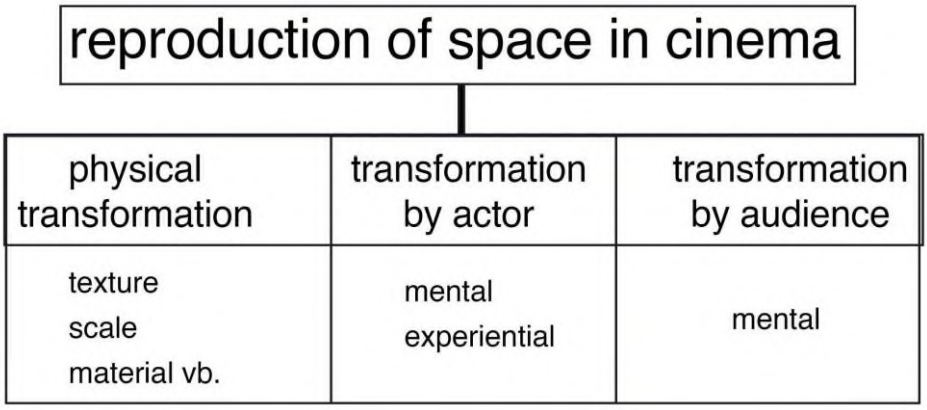

Figure 3. Reproduction of Space in Cinema.

It is almost impossible to limit reproduction in film spaces. It is possible to deal with physical space changes as quantitative data, but it is not easy to examine perceptual reproductions of space as quantitative data. For this reason, this study discusses the character's imagination of a space not in the movie and reproduces it repeatedly in different ways.

Cinematic spaces can use or transform physical spaces as they are. This transformation is called the reproduction of spaces in cinema. This study discusses the movie Dodesukaden, and the imaginary spaces the character reproduces in the mind are examined. This empathy determines the process of the study.

2. Material and Method

One of the main intersections of architecture and cinema is space. The space provides information about the production and usage process, its users, and the events experienced.

Preliminary studies show that the most common concepts when studying the relationship between architecture and cinema are mostly time, movement, and space. These concepts contain data on the identity of the person.

This study covers architecture, cinema, and identity. After explaining these concepts, the selected films were examined as case studies using the visual analysis method. In line with these data, in Dodesukaden, the film by Akira Kurosawa, scenes in which the space is reproduced or designed are seen. These scenes are analyzed with the visual analysis method (Figure 4).

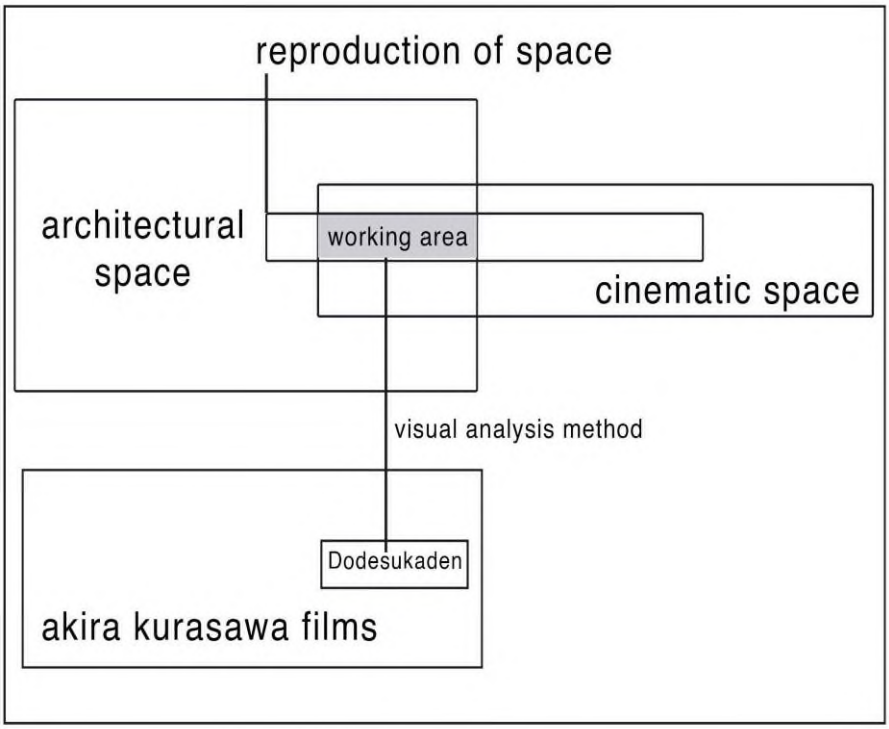

Figure 4. Studying area and use of method.

3. Findings and Discussion

This study, which examines the cinema venues, examines the locations in Akira Kurosawa's movie Dodesukaden. Primarily, the spaces in Akira Kurosawa's films are described. The Dodesukaden film is examined and analyzed as its locations are. Perceptual and imaginary reproduced spaces are discussed in the film. There is a discussion about the process of these spaces.

3.1. Akira Kurosawa Films

Akira Kurosawa has directed thirty films of his own in his film career spanning over fifty years, has undertaken the scriptwriting of many of them, and has taken part in many different films apart from these films (Donald, 1998; Hekimoğlu 2021a). He is one of the important names of the Kurosawa period and is said to be one of the names still discussed and taken as an example in this field (Wild, 2014). Something Like An Autobiography (Kurosawa, 2006) is his first and only book; he describes his life and films in his book. In Akira Kurosawa's films, space is not only physically expressed, but it is seen that every detail makes sense since it is open to change and transformation. In these films, it is seen that the spaces are used as qualified as the character (Çöğür, 2007; Hekimoğlu, 2021a). In addition, imaginary or perceptual reproduction spaces are encountered in these spaces. For this reason, Akira Kurosawa films are considered for this study.

3.1.1. Dodesukaden (1970)

Dodesukaden is a film based on the novel The Town without Seasons by Shugoro Yamamoto (Çöğür, 2007; Sinan, 2020; Barışan, 2022). The

movie depicts people living in similar places but with different characters. It tells the drama of desperation in Tokyo's slums. Desperate people struggling with poverty try various ways to hold on to life. The movie's name comes from the child character Rokuchan, who drives an imaginary tram, saying "dodeskaden, dodeskaden," with the desire to become a tram driver in the house where he lives with his mother. This movie is considered a human tragedy; it depicts poverty, despair, disappointment, and immorality.

In the film, the dreams of an impoverished child are featured. In the film, the dreams of an impoverished child are featured, and among these dreams is the house he wants to have. The house he dreams of is expressed visually as well as verbally. This house has modern lines, expansive openings, and windows (Figure 5). Although the character has not seen a similar structure before, he can visualize it in his imagination.

Figure 5. Dodesukaden, Space 1.

In the movie, the imagined house is constantly changing. This change can be defined as the reproduction of space. In this reproduction process, first of all, the frame of space changes. Then it is seen that the colors of the space change (Figure 6). The reason why the character transforms or reproduces the space stems from the desire to carry his imagination forward. As he imagines, a more detailed space emerges. Therefore, the reason for every reproduction space is to reach a better space.

