PROCEEDINGS BOOK

ICNTAD CONFERENCE

INTERNATIONAL CONFERENCE ON NEW TRENDS IN ARCHITECTURE & INTERIOR DESIGN

10th International Conference on New Trends in Architecture and Interior Design

ICNTAD CONFERENCE

INTERNATIONAL CONFERENCE ON NEW TRENDS IN ARCHITECTURE & INTERIOR DESIGN

April 19-21, 2024

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10th ICNTAD 2024

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Dear Colleagues,

I am honored to invite and send you this call for papers on behalf of the Congress Organization Board of "10th International Conference on New Trends in Architecture and Interior Design (10th ICNTAD'24)", to be held in Budapest, Hungary dates between April 19-21, 2024

The Conference will focus on a broad range of topics related to new trends in architecture and design. The Conference organizers invite papers and presentation proposals relevant to conference themes. Considering the theme of the conference, papers with any of the following or related subjects would be appropriate for presentation:

- Criticism of sustainability/unsustainability
- The architecture of philosophy/architecture without philosophy
- Professional settlement of interior architecture
- Human contact to space with furniture
- Intangible skin of space: lighting design
- Tangible skin of space: material
- Ideology in architecture or architecture of ideology
- Spaces without space: 3D design
- The artistic value of space
- Architecture without architect
- Cultural codes / architecture
- Post-COVID Architecture & Interior Design
- Post-COVID Design Education Models
- Spatial Reflections of Pandemics/Epidemics in History

The 10th International Conference on New Trends in Architecture and Interior Design Conference (10th ICNTAD'24), aims to bring together experts from several institutions such as universities, administrative organizations, architects, engineers and designers, at the framework of conference topics of building, architecture, interior design, product, material, etc. High-level academicians, professionals and design students from around the world will explore the intersection of design, architecture and best practices with leaders from the design professionals. The participation of early-career scholars and postgraduate researchers is also positively encouraged.

We kindly wait for your attendance at our congress to be held 0n April 19-21, 2024, with a hope to realize a satisfactory congress with its scientific ones and leaving a trace on your memories.

Regards

Prof. Dr. Burçin Cem ARABACIOĞLU
Conference Chair

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INTERNATIONAL CONFERENCE ON NEW TRENDS IN ARCHITECTURE & INTERIOR DESIGN

10th ICNTAD'24

19 APRIL 2024 - FRIDAY

OPENING CEREMONY (09:45 – 10:15)

COFFEE BREAK 10:15 – 10:40

10:40 – 11:00
WELCOME SPEECH
Prof. Dr. Burçin Cem ARABACIOĞLU, Conference Chair

SESSION A (11:00 – 12:20)

SESSION CHAIR: Assoc Prof. Dr. F. Pınar ARABACIOĞLU

11:00 – 11:20
PAPER TITLE : MATERIAL HONESTY IN ARCHITECTURAL DISCOURSE
AUTHOR(S) : Bahar AKTUNA - Begüm BAYRAKTAROĞLU

11:20 – 11:40
PAPER TITLE : ANALYSING THE PRODUCTION METHODS IN SPACE INSTALLATIONS WITH READY-MADE OBJECTS
AUTHOR(S) : Hande Zeynep KAYAN - Emir Gökhan SAZLI

11:40 – 12:00
PAPER TITLE : WHY EARTHQUAKE PARKS ARE IMPORTANT FOR CITIES AT RISK?
AUTHOR(S) : Evren Burak ENGİNÖZ - Ayşenur MARANGOZ

LUNCH BREAK 12:20 – 13:40

Lunch is included in the Full Package registration. Participants who booked a Light Package and/or want to purchase an extra ticket should contact the conference registration desk.

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INTERNATIONAL CONFERENCE ON NEW TRENDS IN ARCHITECTURE & INTERIOR DESIGN

10th ICNTAD'24

SESSION B (13:40 – 15:00)

SESSION CHAIR: Prof. Dr. Evren Burak ENGİNÖZ

13:40 – 14:00
PAPER TITLE : EVALUATION OF USER AND PLACE INTERACTION THROUGH ONLINE REVIEWS OF CHAIN COFFEE SHOPS
AUTHOR(S) : Gizem SEYMEN - İrem BEKAR

14:00 – 14:20
PAPER TITLE : A CONCEPTUAL AND METHODOLOGICAL CRITIQUE OF THE "SMART CITY": "WISE CITY"
AUTHOR(S) : Esen SEYMEN - F. Pınar ARABACIOĞLU

14:20 – 14:40
PAPER TITLE : RETHINKING SUSTAINABILITY IN ARCHITECTURE THROUGH CIRCULAR ECONOMY
AUTHOR(S) : Burcu KISMET - Birgül ÇOLAKOĞLU

14:40 – 15:00
PAPER TITLE : THE ROLE OF BIOMIMETICS AND GREEN BUILDING CERTIFICATION IN SUSTAINABLE ARCHITECTURE
AUTHOR(S) : Aliye Rahşan KARABETÇA

COFFEE BREAK 15:00 – 15:20

DINNER & LIVE MUSIC
Vadaspark - Budapest

DEPARTURE: 19:00 Courtyard Marriott Hotel

Dinner is included in the Full Package registration. Participants who booked a Light Package and/or want to purchase an extra ticket should contact the conference registration desk.

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INTERNATIONAL CONFERENCE ON NEW TRENDS IN ARCHITECTURE & INTERIOR DESIGN

10th ICNTAD'24

20 APRIL 2024 - SATURDAY

SESSION C (11:00 – 12:20)

SESSION CHAIR: Assoc. Prof. Dr. Didem TUNCEL

11:00 – 11:20
PAPER TITLE : INTERFERENCES BETWEEN ARCHITECTURE AND ARTS IN THE TWIN VILLAS OF ALBERTO SALVATI AND AMBROGIO TRESOLDI
AUTHOR(S) : Carola D'AMBROS

11:20 – 11:40
PAPER TITLE : SOLIDARITY HOME DESIGN IN THE SERVICE OF SOCIAL SUSTAINABILITY
(A case study from Pécs' Szigeti-Tanya community)
AUTHOR(S) : Tibor Zoltán DÁNYI

11:40 – 12:00
PAPER TITLE : SPATIAL REPRESENTATIONS IN BEHZAD'S MINIATURES: THE MEANING AND EXPRESSION FORMS OF SPACE IN IRANIAN ART
AUTHOR(S) : Sara ÇEBİ

12:00 – 12:20
PAPER TITLE : ARCHITECTURE WITHOUT ARCHITECTS: INTERIOR DESIGN OF KESE VILLAGE HOUSES
AUTHOR(S) : Türkan HARMANBAŞI

LUNCH BREAK 12:20 – 13:20

Lunch is included in the Full Package registration. Participants who booked a Light Package and/or want to purchase an extra ticket should contact the conference registration desk.

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INTERNATIONAL CONFERENCE ON NEW TRENDS IN ARCHITECTURE & INTERIOR DESIGN

10th ICNTAD'24

SESSION D (13:20 – 14:40)

SESSION CHAIR: Asst. Prof. Dr. Hande Zeynep KAYAN

13:20 – 13:40
PAPER TITLE : ECO-BRICKS IN THE FRAMEWORK OF THE INTEGRATION OF THE CONCEPT OF ECO-DESIGN INTO ARCHITECTURE
AUTHOR(S) : Sena Göknur KOÇ - Sibel MAÇKA KALFA

13:40 – 14:00
PAPER TITLE : SUSTAINABLE DESIGN STRATEGIES TO INCREASE THE DAYLIGHT PERFORMANCE OF EMU RECTORATE BUILDING IN GAZİMAĞUSA / NORTH CYPRUS
AUTHOR(S) : Harun SEVİNÇ

14:00 – 14:20
PAPER TITLE : EVALUATION OF ARTIFICIAL LIGHTING CONDITIONS IN ACADEMIC EDUCATION ENVIRONMENTS IN TERMS OF ENERGY EFFICIENCY
AUTHOR(S) :Umay BEKTAŞ - Sibel MAÇKA KALFA

14:20 – 14:40
PAPER TITLE : DESIGN OF A NEW VIRTUAL REALITY STUDIO FOR INDUSTRIAL DESIGN ENGINEERING USING TRIZ APPROACH
AUTHOR(S) : İsmail ŞAHİN - Harun GÖKÇE - Oğulcan EREN - Neslihan TOP - Nurullah YÜKSEL

COFFEE BREAK 15:00 – 15:20

END OF CONFERENCE

21 APRIL 2024 - SUNDAY

Optional Vienna tour by bus with a guide
Hotel Departure : 07:00
Return Back to Hotel : 23:00

Optional Vienna transfer by bus
(One way transfer to Vienna City Center with no return)
Hotel Departure : 09:00

These optional services are only for participants who are willing to travel to Vienna to enjoy the city. Participants who are willing to book these extra services should contact the conference registration desk.

MATERIAL HONESTY IN ARCHITECTURAL DISCOURSE

Bahar AKTUNA[1], Begüm BAYRAKTAROĞLU[2]

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Abstract
This paper studies the intricate historical discourse on material honesty and deception in architecture unfolding over centuries. From the Baroque period to the present, it looks at perspectives on material honesty and deceit, considering structural forms and surface materials. In contemporary times, technology challenges conventional understandings of material authenticity. Sustainability concerns drive the development of environmentally responsive materials, expanding the discourse on material ethics. The study engages with historical discourses, exploring the roots of faux materiality in architecture and its value judgments. It revisits debates from the ancient to the contemporary thinkers presenting the ethical considerations of materials within societal, cultural, and technological frameworks. In the contemporary context, the discourse extends to digital technological realms such as virtual reality, artificial intelligence, and new material developments. Changing material discussions from static final products to dynamic, environmentally responsive materials challenges established frameworks. As architecture stands at the crossroads of technological progress and environmental responsibility, the future of material honesty appears dynamic and complex, necessitating a nuanced understanding in a rapidly evolving world.
Key Words: *building materials; honesty; deceit; faux; imitation*

1. Introduction

Materials that appear as other materials, such as stone-imitating ceramics, wood-imitating vinyl, or marble-imitating plaster, have become widely available and frequently used in construction. Along with composite materials widely used today, materials that 'appear as something else' are explicitly preferred, produced, and marketed by various stakeholders, including users, designers, and manufacturers, possibly for functional, economic, aesthetic, and other reasons. It may seem that the use of such materials results from the possibilities provided by technological advancements and the continuous development of new production methods that have led to endless new materials that are lighter, more economical, easily applied, and have a broader range of products. Nevertheless, the concept of using a building material that resembles another is nothing new in architectural practice, and it appears in historical debates on 'material honesty' and 'material deceit.' Whereas 'material honesty' seeks the principle of agreement between a material and its representation, 'material deceit' pursues illusions through faux (false or fake) building materials, which replicate the visual and tactile qualities of authentic materials. While it may seem that discussions on the honesty of materials originated in the late 19th century with the development of production processes during the Industrial Revolution and the increasing influence of modern architecture in the early 20th century, a historical review reveals that the topic extends back to at least the first century albeit under different concepts. The historical debates on the honesty of building materials and faux building materials, a distinctive material category imbued with nuanced value connotations, raise curiosity about how the subject is addressed in contemporary discourses and practices. While this paper presents a preliminary study on the review of discourses on material honesty, it precedes more comprehensive research on material ethics, a research project on the discourses and works of influential architects. Consequently, this paper will address the following research questions in its limited scope:

- What is the origin of faux materiality in architecture?
- Where does it receive its value judgment?
- How has its relevance evolved in contemporary discourse?

To fully understand how materiality is addressed in current debates, it is necessary to examine the historical discourse and relevance. In this context, this study first chronologically presents the discourses on material honesty and then attempts to answer the final research question through contemporary material debates.

2. Material Honesty & Deception in Historical Discourses

The essence of material honesty initially seems to lie in evaluating the relationship between the material and its representation. A historical review shows the evolution of this subject with various foci as the world and architecture have evolved.

Debates on material honesty, dating back two thousand years, find their origins in the thoughts of Pliny the Elder, a philosopher from the first century AD. With a Stoic perspective, Pliny the Elder communicated ethical evaluations concerning covering one material by another [1]. Although the possibility of these discussions predating him exists, our research has yet to uncover other sources surviving from older times. In this paper, we have instead focused on examining the topic through more recent references. Pliny the Elder, addressing the use of gold in interior decoration, mainly focusing on gold plating, interprets the rise of gold plating in indoor spaces as a deceptive practice. According to Pliny the Elder, who examines the shift in artistic preferences during his time and its societal, moral, and political reflections, this change progressed from figurative painting to marble coverings and ultimately to gold plating. Pliny the Elder suggests that using gold and other precious materials, replacing artistic skill and craftsmanship with commercial value and ostentation, contributed to promoting an anonymous artistic ethos. Similar practices, akin to concealing other materials under a thin layer of gold, are evidently observed in the realm of wood types and their applications. The deceptive act of covering less expensive wood with more expensive wood is a condemnable taste in veneering, signifying the manipulation of natural products, each possessing distinct values [1]. Pliny the Elder views material honesty not merely as an ontological consideration of the inherent nature of materials but rather as an ethical judgment that extends to how materials operate within broader societal, technological, and economic frameworks. According to Pliny the Elder, the ethical evaluation of materials goes beyond their intrinsic qualities and involves considering their effects within the larger context of society, culture, technology, and economy.

In the seventeenth century, crafting things that are not as they seem became very popular. Along these lines, Berit Møller mentions that in the Baroque period, the practice of faking marble with paint, known since ancient times, was expanded to include imitating wood, tortoiseshell, and other expensive materials using paint and polish. The production of fake materials with paint in interior spaces and furniture is not driven by economic reasons, such as replacing expensive materials. Imitating rare substances, inspiring imitations in Asia, and convincingly mimicking nature became popular themes and creative challenges in artistic and decorative practices [2].

Views on material honesty continue with Carlo Lodoli in Francesco Algarotti's "Essay on Architecture," dated 1756. Lodoli, Algarotti's Venetian teacher, defends that the material must represent itself honestly, and he describes the translations of material forms, such as from wood to stone, as abuse while discussing the essence and reality of the material as its density, properties, and durability features [3]. Along these lines, Lodoli suggests that forms appropriate to the nature of the material should be found and that the entire shape should derive from the character of the material. Lodoli highlights material honesty through the material's physical and mechanical properties, and thus, it presents a more mechanical perspective of the ethics of materiality, which resonates with the spirit of the Enlightenment [4].

Approximately eighty years later, Gottfried Semper expressed thoughts on material honesty, incorporating the contemporary materials of the time, such as brick and iron, and emphasizing that materials should appear as they are. He also touched upon the need for protective coverings but did not see it contradicting the idea of materials appearing as they are [3]. In Semper, material properties are mediated by material histories. Along these lines, Jonathan Noble notes Semper's "firm disagreement with the 'materialists' of his day, theorists who wished to derive an architectural rationalism from the inherent logic of building materials and construction" [5]. For Semper, architecture is about processing materials, and he is interested in the materials' potential forms. In the mid-19th century, Eugène Emmanuel Viollet-le-Duc also reiterated the idea that stone, wood, and iron should appear as themselves and emphasized the importance of materials reflecting their functions according to their form. Unlike Semper, Viollet-le-Duc, while calling for materials to express themselves, specified that they should not only be structural but also not covered. Semper's and Viollet-le-Duc's contemporary Karl Bötticher approaches the essence of material from a structural form perspective. According to Bötticher, form endows the material with the ability to fulfill its function [3].

In the 19th century, John Ruskin defined false assertions about the nature of the material as a violation of truth. He saw this as a reprehensible moral crime [6]. He discussed surface deceptions as architectural deceptions through the use of painting, coating, and materials and defined surface deception in general terms

as showing a form or material that does not actually exist as if it existed. The picture is not a hoax as long as it is admitted and makes no claims about the ground material. While it is legitimate to cover the brick with plaster and the plaster with fresco, it is deceptive to cover the brick with cement and divide this cement with joints to make it look like stone. According to Ruskin, even if it is not necessary, whitewashing, like painting, is not considered a deception as long as it does not attempt to imitate the material beyond hiding it and does not make a claim about the underlying material. Gold plating is not considered a deception in architecture because of its frequent use and because it is clearly identified as plating. While gold plating is allowed to some extent in architecture, it is unacceptable in jewelry as the entire material may be mistaken for gold. Similar to gold plating, a marble coating is not considered objectionable if it is clearly understood that it does not mean a marble wall. On the other hand, while the authentic colors of architecture are natural stone colors, mosaic imitations of colored stones are highly deceptive and unacceptable [7].

In his work titled "The Principle of Cladding," written at the end of the 19th century, Adolf Loos further associated the essence of the material with structural forms. However, in a manner akin to Semper's dressing material, Loos also addressed the concept of protective covering. The innovation in Loos' approach lies in his advocacy for separating surface material from structural material. Thus, he introduced a new perspective that considers material in terms of its structural form and as a surface, emphasizing that the surface material should not intermingle with the structural material [3]. Thus, in the 19th century, we see the emergence of the division between the structural form and surface in the ethical consideration of building materials and the treatment of material honesty through both perspectives.

László Moholy-Nagy and Filippo Tommaso Marinetti's discourses on tactile education and tactile sensations show that the surface approach to materials was also addressed in the Bauhaus. Regarding the materials used in sculptures, Moholy-Nagy states that surface imitations should be avoided and that the materials should have their own value. In addition, his interest in the properties of materials, such as flexibility and elasticity, shows that the artist has both structural form and surface approaches. Approaches to combining interior and exterior materials, which is a characteristic feature of modern architecture, contribute to efforts to overcome the distinction between whether the essence of the material is structural form or surface [3].

The honesty of the material was an essential discourse of brutalist architecture, which rose in parallel with the need for cheap construction methods after the Second World War and was known for the expressionist character of structural elements until the mid-1950s. In brutalist buildings, concrete is used to symbolize honesty and simplicity. Brutalism still maintains its influence as an architectural movement because it is considered honest and natural [8].

Materiality emerged as a prominent concept at the end of the twentieth century. Kenneth Frampton, in his discourse on architectural trends in the era of globalization, states that material used to function as a tool to realize the structure of the building, but now its role has turned into a tool to create specific images. According to Georg Simmel, material is not just a structural and technological feature. It is also a cultural feature [8]. Peter Zumthor makes statements regarding the nature of materials in the new century. He also references material nature with the use of materials in his buildings: "Sense emerges when I succeed in bringing out the specific meanings of certain materials in my buildings, meanings that can only be perceived in just this way in just this building" [9]. Based on these words, the meaning Zumthor attributes to the essence of the material includes the relationship established with the context beyond its internal or sensory properties. Arguing that materials should be handled with awareness, Zumthor draws attention to the importance of using them in a way that respects their true nature [10]. Zumthor considers architecture a concrete substance in the concrete world [11]. The transformation of elements in nature into building materials, the existence of materials, their processing, and their relationship with reality have shaped the world of thought and designs.

The issue of material integrity has been discussed for over two thousand years, from the beginning to the present. It appears both in the discourses of thinkers and theorists and in practices. Different approaches emerge depending on the artistic, cultural, and political environments of different periods and societies or how people approach the subject. As a result, it can be seen that the issue of material integrity is addressed from the following perspectives:

- craft or art knowledge on material processing
- availability of and accessibility to materials
- utilization of material as a structural form
- utilization of material as a surface material

Whether or not the coating of the material is for protection purposes, whether it is clearly stated that the material is coated or not, and whether a claim is made about the material under the coating brings about discussions about what is or is not considered deception in ethical terms, or the differences in the degrees of deception. Discussions about whether the material is used by its structural and inherent properties focus on whether the material is left raw or bare, whether the internal properties of the material are suitable for its intended use, and whether the material is used for its economic or social status value in a way that creates a purely visual effect.

Innovations made possible by developments in science and technology have increased the importance of materiality in architectural discourse and practices. With digital production techniques, material has become a more central concept. Similar to Frampton's assertion that the material has turned into a tool for creating specific images, Sandra Karina Löschke mentions that evocative materials and surfaces have become an essential method of presenting architecture, and according to Löschke, Gernot Böhme describes the material aesthetics, which we encounter and attach importance to, especially in high-profile contemporary buildings, as "a mandatory accessory" [12]. Against this approach, some perspectives prioritize an intrinsic aesthetic understanding, such as the raw state of the material, over artificial and superficial aspects.

3. Materiality in Contemporary Discourses

As we leave the first quarter of a new century behind, the point that technology has reached, together with the virtual environment, brings the issue of the fakeness/reality of all non-physical substances to our agenda, causing us to question our relationship with materials again, and perhaps in a way and scope that we have never done before. In addition, very new and diverse materials are emerging worldwide within the scope of sustainability policies produced against environmental problems. With these developments, questions such as where the discussions on material honesty may evolve and whether it can still be a valid discourse in architecture await answers. The way to answer these questions is to sustain the discussions that have been going on for centuries, to determine the point reached regarding material production and use at the turning point we are in, and to interpret its relationship with material honesty.

Technological realms such as virtual reality (VR) and augmented reality (AR), which entered our lives with the digital age, have become effectively used in the discipline of architecture as well as in every field. With the Covid pandemic, the mandatory transfer of architecture's education and production tools to virtual environments for a certain period of time has brought the debates about materiality back to the agenda. The materiality debate challenges the assumption that physical buildings are real and virtual environments are fake. In the pre-digital period, a virtual mechanism was created thanks to conscious copies made with physical materials, and mass education was carried out with these copies through museums and schools. Plaster has been frequently used in such applications. It has also been adapted to show aging levels with different surface treatments of the plaster, allowing successful copies of different forms to be obtained. According to Joshua Bard and Francesca Torello, the fakeness here is not in the intangibility of the material, but in the illusion created by the hyperreality of the material [13]. The materiality of plaster objects provides the necessary clues for the viewer to visualize the original building, just as convincing material effects add content to the environments we experience in the digital world today.

Continuously developing digital technology accelerates new material discovery and production, as well as applications such as virtual reality and artificial intelligence. Material development trends are changing, and methods are becoming more scientifically based rather than random. New generation materials are being produced that shake our established expectations regarding the physical and chemical behavior of materials. Some of these do not fully represent the natural origin of the material nor the technology through which it exists. Materials obtained through various manipulations, such as basalt, which is heated to molten temperature and turned into fibers and then turned into bricks, are examples of new generation materials, also called super materials [14]. It seems that the definition of fixed material honesty, on which modernism's rejection of ornamentation and pro-openness attitude is based, will change with these hybrid materials.

Environmental issues, such as the increasing energy problem and climate crisis in the world, now necessitate a life within the framework of sustainability principles. This is not limited to producing materials with a low carbon footprint. With the help of technology, self-healing, energy-generating, responsive, and reactive materials that even contribute to the environment are produced, and studies continue to develop similar materials. Smart materials that respond to environmental stimuli, activate, transform and adapt have the potential to provide environmentally friendly solutions when used together with smart building systems.

However, established ontological and epistemological frameworks in the field of design are based on final products rather than material formation processes. In addition, designing with shape-changing materials can lead to unpredictable results depending on transformations over time [15]. Although it is not possible to say anything definitive about how the ever-changing nature of these dynamic materials will shape the discussions on material honesty, it is anticipated that it will move the issue away from discussions on static final products and mere appearance.

4. Conclusion

To conclude, the exploration of material honesty and deception in architecture unfolds over a span of two millennia, revealing a complex interplay between ethics, aesthetics, society, and technology. Historical discussions highlight the ethical implications of masking one material with another, with diverse perspectives evolving through the Baroque period, the Enlightenment, and into the 19th and 20th centuries, examining aspects like structural forms, surface materials, and their distinction.

The advent of digital technology, virtual reality, and augmented reality challenges the traditional boundaries between physical and virtual realms and modes of production. Emerging materials, including hyper and super materials, are reshaping expectations on the origin and manufacturing processes of building materials. Sustainability requirements drive the development of environmentally friendly materials, including innovative and smart materials.

The conventional notion of material honesty is transforming in light of these advancements. Dialogues have transcended static final products to consider the dynamic nature, formation processes, environmental impact, life cycle, and ethical dimensions in material choices. Consequently, it has become imperative to reevaluate the authenticity of building materials through diverse frameworks, moving beyond purely natural origins and historical relationships of materials and methods.

Standing at the intersection of technological progress and environmental responsibility, the future of material honesty in architecture appears both dynamic and challenging. This calls for a reassessment of established frameworks and a timely understanding of materials in a rapidly changing world.

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ANALYSING THE PRODUCTION METHODS IN SPACE INSTALLATIONS WITH READY-MADE OBJECTS

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Abstract
Installation art is not a concept independent of the environment. On the contrary, it is a branch of art that is created for a specific space, gives new meanings to the space where it is created and where audience participation is essential. Installation art was named with Duchamp's ready-made objects and Kurt Schwitters' works, and from the moment it was named until today, it has been considered as an inseparable whole with the ready-made-object relationship. At this point, the aim of the organization in which the ready-made object is taken and exhibited from its present space, has been to make the viewer question art and therefore life. The ready-made object gains meaning depending on the vision, design understanding and the main idea of the designer who handles it or thinks of transforming it into an art object wants to share. It is seen that there are changes in the attitude of using ready-made objects in installations with the developing building technologies and designers aim to convey their ideas to the audience from a more holistic framework. Designers use new techniques to find "new originals". The combination of different techniques with different scales increases the diversity of space installations using ready-made objects. In this context, the content is enriched with subtitles that emphasise the diversity of applications, while limiting the study to "accumulation", which serves to regulate in the structural dimension, and "manipulation", which serves to regulate in the material/scale dimension, which are among the frequently encountered construction techniques. Starting with the historical development of the use of ready-made objects in installations, the study focuses on the integration of techniques, which are especially prominent in the art of painting, into design in the third dimension. In the study, which develops with current example analyses, it is seen that the effect of the thought conveyed to the audience can be increased with the technique used, and with the developing technology, installations with technical combination details and value that can respond to aesthetic concerns can be reached rather than examples where ready-made objects are used singularly and unchanged. As a result of this development, it is predicted that today's use of ready-made objects will become aesthetically satisfying and unlimited in scale.
Key Words: *Installation, Ready-Made, Production Methods, Conceptual art, Experienced art*

1. Introduction

Art has been at the focal point of people in every period and has changed with technological developments. In the emergence of an interdisciplinary understanding of art, developing technologies have contributed greatly to change by offering new perspectives and methods. With this feature, art is seen as one of the ways that human beings apply to prove themselves, find the truth and meet their needs [1]. In addition, it maintains its validity in society with its role in adding different perspectives to communication as well as the aesthetic concerns in its nature. When we examine the historical process, art was first separated from craft, then it turned into "fine art", and in the follow-up of developments, "fine" evolved into "modern" and finally into "contemporary" [2]. On the basis of all these developments, it is accepted that the event shaping today's art is the Industrial Revolution [3]. As a result of the industrialisation movements that started in Europe, the production process became very practical and fast as a result of the developing technologies; the widespread use of production lines caused everything, including art, to become machine-dependent and mass-producible. The relationship of the audience with the work has begun to be questioned in the accelerating flow of life [4].