Figure 6. Dodesukaden, Space 2 and Space 3.

While the reproduction process of the imaginary space continues, the space preserves its main form, but the colors are getting brighter. In addition, it is seen that the environment changes with the space Figure 7). The imaginer adapts his environment while reproducing the space.

Figure 7. Dodesukaden, Space 4 and Space 5.

When these imagined spaces are examined, a reproduction is seen through the imagined first space. Instead of redesigning the space he wants to live in every time, the character makes additions or changes to the space formed in his first mind. This situation is because he thinks he has transformed and developed the space for the better.

4. Conclusion and Suggestions

Architecture reflects the data it has about the space scientifically and culturally. In a reproduced space, the data in question also manifests itself. The reproduction of space is seen in cinematic spaces and architectural spaces. For this reason, reproduction spaces can be analyzed in cinema spaces. Akira Kurosawa's film Dodesukaden is used for analysis. This film is Kurosawa's first color film, which is among the reasons for the film's use. In addition, it is seen that the character constantly reproduces the place he imagines in the movie, which is another reason why the movie is preferred. One of the reasons why the spaces in the film are constantly reproduced is to make the space better and more valuable. The other reason is to see the difference between the old and new versions or to improve the space.

In the study, data from architectural spaces is obtained from cinema spaces A space that is imagined but not built on nature is seen through a selected movie, and It proves that cinema supports the production of space and that cinema supports architecture. In addition, we see the space produced by the director or the person who produced the space in the film with his own narrative technique, without any knowledge of architecture. When we look at the whole study in general, we see that the spaces reproduced in

architecture are physical, perceptual, or experiential, and the spaces reproduced in the cinema are similar. We can improve this work by analyzing other films and identifying other types of reproduced spaces.

Acknowledgements and Information Note

The e-book section complies with national and international research and publication ethics. Ethics Committee approval was not required for the study.

Author Contribution and Conflict of Interest Declaration Information

There is no conflict of interest.

References

Bachelard, G. (2013). Mekânın Poetikası. İthaki Yayınları, İstanbul.

Barışan, N. (2022). Resimsel ve görsel anlatı üzerine bir çözümleme denemesi: Akira Kurosawa Sineması Örneği (Master thesis), Marmara University, İstanbul.

Benjamin, W. (2018). Pasajlar, (Çev. A. Cemal), Yapı Kredi Publication, İstanbul, 37-86.

Bruno, G. (2002). Atlas of Emotions: Journeys in Art, Architecture, and Film, Verso, 55- 71.

Çöğür, A. S. (2007). Akira Kurosawa Sinemasında Japon Kültürü ve Batı Kültürünün Sentezlenmesi (Master thesis), Beykent University, İstanbul.

Donald, R. (1998). The Films of Akira Kurosawa. University of California, 10-13.

Damrau, K. (2000). Fantastic spatial combinations in film. Architectural Design, 70, 1, 58-61.

Deleuze, G. (2014). Sinema I: Hareket-İmge, (Çev. S. Özdemir). Norgunk Publication, İstanbul, s.82-231.

Hacıömeroğlu, T. N. (2008). Reconstruction of architectural ımage in science fiction cinema: a case study on New York(Master thesis), Faculty of Architecture, METU, Ankara.

Heidegger, M. (2020). Varlık ve Zaman, (Çev. K. Ökten). Alfa Yayınları, İstanbul, 162- 180.

Hekimoglu, Y. (2021a). Sinemada mekânsal imgelerin mekân deneyimine etkisi: Akira Kurosawa filmleri üzerinden inceleme (Master thesis), Faculty of Architecture, Eskişehir Osmangazi University, Eskişehir.

Hekimoğlu, Y. (2021b). Sinemasal mekanlarda kullanılan mekansal imgelerin anlatı üzerindeki etkisi. İnönü Üniversitesi Kültür ve Sanat Dergisi, 7 (2), 77-86.

Higson, A. (1996). Dissolving Views: Key Writings on British Cinema. Bloomsbury Publishing, London.

Kurosawa, A. (2006). Kurbağa Yağı Satıcısı, (Çev. D. Egemen). Agora Kitaplığı, İstanbul.

Lamster, M. (2000). Introduction, Architecture and Film, M. Lamster, (Ed.). Princeton Architectural Press, pp. 1-8.

Lefebvre, H. (2014). Mekânın Üretimi, (Çev. I. Ergüden). Sel Yayıncılık, İstanbul.

Merleau-Ponty, M. (2017). Algının Fenomenolojisi. İthaki Yayınları, İstanbul.

Morin, E. (2005). The Cinema, or Imaginary Man. University of Minnesota Press, Minnepolis, 201-218.

Norberg-Schulz, C. (1971). Existence. Space and Architecture, Praeger.

Pallasmaa, J. (2001). The Architecture of Image: Existential Space in Cinema. Rakennustieto, Helsinki.

Pallasmaa, J. (2014). Space, Place and Atmosphere. Emotion and Peripherical Perception in Architectural Experience, Lebensvelt.

Penz, F. (1994). Cinema and architecture. Architectural Design, 64, 11(12), 38-41.

Shonfield, K. (2000). Walls have feelings: cut films about sex in 1960s London. Architectural Design, 70(1), 32-35.

Sinan, (2020). Akira Kurosawa sinemasının metinler arasılık bağlamında incelenmesi (Master thesis). Ordu University, Ordu.

Tanyeli, U. (2017). Yıkarak yapmak anarşist bir mimarlık kuramı için altlık. Metis Yayınları, İstanbul.

Tunçok Sarıberberoğlu, M. (2020). Sinematik kurgunun bilinçaltı mekânları-tekinsiz mekânlar. Mimarlık ve Yaşam, 5 (1),27-39.

Vidler, A. (1993). The explosion of space: architecture and the filmic ımaginary. Assemblage, 21(), 44-59.

Wild, P. (2014). Akira Kurosawa. Reaction Books, Glasgow.

Yücel, A. & Ökem, H. S. (2020). Mekânın sinematografik temsili bağlamında beden mekân ilişkisi. Kent Akademisi, 13(4), 688-700.

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Comparison of CFRP and Steel Jacketing Methods Applications for Retrofitting an Existing Concrete Industrial Structure in Earthquake Effect

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Citation: Bal, A. (2023). Comparison of CFRP and Steel Jacketing Methods Applications for Retrofitting an Existing Concrete Industrial Structure in Earthquake Effect. Dal, M. & Karataş, L. (Eds.). **Architectural Sciences and Theory, Practice and New Approaches II.** 2023, Chapter:10, 228-259. ISBN: 978-625-367-256-0. Iksad Publications.