The first movement that set out to change the course, attitude and form of art in the living standards brought by the industrial revolution was the Dadaism movement. The most basic belief of the movement is that everything in the visible universe has the quality of being material for art. The beginning of Dadaism coincides with a very intense period of World War I, which spread from Europe to the whole world. As a result of this war, which changed world history and destroyed judgements, the understanding of art had to be shaped. In the years following the Dada movement, the definition of art has been questioned many times, and this situation has caused one of the movements that form the foundations of contemporary art to be seen as Dadaism. The Dadaism movement, which centred on human life and advocated anti-war thinking,

attracted the attention of the artists of the period. However, although its starting points were in favour of world peace, it caused an aggressive attitude within the art circles. The pressure points for art terminology were established as "destroying every work that puts visual aesthetic perception in front of the message of the work" and the artists of the movement argued that art should be an intellectual concept, not a formal one [5]. In the process that brought the end of the Dada movement, many artists were judged for the styles they wanted to put forward due to the sensitisation of public values, and many of them could not reach the points they wanted to go.

The most basic belief of the Dadaism movement, which set out to change the course, attitude and form of art, is that everything in the visible universe has the quality of being material for art. From this point of view, it is seen that the spiritual value of the object in human eyes dates back to primitive times. For centuries, man has formed the importance of the object in daily life by trying to shape and use what he sees from nature. Considering the first communities, objects appear as the only means of providing people's life needs. For this reason, it suggests that the value of an object in periods may be different from today depending on personal conditions [6]. Over time, objects have become a condition to fulfil functions for people who have started to make connections and inferences between the object/survival relationship. The conditional situation has also caused objects to form separate values apart from their functions over time and made them a whole with their aesthetic values.

The changes that enabled the object to reach its modern attitude in art started with the symbolism movement. Towards the end of the Symbolism movement, the aim was to create an absolute concept by emphasising the quality of conveying the meaning of the work of art to the viewer with its form rather than its aesthetic meaning. In this period, when the effect of "projectionism" was lessened with the development of mass production lines and cameras, artists decided to use elements from their daily lives in their designs to convey their messages to the audience. Marcel Duchamp, who created works by seeing the Cubism movement as a solution until 1910-1915, realised the depression period in art after 1915. He claimed that the situation would never improve if influences from traditional art were not included in the art of the period. However, he put forward the idea of transferring the "found object" technique to the third dimension, which has a great place in the history of art, but which showed its face in the modern period with Picasso's use of objects in some of his paintings. In the first step towards the transformation of everyday objects into works of art, Duchamp wanted to create a systematic way of working in order to eliminate the distinction between them. As a result of his studies on the "space-object" relationship in this period, he questioned the meaning of art by bringing before the eyes of the audience some everyday objects that they use but do not observe clearly. The first product of this system, which he claims to be more experimental and ignores the classical concerns, is the composition he named "Bicycle Wheel" consisting of a stool and a bicycle wheel, which he shared in France before returning to America. With the compositions he prepared, he adopted to convey his message by giving references from the daily lives of the viewers. His style, which has been the subject of many art historians during and after his life, constitutes a leg of the structure of contemporary art.

The art historian Joseph Kosuth and Sol LeWitt, who continued their artistic life and conducted research by analysing Duchamp's attitude, introduced the concept of "ready-made object" and formed the beginning of the conceptualist manifesto. This is how "conceptualism" emerged, aiming to combine the classical art techniques and forms that the public longed for with the art of the period. One of the first works given after the Manifesto is a chair composition that Kosuth constructed, did not produce himself, and did not even photograph it. With this work, Kosuth tried to find an answer to the question "what is art?" from a different perspective. Conceptual thought aims to analyse and redefine the theoretical side of art. For this reason, it is closely associated with logic and philosophy. The artists of the period started to think outside the forms and techniques used until then and adopted different methods to convey their expressions to the audience. This situation enabled the objects produced as surplus with industrialisation to be seen directly as works of art. The increase in the variety of objects produced was seen as a means of expression by the artists of the period [7]. As a result of the inferences of the artists of the movement, it was concluded that art could not only be a work of art that is watched. According to conceptual artists, art has become something to be experienced with all senses. Conceptual artists have adopted multidisciplinary principles to appeal to all senses [8]. The reason for the harmonisation of many techniques integrated from different branches in today's art is the same concern. The elements have reached the present day by developing in a diverse range from everyday consumption objects to surfaces of historical importance.

According to Sözen and Tanyeli [9], a ready-made object is "an industrial object that has been selected

and evaluated among its counterparts as a work of art, used without any change, or the change on it has arisen only due to coincidences during its production". If the use of ready-made objects in art needs to be defined, it is the use of everyday objects to convey the artist's message to the person interacting with the work. According to Toluyağ [10] quoted from Oliveria [11], the concept of space in art has taken its place as a common representation; artists have started to create their own imaginary spaces, works of art, and experienced art with the objects they provide from real space. These spatial searches in art have extended to 'experienced art' works, which are different from the classics of painting and sculpture, and which are based on human perceptual experience and the conceptual messages revealed in this way. In the late 20th century, these efforts to create experienced spaces were called 'Installation'.

The acceptance of installation art as a branch of art started with the use of ready-made objects in the works of artists who thought that the collage initiated by Pablo Picasso with his painting 'Still life with bamboo chair' should be developed and completely three-dimensional with the assemblage technique [12]. Assemblage is literally; "instead of creating the work of art through actions such as painting, drawing, rendering and sculpting, it is the production of natural or industrial objects that are not produced for artistic purposes by bringing them together in a new order" [13]. In addition, the concepts prepared by the works of Dada and Fluxus period artists, who continued the ready-made object technique, caused art to be questioned as a whole. In this sense, the Fluxus group, in addition to Duchamp's ideas integrated with Surrealism and Dada, attached great importance to coincidence in the process of creation, and instead of making artworks that could be exhibited in galleries or kept in private collections, the artists chose to live and create experiences that stay away from the art market and leave traces in memory [14] [13]. In the period when questions about what an artwork is were raised, the concept of "space" was once again brought to the agenda by art circles. In this period, artists realised that they needed space to strengthen the steps towards transforming ready-made objects into works of art. As a result of the increase in the need to search for space in art to ensure the transmission between the viewer/message of the aesthetic concerns in painting, an understanding that puts the space at the centre of art has emerged. In the genre called installation art, the works are shaped according to their space when necessary. The concept of installation aims to break the perception of being untouchable in traditional works of art. While its meaning in art terminology is organisation, its task is to create an environment that will allow viewers to experience the space as a whole. In most installation designs, the space itself is thus exhibited to the audience as an artefact [15]. With this approach, space can be explained as the whole formed by the space between objects and living things in the context of human/object/environment. In art, space functions as a cocoon for the viewer. While it contributes to the development of the viewer one-to-one, it includes him/her in the circulation in the process, but always fulfils the function of a shell. With this approach, the shell both defines the boundary and is unlimited [16]. The erasure of this line between the space/artwork increases the richness of perception created by the works of art and thus eliminates the concept of inviolability of the works [17].

In 21st century installation art, the questioning of the relationship between the quartet of designer/design/user/space is a common concern, mainly the position of the work, its relationship with other elements and its harmony with openings. The concept of "space installation", which emerged as a result of the one-to-one correspondence of installation art with the perception of space, expresses the experience of the relationship between the viewer and the space, which is tried to be created by appealing to more than one of the senses. Space installation is the reflection of the principles of space design in multidisciplinary fiction to art.

Installation is "a production, expression, working style and an understanding of art in conceptual art practices and other art disciplines" [18]. Installation works, one of the most interesting elements of today's art scene, is an application that appeals to all senses as well as visually satisfying those who experience it. According to Danto [19]; although the materials and space used by installation artists are unlimited, artists constantly aim to discover something new. However, 'When placing an object in the installation, it is aimed not to exhibit the selected object in any space as an indicator, but to make the selected space a living space for the object used' [10]. In this sense, space is a space of experience, it consists of the intersection of moving elements and becomes a place that is experienced through the sum of the movements that take place in it [20].

Installations are created with multidisciplinary and multifunctional concerns in order to provide the multi-sensory experience they promise. The aim of creating the integrity of object and space in designs is to affect the viewer conceptually and aesthetically. In this context, the use of ready-made objects is one of the

important elements of space installation designs. With all these approaches, the study aims to examine the support of the technologies used in ready-made object-based installation constructions and the methods by which they are brought together, organised and/or defined. The examples are interpreted depending on the elements (the conditions of the period, the techniques used, the function of the installation space, the message the artist wants to give) that are effective in the way the objects in the designs move from singularity to plural concepts over time. In the installations created with different techniques, the attractiveness increases with the presentations created by the artists in terms of conveying their thoughts to the audience, and originality is brought to the fore. In order not to distract from the subject, in the installations to be examined by limiting them under the main headings of accumulation and manipulation, current examples are discussed with subheadings and inferences are made through them. Throughout the process, the following research questions will form the framework of the study:

. What is the effect of the use of ready-made objects on installation designs?
. Which construction techniques are frequently used in installations using ready-made objects?
. What is the effect of ready-made object based installations on the space/viewer?

2. Production Methods in Ready Object Based Installations

One of the main characteristics of art products is that they also function symbolically as 'memory triggers' for social memory. In this sense, the most influential forms of visual arts in recent years have generally been the works of artists who bring a critical perspective to the experience of human perception, pushing the boundaries of experience and expanding the possibilities it contains. Some of these experiential activities include the creation of unexpected spaces and environments where our visual and mental habits are subverted or questioned, as well as the use of ready-made objects that support this situation [13]. The installations created with this approach constitute a reflection of today's art and living conditions with their suitability for multidisciplinary working environment. Innovation in art is always realised as "a positive and negative adaptation of tradition" by both breaking and maintaining traditions [21]. In this sense, the choice of the structure that will provide interaction by restructuring the relationship between the artist and the audience, that will ensure interaction, that will advance the process/product relationship in a healthy-efficient way, and that will support this flexibility for a sustainable design approach is a separate design problem.

With the integration of ready-made objects into art, the meanings attributed to everyday objects are also differentiated. When we analyse the first examples of the use of ready-made objects in art, we see the importance of singularity and positioning. Since developing building technologies are increasing the permeability between function/form day by day, installations are seen as a means of expression by art circles. Designers try to achieve their goal of finding "new originals" by using building technology as a tool. The fact that the natural sculptural, structural and natural structures of ready-made objects combine with today's building technologies and refer to techniques in other types of art is an indication that installations are a multi-layered thought product. The fact that the techniques used in two dimensions in art can be transferred to three dimensions with the building technologies used potentially increases the production diversity of installations using ready-made objects. With the integration of building technologies into the genre, singularity and location specificity have been replaced by "compositions established with the harmony of multiple elements" and "modular placement possibilities in every scale and location". The differences in technical use that have emerged with the increase in potential have enabled designers to add new functions and circulation patterns to their works as well as the messages they want to convey. In this way, designers can create "spaces within spaces" [22] that can sometimes make the audience a part of the work of art, and sometimes facilitate the socialisation of the audience among themselves. In conditions where there are no restrictions in terms of scale, location and form, ready-made object-based installation works planned in large volumes bring new functions to their audiences and public spaces.

Ready-made objects are seen as an indispensable part of human life due to their place in daily life. The objects, which are associated with fulfilling the functions assigned in the organizations in which they are actively used and relaxing the body anthropometrically, can also undertake different tasks due to their position in the flow. For designers, ready-made objects are an important means of expression due to their timelessness, material diversity and form/function transfer potentials. According to Groys [21] the ready-made object is "the expression not of the object but of the message behind it. It is a phenomenon that becomes visible with its new concept that moves away from the way it is looked at from the moment it is produced. It is the formal equivalent of the existence of the concept and can only achieve its purpose when perceived by

observers". In the way of turning users into observers, the presence of ready-made objects in the exhibition areas in the period when they were first used is considered sufficient as a factor of surprise. However, due to the widespread use of this form of use today, designers have entered into new searches. The idea of presenting ready-made objects, which are with them at every moment of their lives but which they do not have the opportunity to examine due to the flow, to the audience in different techniques and conditions has been developed collectively by adding on since the first period when it was first put forward.

Technology offers new forms of expression and tools to the artist. However, it completely changes the mindset, perception and searches of the artist and the viewer. The productions, which started with the integration of the forms of sculpture and painting into installation, today also address social concerns such as "sustainability, accessibility, multidisciplinarity". Designers use such references to trigger the memories of society and art circles and to convey the underlying text of their works. In this section, the effect of construction technologies on installation art is determined by addressing the "accumulation" technique, which serves to regulate in the structural dimension, and the "manipulation" technique, which serves to regulate in the material/scale dimension.

2.1. Accumulation Technique

The term "accumulation" literally means accumulation, sedimentation, agglomeration and gathering [23]. Different methods such as stacking, layering, framing, taping and hanging can be used in the technique. The purpose of using the accumulation technique is the potential of placing more than one element in harmony in an area scanned in a certain square metre. In the works of the designers who adopt the technique, ready-made objects can sometimes appear haphazardly piled up, and sometimes as if they have come out of a mould. The emergence of the term is identified with the New Realism movement of the 1960s and its pioneer, the artist Fernandez Arman. Accumulation is one of the methods used by artists on the road to modernisation in the transformation of objects described as found in art production into works of art [24]. It can also meet the concerns of "being placed on a large scale, interacting with the user, multidisciplinarity" in installation art.

Accumulation is the technical equivalent of the well-known composition of "pile of objects". Although ready-made objects can be combined with additional surfaces when using the technique, they can be stacked by creating an order suitable for the structure of the direct object. According to the definition of the selected objects and the placed space in the context of the work, it is also possible to talk about functions such as "occupancy-void, scanning, orientation". The accumulation technique appears in many forms in installations, the main ones being; "stacking, framing, hanging, fixing, reducing, wrapping". Thanks to these branches within itself, the technique provides artists with the opportunity of diversity and therefore originality. The classification of the works is defined by their main characteristics such as the location/structural planning/symbolic function of the work.

2.1.1 Accumulation

Accumulation-type installations are works created by placing ready-made objects in a certain area without any concern for order. Considering the design and material diversity / occupancy-void ratio together, installations that offer the opportunity to be placed in a large area, large surfaces can be created that allow the viewers to focus so much that they forget time while drawing them in. The way in which the technique involves users in the relationship between space/concept can be in the form of orientation with the ready-made objects piled up, walking around, creating focal points. Aiming for permanent interaction with users in the area where they are placed, installations actively provide a perception of space in the physical dimension. The installation integrates with the space at some point and becomes an element in the spatial fiction.

The accumulation technique was integrated from the sculpture branch of art to installation during the conceptual art period. Representatives of the technique reflect the context of "sustainability", one of the concerns of our age, in their works. When we analyse the works, we can see that the potential of the accumulation logic to create "new originals" can be seen in the productions of many types of ready-made objects made with this technique.

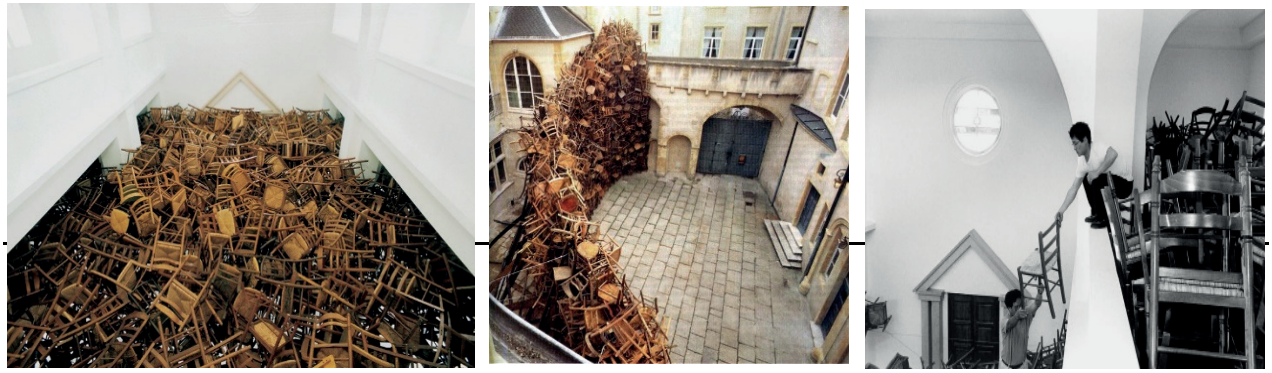

Fig. 1. Les Chaises de Traverse Serisi, Tadashi Kawamata (1998)

Japanese installation artist Tadashi Kawamata has symbolically brought together a hotel and a synagogue in the Metz region. Kawamata connected living spaces with places of worship and people with chairs (Fig 1). When we examine the multiple placement of the installation in the space, we see a planning in direct contact with the structure in the central garden on the synagogue ceiling. The difference in the types of placement used aims to ensure that the chairs are integrated with the space in the eyes of the viewers throughout the visit. The different perspectives that the mobility on the ceiling gives to the space with the contribution of fullness and emptiness increase the effect of the synagogue that includes natural light into the fiction. In order to establish the relationship between the floor and the ceiling, around 2000 chairs were used. He used around 1700 chairs to create the rising transitional effect in the courtyard. In the documentary by the artist Gilles Coudert [25], he explained his work as; "Each of these chairs is a different character with a different story; it is like connecting people with plastic ties, but the bond is always very strong." [26]. By classifying the planned areas of the synagogue on the scale of proportion/space/function and planning their zoning with the density of the chairs, Kawamata aimed to make his masses a part of the space by thinning the line between space/installation as much as possible. Kawamata, who has used the "work in progress" technique and the "stacking" technique many times throughout his artistic life, continues to make references to his environment in the works he creates.

2.1.2 Framing

In the framing method, artists can define the ready-made objects they use within an imaginary frame. When viewed from the outside, a clarity in terms of form can be created with boundaries that are not physical but can be perceived with the senses. With this construction technique, the designer can bring together the ready-made objects that he will place in the space where he will exhibit his work within a system. Whether with the same dimensions and repetition of objects or with the use of different objects, the resulting works can create space within space, define focal points or express surfaces separating areas. The unusualness they add to the spaces where they can be placed from many different angles makes the relationship between space/artwork/user sustainable. The diversity in the occupancy/void ratio increases the alternatives offered by the framing technique for the artist and reflects the connection between space/concept to the viewers.

Fig. 2. A Wall of 300 Chairs and Clothes, Fumiko Kobayashi (2013)

Japanese artist Fumiko Kobayashi's installation work (Fig 2), installed in a hall of the Mori Art Museum, consists of more than 300 chairs and clothes. The work symbolises the devastation after the tsunami, the boundaries of which are clear from the areas it scans on the floor and ceiling, making the viewers feel as if they have stepped out of a mould. The work is divided into two faces, the first is a rigid face filled with clothes and the second is called the mixed face that evokes the moment of the tsunami. Due to the way it is placed in the space, the installation also functions as a partition in the exhibition area. The work, which is placed in contact with the structure between the floor/ceiling/wall, also serves as a reference to other works around it due to the object/occupancy ratio on its surfaces. Thanks to the clear junction of the installation to the points where it touches the floor and ceiling, the continuity of the fiction in the eyes of the user is ensured. In the installation work, in which the structural structures of the chairs are utilised in the construction, the objects are supported by handles from the inside in a way that the users cannot see as much as possible in order to ensure stability. Kobayashi, who aims to create chaos within the composition by using the limits of the technique, creates various works with the framing technique throughout his art life [27]. In this sense, it is possible to talk about the first space where the installation is defined and the new space concepts that emerged after the installation.

2.1.3 Fixing

In the technique of fixing to each other and/or to the surface, surface-junction detail-ready object elements constitute the main order. This technique can also be seen as a way to make environmental aesthetics multidimensional by attracting the attention of people involved in the circulation in public open spaces through its fixings on the vertical plane. It is also a technique used for displaying ready-made objects to users at different levels. Diversity increases with different angles and fixings on unexpected surfaces. Fixing works that contrast the object and ground relationship brought by everyday life can also be considered in harmony with performance arts. Many different perspectives are added to the work with the direct contact of the ready-made objects with the technical boundaries of the space. A permanent bond is formed between the space/installation when the combination details, especially the level relationship, and the harmony between the surface/object are planned. In addition, the works in which the technique is applied offer guiding effects instead of distracting the focus of the viewers in the spaces where they are placed.

Fig. 3. X-Times People, Angie Hiesl (2022)

German artist Angie Hiesl has turned her series of ready-made objects, chairs fixed at unusual elevations and performance artists performing conventional actions, into an international installation (Fig 3). The series of works is on average 6 metres above the ground. The fact that the performance artists perform their actions without seeing the crowd around them is actually an indication that the fixation technique is also used in the context of the concept. The chairs, which constitute absolute focal points in the spaces where they are fixed, have been realised as a result of considering human circulation in two ways. Thanks to its categorisation and placement alternatives, the installation adds many values to the space where it is located. Some of the fixed chairs are placed next to focal elements such as signboards and artworks and serve as supportive. The "relativity of location" in the principles of fixation finds its place in all the pieces of the series and enables visitors to look at public spaces from a different perspective [28].

2.1.4 Subtraction

In the subtraction technique, a certain part of the existing ready-made objects is included in the design. In installations developed with the idea that the eye completes what is missing, the chair element is frequently encountered due to its structural structure and its equivalent in society. In the general use of the

technique starts with creating sections from certain angles and the installation is completed after the production process. The aim of the works in which ready-made objects are placed is to integrate the surfaces into the design and to make us feel that the scenario can continue at any moment. The effect of the technique increases in the works in which the "multi-elementality" concern of installation art is also included. In this sense, works based on subtraction are placed in the space on the basis of section/surface. For this reason, while the installations can be defined in contact with the selected surfaces from different angles, the flow in the active circulation areas can be completed with the continuity effect created. The technique, which causes the viewers to question how the missing surfaces can be completed, offers an intellectual process as well as an experience and also enables the space to gain different symbolic meanings.

Fig. 4. Hasta las Narices, Ivan Puig (2004)

Mexican artist Ivan Puig is known in art circles for his use of the technique of subtraction in large and small scale with ready-made objects. His installation series (Fig 4), in which he subtracted aVolkswagen Beetle model car and chairs and placed them on the ground level, dates from 2004. The artist aimed to create a sense of complexity for the viewers by depicting the most frequently used items in their daily lives as if they were sinking into the ground. The installation work, which brings a dynamic effect to the public space, was placed on the basis of "multiple and direct placement on the ground". The artist determined its boundaries by calculating the occupancy/vacancy ratios due to the placement of the work in an active circulation area. In this way, the desired effects were achieved by avoiding possible risks. In this work, Puig divided each chair at different points and avoided the feeling of repetition. Considering that it is a multi-element scenario, the fact that some of the chairs are at the beginning of the sinking and some at the end shows the continuity in the subtraction technique. Puig, who does not even want the audience to blink their eyes in order not to miss the sinking of the chairs, describes his work as “two sides of a coin” [29].

2.1.5 Suspended

The suspended technique, in the case of ready-made object-based installations, appears as a result of hanging the elements on a surface with various flexible tools. The main purpose of the use is to maintain continuity as a result of hanging the elements. This situation, in scenarios where the objects used are suspended-hanged, can present images in different perspectives to the audience as time passes, as the movement continues with environmental effects. With the strengthening of the fullness-void effect with lighting, different senses can be addressed in the space. In the technique, all kinds of intermediate parts can be included in the design. Since the technique can offer alternative placement possibilities in the space, many ready-made objects can be used at different levels. The technique, in which ready-made objects are suspended by surfaces with certain tensile values, is partially dependent on its environment. Its dependence on the environment requires the artists to solve the relationship between space/installation in the planning phase. In this way, the spatial integrity of the resulting works increases.

Fig. 5. Cold Dark Matter: An Exploded View, Cornelia Parker (1996)

British artist Cornelia Parker's work (Fig 5), which she placed in a crawl space of 4m x 4m x 4m, contains many ready-made objects together. When we examine the ready-made objects, it is understood that they symbolise the objects scattered around at the moment of explosion from a garden shed blown up by the army. Parker, which aims to preserve the moment by hanging from the ceiling, emphasises the ready-made objects with the lighting element placed in the centre and creates an active shadow play in the space. As a result of the technique, the movements of the ready-made objects can be seen from time to time [30]. The ready-made objects are hung in the centre of the space in such a way that each user can experience them. The objects selected for the full depiction of the moment were hung in order in this sense. The lighting element, placed so that the shock during the explosion can be felt by the viewers, emits a strong light from the centre of the installation, allowing the space to be experienced. The artist aims to establish the connection between the user/installation in the space where he places his work by addressing the fiction of "space within space" in a multi-layered manner.

2.1.6 Wrapping

The wrapping technique refers to compositions created as a result of coating ready-made objects. The use of unusual materials and the use of multiple ready-made objects are the principles of the technique. Designers who use the technique to create their series follow material alternatives in order to create new originals and the technique remains up-to-date for this reason. The ready-made objects are formed as a result of the composition of the ready-made objects in the first step and coating all or part of them with the selected material. Material harmony has an important place in establishing the connection between space/artwork. The wrapping technique enables integrated designs to be made in existing spaces as well as objects. When the surfaces to be wrapped come together with the concerns of the designers, interactive details are created in the spaces as a product of the technique.

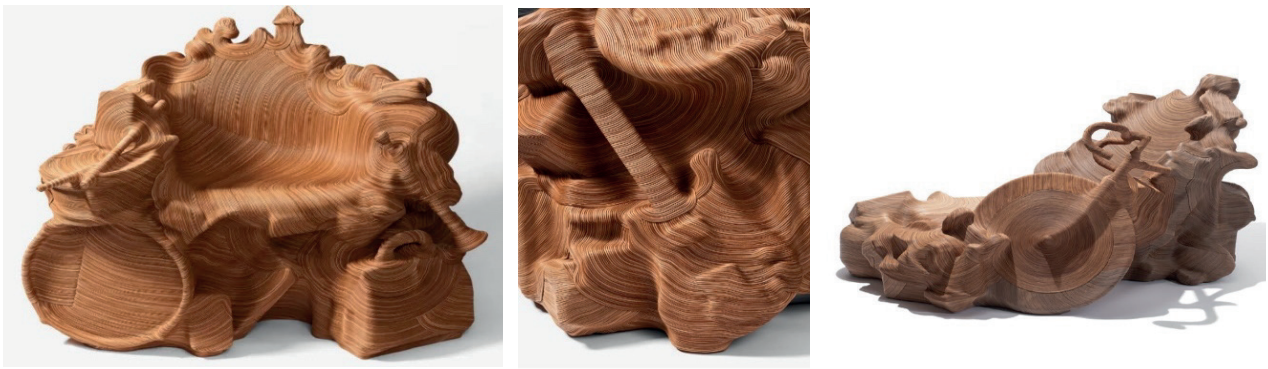

Fig. 6. Savage Chair Normal-Raw, Jay Sae Jung Oh (2014)

The installation (Fig 6), which is part of the series created by the South Korean- American designer Jay Sae Jung Oh using the wrapping technique, symbolises a throne. Oh aims to find a combination that can wrap ready-made objects without loss of space and he thinks that he can achieve this with the harmony of natural/artificial materials. The holistic appearance formed as a result of covering the selected ready-made objects with a mixture of plastic, leather and plywood reveals the place of the elements in our lives and our perceptions. The material effect stands out with its monoblock feature [31].

2.2 Manipulation Technique

The term manipulation is literally translated as directing by adding, subtracting and changing [23]. The integration of technique into installation art has passed through painting with conceptual art. Different methods such as the production of ready-made objects at different scales, interpretation of functions in daily life and material change can be used. The relationship between the ready-made object and the technique is reinforced by the fact that the elements that users constantly see and use in their daily lives are surprisingly presented to them for the last time. The purpose of using the manipulation technique in artefacts is to break down the walls between the artefact/object and to offer new experiences to the viewers.