1. Introduction

Earthquake is the heaviest loading situation that a structure encounters during its lifetime (Bal & Kılıç, 2018). It is known that due to insufficient ductility, insufficient strength and insufficient stiffness in reinforced concrete structures, damages occur under earthquake effect and even the structures reach the collapse point (Bal & Şimşek, 2019). It is possible to reduce the structural damages seen in various ways in the structural elements of reinforced concrete structures under the effect of earthquake loads and to improve the earthquake performance of the structure with different retrofitting alternatives. For the architectural functions of the building to continue, the entire structural system and damaged elements should be retrofitted (Kopuz & Bal, 2022). In our country where reinforced concrete structures are widespread and almost all of them are under earthquake risk, different retrofitting alternatives are suggested (Atalay et al., 2012).

Among these alternatives are jacketing of reinforced concrete elements with qualified concretes, addition of reinforced shear walls in required directions, reinforcement with steel braces and steel jacketing, reinforcement with carbon fiber reinforced polymers (CFRP), behaviour-controlled reinforcement with seismic isolators (active or passive control) (Arslan et al., 2005, Atalay & Aynur, 2017). In the determination of these retrofitting techniques, in addition to the increase in the strength, stiffness and ductility of the structure, ease of application, reduction of installation time and reduction of the total cost of retrofitting should also be considere

(Aka et al., 2001). Selection of the optimum solution is very important in the selection of retrofitting alternatives. Especially the retrofitting of existing reinforced concrete structures according to the new earthquake codes, Turkish Building Earthquake Code-2018 (TBEC-2018) is an important application area.

Within the scope of the study, the earthquake performance of an existing conventional reinforced concrete industrial building was determined, and a retrofitting project was designed. Since the structure to be retrofitted is currently in use, it was necessary to choose a method that would not prevent its architectural functions. Within the scope of the study, alternative projects were prepared for steel jacketing and CFRP retrofitting techniques for the existing structure. In this study, it is aimed to ensure the safety of the structure under operational loads and earthquake loads determined according to the principles of Turkey Building Earthquake Code 2018 (TBEC-2018). As a result of the damage analyses performed on the existing reinforced concrete industrial building, two different retrofitting alternatives were evaluated as steel jacketing and CFRP application to ensure the safety of the structure.

2. Material and Method

Within the scope of the study, the types of damage caused by operational loads on the structural elements of an existing reinforced concrete industrial building designed according to the Turkish Earthquake Code-1975 (TEC-1975) and constructed in 1996 were determined. After the damage analyses, it is aimed to ensure the safety of the structure under the operating loads and earthquake loads determined according to the

principles of Turkish Building Earthquake Code-2018 (TBEC-2018). Two different retrofitting alternatives, steel jacketing and CFRP application, were evaluated to ensure that the building can fulfil its architectural functions and the building safety can be ensured again according to the current standards.

The increase in the capacity of the structural elements with steel jacketing of the existing structural system consisting of column-beam frame system with one-way threaded slab is calculated. In the second alternative, the increase of axial load and shear capacities were investigated with laminated type carbon fiber reinforced polymers (CFRP) for the increase of bending capacity in threaded slabs and beams, unidirectional woven fabric type CFRP for the increase of shear capacity. Two different retrofitting alternatives were evaluated and analysed separately for the continuation of architectural functions, economical, structural safety, structural strength, ductility, stiffness, and displacement control principles. The retrofitting application projects prepared with both methods were examined and their effects on the structural behaviour were investigated.

2.1.Earthquake Behaviour Different Retrofitting Alternatives for Reinforced Concrete Structures

Retrofitting is the improvement of a structure or some of its structural elements to increase its load carrying capacity, rigidity, ductility, or some of them above its existing condition (Bal & Kılıç, 2018). Structural systems are affected by dead loads, live loads, earthquake and wind effects, temperature changes, shrinkage, external environmental effects, explosion, fire, etc. (Darılmaz, 2012).

Under these effects, some defects, quality, and property losses may occur in the structure. Elimination of damages is possible by repair-reinforcement. The purpose of repair-reinforcement is to provide a level of strength that will not cause loss of life in the most severe earthquake expected in the future. The strength level of the structure to be constructed should be determined in advance and it should be ensured that it reaches a strength suitable for the purpose.

Retrofitting can be applied due to changes in earthquake codes, changes in the intended use of the building, changes in operating loads, earthquake and time-related damages, inadequate existing structures (Özmen, 2012). Retrofitting varies from building to building, depending on the building characteristics. Reinforcement that is suitable for one building may not be suitable for another building. The retrofitting method should be decided after the structures are examined in detail. Traditional retrofitting methods require intensive labor, resulting in a long construction period. The change in element dimensions and the discomfort caused to the users are high. However, more experience and the use of cheaper materials are the reasons why these methods are more widely preferred. New generation retrofitting techniques create more effective alternatives in a shorter time. It is possible to retrofit buildings in a shorter time without changing architectural functions.

Retrofitting technique with fiber polymer, one of the new generation methods. It is a system that increases the strength, ductility, and rigidity capacities of the structure, obtained by bonding high-strength fibers such

as carbon, glass, aramid with resins to the surfaces of building elements with different methods and shapes (BASF, 2012).

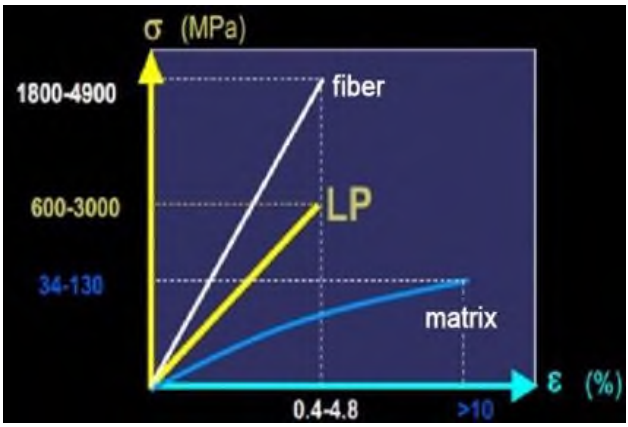


Figure 1. Fiber, Matrix, and Fiber Polymer Stress-Strain Behaviour

Composite materials with very different mechanical properties can be obtained by using different fiber and matrix materials. The fibers can be carbon, glass, aramid, or basalt. Carbon has the highest modulus of elasticity among the other fibers. Carbon Fiber-Reinforced Polymer (CFRP) is a composite material comprising a polymer matrix reinforced with carbon fiber cloth, mat, or strands (Ilki & Kumbasar, 2002, Ilki et al., 2002).

The fibers are the load-bearing component with a high modulus of elasticity. It can be based on glass, aramid, and carbon. The fibers are attached to the reinforced concrete surface with epoxy etc. bonds with a matrix and creates a composite section behavior (Fig. 1). Fiber reinforced polymers increase the strength and ductility of the building elements and increase the ductility of the structure under the effect of earthquakes

Table 1. Characteristic Tensile Strengths and Modulus of Elasticity of FRP Components (BASF, 2012)

FRP Type	Modulus of Elasticity (kN/mm^2)	Tensile Strength (N/mm^2)
Carbon	230-640	2500-4000
Aramid	120-130	2900
Glass	70-90	2000
Steel St37	210	370

Characteristic tensile strengths and modulus of elasticity of FRP components are given in the table 1. Their tensile strength is ten times that of St37 steel. Strength and ductility values of the structure to be retrofitted should be improved on an element basis. For this purpose, after determining the demands of the building under the effect of earthquake and vertical loads, the increase in the element capacities of these demands can achieved with the FRP application. Figure 2 shows the composite properties of fiber reinforced polymers, stress-strain behaviour.

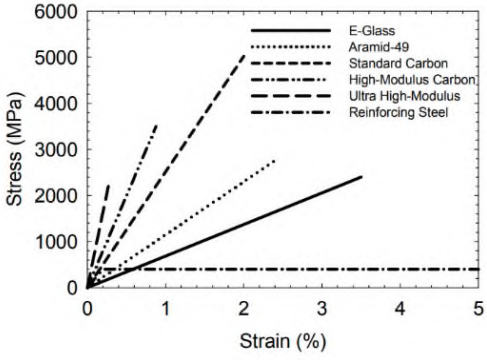


Figure 2. FRP Composite Properties Stress-Strain Behaviour

In the construction industry, CFRP materials are used in the form of rebar, one-way laminated plates, fabric and mesh reinforcements, prestressing tendons, and various profiles (Fig. 3). Fiber-reinforced polymers are used in concrete, steel, wooden beams and columns, -I-beam manufacturing, all kinds of strengthening and restoration applications, bridge coatings, reinforcing joints due to their high strength properties.

Figure 3. Different Types of CFRP materials

The near past years, in Turkey (Kocaeli-17.08.1999, Düzce-12.11.1999, Van-23.10.2011) and in the world (Northridge-17.01.1994, Kobe-16.01.1995, Jiji-21.09.1999, Sumatra-26.12.2004, Sichuan-12.05.2008, Haichi-12.01.2010, East Japan-11.03.2011). Earthquakes have caused great loss of life and property due to their devastating effects. In regions with high seismic effects such as Japan and Turkey, earthquake preparedness is not only possible by constructing new earthquake resistant buildings, but also requires retrofitting existing structures against future earthquakes using new technologies.

The failures of reinforced concrete structures, which account for most of the building stock in Turkey, to perform as expected in past earthquakes have made it necessary to develop new structural solutions. Especially in Japan, important research is carried out on the concept of behaviour-controlled retrofitting and design. Existing reinforced concrete structures are damaged in earthquakes due to insufficient lateral stiffness, ductility, strength, and low energy absorption capacity. Especially most of the public buildings such as hospitals and schools are produced in reinforced concrete in our country and earthquake safety is far from satisfying the required performance. Although it is possible to retrofit such existing reinforced concrete structures with conventional methods, behaviour-controlled retrofitting techniques are included in the regulations, especially in Japan, and provide more effective solutions.

Studies have shown that the use of behaviour-controlled retrofitting techniques such as energy absorbing devices and seismic base isolation are effective in providing the required earthquake performance level (Avcı et al., 2018, 2019).

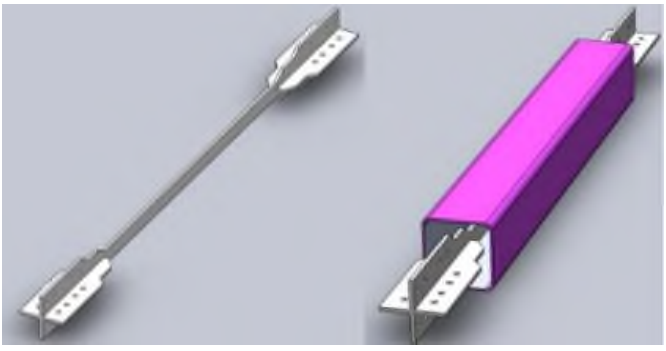


Figure 4. Steel Core and External Tube of Buckling Restrained Braces

In Japan and the USA, behaviourally controlled retrofitting techniques with Buckling Restrained Braces (BRB), a type of metallic damping device, are increasingly used in new building design and retrofitting of existing buildings (Fig. 4).

Tokyo Institute of Technology (TIT) has previously carried out an application in behaviorally controlled retrofitting of existing reinforced concrete buildings with BRBs. A 5-storey reinforced concrete school building built in the 1960s on the campus of Tokyo Institute of Technology (TIT) was behaviorally retrofitted with BRBs. With this feature, the project can be considered as the first application in the world (Fig. 5) (Sütcü et al., 2017, 2020).

(a) (b)

Figure 5. Tokyo Institute of Technology (TIT) Campus Retrofitting of An Existing Reinforced Concrete Building with BRBs and Façade (a) External View (b) Interior View

In this retrofitting method, an integrated facade system was created with the addition of transfer beams and glass panels as well as the addition of BRBs to the reinforced concrete structure to absorb the earthquake effect. With the integrated facade system, the building has a more aesthetic architectural appearance.

2.2. Analysis of Existing Reinforced Concrete Structure and Earthquake Behaviour

The existing industrial structure was built in 1996 in Tekirdağ-Çorlu according to the 1972 Earthquake Codes (TEC-1972). The existing building consists of 160 metres in X direction and 87 metres in Y direction. The building is a single storey industrial building designed in 1996 in conventional reinforced concrete (Fig. 6).

The building is a frame type reinforced concrete building with perpendicular axes and has a facade made of reinforced concrete shear wall with window and door openings that can be considered rigid all around.

Figure 6. Existing Reinforced Concrete Industrial Structure

The structural system of the building consists of a column beam frame system with a one-way threaded slab. The main beams are 40x80cm, the ribs with threaded floor beams are 40x60cm and the columns are 50x50 cm (Fig. 7). The floor height varies between 4 metres and 5 metres. Column axes are 6,50 m in X direction and 7,25 m in Y direction.

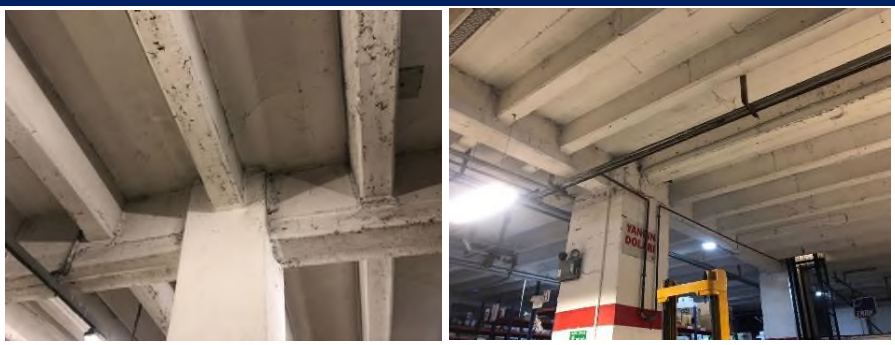


Figure 7. Reinforced Concrete Column-Beam-Ribs Joint Area

In Turkey, which is located on an active seismic belt, devastating earthquakes have occurred in short time intervals. With the development of new technologies, changes were made in the regulations after these earthquakes (Alyamaç & Erdoğan, 2005; Özmen, 2012). In the period when this building was built, the 1972 Earthquake Codes (TEC-1972) was active in Turkey.