Manipulation is the technical equivalent of the reconstruction of objects in installation art. While using the technique, a multidisciplinary type of thinking should be created. Manipulation technique appears in many forms in installations, the main ones being; "manipulation of dimensions, manipulation of function and form, manipulation of material". Since the technique is integrated from the art of painting, it also includes other formal concerns of the discipline and this makes the composition of the resulting works with their surroundings important, compositions become a part of the space. The classification of the works is differentiated by the main features such as the selected ready-made object/composition type/symbolic function/manipulated area.

2.2.1 Manipulation of Object Dimensions

Human measurements play an important role in the perception of proportions, which is one of the features that form the character and identity of the form in design. In the use of ready-made object-based installations, especially in open public spaces, objects can be used in unusual sizes according to human scale. The aim here is to offer different space experiences to the citizens. In order to explain the main text of the work to the audience, the practical function is not exceeded in the use of objects with features that they see around them but do not realise. Objects serve as tools for what people want to create due to their position and scale in daily life. In addition, scaling objects and going beyond their dimensions creates a contrast on behalf of the audience. While the contrast is seen as a form of expression for designers to convey their messages, it also shapes the perception of proportion. The diversification in perception strengthens the bond between the viewer/space/installation in the specific area of the installation. The objects used with this approach often lose their classical functions and acquire symbolic functions.

Fig. 7. Balancing Tools, Claes Oldenburg & Coosje van Bruggen (1984)

Claes Oldenburg and Coosje van Bruggen are known for their series of examples in which ready-made objects are scaled to large proportions. However, "Balancing Tools" (Fig 7) is different from the other works in the series. Oldenburg and Bruggen, pioneers of the "soft art" branch of contemporary art, designed the installation as a gift. The work, which was commissioned by the son of Vitra's founder Willi Fehlbaum for his seventieth birthday, harbours different meanings. Placed between the main road and building complexes of the Vitra Campus, the work is considered as a separate composition with the Vitra Design Museum designed by Frank Ghery. The installation placed in the centre of the inner perimeter of the Design Museum offers perspectives from different angles. The composition, in which ready-made objects are scaled and included, complements the environment/installation relationship in open spaces due to its layout type. Although the installation means "tools in balance", it evokes that they will fall in their next movement. The composition, which points out that handcraftsmanship is about to disappear in the industrialised world, creates a contrast with the objects designed by Vitra and thus reflects Willi Fehlbaum's vision when he founded the company [32].

2.2.2 Manipulation of the Function/Form of the Object

The manipulation of the function of an object occurs when the composition formed as a result of the combination of ready-made objects through their structure serves new functions. For people, objects are seen as a whole with their functions and therefore their forms. The manipulation of the form of an object is formed by new elements designed and placed to fulfil the function of the selected ready-made object. The elements strengthen the conceptual expression underlying most unusual designs, which are the result of the abstraction of these connectors in conventional spaces and their inclusion in the installation fiction. In this context, the shaping of the context of the ready-made objects that make up the installations by the designers diversifies the creative process. The derivation of functions from functions enables the formation of systems in which installations can adapt to any space from large to small in scale. The manipulation technique, which can be shaped from shop windows to city squares, requires a good observation process. The alternative potential of the technique, not only in terms of scale, but also in terms of function / ready-made object combinations, is proportional to what designers think. The technique fulfils the principles of "modularity, sustainability and flexibility" of installation art.

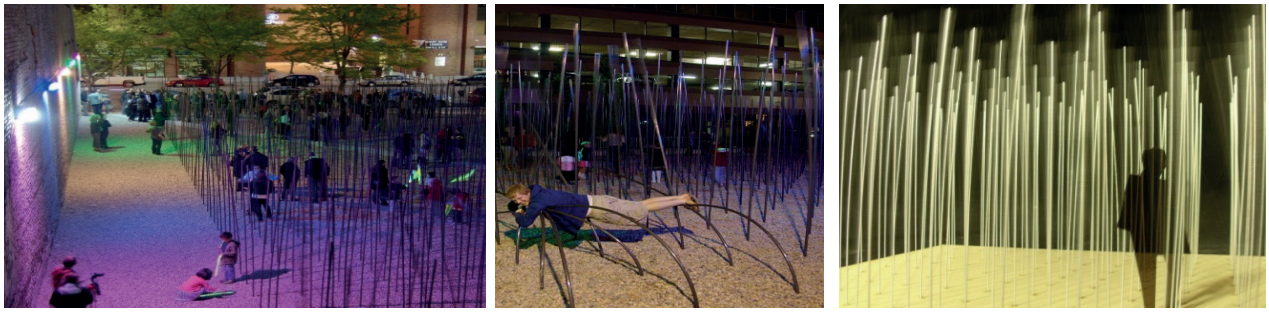

Fig. 8. SWAY'D, Daniel Lyman (2010)

The manipulation of objects as well as the manipulation of their functions are among the issues addressed by installation artists. Daniel Lyman presented a different perspective on the function of sitting and the surfaces that can be sat on with this work (Fig 8), which he made in the public space in 2010. From an aesthetic point of view, the work, which expresses a grassy area swaying against the wind, carries the freedom of movement of each part, but the message that each individual is a part of the whole. The placed rods symbolise the urban order in and around Salt Lake City. The 3-metre rods placed at the midpoint of a square with 80 centimetre sides are planned as rigid. Although the diameter of the rods does not exceed 2.5 centimetres, the mylo nylon composition material used provides full resistance without restricting movement. The project, which has a high interaction with the area where it is located, is equipped with projections for night sequences deprived of daylight. Lyman, who aims to ensure that the maximum experience is transferred from the space regardless of the time of day, has left the future of the installation work to the interpretation of the users. Named after a pun, "SWAY'D" is an example of the manipulation of a function as well as an active urban square [33].

2.2.3 Manipulation the Material of the Project

As a result of the industrial revolution, objects not only fulfil the functions attributed to them, but are also associated with sustainability and cost concerns. The interpretation of the object with materials other than its usual productions promises surfaces that will surprise the viewers and makes the relationship between the viewer and the work multi-layered.

Fig. 9. Snow Furniture Dancing, Hongtao Zhou (2010)

Hongtao Zhou's installation work (Fig 9), produced as a reference to the furniture in the exhibition at the Milwaukee Art Museum, aims to make viewers feel the negative effects of global warming. The ropes, water and ice mixtures needed to create the forms formed a dinner set evoking family bliss. However, the slow melting of the elements due to the warming of the air is a harbinger of impending dangers. In front of a furniture exhibition, Zhou addresses binary relationships, referring to the times when industrial productions polluted the environment as much as they added to human life [34]. This work of the artist, who has created many works by manipulating the forms and materials of ready-made objects throughout his artistic life, is an example where we can see the harmony of the triad of work/message/location.

3. Results

Ready-made objects have been used in various art branches and in various ways from the beginning of the 20th century until today. Ready-made objects, which we first saw with the collage technique in the Cubism movement, have enabled the objects in our daily lives to be examined as works of art. The collage technique, which Picasso also used frequently, has a very important place in terms of the future of the concept of art with the use of ready-made objects. In addition to this, the concept of ready-made object has ceased to be subject to formal questioning thanks to the traditional understandings that Duchamp brought to composition, and has put a lens on the conceptual aspect of art. This change marked the beginning of conceptual art and "Conceptual Art", as Joseph Kosuth called Duchamp's works and thoughts, emerged. In this sense, Installation Art is one of the most noteworthy art movements in terms of its relationship with the concept of space, which was born out of the Conceptual Art endeavor. Installation can be defined as a process experience that leads artists to work with materials and methods not traditionally associated with the visual arts.

Today's designers have the chance to create a new language in their designs thanks to developing technologies and can produce alternative methods to convey the conceptual infrastructure of their work to the audience in the most accurate way. With spatial installations, viewers have the opportunity to have different experiences in the space where the design is exhibited. Being able to be included in the design without being just a spectator, touching, feeling and experiencing the design, appealing to the senses in the sense of touching, feeling and experiencing the design further strengthens the effect of space installations in this sense.

In the research and examples examined within the scope of the study, it is seen that installation examples using ready-made objects integrated with human life are increasing day by day with the opportunities provided to artists. In designs supported by technological possibilities and developed construction techniques, artists present the objects they see around them to the audience in another format. Space installations can be reached with different techniques in designs that sometimes repeat the same object and sometimes strengthen the content by associating with each other. As the relationship between space/artwork strengthens, ready-made objects take their place in installation fictions. The reason and the way the object is placed in the space is important and it is aimed to establish the relationship between space and object. According to this;

- Ready-made object-based installations can gain different meanings depending on the perception and evaluation criteria of the audience as well as the meanings attributed to the work by the designer.
- In ready-made object-based installations, everyday objects used in life can appear before the audience with different functions.
- In ready-made object-based space installations, the structure supports designers to concretise their ideas. In this sense, diversity can be increased with the technique used and different details solved.
- In ready-made object-based installations, the perception of sustainability can be in question through the diversity provided by turning idle, discarded objects into a part of the design.
- Ready-made object-based installations can maximise audience participation with the potential to spread over surfaces of larger than expected dimensions in indoor and/or public spaces.
- With ready-made object-based interactive installation designs, not only indoors but also urbanites can find the opportunity to carry their relations with public open space to a different dimension.
- The use of everyday objects in ready-made object-based installations can enable more sculptural and multi-element designs with new techniques rather than singular exhibitions.
- In ready-made object-based installations, in addition to the messages that artists want to give, the use of ready-made objects in order to break the traditional cycle of use of the object and to provide a visual

interpretation of the elements leaves its place to new searches in terms of material, form, colour and lightness.

- In ready-made object-based installations, the desired composition, rhythm, balance or focal point can be created with the repetition of elements. The effect can be strengthened with the repetition of the same colour and size, as well as the use of different colours and sizes.
- In ready-made object-based installations, the viewer can physically and perceptually experience the real-time atmosphere of the space with all their senses.
- In ready-made object-based installations, memorability can be increased by hanging, fixing etc. techniques.

In the study, it is discussed how everyday objects, which provide the name of installation art, can be included in design with today's technology and construction techniques. It is also possible to add new and sub-branches to the existing construction techniques in the future. Therefore, although the dynamics that can be created through installations are not limited to those mentioned in this study, it is foreseen that more different effects can be defined as the number of examples examined increases.

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WHY EARTHQUAKE PARKS ARE IMPORTANT FOR CITIES AT RISK?

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Abstract (Times New Roman, 9pt, Bold)
Twin earthquakes of 7.7 and 7.6 magnitudes, occurring 9 hours apart, On February 6, 2023, at 04.17 at night, whose epicenter was Pazarcık and Elbistan districts of Kahramanmaraş, has caused disruptions in the rapid and regular delivery of aid and the rescue of those trapped. Many cities in our country are at the risk of earthquake disasters. For this reason, it is very important to manage pre-disaster and post-disaster processes, to identify risks, and develop risk-mitigating planning and strategies. One of the most important of these risk-reducing strategic practices is the planning of open public green areas as safe gathering and sheltering areas for disaster victims after earthquakes. Considering the practices and the negative experiences around the world but also we have experienced in our country, we need to urgently plan new earthquake parks, which are a part of the daily life of the city but can shelter disaster victims at all our cities at risk. It can be asserted that Istanbul and other significant metropolises, which are anticipated to confront a potential earthquake soon, are seriously endangered due to the insufficient presence of green spaces and the subpar quality of those that do exist.
Drawing from this idea, this study aims to discuss the characteristics and usage purposes of earthquake parks in the world and in our country, determining the status of existing earthquake parks specifically in Istanbul, and discussing what important design decisions should be taken into account in improving existing earthquake parks and building new ones.
Key Words: (earthquakes, parks, planning, management, Istanbul)

1. Introduction

Due to the panic caused by the consecutive earthquakes of 7.7 and 7.6 magnitudes, occurring 9 hours apart, On February 6, 2023, at 04.17 at night, whose epicenter was Pazarcık and Elbistan districts of Kahramanmaraş, the climate and weather conditions and the width of the affected area has caused disruptions in the rapid and regular delivery of aid and the rescue of those trapped. However, perhaps the most important problem is that the need for survivors to move to a safe area where they can be protected from the effects of other and aftershocks has not been met at a sufficient level, even though nearly two months have passed.

Even walking around the streets of our 11 almost completely ruined city, has become dangerous after every aftershock. However, despite the nature of the earthquake chain in the region, the main factor that increases the extent of destruction and loss is that the building stock in the region does not meet the necessities and that people, who cannot find safe gathering and shelter areas, are forced to enter their homes. The fact that most of the safe gathering and sheltering areas, which were determined on paper without any thought before the disaster, remained under the collapsed buildings caused the disaster victims who had the means to leave the cities where they were born and raised, to have to try and live among the ruins despite the possible dangers.

We should not forget that earthquakes are natural events and many cities in our country are at the risk of earthquake disasters. For this reason, it is very important to manage pre-disaster and post-disaster processes, to identify risks, and develop risk-mitigating planning and strategies. One of the most important of these risk-reducing strategic practices is the planning of open public green areas as safe gathering and sheltering areas for disaster victims after earthquake(s). Regrettably, it can be asserted that Istanbul and other significant metropolises, which are anticipated to confront a potential earthquake soon, are seriously endangered due to the insufficient presence of green spaces and the subpar quality of those that do exist.

Drawing from this idea, this study aims to discuss the characteristics and usage purposes of earthquake parks in the world and in our country, determining the status of existing earthquake parks specifically in Istanbul, and discussing what important design decisions should be taken into account in improving existing earthquake parks and building new ones.

1.1. Properties and purposes of earthquake parks

Contrary to popular belief, not every urban park or green area in residential areas is suitable and safe to be used for gathering and as emergency shelter after a disaster. In order to be accepted as post-disaster gathering and sheltering areas, after due consideration of the types of disasters that the city in question may encounter and the impact areas and evaluating the environmental risks related to the area(s) to be selected, they need to have the functions, equipment, landscaping and architectural planning that can provide shelter and safe living opportunities when needed.

Regrettably, it was very difficult to find tent settlements with sufficient qualifications in the 11 earthquake-struck cities after the disaster. The places found were either existing parks, empty lands, river or seaside and even stadiums. As settlements were determined without considering other environmental risks besides the earthquake threat in order to meet the urgent shelter need, many disaster victims living in tent cities established in the coastal areas of Mersin and Hatay provinces near the sea being affected once again by sea rise, tsunamis, overflow, and floods

When we examine some examples of disaster/earthquake parks around the world, which play a crucial role in achieving cities that are resilient to disasters, particularly earthquakes, it is seen that countries such as Japan, the USA, New Zealand and China, which frequently face disasters, take into account the phenomenon of disasters in making decisions regarding the planning of green, parks and open areas.

Japan, has to make plans considering the earthquake disaster as well as subsequent accidents and disasters such as earthquake-induced natural gas explosions, fires, tsunamis and the nuclear leak at the Fukushima thermal power plant after the Tōhoku Earthquake in 2011. For this reason, creating residential areas that are resilient and safe in the face of natural disasters is one of the important criteria in the planning of Japanese cities. In this regard, a plan for a disaster-resistant city that is supported by green habitat was suggested under the name of "Green Tokyo", which is targeted for 2050, for the capital Tokyo, a city that is always under the threat of earthquake disasters. Open areas of public facilities, green areas, parks and educational buildings were arranged to be used as evacuation/shelter areas after the earthquake. [1]

In these areas, it is planned to prepare the necessary infrastructure systems to store food, medicine and medical supplies, electricity and power resources to be used in emergencies after the earthquake so that earthquake victims can continue their vital activities. Among Japanese earthquake parks, we can count Tokyo Rinkai Disaster Prevention Park, Hyogo Miki Disaster Management Park and Nakano Central Park among the most important ones, considering their size and the opportunities they offer both before and after the earthquakes. While they normally serve as athletic fields, ball fields, gyms, camping areas, concerts, events or recreation areas, when disasters such as earthquakes, floods and typhoons occur, they functionalize as a center to rescue and shelter the affected people. They collect information in emergencies, coordinate relief units, and have medical care centers for disaster response teams. For sheltered disaster victims, they are equipped with solar-powered charging stations for electric bicycles and smartphones, and public benches that turn into cooking stoves in case of a power outage. They incorporate tent areas, drinking water tanks, electric sockets and LAN connections, temporary toilets, shower and changing areas, warming materials, and radio communication systems for communication with other disaster parks, institutions and organizations. [2]

Tokyo Rinkai Disaster Prevention Park is an attractive area that takes advantage of urban concentration and ability to attract visitors to the Tokyo waterfront subcenter. However, acts as a central base of operations for disaster prevention in the Tokyo Metropolitan Area that houses emergency response facilities including local disaster management headquarters, as well as institutions that compile disaster-related information and coordinate emergency disaster measures. The park is also a disaster prevention facility that acts as a core base camp for regional assistance units and a base of support for disaster medical care that functions in an integrated manner with the Higashi Ogishima region. [3]

Miki Disaster Management Park is an expansive prefectural park featuring an array of facilities within its spacious grounds, including an athletics stadium, an athletics field, a baseball field, a soccer field, indoor and outdoor tennis courts, and a ground golf area. Alongside its everyday function as a widely enjoyed sporting and recreational hub, the site is equipped to operate in unison with the adjacent disaster prevention center as a disaster prevention base for the wider region in the event of emergencies. Displaced persons, supply trucks, and helicopters require a lot of room to maneuver, the government acquired a 742-acre parcel of land on the outskirts of Miki, a town of 84,000, about 20 miles west of Kobe. [4]

Nakano Central Park is another example of a park that has more fully integrated disaster mitigation into spaces such as offices, restaurants and meeting spots. Nakano Central Park is in an area of stable bedrock, meaning that strong against destruction of earthquakes. [2]

In the United States, states are planning their own earthquake/disaster parks under the Earthquake Hazard Reduction Act. For example; Golden Gate Park, which has an area of 1,017 acres (412 ha), hosted 40 thousand people after the Great San Francisco earthquake and the subsequent fires of 1906, regularly hosts visitor who run and do various sports activities, and can host various festivals and cultural events throughout the year. [5]

Beijing, the capital of China, is the first city to address specifically, the role of open space in mitigating potential disasters. In 2001, the Beijing Government passed a new law requiring attention to "necessary lawns, squares and vacant places" to facilitate evacuation and shelter in the event of an earthquake. In addition to parks providing functions ranging from ecological, aesthetic and recreational, the regulation states that they should also play a role in disaster prevention, particularly by providing shelter for displaced people.

In line with this law, the Yuan Dynasty Ruins Park was established in 2003 to protect the ruins of the northern city wall of Khanbaliq, the capital of the Mongol-led Yuan dynasty. This park is both a space used for educational purposes on what to do in earthquakes and other disasters, and is a disaster park where an emergency command center is located, as well as emergency water and electricity networks, telephones, fire extinguishers, temporary toilets and material reserves. In case of emergency, the park can become a safe haven for approximately 250,000 Beijing residents. [6]

1.2. International Standards in Humanitarian Responses

From the examples of disaster and prevention parks, we need to define, promote and apply humanitarian principles and minimum standards to ensure lifesaving, protective and response to humanitarian crises such as disasters. There are Humanitarian Charter and Minimum Standards in Humanitarian Response such as Sphere project, which have been identifying a set of Minimum Standards in life-saving areas since 1997.

The Humanitarian Charter and Minimum Standards in Disaster Response (The Sphere Handbook) is one of the most widely known and internationally recognized sets of common principles and universal minimum standards for the delivery of quality humanitarian response and puts the right of disaster-affected populations to life with dignity, and to protection and assistance at the center of humanitarian action. The Humanitarian Charter and Minimum Standards in Humanitarian Response and The Sphere Project promotes the active participation of affected populations as well as of local and national authorities, and is used to negotiate humanitarian space and resources with authorities in disaster-preparedness work. The minimum standards cover four primary life-saving areas of humanitarian aid: water supply, sanitation and hygiene promotion; food security and nutrition; shelter, settlement and non-food items; and health action [7].

FEMA- The National Disaster Recovery Framework (NDRF) enables effective recovery support to disaster-impacted states, tribes, territorial and local jurisdictions. The NDRF focuses on how best to restore, redevelop and revitalize the health, social, economic, natural and environmental fabric of the community and build a more resilient nation. It defines recovery principles, supports and guidance the roles and responsibilities for pre- and post-disaster recovery planning, coordinates the structure that facilitates communication and collaboration among all stakeholders [8].

National Disaster Risk Assessment-UNISDR (United Nations Office for Disaster Risk Reduction) is designed to support the reduction of existing level of risks and prevent new risks from emerging. In particular, it aims at substantially reducing disaster risk and losses of life, livelihoods and health, and losses of economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries. The Guidelines attempt to contribute to the significant amount of work that is needed to develop tools and methods, to offer further guidance and to create partnerships to support countries in achieving this [9].

Considering these existing practices, sphere project and humanitarian standards with the negative experiences in our country, we need to organize planning disaster (earthquake) and prevention parks conforming these minimum standards, urgently. All our cities at risk, especially Istanbul, which is our most important and largest metropolis awaiting the earthquake. We need to rearrange the existing disaster parks by evaluating their qualities. In this context, considering the upcoming earthquake risks within the scope of the study, we plan to conduct a field study with the help of humanitarian minimum standards to determine the current deficiencies and problems of our earthquake parks.

2. Method of Case Study

Within the scope of the field study, the qualitative and quantitative humanitarian standards of disaster (earthquake) and prevention parks, which are considered successful worldwide, were examined. As a result of these preliminary examinations, it was decided to evaluate Istanbul disaster (earthquake) and prevention parks within the framework of these main headings*: 'transportation, infrastructure, shelter, communication, basic needs/health actions and daily life'.*

In this context, Aykut Barka Earthquake Park, Ozgurluk Earthquake Park, Esenler Earthquake Park, Topkapı Earthquake Park and Ataşehir Earthquake Park, which are stated as the existing earthquake parks in Istanbul, were examined and evaluated by a method of observation based study with a checklist. (Table 1)

Table 1. Evaluation of existing earthquake parks in Istanbul [10]

	AykutBarka Earthquake Park	Ozgurluk Earthquake Park	Esenler Earthquake Park	Topkapı Earthquake Park	Ataşehir Earthquake Park
TRANSPORTATION					
Public transportion vehicles	+	+	+	+	+
Emergency parking	-	-	-	-	-
Helipad	+	+	-	+	+
INFRASTRUCTURE					
Water supply	+	+	+	+	+
Generator	+	+	+	-	-
Internet access	-	-	-	-	-
Electricity/lighting system	-	-	-	-	-
Convertible toilet(s)	-	-	-	-	-
Sound system	-	-	-	-	-
SHELTER					
Tent pitching area(s)	+	+	+	+	+
Ground differentiation (tent pitching)	-	-	-	-	-
Administrative building	+	+	+	-	-
Infirmary	+	+	-	-	-
COMMUNICATION					
Networking with other parks	-	-	-	-	-
BASIC NEEDS/HEALTH ACTIONS					
First aid depot	-	-	-	-	-
Nutrition, Food depot	-	-	-	-	-
Showers/ Baths	-	-	-	-	-
Existing toilets	+	+	+	-	+
Accessibility of toilets	+	-	-	-	+
Catering and services	+	-	-	-	+
DAILY LIFE					
Pre-disaster training units	-	-	-	-	-
Post-disaster training units	-	-	-	-	+
Café/restaurant(s)	+	+	+	-	-
Multifunctional urban furniture	-	+	-	-	+
Boards for orientation/guidance	-	+	-	-	+
Children's playgrounds	+	+	+	+	+
Emergency assembly areas	-	+	+	-	+
Sports grounds	+	+	+	-	+
PTSD support center	-	+	-	-	-

3. Results of Case Study

The following results were reached when the existing quantitative insufficiencies and qualitative deficiencies were evaluated according to (Table 1). Merely for the word 'park' in their name, ordinary open green area landscape designs were applied without taking emergency use into account in the above-ground organization. However, considering the population rates that will be affected by disasters by region in our

cities; new open areas should be created and/or the density of construction should be diluted in cases where existing ones are not sufficient.

Toilet and shower areas, material and food storages and food service areas that meet the basic needs of the park for both daily and emergency use are either missing or insufficient to meet these two different modes of usage. It has been determined that storage areas in disaster/earthquake parks are insufficient, the furniture that are being used are not selected according to emergency use needs, indoor and outdoor areas are not planned to serve different functions (use of sports, play and recreation areas as education, psychological support and gathering areas).

Earthquake/disaster parks must have a design that can meet the physical, psychological and sociological needs of disaster victims, while taking into account different climate, topography and disaster risks. Preparations and planning should be made considering the possibility of subsequent disasters (fire, tsunami, landslide, flood, etc.). In order to minimize risks in the face of disasters, training and drills should be carried out in earthquake parks on a regular basis. Any deficiencies in emergencies should be eliminated.

The lack of alternative communication systems and the fact that almost none of the earthquake parks can directly meet the needs of electricity, internet, clean water, heating, etc., which are vital for disaster victims who take shelter after the disaster, are seen as crucial deficiencies. For this reason, evacuation routes to earthquake/disaster parks should be planned, and renewable, self-sufficient energy sources such as solar and wind should be used. These areas should be equipped with lighting and information elements.

It can be said that perhaps the most important problem among these is that information and direction signs showing shelter arrangements in case of emergency in earthquake parks are either missing or inadequate.

However, clarifying the settlement layout and boundaries by using changes in material or lines as many as the number determined and supporting tent installation plans with visuals can help disaster victims who are in panic, confusion, fear and sadness to hold on to life in the event of an emergency during tent installation. The fact that similar lack of information and guidance in the areas designated for shelter in disaster areas after the earthquake caused inefficient and irregular use of the areas and difficulties in operation, security and aid delivery demonstrates how important this situation is.

Considering the suddenness of disasters and the density of population that will be affected in our cities reveals how important it is to urgently reconsider public open spaces, in terms of both infrastructure and superstructure.

4. Conclusion and Recommendations

Serious inadequacies are observed between the growth rate of cities and the ratio of open space allocated for use during disasters in all our metropolises, especially in Istanbul, where the majority of the country's population lives. Unfortunately, these unplanned and unidentified open green areas are decreasing day by day as settlements following the increase of income in construction.

Disaster parks do not only use as field of emergency shelters but also serve as epicenters for post-disaster crisis management and enables effective recovery support to disaster-impacted settlements. For this reason, we must act as quickly to designate the remaining open and green spaces throughout the country as disaster and prevention parks.

We need to re-plan and define our disaster and prevention parks like the examples from abroad, integrated into daily urban life but available to be functionalize as disaster prevention areas in emergencies. We must not forget that disaster and prevention parks serve to survivors for urgent requirements in disaster conditions. Thus, each disaster and prevention parks must have sets of common principles and universal minimum standards to response the disaster-affected populations, to protect and assist all humanitarian actions.

With the help of widely known, international design principles, guidelines and universal minimum standards against humanitarian crises such as *Sphere project-Sphere handbook, Japan International Cooperation Agency (JICA) standards, FEMA- The National Disaster Recovery Framework (NDRF), and National Disaster Risk Assessment-UNISDR (United Nations Office for Disaster Risk Reduction*). We can list some important decisions that should be considered in the planning of disaster and prevention parks as follows;

- We must consider about different risks of disasters when we select places for disaster parks. Criteria for location selection are; configuring the place according to the socio-cultural structure of the disaster area, the diversity of disasters it faces, and its climatic and topographic characteristics.