Figure 8. Turkey Earthquake Zones Map of 1972

As shown in Figure 8, the risk status for Çorlu/Tekirdağ according to Turkey Earthquake Zones Maps 1972 is the third-degree earthquake zone. 2018 Turkish Earthquake Code (TBEC-2018) has been officially enforced as of January 1, 2019 (Fig. 9). Four different earthquake ground motion levels are specified in Turkey Building Earthquake Code 2018 (TBEC-2018). DD-2: 10% probability of exceeding in 50 years, corresponding to a return period of 475 years. This earthquake ground motion is also called standard design earthquake ground motion.

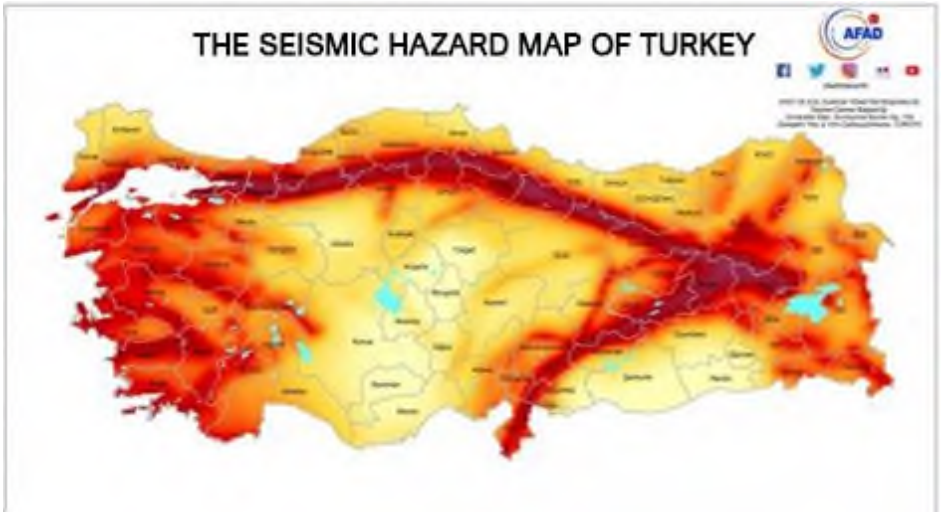
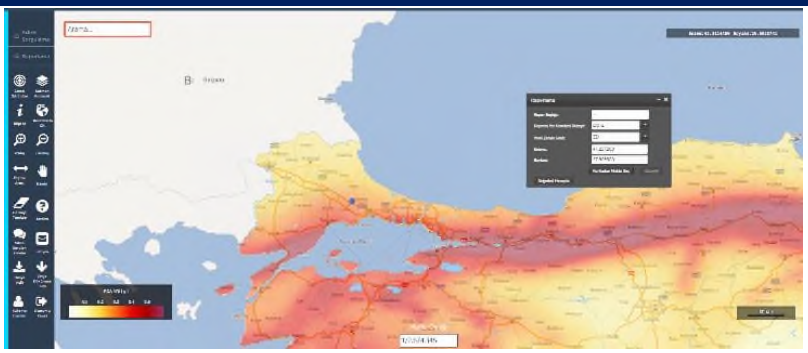
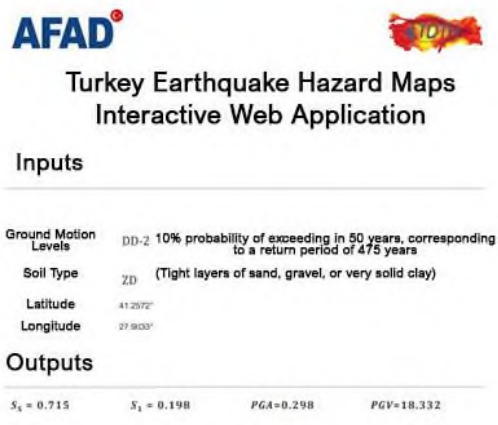


Figure 9. Turkey Earthquake Zones Map of 2018

For the coordinates where this building is located, the maximum ground acceleration (PGA) for ZD soil type (Tight layers of sand, gravel, or very solid clay) was determined as 0.298g from the AFAD Turkey Earthquake Hazard Maps Interactive Web Application (AFAD, 2018). The maximum ground speed (PGV) is 18.332 cm/sec (Figure 10).



(a)



(b)

(c)

Figure 10. (a) AFAD Turkey Earthquake Maps Interactive Web Application (b) An Existing Reinforced Concrete Industrial Building, (c) Earthquake Spectrum

Firstly, damage analysis was carried out for the structure under operating loads. In the damage analysis, flexural and shear cracks with thicknesses ranging from 0.2mm to 3mm were identified in the slab rib beams of the structure. Figure 11 shows the crack map of the structure and Figure 12 shows the crack repair.

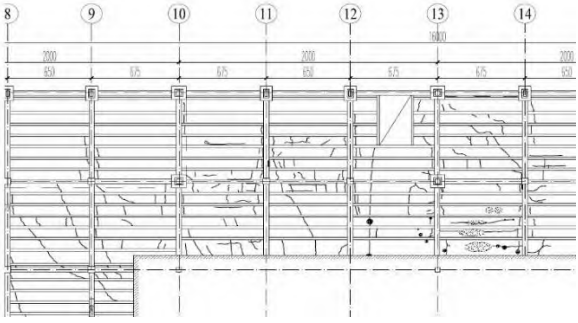


Figure 11. The Crack Map of the Structure

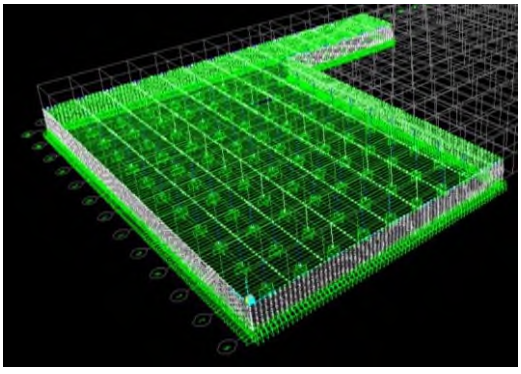
In accordance with the regulations, destructive (concrete core sampling, steel stripping) and non-destructive (x-ray and schdimite hammer) test methods were used, and it was determined that the concrete class was C25/30 in accordance with the project and the reinforcing steel was S420. It was decided to repair the cracks in the structure by epoxy injection method and the application was carried out accordingly.

Figure 12. The Crack Repair

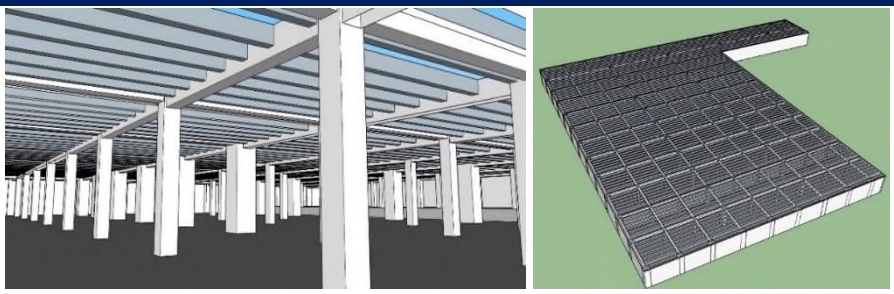
The cracks in the area between the 12-13 axes were detected in detail and repaired. The surfaces with cracks were cleaned. Holes were drilled with a drill at appropriate points on the cracks. The dust in the holes was removed and cleaned and appropriate materials were placed in the appropriate places. The plastering of the roofs, which were cleaned with epoxy-based repair, anchoring and installation mortar and paker nailed, was completed.

3. Findings and Discussion

The existing structure consists of one-way threaded slab, column beam frame system and shear walls. The existing structural system in the building was analysed in three dimensions according to the operating loads and earthquake effects. The building models are shown in Figure 13. The analyses of the structure were carried out in SAP2000 programme (Anonymous, 2004). The building is a low period structure due to the perimeter shear wall on the facade. The retrofitting decision was influenced by the effects of vertical loads and the ductility demand of the earthquake.



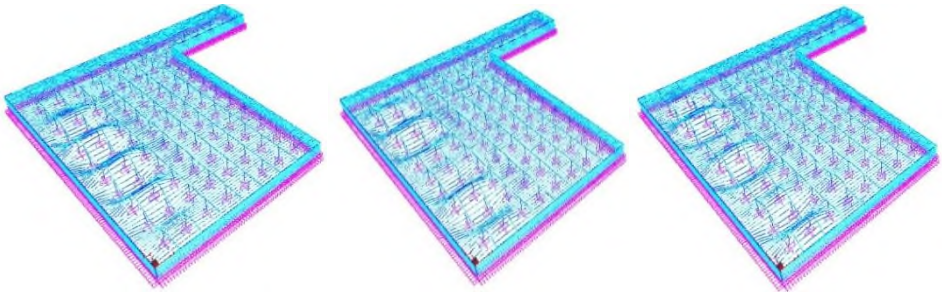
(a)



(b)

Figure 13. Modelling Of Existing Reinforced Concrete Industrial Structure (a) Mathematical Model (b) 3D Model

In this case, the structural system of the building was analysed under operating loads consisting of dead loads, live loads, installation loads and earthquake. The stiffness, natural vibration period and vibration modes of the existing structure were determined. The existing natural vibration modes of the structure are shown in Figure 14. The 1st natural vibration mode of the existing reinforced concrete structure is 0.125 second, 2nd natural vibration mode is 0.121 second, 3rd natural vibration mode is 0.115 second. This data shows that the structure is a rigid structure and torsional modes do not occur.



(a)

Figure 14. Natural Vibration Modes of The Existing Structure

It was observed that the shear strength capacity at the bearings of the one-way threaded slabs of the structure was inadequate and the bending capacity was inadequate at the span. The bending and shear capacities of the main beams and columns were also determined to be inadequate.

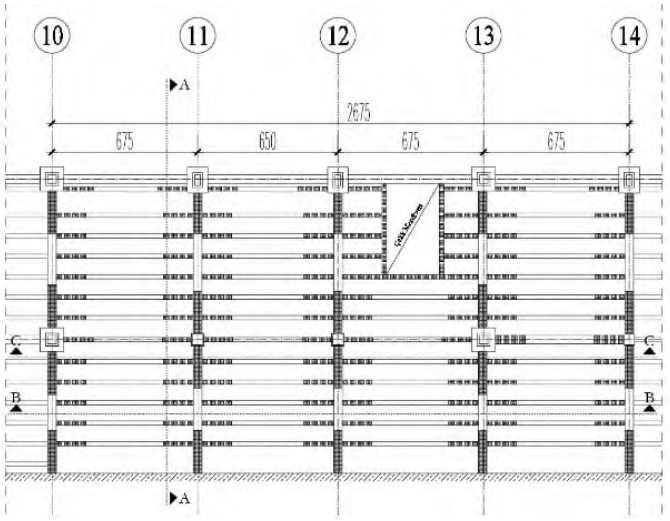
3.1.Alternative of Retrofitting Existing Reinforced Concrete Structure with CFRP

Carbon fiber reinforced polymers (CFRP) are load bearing composite materials with high modulus of elasticity when applied with a matrix such as epoxy. Carbon fibers bond to the reinforced concrete surface with a matrix such as epoxy etc. And create composite cross-sectional behaviour. Fiber polymers increase the strength and ductility of structural elements. It is one of the new generation alternatives especially in retrofitting applications. Studies show that the tensile strength of CFRP is 10 times that of steel.

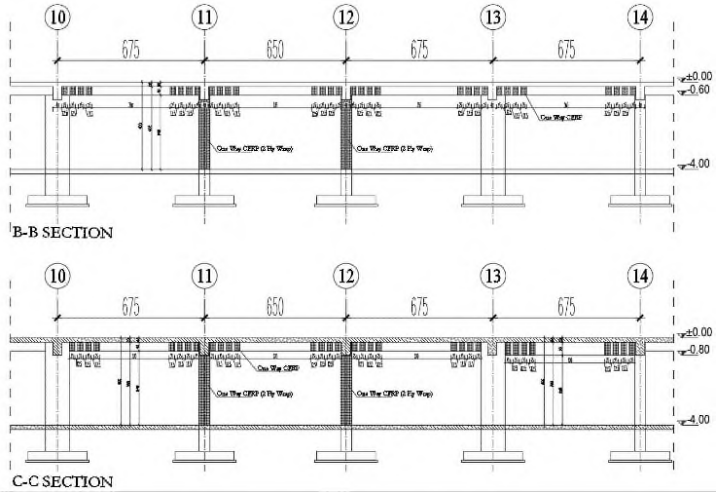
One of the most effective areas of CFRP is the reinforcement of existing columns by wrapping. This provides higher axial compressive strength, higher ductility, higher shear force and flexural strength capacities in existing columns. CFRP systems have been shown to increase the shear strength of existing concrete beams and columns by wrapping or partially wrapping the members. Shear retrofitting using external FRP may be provided at locations of expected plastic hinges or stress reversal and for enhancing post-yield flexural behavior of members in moment frames resisting seismic loads only by completely wrapping the section.