- We should design urban disaster parks at scales that will balance shelter demand and supply.
- A community-based disaster risk reduction system should be implemented, including training and drills that are conducted in the field on a regular basis. Thus, we can evaluate the adequacy of the area in the face of emergencies.
- Whether existing parks are converted or new ones are designed, we must consider disabled, sick and elderly survivors.
- Temporary housing units should be designed within certain standards and constructed in proper settlement order. In this way, while survivors feel better to continue their old lives psychologically, because of in a healthy and safe environment, they adapt themselves to a new life more quickly. It is necessary to determine the number of tents to be set up after a disaster. We must set up, clarify the tent pitching ground by using lines or different materials, and support the tent installation plans in visually.
- We should also make preparations by creating evacuation routes at Disaster Parks against subsequent disasters (such as fire, etc.).
- As Miki Disaster Management Park, disaster parks and evacuation routes should be equipped with lighting and information elements using renewable energy sources (solar energy, wind energy, etc.).
- In designing disaster parks, building additional structures that can meet the basic human needs of survivors should not be forgotten aside from meeting the daily park and recreational needs,.
- Designing earthquake parks in risky regions is of "Pre-Earthquake Precautions" and these parks are spaces that will be employed in a case of an earthquake so that earthquake victims shall be provided with life activities at a minimum level that will be considered within recovery phase [11]. We should study on a disaster and prevention park design guide serves for different disaster zones of our country. It is very important to determine the effects of potential disasters faced by the regions where disaster parks will be built before, in order to minimize the physical and mental damages on survivors.

Disaster and prevention parks are successful with this type of disaster management model, which meet the functional and programmatic requirements of the disaster zone. Thus, in addition to the fact that our green poor cities have the desired green parks, as well as we can also provide the emergency shelters and the epicenters for post-disaster crises.

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EVALUATION OF USER AND PLACE INTERACTION THROUGH ONLINE REVIEWS OF CHAIN COFFEE SHOPS

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Abstract
The aim of the study, in which the evaluation of user and space interaction through online comments is determined as the main problem, is to determine space and space-related concepts through comments and to reveal the place of comments in defining spatial features. In this context, chain coffee shops were determined as samples in the study. The scope of the study is limited to chain coffee shops located in Forum Trabzon shopping center. In this context, a mixed research design was used in the study, which was carried out in four stages and used a combination of qualitative and quantitative research methods. In the first stage, a preliminary study was conducted by conducting a literature review. In the second stage, a field study was carried out on three chain coffee shops (Caribou, Kahve Dünyası and Gloria Jeans) in the Forum Trabzon shopping center in order to assist in the analysis of the data to be obtained later. In the third stage, Google Maps, the platform from which online comments would be received, was determined and the comments of three coffee shops were compiled. In the fourth stage, the obtained data was analyzed. At this stage, comments about three coffee shops were analyzed through the NVivo program. Based on the data obtained as a result of the analysis, frequently used words and visual data (word clouds) of online comments related to the place were revealed and evaluations and comparisons were made. As a result of the data obtained, it was seen that users frequently included places and spatial expressions in their online comments about the three chain coffee shops located in Forum Trabzon shopping center. Through comments, the relationship between spatial features and usage satisfaction has been revealed.

Key Words: *Place, User, Online Review, Google Maps, NVivo*

1. Introduction

The common goal of venues used in the service sector is customer satisfaction. These places can be successful as long as they meet user satisfaction. Customer satisfaction appears as an important element in understanding the difference between businesses operating in the same sectors or doing the same job in different sectors [1]. Factors that determine customer satisfaction can be listed as past experiences, advertising, word-of-mouth communication and price information [2]. Before experiencing a product or service, people try to make the best decision by reading the comments and opinions of people who have experienced that product or service before. Nowadays, when technology and informatics are advancing rapidly, the rate of internet usage has increased and access to information has become easier with the widespread use of the Internet and especially its integration into smartphones. The phenomenon of globalization has accelerated the circulation of products, capital, information and people at national and international levels and has also affected consumers with the rapid and instantaneous dissemination of information [3]. At this point, online review platforms have become one of the most used environments to see user experiences.

Nowadays, with the widespread use of the internet, online comments made by a large audience of internet and social media users have become a very important data source in terms of accessibility and diversity [4]. Before experiencing a product or a service, potential customers frequently use online platforms to gain information about the product by examining sites, applications, etc. platforms where the opinions of people who have previously experienced that product or service are shared. According to a study, 84% of internet users take online comments as personal advice and 68% state that they make a judgment after reading 1 to 6 online comments [5]. Mathwick and Mosteller [6] concluded in their study that online customer comments are the primary factor behind 20-50% of all purchasing decisions and that online comments have become important data sources for consumers.

Over time, with the increase in the number of internet users and awareness of their use, the use and evaluation of online comments has also increased. With these developments, online review sites where users' experiences about the products they have purchased have started to increase [7, 8]. Review platforms such as Google Maps, TripAdvisor, Yelp, Amazon, Netflix can be given as examples. Each allows online reviews, star ratings and ratings for different areas (hotels, restaurants, movies, etc.). These platforms allow users to interact and make comments that help them express their feelings, provide information, convey their experiences, and make suggestions [9, 10, 11, 12].

There are many studies in the literature by different researchers on the impact of online comments on potential customer position, analysis of the current situation of the business, and people's decisions. For example, examining online comments of thermal hotels [13], examining the tourism values of a destination with online comments [14, 15, 16], online reviews about food and beverage establishments in a destination evaluation of comments [17], examination of a cultural landscape area with online comments [18], evaluation of consumer experiences about a product through online comments [19], the effect of online comments on hotel sales prices [20], the effect of online evaluations on purchasing behavior [21], examination of online comments about Istanbul Airport [22].

User opinions and satisfaction cover all channels through which the brand communicates with the customer. At this point, spatial features, which are one of the most effective factors in the communication of the business with the customer, also gain importance. Demonstrating spatial quality requires investigating the communication between spatial factors and user satisfaction. All features that reveal the ability of spatial features to meet user expectations are one of the most important elements in determining the success of the space. At this point, including the user in the process and investigating their expectations and satisfaction from the space is one of the most important requirements to determine the success of the space. Online comments provide important data in revealing the user's opinions about the place.

In this study, the user's interaction and satisfaction with the space is discussed through online comments. The study evaluates the comments made through Google Maps, one of the most effective platforms for using online comments, and focuses on the locations of chain coffee shops. Considering that coffee is one of the most consumed beverages in the world, space and spatial features, which are the most important elements in the interaction of coffee shops with people, gain importance. Starting from this point, the spatial characteristics of coffee shops and their effects on the user are investigated within the scope of the study on space user interaction. In this context, three different chain coffee shops (Kahve Dünyası, Gloria Jeans, Caribou) located in Trabzon Forum Shopping Center were discussed. The aim of the study is to determine space and space-related concepts through content analysis method in user comments made on Google Maps and to reveal the place of online comments in defining spatial features.

2. Materials And Methods

Chain coffee shops were selected as samples in the study where user-venue interaction was discussed through online comments. Within the scope of the study, chain coffee shops located in Forum Trabzon AVM were considered as the research area. In this context, three different coffee shops were examined in the shopping center: Caribou, Kahve Dünyası and Gloria Jeans.

Forum Trabzon shopping center, located in the Development District of Trabzon city, was opened in June 2008. The building, built on approximately 72,000 m² of land, has a coastal road, Eyof Park, 100th Year Park and Karadeniz Technical University in its immediate vicinity. Caribou is located in the basement of the shopping center and there are shopping mall entrance, parking lot entrance, elevator, stairs and other stores in the immediate vicinity. Kahve Dünyası is located on the ground floor of the shopping center and there are the shopping mall entrance and other stores in the immediate vicinity. Gloria Jeans is located on the first floor of the shopping center and has elevators, stairs and food and beverage areas in its immediate vicinity (Figure 1). All three venues have both indoor and outdoor space.

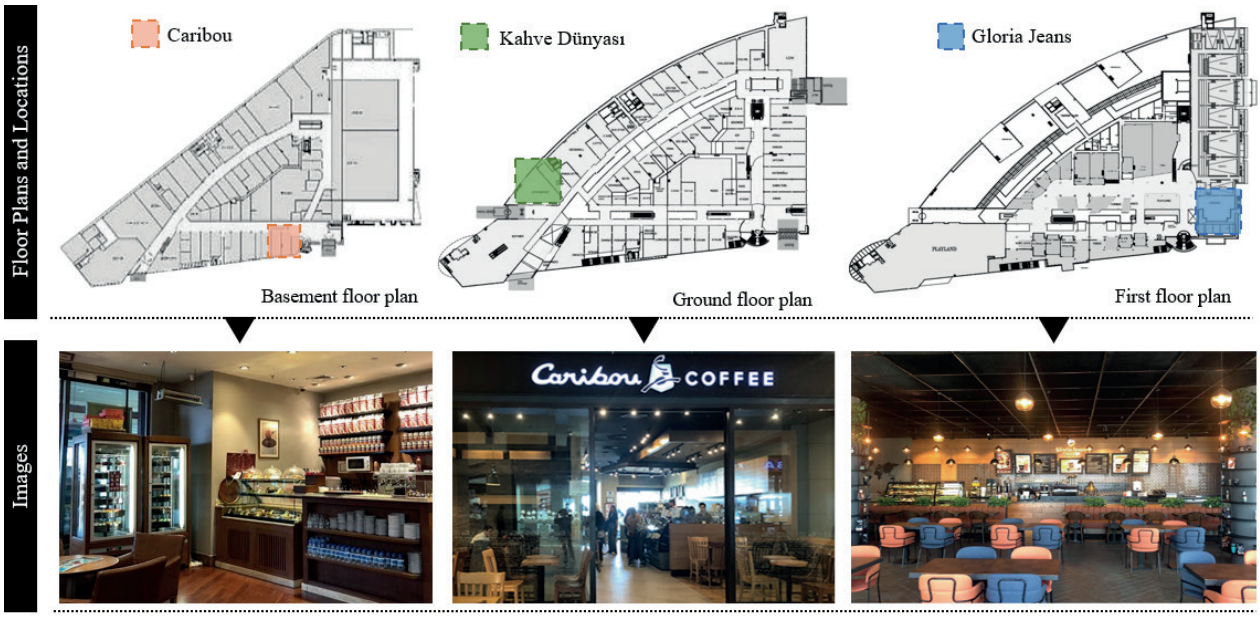

Figure 1. Locations and images of coffee shops in the shopping mall

In the study, a mixed research design combining qualitative and quantitative research methods was used. In this context, the study was structured in four stages.

a) First stage; It is the information gathering phase in which literary information is collected about the relationship between user satisfaction, online comments and space concepts. At this stage, the theoretical basis of the study was created by examining the studies in the literature on the subject.

b) Second stage; It is the field study phase in which the study areas are visited and spatial and visual data of all three places are obtained. At this stage, location, immediate surroundings and relationship information of three different chain coffee shops located in Forum Trabzon Shopping Mall were revealed. Then, visual data was obtained through photographs and videos for each location. In this way, a better understanding, interpretation and evaluation of the reasons for the data obtained from the analysis will be possible.

c) Third stage; This is the stage where it is determined which platform the online comments will be handled and the online comments of the chain coffee shop in Forum Trabzon AVM are obtained on the determined platforms. In this context, Google Maps was determined as the online review platform. Google Maps is a worldwide interactive online and offline mapping service that includes landmarks, road lines, landforms, vector and satellite maps, topographic maps, comments, integrated applications, and routing services [23]. It has become the 6th most downloaded application of all time, with more than one billion downloads according to February 2019 data from Google Play, which is the application center for Android operating system phones, and more than 500 million downloads on Apple Store, the application provider for iOS operating system phones, according to App Annie data [18]. With a high review score in both online stores, the integration of the application into all mobile devices is highly likely to be a mainstream trend in the near future, as it has been and is today. Due to these features, Google Maps was preferred within the scope of the study to obtain online comments. The population of the research consists of 413 visitor comments left on Google Maps by 140 users who visited Kahve Dünyası, 136 users who visited Gloria Jeans, and 137 users who visited Caribou until January 18, 2024. Visitors who did not leave comments but only evaluated with points were not evaluated within the scope of the study.

d) The fourth stage of the study is the stage where the comments obtained are analyzed. In this context, the content analysis method was used in the study. Content analysis is a set of methodological tools and techniques that aim to extract meanings from concepts, texts, verbal or written materials according to predetermined criteria as an objective, systematic, deductive reading tool [24, 25]. Content analysis in the study was conducted through NVivo. NVivo is data analysis software that allows collecting, organizing, analyzing, visualizing and publishing large amounts of data using qualitative and mixed methods. In the study, data obtained from Google maps were analyzed through NVivo. Online comments were documented

separately for each coffee shop and uploaded to the software. Based on the data obtained as a result of the analysis, frequently used words in the comments were revealed. Among these words, words related to the place were selected and frequently used words were updated. Then, visual data (word clouds) were created through the program and evaluations and comparisons were made. Afterwards, the frequently used words of all three coffee shops were combined to obtain the frequently used words for the three shops and evaluations were made.

3. Findings And Evaluation

In the study, the frequencies of the words used in the online comments made on Google Maps for the chain coffee shops located in Forum Trabzon AVM were revealed with the NVivo qualitative analysis program and word clouds were created.

In the comments made for coffee shops, there are positive and negative evaluations in different scopes regarding the satisfaction with the locations, services, food and beverages, staff and spatial features of the places. Within the scope of the study, among the frequently used words revealed by word analysis, only words describing space and spatial features were selected, other words were not evaluated. In this context, words with a frequency of 4 or more were used to determine frequently used words and create the word cloud.

The words most frequently repeated by users for Caribou Coffee venue are; space (f=29), place (f=24), beautiful (f=24), table (f=16), crowd (f=10), area (f=9), forum (f=8), good (f=8), recommendation (f=8), Trabzon (f=8), shopping mall (f=7), sitting (f=7), outdoor (f=6), wonderful (f=6), open (f=6), pleasant (f=6), cafe (f=4), atmosphere (f=4). Among these, it has been observed that the words "place", "space", "atmosphere" are generally used with adjectives such as "beautiful, good, bad, etc." that describe them. When we look at the frequency of the words used, it is noteworthy that the word "table" comes to the fore. When the sentences in which this word is used are examined, negative features are generally mentioned. These can be listed as the tables not being clean, the distance between them being small, being cramped, the table arrangement being irregular, and the tables being low. In line with user opinions, dissatisfaction with the layout and ergonomic features of the tables requires the venue management to make arrangements and improvements in this regard. The fact that the place has both indoor and outdoor space was also a frequently mentioned issue in the comments. When the sentences containing these concepts are examined, it is revealed that users find the indoor space inadequate and use the outdoor space more. The fact that the adjectives that come to the fore in word frequency analyzes are generally positive concepts such as "beautiful, good, wonderful, pleasant" can be interpreted as an indicator that the users are generally satisfied with the place.The frequency of use of words and the word cloud for Caribou are shown in Table1.

Table 1. Frequency of word usage and word cloud for Caribou

Word	Length	Count	W.P.%	Word Cloud (Caribou)
space	5	29	012	
place	3	24	010	
beautiful	5	19	008	
table	4	16	007	
crowd	9	10	004	
area	4	9	004	
forum	5	8	003	
good	3	8	003	
recommendation	7	8	003	
Trabzon	7	8	003	
shopping mall	3	7	003	
sitting	7	7	003	
outdoor	3	6	003	
wonderful	6	6	003	
open	4	5	002	
pleasant	3	4	002	
cafe	4	4	002	
atmosphere	5	4	002	

The most frequently repeated words of the users for Kahve Dünyası venue are beautiful (f=24), place (f=16), good (f=10), cafe (f=7), space (f=5), shopping (f=4).), shopping mall (f=4), great (f=4), air (f=4), crowd (f=4), table (f=7), store (f=4), perfect (f=4) , atmosphere (f = 4), sitting (f = 4). The words "nice" and "good", which rank first among these, can be interpreted as the general satisfaction of the users with the place. The fact that the words “perfect” and “wonderful” also appear among the words supports this. When we look at the most frequently used words, the only word that appears as a negative concept is the word "crowd". When the comments using this word are examined, it is seen that the interior of the place is specifically mentioned and this area is found to be insufficient for seating, product display and ordering (self-service) functions. At this point, the necessity of rearranging the interior of the space in terms of user satisfaction emerges. It is seen that among the most frequently used words is "table", one of the furniture used in the space. When the sentences containing this word were examined, comments were made that the tables were comfortable but not clean. Additionally, the lack of sockets near the tables was determined to be a negative situation in terms of user satisfaction. When we look at the frequently used words, it is seen that in the comments where the words "place, space, environment, store" are used to describe the place, they are generally associated with the positive features of the place. In addition, although the place has both indoor and outdoor environments, it has been observed that the use of the outdoor space is more satisfied due to the clean "air". Another issue that draws attention in frequently used words is the presence of words related to some actions. The words “shopping, sitting” show two of the usage functions of the coffee shop. The frequency of use of words and the word cloud for Kahve Dünyası are shown in Table 2.

Table 2. Frequency of word usage and word cloud for Kahve Dünyası

Word	Length	Count	W.P.%	Word Cloud (Kahve Dünyası)
beautiful	5	24	017	
place	3	16	011	
good	3	10	007	
cafe	4	7	005	
space	5	5	004	
shopping	9	4	003	
shopping mall	3	4	003	
great	6	4	003	
air	4	4	003	
crowd	9	4	003	
table	4	4	003	
store	6	4	003	
perfect	8	4	003	
atmosphere	5	4	003	
sitting	7	4	003	

The most frequently repeated words of the users for Gloria Jeans place are space (f=29), beautiful (f=23), place (f=15), recommendation (f=14), warm (f=10), sitting (f=9).), good (f=8), view (f=8), table (f=8), atmosphere (f=7), Trabzon (f=7), comfortable (f=5), spacious (f=4) , quality (f=4), park (f=4), quiet (f=4). When we look at the frequently used words for Gloria Jeans, we see that adjectives such as "beautiful, good, spacious, comfortable, quality, calm, warm" are used. When we look at the words resulting from the word analysis, the fact that there are no negative expressions is a clear indication that the users are generally satisfied with the place. When the comments where words were used were examined, it was determined that words such as "spacious, quality, calm, warm" were generally associated with the indoor atmosphere. While the fact that Gloria Jeans has both indoor and outdoor spaces is welcomed by users, it has been observed that the indoor atmosphere is more decisive in terms of user satisfaction. The word "view" is often mentioned when talking about outdoor seating areas. At this point, it is thought that the fact that Gloria Jeans is on the top floor and has a sea view is a decisive factor. Among the equipment used in the space, "table" was the frequently used word. When the comments mentioning the word "desk" are examined, the most satisfactory issues for the users are that the tables are suitable for working and that there are sockets on or near them. Another frequently used word is “park”. When the comments where this word is mentioned are examined, it

is seen that evaluations are made about the location being far from the parking lot. It is thought that this is because the place is on the top floor. The frequency of use of words and the word cloud for Gloria Jeans are shown in Table 3.

Table 3. Frequency of word usage and word cloud for Gloria Jeans

Word	Length	Count	W.P.%
space	5	29	014
beautiful	5	23	011
place	3	15	007
recommendation	7	14	007
warm	5	10	005
sitting	7	9	004
good	3	8	004
view	7	8	004
table	4	8	004
atmosphere	5	7	003
Trabzon	7	7	003
comfortable	5	5	002
spacious	5	4	002
quality	8	4	002
park	4	4	002
quiet	5	4	002

Word Cloud (Gloria Jeans)

By examining the comments made for the chain coffee shops in Forum Trabzon Shopping Mall, frequently used words and word clouds are given and examined separately above. In addition, the words obtained as a result of evaluating the frequently used words of three coffee shops together are given in Figure 2 in order of frequency from most to least. In this context, general conclusions about frequently used words are as follows:

- In order to describe coffee shops, the words "space, place, area, cafe, atmosphere, store" are used together with the adjectives that precede them.
- Adjectives that are frequently used to describe coffee shops are “nice, good, great, pleasant, excellent”. When we look at these words, it is seen that there are more positive evaluations about the places than negative ones.
- The words "table, outside, open, air, park" were used when evaluating the interior and exterior spaces of coffee shops.
- The words "crowded, warm, view, comfortable, calm, spacious, quality" were used to describe the spatial characteristics of coffee shops. When we look at these words, it is seen that there are more positive evaluations about the places than negative ones.
- The words "forum, Trabzon, shopping mall" were used to describe the location of the coffee shops.
- The words "sitting, shopping" were used to describe the functional features of coffee shops.
- It is seen with the presence of the word "recommendation" that coffee shops are recommended in positive or negative ways.

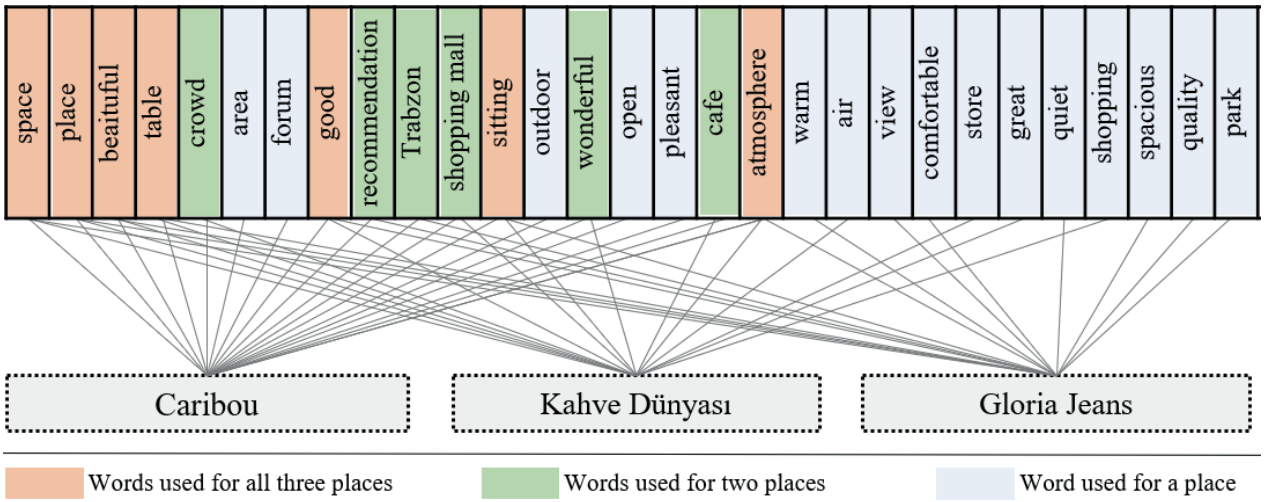

Figure 2. Common words used for coffee shops

In the analysis conducted for three coffee shops, it was seen that there were common and different words. Common words in three shops are "space, place, beautiful, table, good, sitting, atmosphere", common words in two shops are "crowd, recommendation, Trabzon, shopping mall, wonderful, cafe", and common words in one shop are "area, forum, exterior, open, pleasant, warm, air, view, comfortable, store, excellent, calm, shopping, spacious, quality, park" (Figure 2). At this point, it can be seen that Gloria Jeans stands out more in terms of "view, warm environment, comfort, calmness, spaciousness, quality" compared to other places, and Caribou stands out more in "outdoor, open space" issues.

4. Conclusion

Before experiencing a product or service, people tend to examine platforms where the opinions of people who have previously experienced that product or service are shared. Nowadays, when technology and informatics are rapidly advancing, online platforms are frequently used to get information about a product with the widespread use of the internet. Seeing user satisfaction through online comments contains important data for both potential customers and the venue business. So much so that venue businesses are looking for ways to further satisfy their customers by taking online comments into consideration.

In the study, the satisfaction level of the user in his interaction with the place was discussed through the chain coffee shops located in Forum Trabzon Shopping Mall. Based on the data obtained from online comments, it is seen that the frequently used words generally consist of positive expressions. Based on the data obtained, while Gloria Jeans stands out in terms of indoor atmosphere, Caribou stands out in terms of outdoor use. Comments about the tables in all places in terms of the furniture used have revealed that users have expectations about tables in coffee shops and the importance of the ergonomics and layout of the tables. The presence of both indoor and outdoor spaces in all three spaces examined was positively received by the users. In addition, it has been observed that users expect a working environment from coffee shops and sockets for electronic devices, and these issues are decisive in terms of spatial satisfaction in coffee shops.

It is thought that the study will be a guide for other studies in terms of revealing the relationship between online comments, spatial features and usage satisfaction. In this study, expressions describing the place in words frequently used in online comments were evaluated. These expressions can be examined by grouping them under different subheadings in future studies. It is thought that this study, conducted on chain coffee shops, will be used to determine the satisfaction level of places with different functions and will contribute to improving the performance of the places.

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A CONCEPTUAL AND METHODOLOGICAL CRITIQUE OF THE "SMART CITY": "WISE CITY"

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Abstract

Digital transformation and developing technologies have an impact on urban structures in every field. The smart city approach that emerged as a result of this transformation is aimed at making cities more livable and sustainable by digitalizing urban living spaces. On the other hand, urban identity sustainability emerges as a prerequisite for urban settlement sustainability. Historic environments, which are formed by cultural accumulation, play an important role in the formation of urban identity and carrying it into the future with their capacity to adapt to change. These features make historical environments a valuable resource for making sustainable future decisions. However, since smart city approaches are generally addressed within the limitations of new and technological urbanization, the continuity of urban spaces is undermined, leading to a sharp gap between them. These solutions, which are rigid and separate the past and the future, prevent a holistic approach. In addition, the spatial data analysis and synthesis processes of smart city applications are predominantly based on geographic information systems. Due to the point, linear, and planar representation approaches of geographic information systems, the intervention area of smart city practice is limited to the two-dimensional-horizontal approach of urban planning. Due to the multi-layered structure of historical environments, the intervention area of the smart city should also include the third dimension to address all above- and below-ground layers. In this context, it is thought that integrating the three-dimensional vertical spatial analysis and production practice of the discipline of architecture into smart city methods will provide stronger solutions for the improvement of urban life.

The aim of the study is to put forward the concept of a "Wise City" that analyzes the spatial knowledge and accumulation of the historical environment by developing smart city methods instead of the new and technology-oriented "smart city" approach in urban and spatial design practices. Within the scope of this purpose, the concepts of smart cities and historical environments were reviewed in the literature, and all related concepts, qualities, and indicators were examined through a literature review and conceptual and comparative analysis methods. Then, by defining the theoretical framework of the "wise city" alternative model through the critical evaluation method, it is concluded that the application of the "wise city" theoretical model, which is proposed as an inclusive and holistic alternative to the smart city, in cities with high historical qualities can make significant contributions to the quality of urban design and project design processes.

Key Words: wise city, smart city, historical environment, space syntax, spatial knowledge.

1. Introduction

While cities and urbanization create problems such as energy and resource consumption, climate change, social-economic inequality, migration, population growth, and security, they also contain the infrastructure and potential to solve these problems. These problems, which are caused by changes in the existing urban fabric, are trying to be solved with new planning approaches. In recent years, these approaches have focused on digital transformation and the use of new technologies. However, these approaches, shaped by digital transformation and technology, approach the city in a manner that disregards its accumulation and contextual characteristics. This decomposes the structure of the city, which consists of many layers, such as social, physical, historical, and semantic. However, the city is a multi-layered structure that includes the experience and spatial and temporal knowledge of the past, as well as the instant solutions of the present and data about events and people. Treating these layers separately prevents a holistic approach and consideration of urban dynamics' relational consequences. We should approach interventions to enhance urban life from a subjective, city-specific wisdom perspective, not an objective one. In this context, the spatial and temporal layers form a three-dimensionality that transforms smartness into wisdom and transforms a smart city into a wise one.

This dimension, which is conceptually constructed through the historical environment, can be achieved methodologically through the sub-scale and three-dimensional approach of architectural design in addition to urban planning.