In this alternative, firstly, the cracks in the slabs identified because of the damage surveys were repaired. The concrete surface was cleaned in the

cracked areas and holes were drilled at a 45-degree angle. Then, crack surfaces were closed by preparing suitable mortar. Afterwards, CFRP and laminate were applied to the surface columns, beams, and floor elements.



(a)



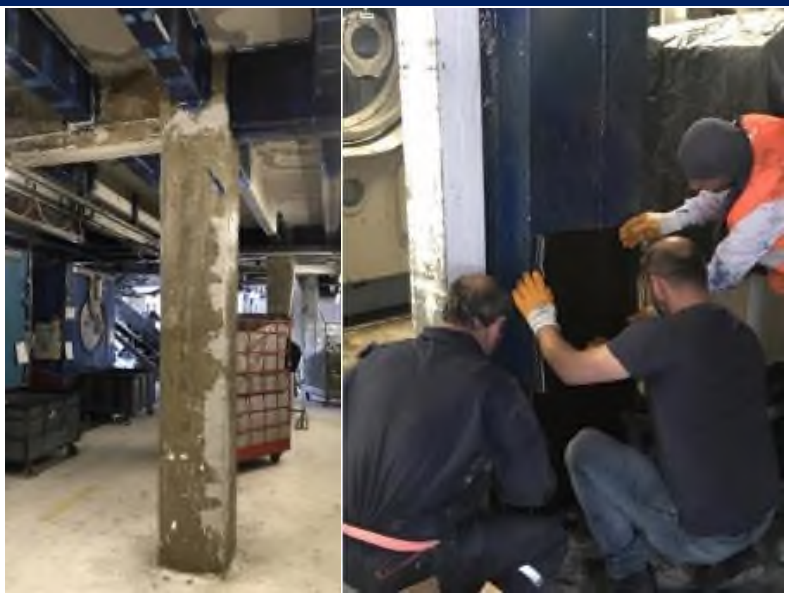
(b)

Figure 15. CFRP Reinforcement Project Details (a) Layout (b) Sections

Laminated type CFRP was used to increase the bending capacity of the ribs in the threaded slab and the lower parts of the beams. Laminated CFRP was placed two parallel to each other under the bearing beams and one under the floor rib beams. Unidirectional woven fabric type CFRP was applied to the beams and threaded slabs as a single layer to increase the shear capacity. During this application, epoxy was firstly applied to the surfaces which were previously surface cleaned. Then the fiber polymer fabric was stretched and placed on the surface in the direction of the fibres. In the columns, the increases in axial load and shear capacities were evaluated with unidirectional woven fabric type CFRP applied in 2 layers with the same steps on both beam-column joints and column surfaces. CFRP laminated project and details are given in figure 15 and application stages and field works are given in figure 16.

CFRP alternative retrofitting was selected due to the dense machine layout in this region, the inability to remove the installation and the net floor height not decreasing. CFRP retrofitting was applied in this region due to the unchanged cross-sectional dimensions and ease of application.

(a) (b)



(c)

Figure 16. CFRP Application (a, b) CFRP Fabric and Laminated Reinforcement of RC Beams (c) Reinforcement of RC Columns

The technical properties of the CFRP fabric used are given in table 3 and the technical properties of the CFRP laminates are given in table 4. These values were used in the application and retrofitting calculations.

Table 2. Technical Properties of Reinforced Concrete Beams

fc′ (N/mm²)	30
fy (N/mm²)	420
As (mm²)	3012
Modulus Of Elasticity of Concrete (N/mm²)	32000
Modulus Of Elasticity of Steel (mm²)	200000

Table 3. Technical Properties of CFRP Fabric (BASF, 2012)

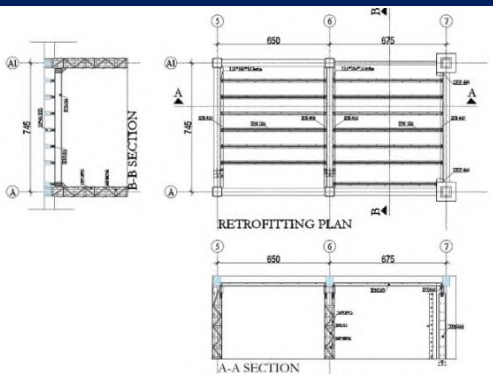
Modulus Of Elasticity (N/mm²)	230000
Type of Fiber	High Strength Carbon
Tensile Strength (N/mm²)	4900
Elongation at Break (%)	2.10
Thickness S (mm)	500
Mass Of the Fabric Per Unit Area (g/m2)	300
Reaction to Fire	Classe F

Table 4. Technical Properties of CFRP Laminates (BASF, 2012)

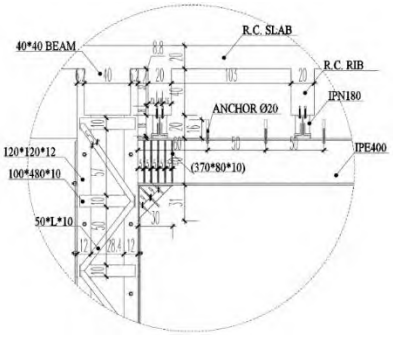
Modulus Of Elasticity (N/mm²)	165000
Tensile Strength (N/mm²)	3000
Elongation at Break (%)	1.5
Thickness S (mm)	1.2
Width (mm)	50
Cross Section Area (mm^2)	60

5.1.Alternative of Retrofitting Existing Reinforced Concrete Structure with Steel Frames

In this alternative, columns, beams, and slabs are wrapped in steel jackets to increase the capacity of the structural system elements. In this alternative, St52 steel profiles were used. L120x120x12 corners, 480x100x10 plates, 50xLx10 steel cross members were used in column steel jacketing reinforcement. In steel jacketing, firstly, L120x120x12 corners were connected to the four corners of the column symmetrically in the longitudinal direction with chemical anchors fifty centimetres apart (Fig. 17).



(a)



(b)

Figure 17. Steel Jacketing Application Details (a) Steel Jacketing Layout and Section (b) Details

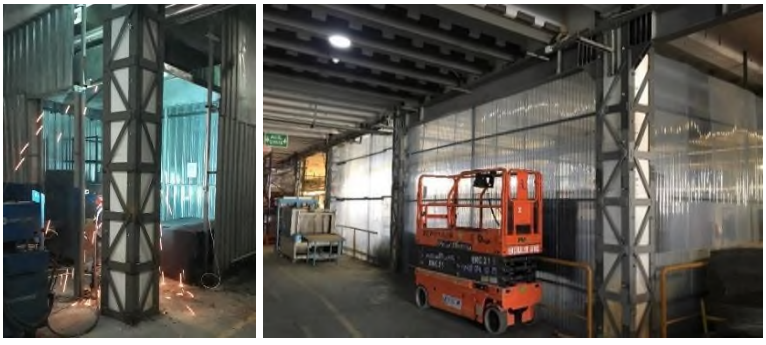


Figure 18. Steel Jacketing Applications

4. Conclusion and Suggestions

The safety levels of buildings may change for many different reasons after their construction. These reasons may include generally negative interventions at different times and levels, changes in building and earthquake codes, structural damages, earthquakes, differences in use/function, etc. The problem in the existing building stock is very similar not only in big cities but also in almost all of Turkey. The structures that were built in the past years without supervision are in fact the biggest source of the problem. There are two main ways to overcome the problems in the existing building stock: The first one is structural retrofitting and the other one is renovation. Retrofitting of existing structures is very important for the establishment of earthquake safe cities. After the disaster, especially the safety of industrial structures plays an important role for the region to be active and productive.