Fig. 1. Sustainability of city

Fig. 2. Sustainability of urban identity

In this study, the concepts and methods that carry the concept of "smartness" to "wisdom" are examined through conceptual analysis, literature review, and comparative analysis methods. The analysis yielded a critical evaluation that considered the limitations and shortcomings of the "Smart City" paradigms, leading to the creation of the theoretical framework for the "Wise City" proposal model.

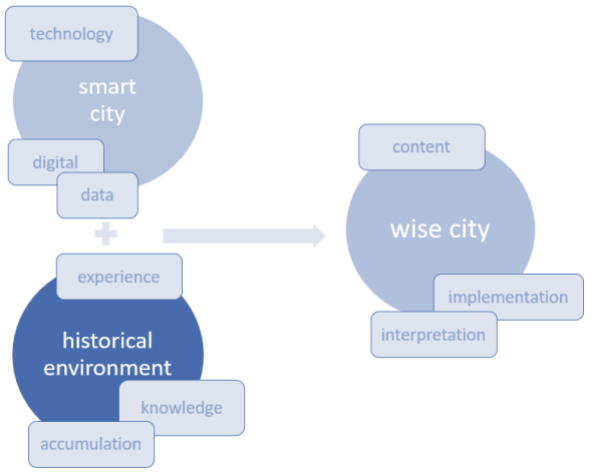

Fig. 3. Basic concepts and structure of the study

Literature review-Smart City and Historic Environment

A smart city is an urban model that supports sustainable economic growth and high quality of life through community and social capital, traditional (transportation) and modern (ICT) communication infrastructure investments, participatory governance, and wise management of natural resources [7]. One of

the key characteristics of smart cities is that technology is seen as the most fundamental tool to accumulate, organize, and make accessible large amounts of information for an increasing number of people [2]. These smart city technologies aim to increase environmental sustainability and improve urban functions. Several empirical studies on smart cities have proposed various multidimensional indicators and components instead of a single, holistic analysis. In addition to the sustainability and livability factors that are frequently mentioned in the smart city concept, Chourabi et al. (2012) described a graph consisting of interdependent components to understand smart city applications by mentioning factors such as the natural and built environment and organization. According to Dameri (2014), a smart city is a place where digital data, services, and communication are realized through internet connections in order to improve quality of life and reduce the environmental footprint. Nam and Pardo (2011) discuss the components of a smart city in three different dimensions: technology, people, and institutions [23]. Komninos (2008), on the other hand, defines the smart city as having three components: "people, the collective intelligence of the urban population, digital spaces, and artificial intelligence" [16].

There are much literature and implementation approach on smart cities. However, among these approaches, Cohen's "Smart Cities Wheel" (SCW) methodology stands out the most. This method and approach have been accepted by the European Commission and reinterpreted by determining three sub-factors under each of the six basic components of the wheel, considering 28 countries. The six basic components of the Smart Cities Wheel are as follows:

- Smart mobility: This component includes ICT-enabled transportation systems. It primarily aims to provide environmentally friendly and inclusive transportation solutions, especially for disadvantaged groups. Generating real-time traffic information and sharing it with passengers, drivers and operators is one of the priorities.
- Smart living: Information and communication technologies facilitate people's lives and provide a healthier and safer environment for city dwellers.
- Smart governance: adopts the principles of effective and efficient communication, transparency, and participation among different stakeholders of the city through interoperable ICT solutions. It also refers to a healthy and safe life in a vibrant and attractive city that emphasizes cultural opportunities. It is linked to high levels of social cohesion and social capital. It is also important to ensure transparency and open and free sharing of publicly generated data with all city stakeholders.
- Smart environment covers solutions such as renewable energy, smart grids, microgrids, smart meters, advanced air pollution monitoring systems, environmentally friendly buildings and urban planning, energy-efficient smart street lighting, solid waste management, smart water management and drainage systems.
- Smart economy includes applications such as productivity gains, e-commerce, advanced production and supply systems, business ecosystem models and living laboratories instead of traditional methods using ICT.
- Smart people Within the scope of this component, it is aimed to create a lifelong learning urban society with high levels of awareness and creativity by improving people's ability to use and produce information and communication technologies and raising awareness about smart applications and designs.

In the literature, many of the current planning approaches around smart technologies tend to focus on strategies for infrastructure in new cities [2]. Governments, universities, and researchers are developing various studies to explain, develop, and implement the smart city concept. In general, the smart city is associated with concepts such as technological capital, new technologies, and ICT. [2][4][18]. Similarly, Lombardi et al. (2012) defined smart cities as "the application of information and communication technology (ICT) with the role of human capital and education, social and relational capital, and environmental issues." Although researchers such as Komninos (2011) define a smart city as a region with a high capacity for knowledge, learning, and innovation, the concept has been discussed on the axis of indicators such as transportation, governance, ecology, etc. [12] [8] and separated from the existing knowledge and experience that shape the socio-spatial structure, such as identity, belonging, continuity, and compatibility.

Table 1. Smart city definitions prominent in the literature

Writers	Smart City Definitions
Angelidou, M. (2014).	Smart cities represent a conceptual model of urban development based on the use of human, collective and technological capital to increase development and prosperity in urban agglomerations.
Bakıcı, T., Almirall, E., & Wareham, J. (2013).	It is a high-tech intensive and advanced city that connects people, information and city elements using new technologies to create a sustainable, greener, competitive and innovative economy and increased quality of life.
Barrionuevo, J. M., Berrone, P., & Ricart, J. E. (2012).	Being a smart city means using all available technologies and resources in an intelligent and coordinated way to develop urban centers that are simultaneously integrated, livable and sustainable.
Caragliu, A., Del Bo, C., & Nijkamp, P. (2011).	A smart city; It is a city model that supports sustainable economic growth and high quality of life through investments in human and social capital, traditional (transportation) and modern (ICT) communications infrastructure, and wise management of natural resources through participatory governance.
Giffinger, R., Fertner, C., Kramar, H., & Meijers, E. (2007).	A city built on the smart combination of donations and activities of self-determined, independent and informed citizens who perform well in a forward-looking manner in the areas of economy, people, governance, mobility, environment and living. Smart city generally means the search and identification of intelligent solutions that enable modern cities to improve the quality of services offered to citizens.
Harrison, C. vd (2010).	It is a city that connects physical infrastructure, IT infrastructure, social infrastructure and business infrastructure to leverage the city's collective intelligence.
Hollands, R. G. (2008).	The smart city must balance economic growth with sustainability while ensuring the balance of power between not only technology but people's existing knowledge and skills, and the use of information technology by business, government, communities and ordinary people living in cities.
Komninos, N. (2011).	Smart cities can be defined as regions with high capacity for learning and innovation, based on society's creativity, knowledge creation institutions, and digital infrastructure for communication and knowledge management.
Lazaroiu, G. C., & Roscia, M. (2012).	The smart city represents the challenge of the future, a city model where technology serves the person and the improvement of the economic and social quality of life.
Lombardi, P., Giordano, S., Caragliu, A., Del Bo, C., Deakin, M., Nijkamp, P., ... & Farouh, H. (2012).	It refers to a complex urban environment in which market demand, governance, citizen participation and citizen characteristics, as well as cultural and social capital endowments, shape the relationships between the traditional spirals of university, industry and government.

The sustainability and continuity of urban identity are prerequisites for the sustainability of urban settlement, which is the main objective of the smart city model. Historic environments, which are formed by cultural accumulation, play an important role in the formation of urban identity and carrying it into the future with their capacity to adapt to change. With these characteristics, historic environments are a resource for decisions to be taken for a sustainable future. According to Lynch (1972), there is a visible accumulation of historical events in the urban area; through this historical accumulation and the passage of time, the old and the new come side by side. According to Sack (1978), considering that every city is a historical formation, historical environments that harbor the coexistence of old and new appear to be the most important element in defining the present existence of the concept of 'city' independent of any adjective. Mumford (1938) and Lynch (1972), as a common idea, stated that cities are formed in layers and continue to exist today as a reflection of time, and defined these layers as a reflection of overlapping temporal traces. According to Ostanevics (2017), these traces have the ability to bridge the 'present' and the 'past'.

Table 2. Historical environment in the literature

Writers	Historical Environment Approaches
Mumford, L. (1938)	Cities preserve the traces of generations in different layers of time for future generations.
Lynch, K. (1972)	The layering it defines is the visible reflection of overlapping traces in cities; each trace expresses a collage of time.
Schulz, C.N. (1978)	They are spaces that are distinctive and give their inhabitants a strong sense of belonging and enthusiastic confidence.
Sack, M. (1978)	Every city is a historical formation.
Erginoğlu, İ.K. (1996)	Historical environment; They are interior and exterior spaces where certain movements that affect the lives of societies and nations occur and where events resulting from these movements occur.
Ostanevics, M. (2017).	Cities; It represents a living and changing phenomenon that provides a connection between past traditions, identity and the perception of the passage of time.

Historic environments form cities' identity and memory spaces. A change in the physical structure of the historic environment also affects the memory and belongings of the community. Maintaining the existence of collective memory is the basic condition for the community to survive together with the city.

Conceptual analysis- Smartness and Wisdom

The definition of the word "smart" in TDK is "a person who is able to distinguish right from wrong, good from bad, and who can act correctly and cautiously as he should by taking lessons from his experiences and seeing reality well." The word "wise," on the other hand, is defined as "one who has broad and deep knowledge, uses it in the most accurate and useful way, has good morals, is mature and exemplary (a person); judges." and "one who evaluates events with a superiority that comes from virtue and knowledge. This perspective suggests that values and meaning can challenge the fundamental distinction between smartness and wisdom. While smartness refers to a concept specific to the individual and a single moment, including special abilities, intelligence, and instant solutions, wisdom is closer to a concept related to accumulation and experience, processes, social and collective.

The Oxford English Dictionary defines wisdom as "the capacity to judge rightly in matters of life and conduct; soundness of judgment in the choice of means and ends; sound sense, especially in practical affairs." Charles Haddon Spurgeon defined wisdom as "the right use of knowledge." Wisdom is associated with the essential qualities of impartial judgment, compassion, experiential self-knowledge, self-transcendence, ethics, and virtues. Smartness is associated with reasoning, grasping objective facts, and drawing conclusions, while wisdom is associated with abstracting knowledge, adapting it to new situations, and interpreting it. Smartness deals with data; wisdom deals with knowledge.

Smart city and Geographical Information Systems

Geographical information is defined as data about places on the earth's surface, where something is, and what is happening at a particular location [30]. Information about geographical entities is represented in digital environments in the form of vector data in the form of points, lines, and areas and in the form of raster data in the form of cells (Longley et al., 2005). In summary, "GIS is an information system that performs the functions of collecting, storing, processing, and presenting spatial and attribute information obtained through location-based observations to the user with integrity" [31]. Compared to other information systems, the most basic feature of GIS is that it stores and processes the geometric information of all kinds of objects on the map in the database.

Geographical information systems, which can be characterized as the application method of the smart city, analyze the city from a planning perspective in two-dimensional and horizontal planes and make recommendations. In this context, while geographical information systems work systematically and accurately in two-dimensional city reading, they are insufficient for reading the city in all its dimensions. In order to read the city in a holistic way with all its inputs, it is necessary to deal with all its layers and elements both horizontally and vertically. A method in which the third dimension is added, including architecture, has the capacity to move the city's instantaneous, objective, and often virtual smartness to the contextual, subjective, and real concept of wisdom.

In this case, the proposed method is different from the current 3D GIS method because it creates a framework that includes the intervention style and scale of architecture into the system instead of the intervention area and approach of planning science. In addition, instead of the satellite image, height, and three-dimensional geometry of the existing built environment, it allows the representation of the three-dimensional structure of the historical building in certain periods, as well as the sub-surface and non-visible structures. We can use the three-dimensional geographic information system model "CityGML" and the "CityEngine" modeling software as references to define the methodology of this new approach.

Historical environment and spatial knowledge

Space is produced as an expression of relationality in every period and is shaped by the interrelationship of material objects (buildings, streets, walls, etc.) as a result of the conscious interventions of people and is reshaped by the interventions of different users, decision-makers, and experts in the process. According to this framework, human activity experiences a 'change of state' in space throughout the historical process. In each change of situation, a new relationality takes the place of the previous relationality. The change in situation becomes concrete and observable with the spatial change in the city, revealing different spatial

organization structures in different periods. These relationalities emerge one after the other in the process of development and cause space as a physical object to be constantly reshaped. Social relationalities shape space, transforming it into an object that embodies these relationalities, but eventually, space itself becomes a component that generates these relationalities. This dialectical network of relations appears as a built environment that constantly produces, consumes, and reproduces itself. Today's built environment also contains the built environment sequences formed in the past as a layer of the historic environment. On the other hand, the historic environment's presence today is an indicator of its ability to adapt to urban conditions over time. Therefore, historical environments, with their temporal layers that bear the traces of all the social, physical, and semantic effects experienced in the past, contain spatio-syntactic codes that can be read from their physical structure.

For example, the image below shows one-square-mile shape-ground diagrams of 12 cities around the world. At top left, Portland, Oregon, and San Francisco, California, represent the American orthogonal grid of the late 19th century. The Interstate 405 freeway, which fragmented the city's center in the 1960s, interrupts Portland's famous compact, walkable, 200-meter x 200-meter blocks. The business park in the California suburb of Irvine, at center left, illustrates the coarse-grained, modernist, automobile-centric form that characterized American urbanization in the second half of the 20th century. Rome, by contrast, has a more fine-grained, complex, and organic structure, developed over millennia of self-organization and urban planning. When we represent each of the street networks here at the same scale (one square mile), it is easy to compare the qualitative urban textures in these different cities. At the center of the Parisian square mile is the Arc de Triomphe, whose streets radiate outward as remnants of Baron Haussmann's massive demolition and renovation of 19th-century Paris.

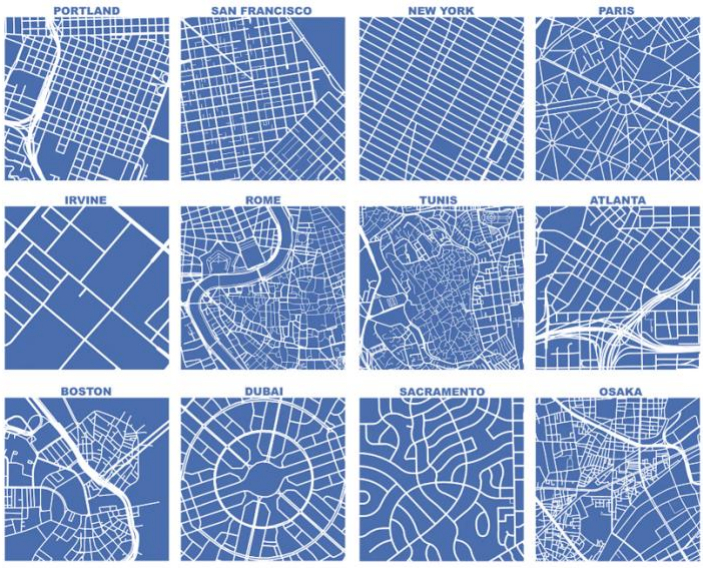

Fig.4. one-square-mile shape-ground diagrams of 12 cities

As seen in the example, even different cities in the same country have a very different and unique urban structure in terms of form and syntax. This necessitates the development of a holistic method and reading in spatial analysis, while developing a hybrid and adaptive approach in the context of its own spatial codes. In order to read the syntactic information of historical space, which contains many layers, types of knowledge and spatial configurations, it is first necessary to analyze this structure at the architectural scale. The scale hierarchy from space to city in the formation of historic environments is also valid for the processes of reading spatial information and designing projects based on these readings. For this reason, prioritizing architectural design and spatial scale in the reading of historical environments that form the identity of cities will enable a detailed reading of all the relationships between the urban whole and the historical structure.

The spatial syntactic analyses made through this reading can provide information that has gained value through experience and accumulation rather than data for current developments and practices.

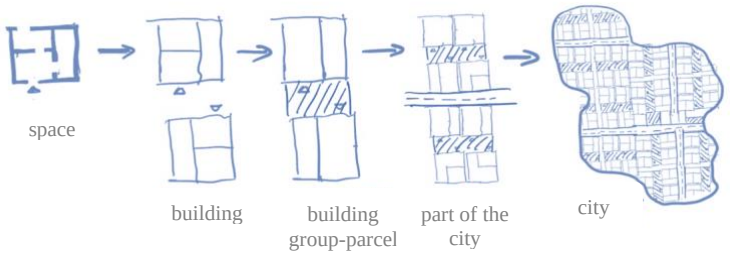

Fig.5. one-square-mile shape-ground diagrams of 12 cities

Wise City theoretical model

In our country, the restoration of lost registered monuments in the historical environment is the first priority. At the point of carrying these works to the present day, it is important to determine which qualities and components will be carried, how they will be carried, and how their association with the existing built environment will be constructed. Urban planning uses smart city applications to express historical environments as two-dimensional and planar geometric forms. In this context, the Wise City is put forward as a proposed model that criticizes the Smart City, first conceptually through smartness-wisdom and then in terms of its inadequacy in reading and analyzing the city. This model also defines an approach at the intersection of architectural project processes and urban planning in the historical environment.

The wise city model proposes to investigate the traces of the great accumulation in the city and to transform these traces and knowledge into a three-dimensional wise city inventory. This inventory is important not only as documentation but also as an area of intervention at the scale of architectural design. Records on the historical environment and cultural heritage are scattered, irregular, and two-dimensional. The ones recorded today include only the ground level. There is no information on the upper elevations of historical buildings, especially below ground. With three-dimensional geographical information systems, Wise City allows for an approach where many layers in the historical environment can be added and developed with lost artifacts, other registered immovable properties, protected areas, and archaeological soundings.

Conclusion and recommendations

The era of ubiquitous urban data and computational tools has opened a new era for improving urban life worldwide from integrated quantitative and qualitative perspectives. Data-driven urban planning explores urban form by modeling spatial data to trace histories, configurations, and trends in physical space, but reading urban form as a whole requires uncovering the nuance of local context and history.

In this context, the contextual, socio-spatial, and cultural values that are missing in new urban design and planning approaches are present in historical environments. An approach where smart city technologies and the context of historical environments support each other can lead to a sustainable city system in a holistic sense, and the city can be developed with technological and digital tools. We have concluded that we can become "wise" by synthesizing real-time data with historical records of the built environment using three-dimensional tools. In line with these inferences, the proposed Wise City model will make significant contributions to shaping architectural project processes such as reconstruction, refunctioning, and new building design in historical environments.

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RETHINKING SUSTAINABILITY IN ARCHITECTURE THROUGH CIRCULAR ECONOMY

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Abstract

Circular economy (CE) is a new systematic model to increase the applicability of global sustainability goals. CE is a design-led concept which aims to use resources in a more renewable way to minimize the waste production and extend the life of all kinds of products including the built environment. Moreover, Architecture-Engineering-Construction (AEC) industry has to rethink and redesign its conventional processes and attitudes considering sustainability, as it is responsible of 40% of global carbon emissions and one third of the total global waste. This study questions sustainability in architecture by rethinking and reevaluating itself through circular economy concepts. The main purpose is to propose a potential innovative contribution to reach circular built environment by investigating the CE-related concepts according to CE applicability areas: circular design, materials and reuse potentials. The method of the study consists of two steps. In the first step, relations between circularity and architecture were examined through bibliometric analysis, using Scopus and Web of Science database and VosViewer. Then, CE-related concepts were explored. In the second step, determined CE-related concepts were categorized according to their applicability in design-construction or in usage phases. Furthermore, the potentials of CE concepts were evaluated. In this regard, this study presents the current state of adapting CE in the built environment and its future directions.

Key Words: *Circular economy, circularity, sustainability, architectural design, bibliometric analysis.*

1. Introduction

Sustainability is a broad term that aims to decrease the harmful effects of global climate change which is result of excessive consumption of natural resources and fossil fuels, uncontrolled rapid urbanization and destruction of nature. Even though the term "sustainability" first used in "Our Common Future" in 1987 (WCED, 1987) and defined as 'an approach meeting the basic needs of all people and extending to all the opportunity to satisfy their aspirations for a better life without compromising future generations' ability to meet their own needs", it did not reach the large audience until 2000s. During the last two decades, sustainability is one of the most studied topics in academia. However, the real-life applicability and examples are still limited especially for the Architecture-Engineering-Construction (AEC) industry because of the complexity of the sustainability AEC industry. Some strategies and models have developed to achieve sustainable development, circular economy (CE) is one of these models. CE establishes a more sustainable production and consumption model which will contribute to reach sustainable development.

Circular economy (CE) is a new systematic model to increase the applicability of global sustainability targets including United Nations' (UN) sustainable development goals (SDGs). CE is a design-led concept which aims to use resources in a more efficient and renewable way to minimize the waste production and extend the life of all kinds of products. CE aims to transform "take-make-waste" based linear economy to "take-make-use-reuse" based model in all industries. In this regard, AEC industry has to rethink and redesign its conventional processes and attitudes considering circularity, as it is responsible of 40% of global carbon emissions and one third of the total global waste. The concept of a circular economy, a model in which waste and pollution do not exist by design, products and materials are kept in use, and natural systems are regenerated provides much promise to accelerate implementation of the SDGs. This study questions sustainability in architecture by rethinking and reevaluating itself through circular economy concepts.

2. Methodology

The main purpose is to propose a potential innovative contribution to reach circular built environment by investigating the CE-related concepts according to building life cycle: design-construction or usage phase. The methodology of this study consists of two steps (Figure 1). In the first step, relations between circularity and architecture were examined through bibliometric analysis, using Scopus database and VosViewer and CE-related concepts were explored. In the second step, determined CE-related concepts were categorized according to their applicability areas: circular design, materials and reuse potentials. In this step, the potentials of CE concepts were evaluated.

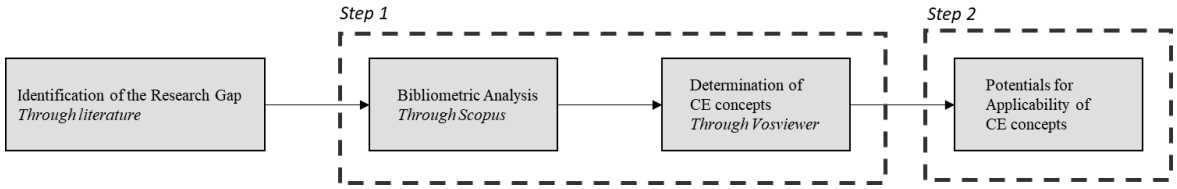

Fig. 1. Methodological flowchart of the study.

The first step of this study's methodology is based on bibliometric analysis to understand and state the current relations between circular economy and architecture. The literature sample was retrieved from Scopus and Web of Science (WoS) databases. Scopus and Web of Science are accepted as the world's largest peer-review databases (Guz & Rushchitsky, 2009; Aghaei Chadegani et al., 2013). Reviewing process was proceeded according to PRISMA (2020) protocol (Figure 2).

The keywords were utilized in the literature search: TITLE-ABS-KEY ((“circularity” OR (“circular” AND “economy”)) AND (“architecture” OR “building” OR “construction” OR “urban” OR “city” OR (“built” AND “environment”))). Besides, keywords which had same meaning were organized using the TITLE-ABS-KEY as follows: (“architecture” OR “architectural”) and (“urban” OR “urbanism”) and (“building” OR “buildings”) and (“city” OR “cities”). Accordingly, the first retrieval resulted in identification of 613 publications, 476 from Scopus and 137 from WoS. The time span selected for review was from January 2010 to December 2023. Identification phase included removal of duplicated publications; 51 publications were excluded in this phase.

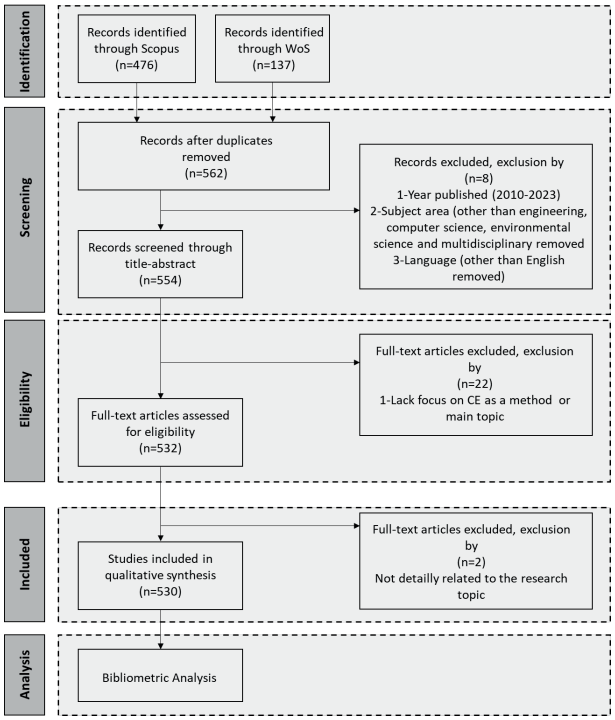

Fig. 2. Meta-analysis through Scopus and WoS considering PRISMA (2020).

Screening phase included removal of same publications and filtering process according to certain criteria. Only articles in English language and with full text available were considered in this study. Also, only engineering, and multidisciplinary areas were included; other subject areas were excluded. Additionally, notes, text notes, editorial notes were removed. The number of excluded papers were 8 papers, 554 papers were continued to screen through title and abstract. 22 papers were not retrieved because of lack focus on CE as a method or a main topic. The number of publications assessed for eligibility was 532 and these 532 papers continued to the PRISMA protocol.

Inclusion phase provided additional criteria as studies aims and relations to the related topic were awnalysed in detail. In this phase, 2 paper was removed. At the end of the PRISMA protocol, 530 papers remained. Then, analyses were applied on these 530 papers.

3. Bibliometric Analysis

The methodology of analyses was based on bibliometric analysis in order to understand and state the current relations between CE-related topics and architecture. In general, bibliometric analysis was applied to map the scientific retrieved data for evaluation of themes, dynamic aspects of data, and processing a wide range of information (Tijssen & Van Raan, 1994; Khan et al., 2021). Bibliometric analysis of scientific research has accepted as one of the most common methods to evaluate the research performance of academicians, universities, and even countries as well as academic journals (Konur, 2012; Khan et al., 2021). In this study, bibliometric analyses employed through VOSviewer software focusing on co-occurrence of keywords, country-based and author-based analyses. VOSviewer was considered as a bibliometric network software to construct and visualize bibliometric maps from the databases.

The main aim of the bibliometric analysis in this study is to understand and map current situation with an aim of proposing a potential innovative contribution to reach circular built environment by investigating the CE-related concepts.

3.1. Number of Publications According to Country

Figure 3 illustrates the publications classified by the 9 countries of origin between 2010 and 2023. This diversity in various geographic distribution suggests a global interest in circular & sustainable transformation of the built environment. Articles from the United Kingdom (66), Netherlands (64) and Italy (61) are at the forefront of this new field, which account for 36 % of all publications. Next comes China with 48 publications and United States, with 41 publications, and these are followed by Australia (39), Denmark (28), Germany (27) and Spain (25). In total, 43 different countries published papers on this topic how only 29 of them have more and equal than 5 papers. These countries are Switzerland (21), Austria (18), Canada (17), France (16), Portugal (16), Sweden (15), Finland (15), India (13), Belgium (12), South Africa (9), Japan (7), Poland (7), Brazil (6), Turkey (6), Singapore (6), Romania (6), Hong Kong (5), Greece (5) and Malaysia (5).