Within the scope of this study, two different retrofitting methods on the existing prefabricated reinforced concrete industrial structure were discussed and evaluated in detail. In this study, carbon fiber polymers and steel retrofitting alternatives were compared. It was observed that both retrofitting alternatives contributed similarly to the increase in strength and ductility of the existing structure under operational and earthquake loads. It was determined that the steel jacketing method contributed more to the increase in structural stiffness than CFRP. It was observed that CFRP method contributed more to the ductility of the structure and elements. Structural safety was established in both methods.

The most important advantage of CFRP application is that the application time is much less than steel jacketing. In addition, anchorage construction, welding etc. Processes in steel jacketing application prolong the labour time also CFRP application is more advantageous than steel jacketing in the architectural functions.

Table 5. Material Quantities Used in Both Retrofitting Alternatives and Cost Comparisons

Retrofitting Alternative	Quantity of Material Used	Applied Unit Area	Total Cost (In Weight of Steel)	Unit Cost
CFRP (Laminate&Fabric)	CFRP Fabrics: 260m^2 CFRP Laminate: 454m	2units (hall)	30 tonnes	15 tonnes/halls
Steel (St52)	Column:40 tonnes Slab/Beam:55 tonnes	17units (hall)	95 tonnes	5,58 tonnes/halls

The amount of materials used in both retrofitting alternatives and cost comparisons are given in Table 5 in terms of total steel weight. CFRP retrofitting was applied in 2 units and a total of 260 m2 fabric and 454m cfrp laminate were used. The alternative of retrofitting with steel jacketing was applied in 17 units and 40 tons of steel was used for columns and 55 tons of steel was used for slabs and beams. When a unit usage is considered, 15 tons/unit of material was used in the cfrp reinforcement

alternative, while 5.58 tons/unit of material was used in the steel jacketing alternative. According to these results, CFRP was behind steel jacketing in cost comparison. Engineer Hüseyin Yılmaz for their contributions to the study.

Acknowledgements and Information Note

I would like to thank the BASF Construction Chemicals, Erak Giyim San. Tic. Aş employees and Mechanical

Author Contribution and Conflict of Interest Declaration Information

There is no conflict of interest.

References

Anonymous (2004). *SAP2000 v8 Educational, Computers and Structures.* Inc. Berkeley, Cal.

Aka, İ., Keskinel, F., Çılı, F. & Celik, O. C. (2001). *Betonarme*. İstanbul, Birsen Press.

Alyamaç, K. E. & Erdoğan, A.S. (2005). *Geçmişten günümüze afet yönetmelikleri ve uygulamada karşılaşılan tasarım hataları*. Mart 2005 Earthquake Symposium, Kocaeli (2005).

Arslan M.H., Gülay F.G., Korkmaz H.H., (2005). *Mevcut prefabrike betonarme sanayi yapıları için güçlendirme önerileri*. Earthquake Symposium, Kocaeli (2005).

Atalay, H. M., Ozden, Ş., Akpınar, E., & Erdoğan, H. (2012*). Structural precast concrete in Turkey: development and earthquake performance in last decades*. In Proceedings of CENG'12 the 7th International Symposium on Civil and Environmental Engineering (p. 13).

Atalay H.M. & Aynur S. (2017). *Strengthening of reinforced concrete frames using steel bracing*. 4th International Conference on Earthquake Engineering and Seismology, Eskişehir (2017).

Avci-Karatas, C., Celik, O. C., & Yalcin, C. (2018). Experimental investigation of aluminum alloy and steel core buckling restrained braces (BRBs). *International Journal of Steel Structures*, 18(2), 650-673.

Avci-Karatas, C., Celik, O. C., & Ozmen Eruslu, S. (2019). Modeling of buckling restrained braces (BRBs) using full-scale experimental data. *KSCE Journal of Civil Engineering*, 23(10), 4431-4444.

Bal, A. & Kılıç, A.M. (2018). *Investigation of strenghtening an existing five-storey rc residential structure with fiber reinforced polymers*. 2nd International Architecture and Design Congress, 2018.

Bal, A. & Şimşek, S. S. (2019) The ınvestigation of retrofitting alternatives in historical masonry building with fiber reinforced polymers and

project. *Application Harran Üniversitesi Mühendislik Dergisi*, 4(3), 112-119.

BASF(2012). Fibrous Polymer (FRP) Reinforcement System.

Darılmaz, K. (2012). *Depreme dayanıklı betonarme binaların tasarımına giriş*. İstanbul, Yapı Yazılım Press.

Earthquake Hazard Map (2018). *AFAD, Turkey* https://deprem.afad.gov.tr/deprem-tehlike-haritasi

Ilki, A., & Kumbasar, N., (2002). Behavior of damaged and undamaged concrete strengthened by carbon fiber composite sheets. *International Journal Structure Engineering And Mechanic*, 13(1), 75–90.

Ilki, A., Peker, O., Karamuk, E., Demir, C., & Kumbasar, N. (2008). FRP retrofit of low and medium strength circular and rectangular reinforced concrete columns. *Journal of Materials in Civil Engineering*, 20(2), 169-188.

Kopuz, A. D., & Bal, A. (2022). The conservation of modern architectural heritage buildings in Turkey: İstanbul Hilton and İstanbul Çınar Hotel as a case study. *Ain Shams Engineering Journal,* 101918.

Özmen, B. (2012). *Türkiye Deprem Bölgeleri Haritalarının Tarihsel Gelişimi*. Türkiye Jeoloji Bülteni.

Sutcu, F., Bal, A., Fujishita, K., Matsui, R., Celik, O. C., & Takeuchi, T. (2020). Experimental and analytical studies of sub-standard RC frames retrofitted with buckling-restrained braces and steel frames. *Bulletin of Earthquake Engineering*, 18(5), 2389-2410.

Sutcu, F., Bal, A., Fujishita, K., Celik, O. C., Takeuchi, T., Matsui, R., ... & Maeda, Y. (2017). *Near full-scale experimental investigation of low-standard RC frames retrofitted with buckling-restrained braces.* In The 16th World Conference on Earthquake Engineering (16WCEE), Santiago, Chile.

TEC-1972(1972). *Turkish Earthquake Code*. T.C. Resmî Gazete: Ankara, Turkey.

TBEC-2018 (2018). *Turkish Building Earthquake Code*. T.C. Resmî Gazete: Ankara, Turkey.

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September-2023