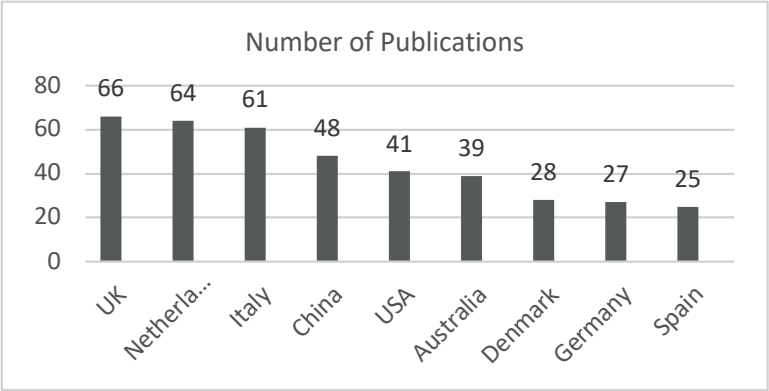

Fig. 3. Number of publications by country.

Figure 4 illustrates the number of citations classified by the 9 countries of origin between 2010 and 2023. In general, the number of publications and number of citations are in parallel. Citations from the United Kingdom are at the forefront of this new field with 1452 citations and followed by Netherlands (1064) and

Italy (1011). Next comes Australia with 767 and USA with 753 publications. These are followed by Denmark (470), China (453), Germany (409) and Spain (409). Even though China is the fourth place in number of publications, it is 7th for the citations as results of the country's conservative characteristics and language. Such high number of citations are significance of global interest towards CE.

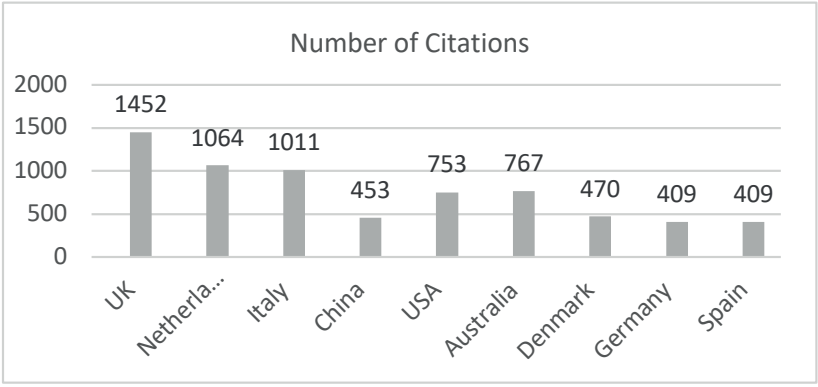

Fig. 4. Number of citations by country.

3.2. Author-based Analysis

This study aims to point out the most significant academic achievements on CE in built environment research. There are some authors who are specialized in CE research and articles which have larger impact (Table 1). For the impact of particular author, Urbinati, A. received the highest citations in this domain with 18 documents and had the largest number of normalized citations in highly cited articles. Therefore, it can be concluded that Urbinati, A. has led a significant series of research on the CE concepts in AEC industry. Also, articles of Urbinati, A. have the highest total link strength. In addition, total link strength means the interrelationship between the given document and other documents. Furthermore, Pomponi, F. has 6 documents but his papers are cited 606 time.

Table 1. Authors Citation Analysis.

Author	Number of Documents	Citations	Total Link Strength
Urbinati, A.	18	1359	3046
Birkved, M.	11	214	1728
Van Stijn, A.	9	169	1978
Pomponi, F.	7	606	2049
Birgisdottir, H.	6	104	1434
Eberhardt, L.C.M..	5	172	1285
Bragança, L.	5	191	796

More details of highly cited articles were shown in Table 2, including the name of authors, the full source title and total citations. The most cited article focused on developing a new taxonomy to run circular business models. Second and third most cited articles are literature review and guide to reach circular built environment. Fourth article focused on developing a digital tool for circular building industry. Fifth article discussed the framework and strategies to reach circular AEC industry.

Table 2. Paper Citation Analysis.

Author	Source Title	Citations
Urbinati, A., Chiaroni, D., Chiesa, V.	Towards a new taxonomy of circular economy business models	528
Pomponi, F., Moncaster, A.	Circular economy for the built environment: A research framework	509
Benachio, G.L.F., Freitas, M.D.C.D., Tavares, S.F.	Circular economy in the construction industry: A systematic literature review	304

Leising, E., Quist, J., Bocken, N.	Circular Economy in the building sector: Three cases and a collaboration tool	272
Ghaffar, S.H., Burman, M., Braimah, N.	Pathways to circular construction: An integrated management of construction and demolition waste for resource recovery	234

3.3. Co-occurrence of Keywords Bibliometric Analysis

The mapping of co-occurrence of keywords indicates the frequency of appearance of study topics in one paper and the interrelatedness among topics (Jin et al., 2018). Figure 3 provides an insight into the selected data from the eligibility phase of the PRISMA protocol, demonstrating the important keywords in the literature. The circles' sizes denote the frequency and interconnection weights. The larger the circle of an item, the higher the weight in the network. The distance attribute says the relatedness among the keywords, which is in terms of co-occurrence linkage. Therefore, if two keywords are close, the connection between them is stronger. Keywords co-occurrence provides the mental map of research topics in the field and facilitates the researchers to identify the relation between those keywords. Moreover, this mapping helps to identify the clusters and frequency of keywords addressed.

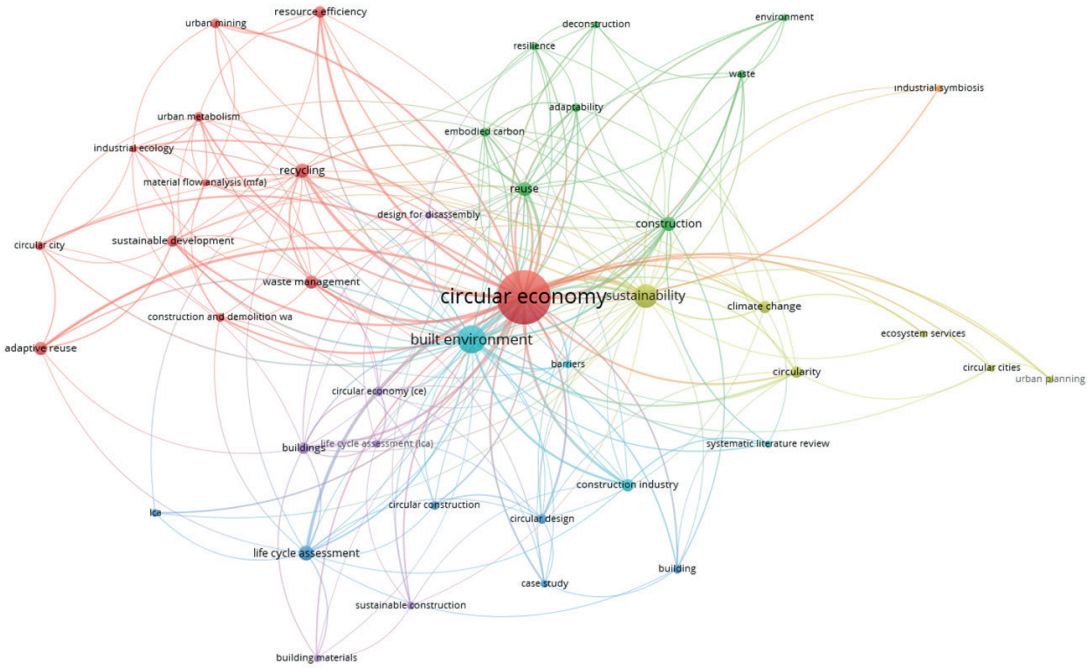

Fig. 5. Co-occurrence of Keywords Analysis.

The keywords which are the same in meaning but different in spelling are also combined. For instance, "ce" and "circular economy"; "building" and "buildings"; "sustainable" and "sustainability"; "recycle" and "recycling"; "design for disassembly" and "DfD"; "life cycle", "building life cycle" and "project life cycle" are merged. Since circular economy, sustainability and built environment have larger circles, respectively, they have a higher weight than the other keywords for the network. In addition, CE is the most connected keyword in built environment research with 269 occurrences. Built environment has 72 and sustainability has 54 usage and are followed by construction, recycling, reuse, life cycle assessment and waste management. Total link strengths are shown in Figure 5. Additionally, Table 3 summarizes the most occurred keywords and total interrelation link strength.

Table 1. Co-occurrence of Keywords Analysis.

Keyword	Occurrences	Total Link Strength
Circular economy	269	347
Built environment	72	148

Sustainability	54	94
Construction	26	54
Recycling	24	52
Reuse	22	50
Life cycle assessment	20	50
Waste management	19	48
Adaptive reuse	18	45
Buildings	16	41
Architecture	16	40
Sustainable development	15	40

4. Potentials for Applicability of CE Concepts

Based on the previous co-occurrence of keywords analysis, a classification of keywords into the topics is generated according to the similar research areas, as shown in Figure 6. By the help of VOSviewer, keywords from similar or interrelated research areas are illustrated closer to each other. Also, interrelations between these keywords are linked each other which allows to reach easier interpretations. The keywords are classified into three potential CE applicability areas: Circular design, material and reuse potential (Figure 6).

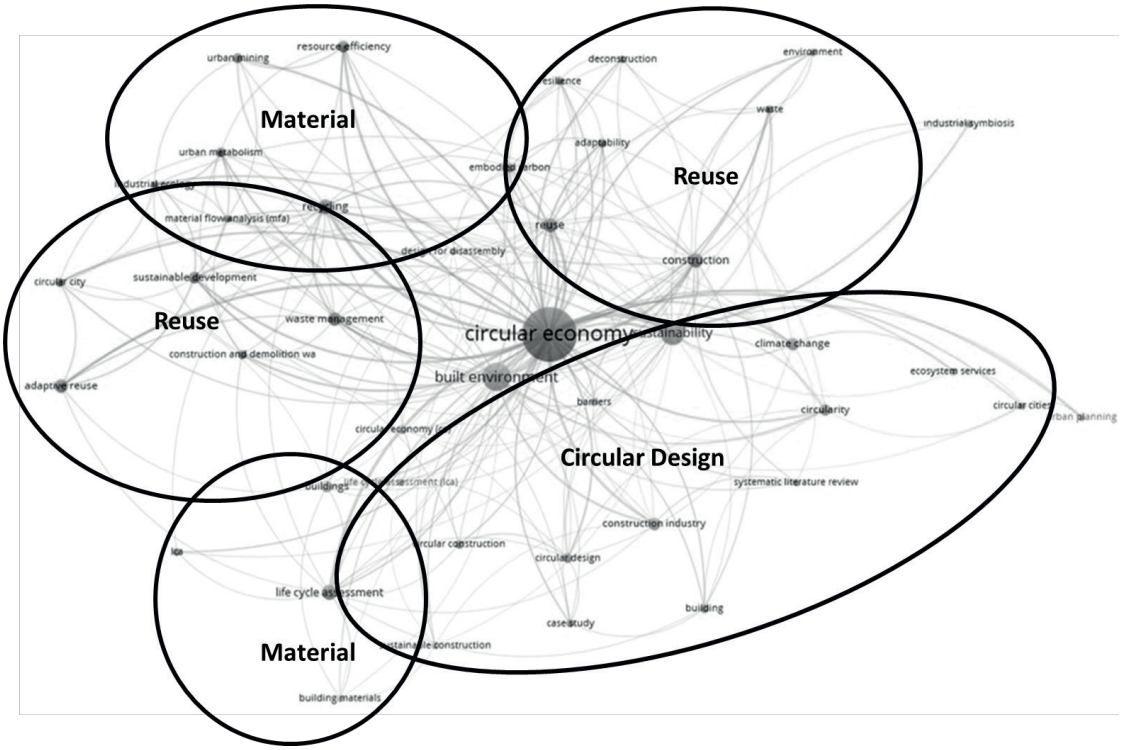

Fig. 6. Classification of keywords into related topics.

4.1. Circular Design

Circular design strategy adopts the "take-make-use-reuse" concept to different scales from urban to material scale. CE foresees transforming architecture to become more responsive to environmental and social realities; to a shift towards sustainable and circular design thinking. Circular design covers consideration of systems as integrated, flexible, dynamic and adaptable to different life scenarios. On an urban scale, a circular urban design embeds the principles of a CE across all its functions, establishing an urban system that is regenerative. These principles enhance environmental quality, economic prosperity and social equity. Continuity of natural and cultural values is crucial to reach circular economy by closing the loop. In this regard, considering socio-cultural contexts, culture and heritage act as a circular design notion. On a building scale, circular design involves circular construction techniques and materials such as: modularity &

transformability and low carbon material usage. One way of moving towards a circular built environment is to extend the service life of buildings through various design approaches such as adaptive design, adaptive reuse, design for dissassembly (DfD) and design for repair and remanufacturing (Ness & Xing, 2017; Pomponi, De Wolf, & Moncaster, 2018; Hopkinson, De Angelis, & Zils, 2020; Joensuu, Edelman & Saari, 2020; Minunno et al., 2020). In addition, Product service system (PSS) practices are discussed as relevant to the context of the built environment, as these systems could help facilitate maintenance activities and service life extensions of buildings through adaptive reuse and the more efficient use of buildings (e.g., sharing economy principles), which could decrease resource consumption and limit the growth of the building stock (Fargnoli et al., 2019; Joensuu et al., 2020).

4.2. Material

The principles of CE focus on optimization of resources, reduction of the raw materials consumption, and waste generation. These are all related with the value of the material. Value of the material depends on the "End-of-Life" concept which means the extension of the lifespan and usage of the material. A circular built environment can decrease the high rate of material consumption by keeping materials in use for longer at the highest value possible. On the other hand, material use is intricately linked to greenhouse gas (GHG) emissions. Also, embodied carbon value of the materials has to be taken into account. As result of carbon-based material consumption, material-intensive sectors are also known as carbon-intensive. It is necessary to decrease embodied carbon value and create a shift towards carbon free built environment industry. Regenerative and non-toxic material usage and increasing renewable energy sources are key factors.

Buildings and infrastructure act as huge banks of often-reusable materials. If buildings are designed to maximise energy efficiency, material flows used for heating and cooling will be narrowed. Material choice is a critical factor in reducing buildings' embodied carbon and material intensity. Revamping the entire construction ecosystem, from material choices to building practices, as well as shifting to more sustainable and inclusive urban planning will be crucial for realising a more circular—low-carbon and resource-light built environment.

On the other hand, accessing information about materials is crucial. The process of documenting materials and products utilized in the construction of the Urban Mining and Recycling (UMAR) that designed as a material depot for future constructions which will lead to have material passports. The overall goal of a materials passport is to document materials present in a product or building to maximize reuse potential. Material passports contain some detailed information in the form of digital data sets, these records of exactly what materials, products, and components go into a structure make it vastly easier at the end of the building's life to recover everything of value, preventing these materials from being dumped or incinerated during demolition or renovation. Material passports support architects in conceptualizing buildings as material banks from which valuable products can be harvested after the buildings, or part of the buildings. Additionally, Madaster is the most well-known online platform, which generates and registers materials passports

4.3. Reuse Potential

As the objective of CE is "doing more with less, over longer periods", reuse is the key strategy. Besides, behind the principles of transformability, adaptive reuse and design for dissassembly (DfD) is the reuse potential of a building or a building element or a single material. Additionally, sharing economy principles and PSS focus on reusing the service for thousand time by many people. Increasing the usage rates of buildings, building systems and urban ecosystem contributes to reach circular built environment. In practice: Sharing and rental models that increase product utilization whilst decreasing the number of products needed, multifunctional urban areas or buildings are some essential reuse potentials.

Optimising new builds and increasing the reuse of building materials (steel, concrete and timber, for example) and components (doors and window frames, for example) and buildings itself, will reduce the demand for virgin material inputs and energy. At the same time, this intervention presents a range of strategies to increase building occupancy, which will cut the total number of new buildings needed—ultimately narrowing material flows. Retrofitting is thus a key circular strategy to reduce the energy demand

of existing buildings. Retrofitting activities should use secondary and non-toxic materials to the greatest extent possible, cycling and regenerating flows.

The reuse of materials or systems or buildings, in general products at end-of-life is optimised, facilitating a circular flow of products. This is enhanced with improved collection and reprocessing of materials and optimal cascading by creating value in each stage of reuse and recycling. In practice: Design for repair, Design for refurbish / remanufacture, repurposing, Design for recyclability (both technical and biological), design for disassembly, reuse and recycling.

5. Conclusion

This study discussed the current situation of CE in architecture from sustainability point of view. Accordingly, the current situation of CE in architecture were investigated based on a comprehensive literature review and bibliometric analyses, to provide an insight for researchers and the AEC professionals. Bibliometric analyses depend on Scopus and Web of Science database and mapping has done through VosViewer. Country-based, citation-based, author-based and keyword-based analyses conducted. Considering these analyses, CE-related concepts as circular design, materials and reuse potentials were explored.

Circular design embeds the “take-make-use-reuse” and other CE concepts to reach sustainable and circular built environment. Circular design should be investigated in two scales: urban and architecture. Circular design aims to cities or buildings be regenerative and restorative by design. Material has five sub-topics to be discussed further: End-of-Life and value, low carbon and carbon free materials, waste as resource, material bank, material passports. Reuse potential focuses on doing more with less, over longer periods. It has different applicability areas such as reuse of a material, a component or a building itself. Each area needs own design & construction solution. Additionally, product service system, sharing economy and retrofitting are related to reuse potential.

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THE ROLE OF BIOMIMETICS AND GREEN BUILDING CERTIFICATION IN SUSTAINABLE ARCHITECTURE

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Abstract

"The ability of something to last" is a basic definition of sustainability in many dictionaries. In architecture, sustainability is beyond this definition. It is more likely to create healthy environments that will sustain other factors to last, such as socio-economic conditions and sustainability in ecological requirements. It is not something individual to last forever; it lasts within and together with users. Susan Maxman, the architect, states that sustainable architecture is not a prescription but an approach [1]. Despite this definition, architectural sustainability requires specific criteria designers must follow for better results. This paper examines the role of green building certification and biomimetics in maintaining architectural sustainability. It aims to highlight the benefits, negative and positive impacts before, during and after design processes. Designers started to consider this "before, during and after" the design stages. The constructional process is as important as the design process. Sustainable architecture does not only mean using ecological and sustainable materials and design approaches but also being sustainable while constructing the project. The study underlines the importance of sustainability and its effects on architectural design. There are several design approaches that are effective in achieving architectural sustainability. However, it focuses only on two essential approaches: firstly, *the green building certification criteria*, its durations, processes, stages, and results, and secondly, *biomimetics*, which guides designers to improve sustainable architectural designs and environments by inspiring from nature. Green building certification is one of the significant sustainability criteria that aims to advance the wellbeing of users and the environment. It provides resilience, health, prosperity, and sustainability for all life forms [2]. While certification focuses on the physical conditions of a building, biomimetics inspires the whole design process by finding nature-based sustainable solutions. There are specific examples for both approaches to prove that these design approaches effectively provide sustainability in architecture. The paper's methodology comprises a profound literature review, analytical research, and analysis of examples related to the abovementioned approaches.

Sustainability in architecture is viewed as a conceptualisation of architecture in response to numerous contemporary concerns regarding the impacts of human activities [3]. Since architecture is one of the major professions that considers sustainability, there is an urgency to mitigate the environmental effects in the built environment.

Key Words: *Sustainability; biomimetics; green building; architecture; ecology*

1. Introduction

Architectural sustainability aims to conserve non-renewable energy, material, and ecological resources; it recycles and reuses materials and outputs within the built environment. It also seeks to minimise the emission of toxic substances to lower the carbon footprint [4]. However, a built environment that aims for eco-centric image pooves its negative environmental impacts. When considering buildings, they become the primary unnatural form of consumption, interrupting the cycle of nature [1]. Architects must be educated to develop methods and find solutions to prevent such problems. The understanding of sustainability, which strives to establish principles regarding quality of life for today and the future, has become one of the essential criteria of architectural design. Sustainable architectural design, which includes economic, social, and environmental elements, requires effective design and energy use.

When mentioning sustainability, certain essential factors must be considered: What major causes affect global warming? What is the role of architecture in this? Could architecture by itself decrease the environmental crisis? Architecture alone may not reduce the ecological crisis, but it may play an essential role in minimising it by creating healthy built environments. Sustainable architecture has emerged as a

critical approach to addressing environmental concerns while meeting the needs of modern society. Within this field, two significant factors have gained prominence: green building certification and biomimetics. Green building certification offers a standardised framework for assessing and promoting environmentally responsible construction practices, while biomimetics draws inspiration from nature to design innovative and sustainable solutions. This proposal explores the interplay between these factors and their influence on sustainable architecture. These two specific approaches have a significant impact on providing sustainability in architecture. The aim and scope of this research are to analyse and propound the importance and advantages of these approaches in terms of architecture. Although many examples exist in many countries, four specific examples based on these two approaches have been analysed to state their role in sustainable architecture in general.

2. Sustainable Architecture

There are many design approaches in architecture, but only several have a role in designing sustainable architecture that considers environmental, social, and economic sustainability. When architecture becomes sustainable, the environmental impact of buildings throughout their lifecycle, from the design stage to the building and construction process, operation and usage, maintenance until the demolition and reuse, reduces significantly [5]. However, the green Architect William McDonough states in his book Cradle to Cradle, “Less bad is not good”. The reason why McDonough disapproves of the phrases “minimise”, “reduce”, or “make less bad” is that the destruction we as humans understand at the end of this “make less bad” philosophy, even if we never intended to cause such destruction, all of us become part of this destruction and involved in a strategy of tragedy [6]. This growing destruction caused a need for sustainable architecture.

Sustainability in architecture refers to designing and constructing buildings that minimise environmental impact, conserve resources, and promote social equity and economic viability. It encompasses a holistic approach to the built environment, addressing the environmental, social and economic dimensions of sustainability. There are many checklists for design actions to provide sustainable design in many resources. For instance, William McDonough, one of the pioneers of sustainable architecture, wrote the Hannover Principles for Germany for the Expo 2000 World’s Fair. In this list of principles, McDonough focuses on principles that strongly relate to nature and humans. Some other countries have commitments on sustainable design principles. Denmark, Sweden, Netherlands, Norway, Singapore, and Australia prioritise renewable green energy, energy-efficient public transportation, and sustainable building practices.

Some fundamental principles of sustainable architecture include energy efficiency, water conservation, ecological materials selection, indoor environmental quality, and site planning. Considering these principles helps designers balance meeting human needs for shelter and comfort while protecting natural resources and eliminating negative impacts on ecosystems and communities. Energy efficiency is the leading principle of minimising energy consumption and reducing the greenhouse effect. There are many examples all over the world which were designed based on these principles. Masdar City in Abu Dhabi, United Emirates, is intended to consider buildings with sustainable performance based on various criteria, including energy and water efficiency and ecological materials (Fig. 1) [7].

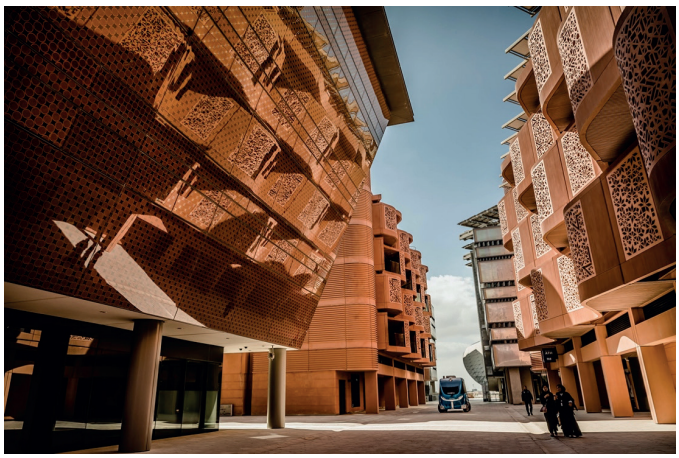

Fig. 1. A street view between iconic buildings, showing some parts of the Incubator Building and Masdar Institute of Science, Masdar City, Abu Dhabi, UAE [7].

Some buildings in this city received the LEED certificate from the U.S., the Estidama Pearl Rating System certificate developed by the Abu Dhabi Urban Planning Council and BREEAM by the U.K. Other buildings in the city are under construction or practice for receiving green building certificates [7]. These kinds of innovative designs are inspiring examples for other countries. The contribution of such examples to sustainable architecture is undeniable.

Considering that cities are designed this way, it may result in serious energy savings, conserving large amounts of water and unrenewable resources, recycling, and waste reduction. Creating successful sustainable architecture involves several steps. One of the main principles is the location of the building: sites that can minimise environmental impacts, such as sites close to public transportation, existing infrastructure, renewable energy potential and minimal ecological disturbance. In addition to these steps, there are several specific principles to achieve sustainable architecture: using passive design strategies, optimising the orientation of the building or natural light and ventilation, using shading devices, etc., eco-friendly material selection, water conservation and management, adaptability and flexibility, IAQ (indoor air quality), and recycling, renewable energy integrations such as wind turbines or solar panels, and energy efficiency such as using LED lighting and highly efficient HVAC, are other crucial principles that must be followed when designing for sustainability in architecture [8].

Besides the environment, sustainable architecture contributes to users' quality of life and wellbeing. For example, thermal comfort, natural light, relationship with nature, noise control and reduction, healthy materials in which VOC -volatile organic compound- is not an issue, interaction with the community, and a sense of purpose for sustainability indoors are the main criteria to be considered for the wellbeing of users [8]. Ken Yeang states in his book Ecodesign that several health problems like asthma and chronic respiratory diseases may occur when using non-eco-materials indoors. Moreover, he suggests that using plants as humidifiers can minimise such issues, and precautions can be taken to discourage microbial growth. In Figure 2, Yeang summarised the users' most frequent complaints about IAQ [4]. Besides this, the figure shows that the complaints about IAQ relate to basic and simple design problems carried out by designers and the principals listed above.

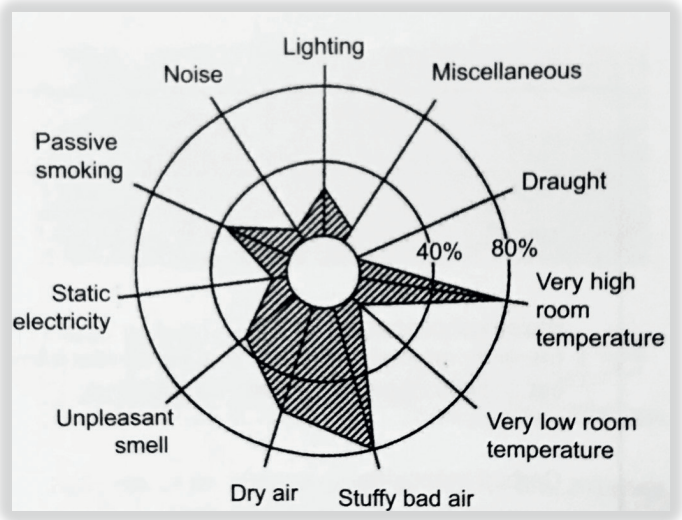

Fig. 2. The users' most frequent indoor environment complaints [4].

According to the environmental news website Earth.org, fifteen of the most significant environmental problems have the most considerable destructive impact on planet Earth (Table 1) [9]. These problems did not appear suddenly. They are the results of specific causes and triggers made by humans. One of these triggers is the architecture. It might not look related to architecture initially, but architecture is responsible for most of these problems besides other fields. Table 2 shows the significant adverse effects of architecture causing these environmental problems. The adverse impact on the table can be expanded and not limited to fifteen.

Table 1. Table showing the world's most known and biggest environmental problems [9].

15 Biggest Environmental Problems of the World	
1. Global Warming from fossil fuels	9. Ocean Acidification
2. Poor Governance	10. Agriculture
3. Food Waste	11. Food and Waste Insecurity
4. Biodiversity Loss	12. Fast Fashion and Textile Waste
5. Plastic Pollution	13. Overfishing
6. Deforestation	14. Mining (cobalt, gold, natural stone, etc.)
7. Air Pollution	15. Soil Degradation
8. Melting Ice Caps and Sea Level Rise	

It must be remembered that when not under sustainable control, architecture causes severe environmental problems. For instance, 30% of global final energy comes from building operations, and 26% of global energy-related emissions [10]. Also, the construction sector is responsible for 55% of global electricity use [11]. However, these adverse effects can be converted to positive ones by following architecture's sustainability principles, such as green building certification and biomimetics.

Table 2. The adverse impact of architecture on environmental problems. Table prepared by the author.

The adverse impact of architecture on environmental problems			
Global Warming, **Poor Governance,** **Deforestation,** **Air Pollution**	Energy consumption of buildings, Insufficient building regulations of governments, Construction of built environments, Urban heat island effect	**Fast Fashion and Textile Waste,** **Air Pollution** **Soil degradation** **Biodiversity loss**	Production process of synthetic textiles for cheap design causes waste Too much excavation for construction, chemical leakage on construction soil Relocation of the excavated soil to somewhere else which causes soil degradation
Mining, **Deforestation,** **Biodiversity loss,** **Ocean acidification**	Careless land use for developing cities, Unrestrained growth of built environment, Waste disposal to the oceans due to the architectural production processes (factories)	**Plastic Pollution,** **Air Pollution** **Biodiversity loss**	Usage of unsustainable materials causing plastic waste, Production of plastic-based materials causes too much smoke and waste, killing organisms
Food and Waste Insecurity	Lack of ecological canalization, Too much waste during and after construction,	**Air Pollution,** **Melting Ice Caps and Sea Level Rise**	Unsustainable production process of construction materials, Energy Consumption increasing temperature in the seawater causing ice melting

Sustainable architecture stands as a ray of hope amidst our planet's environmental challenges. While traditional approaches to architecture may inadvertently contribute to environmental degradation, embracing sustainability principles offers a path towards mitigating these impacts. By prioritising energy efficiency, ecological materials, and holistic design strategies, architects can create buildings that minimise environmental harm and enhance the well-being of inhabitants. Innovative examples like Masdar City serve as beacons of possibility, demonstrating the transformative potential of sustainable design. However, the urgency of the environmental crisis necessitates widespread adoption of these principles across the architectural industry. By recognising the profound influence of architecture on environmental sustainability and embracing a commitment to sustainable practices, we can transform the built environment into a force for positive change, mitigating environmental harm and fostering a more sustainable future for generations to come.

3. The Role of Green Building Certification

The green building certification system was first introduced in the United States of America in 1993 by the United States Green Building Council. “Transforming buildings and communities to advance human and environmental wellbeing” is the central vision of the council, as stated on their website [2]. This program is called Leadership in Energy and Environmental Design, and it encourages architects to design environmentally friendly buildings with green energy systems, whether old or new, residential or commercial [12]. When the green building certification system started to become popular and created awareness of sustainability, different countries developed green building certification systems to ensure that buildings are sustainable designs. The most known certification systems are Leadership in Energy and Environmental Design (LEED), Building Research Establishment Environmental Assessment Method (BREEAM), Green Star by Green Building Council of Australia, WELL Building Standard by International WELL Building Institute, Living Building Challenge (LBC) by the International Living Future Institute [13]. All these councils and institutes have the same aim and vision of providing a sustainable certification system that ensures the wellbeing of humans and their environment.

The role of green building certification systems is crucial, and they have valuable tools for advancing sustainable architecture by providing guidance, recognition, and incentives for environmentally responsible building practices. Sustainable architecture is prevalent in providing a holistic ecological design approach that considers the environment's wellbeing. Sustainable architecture requires efficient energy use, site selection, ecological materials, good IAQ, passive design strategies, integration of renewable energy, recycling, water and waste management, LCA (Life Cycle Assessment), adaptability and flexibility, and community engagement [14].

Establishing specific practical limitations where the level of environmental integration must be achieved could be provided by standardising the criteria and metrics for evaluating the environmental performance of the building [4]. In addition to standardisation, the environmental benefits of green buildings are much more potent than conventional buildings, such as reducing greenhouse gas emissions, less resource depletion and lower waste generation. Besides all these benefits, green building certification systems continuously improve, and ongoing monitoring and performance tracking are the most important contributors. Additionally, to satisfy all the abovementioned criteria, architectural professionals work on suitable designs with the intention of receiving a green building certificate. It is essential to clarify the role of green building certification in sustainable architecture by exemplifying two sample buildings: The Edge and The Crystal.

3.1. The Edge, Amsterdam, BREEAM Outstanding

The Edge is an office building in Amsterdam, Netherlands (fig.3). It is one of the most sustainable office buildings globally. It was completed in 2015 and has achieved the highest rating for sustainability from BREEAM, known as "Outstanding". The building has a 15-floor atrium, a giant window providing maximum daylight and a visual connection with the outside world. Architects of the Edge focused on an exclusive design that offers many different working, meeting, and stopover environments where health, comfort and productivity are essential for users. The building allows people to work anywhere they want, and it has a particular app that lets people find each other or look for a place or desk to work, enabling them to adjust the lights and indoor temperature to their preferences [15]. Creating such working environments aims to increase the efficiency of people working in these environments, providing energy savings simultaneously.

Fig. 3. The Edge (middle), transparent 15 floor atrium [15].

The collaborative work environment in the Edge shows that the highest sustainability level has been achieved in the building. It is the world's most sustainable office building, rating an Outstanding degree of BREEAM for new construction with a score of 98.36%, incorporating smart technology and a cognitive attitude to sustainability [15]. It can be understood that this building includes the most innovative technologies and design approaches considering the sustainable design criteria. Starting from the orientation of the building to achieving climatic energy performance to create a north-facing atrium that provides natural daylight reaching the offices, the Edge proves that it is a successful example of sustainable architecture (fig.4).

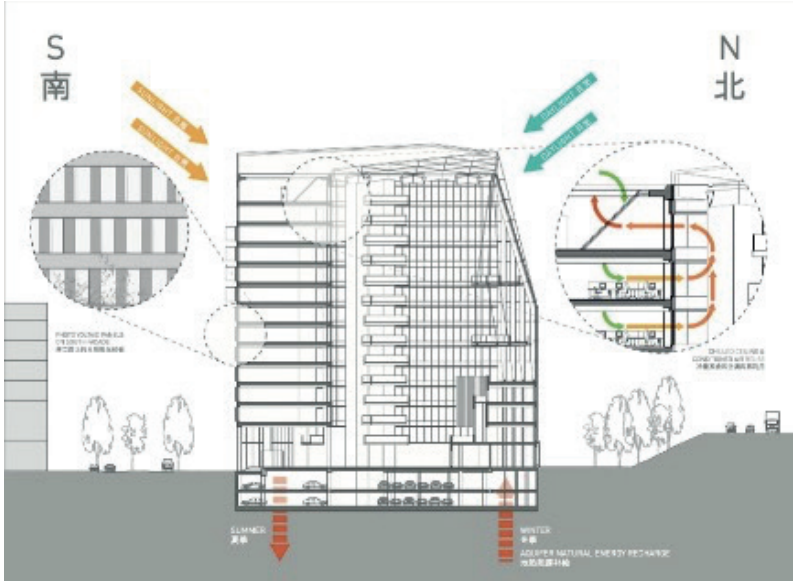

Fig. 4. Section showing the atrium and south-facing façade providing thermal mass and shading [15].

The Edge also stores rainwater to flush the toilets and for garden works in and out of the building. Energy and water efficiency, temperature control, and natural ventilation are some of the significant criteria in this project.

3.2. The Crystal, United Kingdom, BREEAM Outstanding and LEED Platinum

The Crystal, an exhibition centre in East London, United Kingdom, is the first sustainable building which achieved the BREEAM Outstanding and LEED Platinum highest ratings of both systems(fig.5). There were two main aims that this building was designed: to host events on sustainability and make London the global leader in the low carbon economy [16]. The Crystal includes high-standard offices, conference facilities, an auditorium, and the largest interactive exhibition. It is assumed that the building emits 85 %less carbon dioxide (this means a 42 % improvement over other buildings), uses 52% less electricity, and uses mains water for 10 % of its needs. Besides technological innovations that provide all these criteria, The Crystal has a façade system that minimises the demand for heating and cooling, just like The Edge in Amsterdam (fig 5) [16].

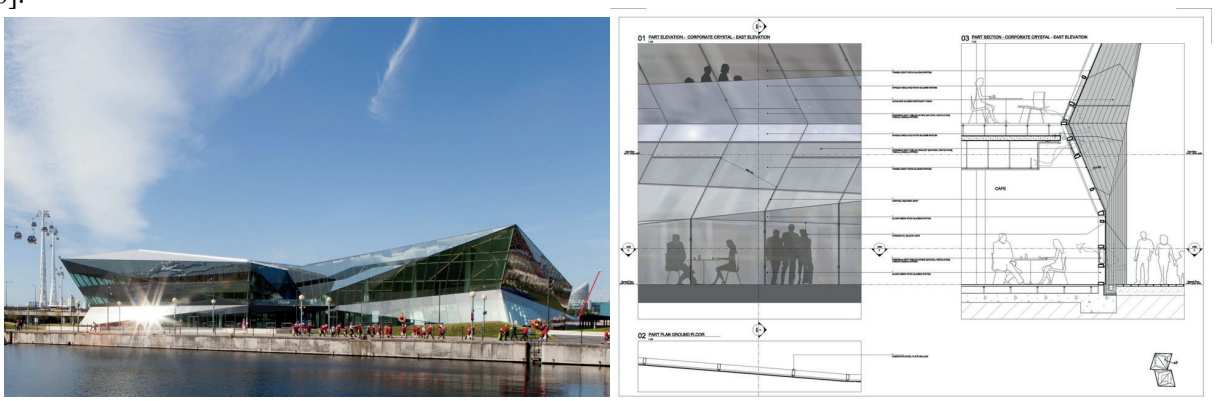

Fig. 5. (a) The Crystal, East London, (b) Section showing the façade system [16, 18].

On the façade of the Crystal, six different types of highly insulated glass have been used. These glasses were made to moderate the solar gain and provide extensive scenery inside and outside. It is stated on Wilkinson Eyre's website, which is the architectural office that designed the building, "The Crystal is accepted as a demonstration of sustainable design that employs several new technologies to reduce energy use" [17].

The advanced pump system in the building recycles the rejected heat from other server rooms or exhibition areas to heat different areas of the building. There are PV panels for solar energy, smart operation systems, and LED lighting, which enables users to dim according to daylight [16]. The Crystal is all-electric, and no fossil fuel is used on the site. Rainwater is harvested, and the building provides 90% of its water by itself [18]. According to the information provided above, The Crystal provides perfect sustainability. If at least half of the buildings in the world were like the Crystal and Edge, what would be the results of the problems listed in Table 1?

4. The Role of Biomimetics

Biomimetics is a design approach that provides inspiration from nature to achieve sustainable designs. The applicability of biomimetics is simple yet profound. The increasing sophistication of technology in science enables scientists to discover nature's design strategies and apply them to solve our challenging problems [19]. Besides the criteria for green building certification, biomimetics reveals fresh, innovative solutions from nature. In sustainable architecture, biomimetics provides innovative approaches to designing eco-friendly yet naturally sustainable and resilient buildings and urban environments. Biomimetics has some key aspects to consider forms and systems in nature; sustainable material selection, energy efficiency, water management, resilient structures, integration of ecosystems, and animal behaviors are some of them. These key aspects are very similar to the sustainable design criteria stated above.

Nature has found solutions over 3.8 billion years by evolution [20]. Thus, nature knows how to be sustainable and efficient. Many organisms, such as immigrating birds, polar bears, or termites, can save energy. The energy-saving strategy could be studied and applied to our energy-saving problems. The office building Eastgate has the same system with termite mounds. It is one of the most famous biomimetic designs in the world. The energy efficiency of Eastgate is almost 70% higher than that of other regular buildings [21]. As architectural examples, there are few buildings designed with a biomimetic approach; two of them have been selected as case studies for the role of biomimetics in sustainable architectural design: The Bullitt Center in the USA and Hive House in India.

4.1. The Bullitt Center, Seattle, USA

The Bullitt Center is a commercial building in Seattle, USA, designed to be the most energy-efficient building in the world (fig.7) [22]. According to the Pacific NW Magazine author Lawrence Cheek, Bullitt aims to change the way buildings are designed. In addition, it seeks to change buildings' operation and building processes to achieve healthy long-term environmental performance [22]. The owners and designers of the building prepared a report about the design and construction stages of the Bullitt to inform other building owners and inspire them to create the next generation's robust, sustainable buildings [23]. Bullitt Building was inspired by a forest. It functions just like the same stagey of Douglass-fir Forest. P.V.s on the roof work as leaves, photosynthesising the energy from the sun.

Fig.7. The Bullitt Center glass façade allows natural daylight [24]

It generated 30% more energy than it consumed in the first decade, aiming to be zero. The roof system collects water from rain like the roots of a tree, filtering and delivering it to the faucets. The building has a system for composting toilets. The system is like a brain; it helps the building to interact with the environment. Due to the integrated design approach, Bullitt received a Living Building Challenge Green Certificate (LBC) operated by the University of Washington Department of Architecture. According to the LBC, the building must perform as designed. It should meet all LBC criteria before it receives the certificate. All achievable requirements, such as energy, water, materials, etc., must function [23]. This integrated design created a sustainable building.

4.2. Hive House, India

Hive is a sustainable house built in 2019 in Surat, Gujarat, India. The designers of the Hive were inspired by honeycombs and carbon crystals. The façade changes and follows a diurnal pattern, which is a pattern that cycles every 24 hours, resulting in the rotation of the world (fig.8) [25].

Fig. 8. (a) The biomimetic honeycomb façade and (b) diurnal pattern [25]

This solar sensor-based façade system provides quality light exposure and thermal comfort levels in the house. All these features make the house intelligent, adaptable, and sustainable. The design of the house is based on function, biomimetics and structure [25]. The roof is green and walkable, making it sustainable regarding heat gain and heat loss. On every floor, the building opens to greenery, and natural light control is an issue. Although the façade design is nature-based, the building requires more design aspects based on biomimetics. The Hive does not have a certification of any sustainability systems. However, with certain additions and improvements, it might have a chance to get a green certificate. Such designs do not have to receive any certificate, but they can be sustainable regarding energy efficiency, indoor air quality, and thermal comfort. As a result, these designs can potentially increase the successful sustainability in architecture.

Conclusion

The building's size and location do not matter if the sustainability is in charge. Certification systems are needed to certify these buildings as sustainable buildings. Although green building certification is essential for sustainable architecture, there are some risks to sustainable design, such as cost, risk of greenwashing, limitations of rating systems, and lack of enforcement and monitoring. These negative impacts may slow architecture's sustainable design and test and commissioning processes.

Through a holistic approach that considers environmental, social, and economic dimensions, sustainable architecture offers a pathway to mitigating the harmful impacts of the built environment while promoting human wellbeing. The examples of innovative sustainable buildings such as The Edge, The Crystal, The Bullitt Center, and Hive House showcase the transformative potential of sustainable design principles in action. These buildings minimise environmental harm and prioritise the health, comfort, and productivity of their occupants. By integrating cutting-edge technologies, renewable energy systems, efficient water management strategies, and biomimetic design principles, they set new standards for environmental performance and sustainability.

However, the urgency of the environmental crisis demands widespread adoption of sustainable architectural practices across the industry. It requires a collective effort from architects, designers, developers, policymakers, and communities to embrace sustainability as a fundamental guiding principle in every aspect of the built environment. Moreover, while green building certification systems and biomimetics offer valuable frameworks and inspiration for sustainable design, they are not without challenges. It is essential to address potential limitations and continually strive for innovation and improvement in sustainable architectural practices.

Ultimately, we can positively change the built environment by recognising architecture's profound influence on environmental sustainability and committing to sustainable practices.

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Interferences between Architecture and Arts in the Twin Villas of Alberto Salvati and Ambrogio Tresoldi

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Abstract
At the beginning of the 1950s, the economic boom and the wave of consumerism sweeping through Italy produced significant cultural and social transformations, guaranteeing an increase in living standards for a large part of the population. With the "economic miracle" came an increase in commissions from private, often with open, avantgarde horizons, willing for novelty and eager to see their new *status quo* represented by their homes.
This new range of possibilities, both economic and creative, has generated the emergence of a new design attitude paradigmatic of a collaboration between arts and architecture. This phenomenon is more commonly and internationally known as "synthesis of the arts". A multifaceted practice that, in both the artistic and architectural fields, has left deep furrows in creative praxis and has been the subject of numerous discussions within the fervent Milanese cultural circles. The subject of the dispute is the procedures with which to re-establish the dialogue between architecture, painting and sculpture and the theoretical foundations on which to establish new design methods based on the collaboration between artist and architect [1].
Starting from this cultural background the essay aims to trace and analyse the different forms of interaction between architecture and the arts and the consequent effected generated in a project conceived by Alberto Salvati and Ambrogio Tresoldi − architects active in the Lombardy region, a fertile terrain for collaborations between artistic craftsmen –: the Twin Villas realised in Toscolano Maderno (Brescia) between 1970 and 1971. The investigation conducted is aimed at examining the more tangible aspects but also to explore and interpret the more ephemeral ones linked to the phenomenological experience of space. This analysis will highlight a design process and a compositional method in which the architects, endowed with a marked artistic sensibility, adopt a procedure borrowed from art and then translated into spatial and perceptive devices. So, the work of the Twin Villas is intended to show an art-architecture fusion intrinsic to the creative process, exemplary of a specific declination of artistic synthesis.

Key Words: *Synthesis of the Arts; Italian Interiors; Alberto Salvati; Ambrogio Tresoldi; Twin Villas.*

1. Introduction

There are numerous studies on the architecture designed after the Second World War, in the Milanese environment, less investigated, however, is the peculiar context of domestic interiors. The choice of the domestic "interior" derives first and foremost from the fact that it proves to be a privileged place of encounter between arts and architecture. Secondly, in the context of a private home, the degree of freedom granted to the architect and the frequent openness of clients allow to carry out design experiments that would not be permissible in public buildings subject to strict constraints, regulations and laws. Last but not least, the decision to examine an interior design depends on its particular nature: as an articulated spatial device, determined by the way in which the environments are linked, proportioned, illuminated, placed in physical, visual and emotional relation, the furniture is arranged, the planimetric organisation affects the architectural envelope and participates in its volumetric conformation determining its relationship with the external space; as a polysemic place that refers to the cultural world to which the architect and client belong and expresses, through forms and spaces, a concept of living and domesticity; as an environment marked by a precise "atmosphere" to the construction of which a series of choices contribute, such as the presence of polychromy, of a certain type of structural and cladding materials that arouse tactile sensations

or synaesthesia, of views of the urban or natural landscape, of natural and artificial light gradations, of the presence of artworks envisaged in the project aimed at stimulating particular perceptions and emotions.

The chosen project is the Twin Villas built between 1970 and 1971 in Castelletto − in the municipality of Toscolano Maderno (Brescia, Italy) −, a small village overlooking a hill on the western coast of Lake Garda, and conceived by Alberto Salvati (1935-) and Ambrogio Tresoldi (1933-2005), architects rightfully among those who made the integration of art and architecture one of their strong points.

Fig. 1. Alberto Salvati and Ambrogio Tresoldi, *Twin Villas*, Toscolano Maderno, 1970-1971.

2. School of Milan

Before going into the details of the project, it is worth highlighting the artistic spheres that Salvati and Tresoldi encountered. They enrolled in the Faculty of Architecture at Politecnico di Milano where they received a rationalist education which they "develop by adding the element of colour as a fundamental entity in the determination of spaces" [2].[a] This attitude is fostered by certain professors such as Gio Ponti but also Vittoriano Viganò and Carlo Perogalli who, as members of the Movimento Arte Concreta (M.A.C.), spur and encourage the two architects' relations with the art world.

Above all, it was the painter Galliano Mazzon who insinuated the artistic vein into Salvati and Tresoldi's work. Also a member of the M.A.C., he is for the two architects a friend and before that a teacher and mentor. In fact, at a young age (1946-1949) Salvati attended the Panzini Middle School in Milan where Mazzon taught pictorial composition, educating the students in creative freedom [3]. The contact between the two continued during the university period and extended to Tresoldi when, after graduation, they embarked on didactic career teaching drawing in a public school in Brianza, using Mazzon method [4]. A bond that continued to be renewed on several occasions and that is evident in the two architects' desire to combine architecture and arts in their projects through the fundamental role of colour: associated with architectural constituent elements, it becomes a tool for defining an environment; consciously used, it can be a device for "igniting feelings and vital projections" [5].

This attitude of total openness towards art lays the seed of a shared "doing" that characterises the entire career of Salvati and Tresoldi marked by mutual interference between disciplines and by an *ad hoc* conception that combines artwork and environment. Their approach to art does not remain only on a theoretical level, but is realised through their collaboration with numerous artists, stimulated and nourished by the often-unnoticed activity of the two architects as animators in the Milanese cultural circle through the various exhibitions they organised at their studio from the mid-1960s onwards, in particular with the artists

a All translations of quotations are provided by the author.

of Programmed Art [2]. The interdisciplinary training of Salvati and Tresoldi is transposed into an approach to architectural project that aims to renew the conception and meaning of living space by considering the different disciplines − from architecture to art passing through object design − "as an integrated system of diversified intervention in a continuous reciprocal osmosis" [6]. It's a team effort and a collegial approach that often sees the involvement of artists called upon to operate in the space, not through the passive insertion of artworks, but by means of sincere collaboration aimed, via art, at qualifying the space with "episodic interventions" and "symbolic emergencies" [7]. This com-participative procedure recognises in the figure of the artist a true stimulus capable of contributing to the definition of architectural language and of modifying the conception and perception of space [8].

3. Villas in Locus Amoenus

3.1. The Twins

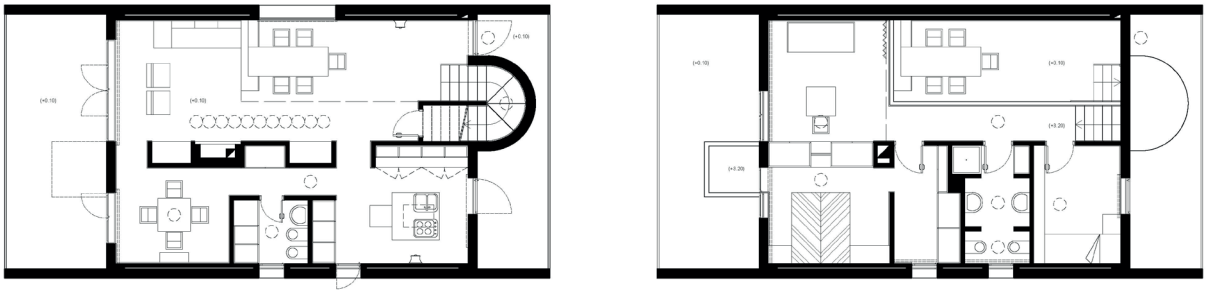

Fig. 2. Plans of Twin Villas, from left to right, ground floor and first floor.

The two houses are conceived by the architects as holiday homes for Alberto's two brothers, Giovanni and Paolo Salvati, and their families [2]. The dwellings, which depart from the vernacular architecture of Lake Garda in their use of concrete and modern, rational forms, reveal the primal intention of this project. The original task entrusted to the two architects was to conceive a low-cost tourist settlement. The proposal was a box-shaped cell composed of the successive assembly of prefabricated concrete "rings", with two transparent heads and completely blind sides to allow horizontal, as well as vertical, aggregation with other cells. There are no documents specifying why the design of the complex was not completed, but the nucleus of three dwellings that stands in its place is clear evidence of the two architects' early ideas. This nucleus, built on a hill of olive trees, consists of a single-storey cell that Salvati destined for himself and two duplex cells for the brothers, the aforementioned Twin Villas.

They are arranged on the plot in a row to each other with an independent entrance and an orientation that sees the main axis, i.e. the longitudinal axis, in a north-south direction. This ensures that the sides, almost completely blind, are kept towards the access road and the hill slope, the façade, characterised by the staircase volume, to the north and the predominantly glazed elevation with balcony to the south, ensuring a splendid view of the lake.

Their structure is composed of a concrete parallelepiped divided into two levels. The ground floor consists of the living room with adjoining dining area, the kitchen, the bathroom and a multifunctional room that can be used as a second and smaller dining room, a study or a possible sleeping area for guests; on the first floor, a balcony hallway, overlooking the living room on the ground floor, provides access to a single bedroom, a bathroom, a double bedroom with closet, and a hybrid space that can be used either as a small living room/study, open via a balcony to the environments below, or as a third bedroom that can be screened with a sliding element. The two levels are connected by the self-supporting structure of the staircase.

The setback of the headboards, with respect to the perimeter walls and the roof, creates two additional environments. These are double-height porticoed spaces each of which has a specific function in relation to the daily experience of the house. On the north façade, it becomes a space dedicated to "welcoming" [9]: it anticipates the access and defines a boundary with the outside, symbolically through the cornice of the

elevation that raises the walking surface 10 cm above the ground. Also the terrace on the south side fulfils a dual function: both that of "looking out", connecting the internal environments of the house with the external space, and that of "withdrawing" [9], allowing the possibility of gathering and contemplating the landscape in front. These spaces well exemplify Salvati and Tresoldi's intention to make the house the "theatre of the world" [4] in strong connection with the external environment.

3.2. Modular composition of concrete forms and primary colours

Taking a closer look at the villas, it is clear how the formal composition is dictated by the parallelepiped architectural envelope, thus configured to respond to prefabrication requirements and to guarantee future possible aggregation with other cells: the pebble roof is kept flat and the aforementioned blind sides. This, however, is what was initially conceived. In fact, in retrospect, when the villas probably begin to be inhabited and the idea and need for them to be part of a nucleus of several juxtaposed modules disappears, the blind elevation, i.e. the one facing west, is pierced with a large circular window that guarantees more light into the living room.

What emerges most strongly, however, are the references to the aesthetic experiences of concrete and programmed artists. Mazzon in his paintings often uses primary colours composed in symmetrical scheme of concrete forms and this is what Salvati and Tresoldi did in the elevations of the villas. Here they adopt black, white, yellow and cyan colours with pure, geometric conformations. The reference to the programmed art is more hidden and can be traced back to the issue of modularity. It could be interpreted on two scales: either the major one that considers the villa as a single cell that can be repeated n-times or the minor one that sees the "programming" of the elevations and the plan starting from the scansion dictated by a 70 cm module. Examining each façade in detail[b] it is evident how they are conceived on the basis of an interplay of contrasts. The west elevation just mentioned shows a surface that can be summed up in a composition of elementary forms − repeated with some variations in the other façades of the building −: the rectangle of the architectural volume, the triangle of the chimneys and the circle of the opening. What mainly emerges, however, is the opposition between the "rigid" and linear geometry of the building's parallelepiped and the curved shape of the window. This opposition is also visible in the north elevation, the square shape of which is counterbalanced by the cylindrical volume of the staircase, or, on a more detailed scale, in the chimney whose rectangular shape is pierced, for the passage of fumes, by a circular hole. However, the contrast is not only formal but also chromatic: on the white plaster of the header, the yellow of the staircase and the cyan and black of the two triangles forming the composition visually joining the French window on the ground floor and the window on the first floor stand out, giving a greater sense of verticality. An attempt at formal counterbalancing is also made in the south elevation. To equilibrate the "weight" of the large square opening on the ground floor, located to the left of the median axis of the façade, the two openings on the first floor together with the cubic volume of the balcony are unbalanced towards the right. The most characteristic feature of this elevation, however, is the modularity and reiteration at different scales of the square form, which is proposed both white and coloured (cyan or yellow depending on the two dwellings), both opaque (in the balcony) and transparent (in the openings).

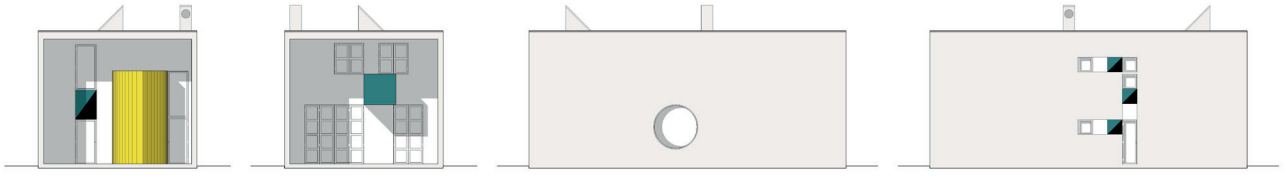

Fig. 3. Elevations of the Villa, respectively north, south, west and east.

b Here will be examined one of the two dwellings remembering that they are identical to each other with the only difference being the colour variant: what is cyan in one dwelling is yellow in the other, and what is yellow is presented in the other villa in cyan.

Analysing all elevations together, two further dialectical relationships are established between them. The first is based on the contrast between the deep breakthroughs to the north and south and the coplanar surfaces to the east and west. This antinomy is also emphasised by the treatment of the surfaces: while in fact the side walls are finished with a cement plaster arranged with trowel, the heads are finished with a white-coloured plaster. The combination of the two factors – "broken" headers and diversification of the exterior texture – contributes to the impression of a "box within a box". The second contrasting correlation is that between the extruded volumes in the headers and the flat hollowed-out forms in the flanks: a parallel can be drawn between the cube of the balcony to the south and the square of the windows set back from the façade line to the east, but also between the semi-cylinder of the staircase to the north and the glazed circumference to the west. Contrast is thus also played out between a flat figure and its three-dimensional counterpart obtained by extrusion.

3.3. Space Sequences

To fully understand the possible perception and the atmospheres created by the architects through the combination of volumes, shapes and colours, an attempt is now made to analyse the "sequence of spaces" [10] in a hypothetical route through them all, investigating the luminous, formal and volumetric variables.[c]

Crossing the driveway in the shade of the olive trees, it is immediately clear to read the entrance: both because the path points straight towards the dwelling, and because the emerging volume of the staircase, with its yellow colour, functions perfectly as a landmark [11] drawing all attention to itself. Once the porch is reached, it is precisely the semi-cylindrical form of the staircase that invites towards the preferred entrance. Having crossed the threshold, the horizontally contracted space between the staircase and the side wall continues to maintain the same expansion in a vertical sense, developing to its full height up to the roof. The front view is unobstructed, there is no spatial threshold or visual obstacle between the entrance and the porch on the opposite side. The nature just left behind then reappears framed by the living room space and becomes part of the domestic landscape. Moving forward, the volume undergoes a vertical contraction caused by the slab on the first floor, which is however compensated by the sense of openness provided by the large glass wall. Going outside, the volume expands again and, in this case, there is not even a staircase limiting the space, thus allowing a 180° view of the landscape. Returning to the interior, the secondary dining room can be read as an internal appendix to the porch and garden, a place of *convivium* projected outwards, and at the same time, welcoming the landscape. The fluidity present in the previous environments is partly lacking here, both because there is no double-height volume and the bathroom, interposed between the secondary dining room and the kitchen, breaks the rhythm and connection between the environments, probably to generate a more specific belonging of the space to the kitchen. The architects perhaps sought to restore fluidity to the environment by lowering the equipped wall in the centre of the floor plan – which also serves the function of shielding the entrance to the bathroom from the living room – compared to the inter-floor level, bringing it to a total height of two meters. In this way the space is less contracted and some continuity is restored to the ceiling. The short section of corridor that disengages the bathroom flows into a spatial node from which it is possible to access: the kitchen and from it, through the French window, the porch; the staircase, of which one has a foreshortened view exactly as with the entrance door; and finally, the dining area. It is as if the architects wanted to redefine the coordinates of the space through this junction, allowing clear views and agile movement [12]. Crossing the narrow passageway, one returns to the double-height living-dining area where, precisely by contrast with the small size of the previous passage, one can perceive an accentuated feeling of space expansion.

The ascent up the staircase shows Salvati and Tresoldi's ability to connect environments. Even though the semi-cylindrical volume − precisely because of its shape combined with the centripetal movement of the ascent around the central pivot of the handrail − gives the impression of a separate spatial unit enclosed between the load-bearing walls that determine a "compression" in the sequence described, it is articulated

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c The villa to the north of the property is also taken as the sample for this analysis.

in such a way as to allow a visual interrelation with one or more environments along the entire route. This interrelation is also maintained on the first floor. Here the space of the balcony on one side suffers a sort of compression exerted by the wall in which the entrances to the bedrooms and the bathroom are distributed, however compensated by the "dilation" ensured by the overlooking of the double-height volume of the dining area. The brightness, which is attenuated in the stairwell, regains intensity in this space thanks to the window on the front and the one positioned next to the staircase, above the French window at the entrance. What mainly differentiates the ground floor from the first floor is the "rhythm" of circulation determined by the morphology of the spaces, fluid in the first case and syncopated in the second.

3.4. Chromatic atmospheres

The design of the furnishings goes hand in hand with that of the space and has repercussions on the latter in terms of perception and utilisation. The distribution of the environments, based on the principle of interconnection, in rather small areas (approx. 65 sqm on the ground floor and 50 sqm on the first floor) leads to the difficulty of condensing and organising the functions in such a way that they can communicate with each other but still have the necessary area to carry out their activities.

The most significant element in this perspective is the wall on the ground floor separating the living-dining room from the kitchen, the secondary dining room and the bathroom. It is a two-meter-high masonry element which is equipped on both sides. In front of the dining room, it is provided with shelves which can be useful for storing dishes, and facing the living room, it is equipped with a fireplace and further ledges where the TV and other objects can be placed. On the opposite side, instead, it forms an alcove in which a service cupboard is inserted, functional for both the secondary dining area and the bathroom.

Another furnishing element which, although not integrated into the architectural envelope, participates in the construction of spatiality is the system consisting of the dining area table and the cabinet with shelves perpendicular to it. Furthermore, its structure continues to form the seating support of the three-seater sofa and then a small shelf. The conversation area combines the very simple, square lines of the sofa with a low, round coffee table and two Wassily armchairs by Marcel Breuer.

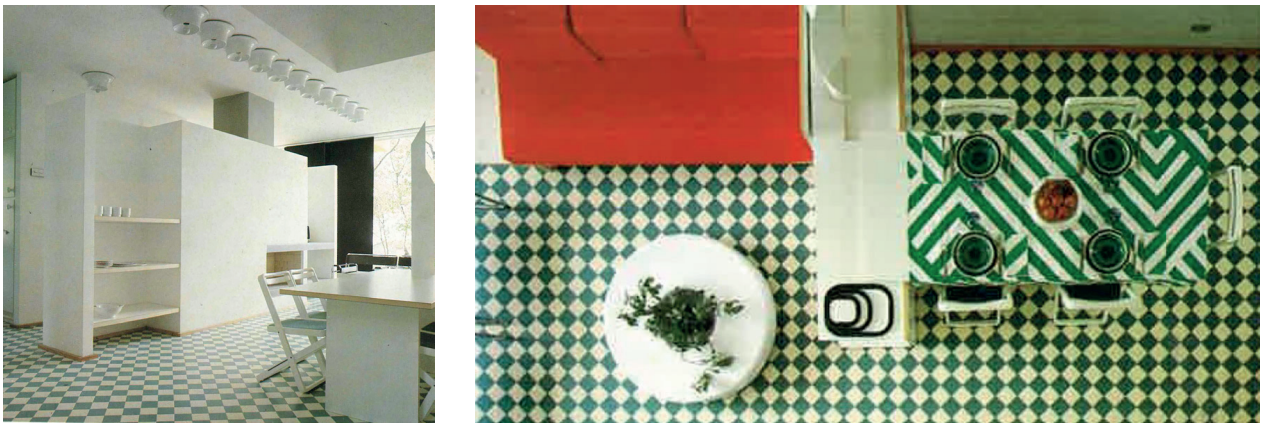

Fig. 4. (a) View of the equipped wall in the living room; (b) Top view of the table-mobile-couch furniture system.

The movable furnishings are thus reduced to the essential and respond to the principle of being light and easily transportable, as can be seen in the folding chairs[d] matched to the dining table, similarly re-proposed

d *Gray* wooden folding chairs produced by Cesare and Eugenio Pozzi of Mariano Comense.

in the secondary dining room together with a table, having metal legs and a square crystal top, placed in the centre of the room and a cupboard unit with wheels that can be transformed into a bed.[e] Equally, the resolution of the kitchen environment starts from reflections on the rather small space available, trying to unite all functions in a single equipped block. Two walls are kept free in order to arrange the French windows which allow access to the portico to the north and the garden to the east. The remaining two walls are used, in one case, to accommodate a full-height cupboard and in the other to house the worktop with wall units. In the centre of the room, a functional block with a hob is arranged, in which the appliances for food preparation are integrated.[f] The monobloc, proposes a centralisation of work, condensing the main kitchen elements into the 130 x 130 cm space.

The logic of essentiality is repeated on the upper floor. The bedrooms are uncluttered and only the bed, bedside tables and some shelves find space there. The wardrobe system is integrated into the architecture: the closet in the master bedroom is joined to the wall partition separating it from the bathroom, creating a walk-in wardrobe, while the dividing element between the bedroom itself and the multi-purpose room is a wall equipped with two double-door wardrobes with a shelf system in between which can be used by both spaces. The aforementioned multifunctional room is furnished with a folding seat combined with a square table, which is also imagined to be foldable, and possibly stowable in the cupboards so that the sofa can be transformed into a bed.[g] To give the environment more privacy when it is used as a bedroom, a folding wall is inserted to screen the space from the hallway and balcony towards the living room on the ground floor.

Salvati and Tresoldi then studied the arrangement of the artificial lighting in such a way as to differentiate the positioning of the light source according to the actions taking place in the environment. The lamp designed by the two architects and used everywhere in the house is the Civenna, a solid generated by the rotation of a circumferential arc, made of white moulded aluminium, from which the bulb protrudes. Except for the ground floor area where the lamps, placed in succession, emphasise the path from the entrance to the south porch and underline the continuity of the environment, in the other spaces they are reduced to a minimum and are positioned, either on the ceiling or on the wall, in such a way as to ensure functional optimisation.

The attention Salvati and Tresoldi pay to the project reaches down to the scale of detail, and even the chromatic choices are weighed. The palette employed is that of concrete artists, i.e. the primary colours, used punctually, as opposed to the monochrome of the wall envelope, thus accentuating the formal interrelationships. Examples of this on the exterior are the yellow and cyan volumes of the staircase and balcony. The same kind of contrast, however, is repeated inside. The walls, treated with plastic plaster, like most of the furniture, predominantly clad in laminate [15], the window frames, made of enamelled steel, and the doors are white. This apparently dominant clarity is punctuated by chromatic details that act either as a reminder between one space and another or as centralisers of attention. It could be argued that, for the first function, the tonal colours of light blue are used to create a calm and reassuring atmosphere spread throughout the various environments, while for the second, the timbral colours of red and yellow are used as visual shock points that urge attention. We thus see the introduction of two atmospheric generators [16]: the first group includes the light blue and white chequerboard of the square glazed ceramic tiles that make up the floor of the entire dwelling, without any distinction between outside and inside, service and non-service areas, which are also used as wall coverings in the bathrooms and kitchen, corroborating the sense of environmental continuity sought by the two architects. The colour light blue is then used for the upholstery of the folding chairs and, in a darker shade, for the sanitary fittings in both bathrooms. The second group includes, on the ground floor, the red sofa in the living room, the yellow wardrobe-bed in the secondary dining room, the tablecloth with white and green oblique stripes in the dining area, while on the

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e It is the *Armadio-letto* (wardrobe-bed), belonging to the series of transformable furniture designed for Campeggi in 1969.

f This element arose from the collaboration between the two architects and the RB company between 1963 and 1964 to design a kitchen that would comply with the latest European production of matching appliances, thus extending its depth and using a new 60 cm module. In 1969, the *Kitchen-block Center*, from the Rossana series, was produced and exhibited at Eurodomus in Turin [13].

g It is the *Diletto*, i.e. a sofa-bed, designed in 1969 for the convertible series and produced by Campeggi [14].

first floor, the red sofa-bed as well as the respective folding wall and the bedspread in the master bedroom, again with oblique stripes in alternating shades of red and white.

3.5. Art intervention

The use of colours is not the only tool that Salvati and Tresoldi use to give a particular atmosphere or induce a specific perception of space. They include in the house a painting by Nilde Carabba and two sculptures by Thea Vallé. There is no evidence of whether the two artists intervened during the design of the space or whether they were called upon afterwards, but their works undoubtedly have a perceptive impact on the environment.

Carabba's work is a square canvas on which a series of six centripetal circumferences cut by lines that trace the axes and diagonals of the square, stopping on the smallest circumference, in the centre of the canvas, is drawn in brown. Some of the sections derived from the various sectors of the circumference are smeared blue – the others are left white – activating the perception of a centrifugal expansion of the circles.

Vallé's sculptures, on the other hand, a smaller one inside and a larger one outside, are monochromatic volumes composed from the surface of an isosceles triangle, which is flexed at various points. Despite being completely white, these artworks manage to have a particular visual effect given by the incidence of light breaking on the enamelled metal.

Beyond the meaning contained in each work, their importance derives from the interrelation they create with each other and with the space in which they are placed. Carabba's painting is positioned on the west wall at the dining table, and precisely at a height where its left vertex, at the top, matches the edge of the connection between the extrados of the first-floor slab and the side wall. Vallé's sculpture – the smaller one – is instead positioned above the shelf perpendicular to the dining table, with the vertex of the triangle pointing straight towards the centre of Carabba's painting. What the two works suggest through their choral interaction in the environment is a precise perceptive modality of spatial fruition: the vertical progression of the sculpture urges the eye to look upwards in an environment that develops at full height; the eye "captures" Carabba's painting, which in turn anticipates the expansion that the architectural volume undergoes as it expands on the upper floor, not only vertically but also horizontally. Interestingly, when Salvati and Tresoldi decide to bring more light into the dining-living area, they conceive a new opening and give it a circular shape.

Fig. 5. (a) View of the living room with painting by Nilde Carabba and sculpture by Thea Vallé; (b) Thea Vallé's sculpture; (c) View of the exterior with sculpture by Thea Vallé.

The large, glazed porthole, although in a slightly different position, more centred with the dining table area, actually replaces Carabba's painting. It could therefore be assumed that the latter is the inspiring

intertext for this new window. The reference between the two is not only formal but also perceptual because, just as the painting, through its fields of colour, suggests the theme of expansion in an abstract manner, the porthole concretises it by letting the gaze go beyond the wall, towards nature and the slopes behind. As for Vallé's second sculpture, it is placed outside, in the garden in front of the south front, almost at the edge of the declivity on the west side of the property. With its sharp, contoured profile and its whiteness, it contrasts with the organic forms and the green of the olive trees in which it is immersed, and acts as a sort of signal between the two villas, being placed about halfway between them.

4. Conclusion

The perspicacity of the two architects lies in the fact that they have always had a glance towards the future and novelty: "We are for overcoming the architecture of rationality for an architecture of fantasy, for a design that formalises a more complex assumption, organises living, organises the interior spaces of dwellings with new shapes and colours, seeking the new comfort" [13].

Emerging in this statement is one of the cardinal principles of Salvati and Tresoldi's work, also found in the design of the Twin Villas, namely how the correlation between forms, colours and space is consubstantial to the architectural design of living. And this is the main reason why this project was chosen to be analysed as an emblematic interior of an artistic synthesis. The investigations conducted have also made it possible to identify more precisely which declinations of the synthesis "animate" the space [17]. The two architects conceive the villas independently, without the intervention of an artist. They study the articulation of the volumes and how to combine the use of elementary forms with primary colours in the balcony, the staircase, the graphic composition of the east elevation, or in the interior cladding rather than the furniture elements. To do this, however, they adopt an approach to design that has much to do with the pictorial method used by concrete artists [18]. In this sense, therefore, the type of synthesis that emerges depends on the architects' ability to have introjected the artist's creative process, a synthesis in which disciplines are fused in the design process of creation [19].

The works of Carabba and Vallé, on the other hand, testify to a different version of the relationship between the arts and architecture. First of all, the artists are probably called upon when the project is completed, so they do not conceive their works alongside the architect. Although they work autonomously, it is however evident how much their reasoning starts from the search for an understanding of the connection between their intervention and the already characterised space of the architecture and, at the time of their insertion into the villas, of the reciprocal correlation between their works and the architectural volume. It is these reflections that make the installation of the artworks in space an added value for the architectural project, the integration of which is capable of producing effects in the perception of space [20]. If in this case it seems to be the architecture that dominates, while the painting and sculpture a posteriori implement its meaning, observing the exterior of the villas, their sculptural aspect given by the particular formal and volumetric "modelling" accentuated by the use of colour is manifest. One could almost associate the dwellings with a poetic vision in which two works of architecture-sculpture inhabit the olive garden in Toscolano Maderno.

Acknowledgements

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SOLIDARITY HOME DESIGN IN THE SERVICE OF SOCIAL SUSTAINABILITY

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Abstract
In addition to economic and environmental sustainability, social sustainability is appearing more and more prominently as a research topic. While this investigation demonstrates ways in which the first two might serve the latter, it is rather difficult to find a clear definition of social sustainability. [1]
More evident are the unsustainable consequences of the income conditions of today's Hungarian society. Broad populations do not have access to basic services. So, for example, they do not receive adequate health care, or very often drop out of the education system prematurely. As a consequence, they are unable to acquire skills that would ensure them access to work and thus to an adequate income. In the absence of adequate income, the creation of decent housing is also a serious challenge. However, among the services provided by local homeless organizations, basic options such as long-term housing for married couples, people in civil partnership, and families are missing. That is why many people do not appear in the homeless statistics, because instead of using the services of homeless care, they try to manage their housing on their own. [2] Despite this, they very often fail to create the conditions for decent, safe, durable and sustainable housing.
This research addresses this social context partly through the lens of circular economy as a means to environmental sustainability. The investigation further proposes a definition of social sustainability as an outcome of the planning, design and building research. Ultimately a team of researchers, students, citizens and unhoused residents created a durable, protected living space that both takes into account the needs and possibilities of its occupants while being suitable for them to maintain the home independently.
The article also presents the planning process of the implemented temporary shelter, the realization of circular economy from design through construction and the family's participation across the entirety of these processes. Finally, the investigation shows how minimizing waste produced in the difficult-to-sustain consumer society itself can contribute to the alleviation of social inequalities through the noble framework of solidarity.

Key Words: *sustainability; social sustainability; homelessness; circular economy; solidarity architecture*

1. Introduction; THE CIRCULAR ECONOMY OF PEOPLE IN NEED

Many studies have already dealt with the effects of favela architecture on the environment. It is generally believed that the residences created here pose a significantly lower burden and pollution on the environment than investments that take into account building codes and local regulations. [3] People who build in this way are not only forced out of the housing market, they also do not have access to modern building materials, and they cannot afford the services of architects. At the World Congress of Architects held in Copenhagen in 2023, the closing, summarizing document concluding the meeting was about this, among other things. [4]

Due to their financial means and low consumption the residents of the gardens around Pécs pollute the environment to a much lesser extent than those with higher incomes, especially. Although out of compulsion, many services of the consumer society are rejected. They reduce their consumption, most of the time only to the necessary minimum, they reuse many materials that they can repair, and instead of new construction, they very often renovate and recycle the existing elements of the built environment [5]. Participating in Recycling is perhaps the weakest of the 10 R-s of the circular economy [6]. Probably because they are not financially interested in this, they are not required to selectively collect the waste generated during everyday life and transport it to waste yards. This may change with the deposit fee system that is now being introduced.

A deposit fee of HUF 50 (13 Euro cents) per bottle can be enough motivation to make empty beverage bottles and cans disappear from the streets, squares, parks and continue their life cycle in processing plants instead of landfills.

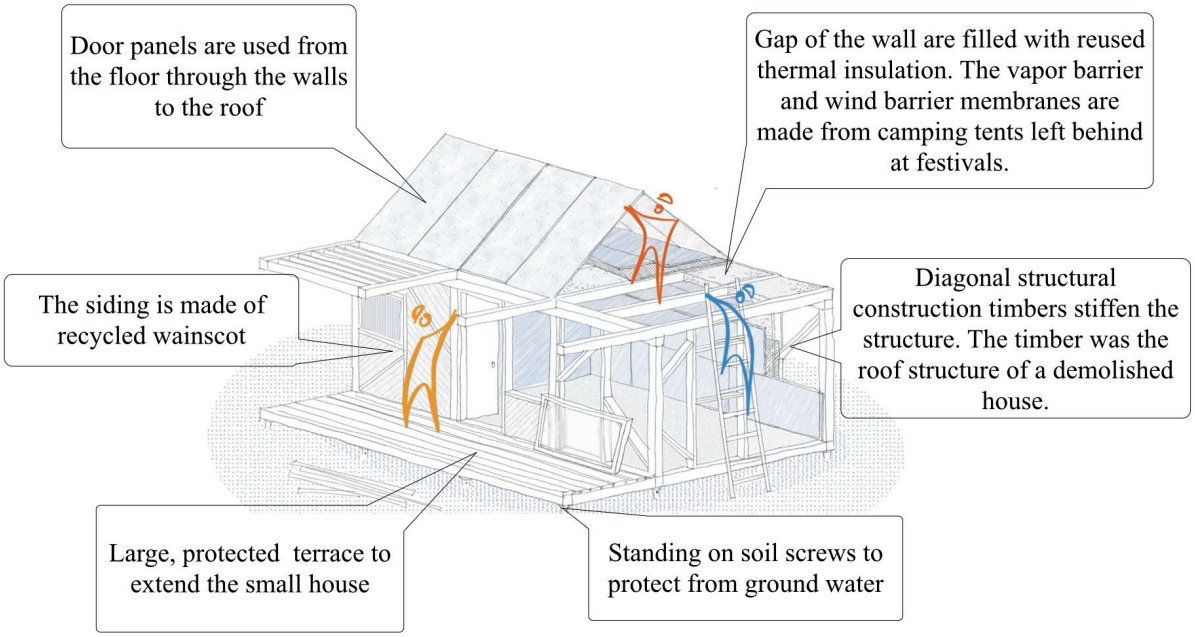

Fig. 1. Design principles

The homeless people in the Pécs area that I studied together with social psychologist researchers earlier 2023 seek shelter in gardens rented from the local government. The most common reasons for not going to a homeless shelter are the lack of intimacy, frequent conflicts with the residents, and the fact that the homeless care system does not offer a long-term solution for families and couples. Those who are more skilled here in the gardens build shelters themselves - mostly from found building materials. But, of course, there are also those who do not have the necessary skills and tools for this, so they can only use what they find ready, such as garden tool sheds.

2. LIFE SPACE DESIGNED BY STUDENTS

The task of architecture is to pay attention to all members of society, especially those in need. We can't leave anyone behind. This was precisely one of the main objectives of this project, to find - with the involvement of university students - sustainable architectural solutions for people living in an extremely serious housing crisis, and also to build it with the involvement of students, in voluntary work.

The family in this study had like others in Szigeti Tanya moved into a garden tool shed in the spring of 2023, but they were unable to make it livable on their own. Organized by the Research Group for Solidarity in Architecture of the Faculty of Engineering and Information Technology of the University of Pécs, the voluntary program was realized with the participation of students from several faculties, in the framework of which we built a shelter for them taking into account the principles of the circular economy.

The cottage was designed by three students, see Fig.1. In the first phase of the planning, they got to know the family living here, their way of life, the conditions and the possibilities available to us. Construction of structures is permitted on this plot owned by the municipality, but only if they can be easily dismantled. That is why there was a great offer of 12 pieces of 160 cm long soil screws from the company Talajcsavar (talajcsavar.hu). This technology allowed us to not have to make a concrete foundation that is difficult to

remove at the end of the lifecycle of the building. The number of family members living on this plot changes quite dynamically. In addition to Á and T, who are in their sixties and live in a civil partnership, one of their children or their partner spends more or less time with them. In terms of planning, this meant that living space had to be designed for two permanent residents and one or two temporary residents.

Before preparing the concrete plans, the students also got to know the construction technologies of the shelters in the area, and the first plans were already based on their inspiration. One of the most skillful residents of the neighborhood is L, who builds structures in his garden from old door panels, see Fig.2. Structures with a module system that follows the size of the door panels are stable structures that can be built efficiently and quickly, which can be easily expanded due to their modular dimensions. However, its big shortcoming is that the walls are not thermally insulated, so they need to be improved energetically.

The project did not have the objective of following the regulations in force for residential buildings. The goal was to create a space suitable for human habitation that does not get wet either through the roof or through the floor. What keeps the heat in, the wind doesn't howl through it where it's light enough, because the sun shines through the windows of the right size.

The image of the completed building partly reflects the original ideas and the continuous adaptation to changing conditions. It often happened that we did not receive the material as a donation that we expected, perhaps not as much as we expected, or not when it was needed.

Fig. 2. Self-made house, made of door panels, covered with PVC sheets and plastic shutter

3. ORIGIN OF BUILDING MATERIALS

All significant ingredients came to the building as a result of a collection announced in a Facebook post. Thanks to the generous offer of company Talajcsavar, a professional foundation could be prepared. During

the entire construction, this was the only case where a new building material was used in its original function. With the use of ground screws, we could design the structure raised from the ground, so there was no need for insulation against soil moisture, see Fig.3.

The original plans changed frequently and constantly, depending on what material was received from donors. The frame of the building was provided by pieces of the roof structure of a residential building demolished years ago. The frame of the house follows the statics and structural logic of Fachwerk buildings. In order to strengthen it, we covered it with planar elements, which we received from different donors:

In the lower plane of the floor, we placed the chipboards of a dismantled bathroom display area of a DIY store, and on top, for stronger load-bearing capacity, there are door wings in two layers, perpendicular to each other. These are dimensionally incorrect door panels that were not accepted by the customers and were collected in the distributor's warehouse.

The chip boards that strengthen the rigidity against horizontal forces were placed on the inside of the walls, also from the dismantled sample bathrooms of the DIY store. Lacquered wainscoting that became unnecessary during the renovation of a Pécs cultural institution was added to the exterior surface of the walls, see Fig.4.

The low sloped roof was covered with the same wainscoting at the bottom, and at the top we also placed the door panels with incorrect dimensions, but unlike the floor - due to the different loads - only in one layer.

Fig. 3. The framework of the new building was made from old roof timber, lifted from the ground and attached to soil screws. The space between the beams were filled with leftover thermal insulation.

A vapor barrier and wind barrier film was used under the covers, and the gap was filled with leftover insulating material from various donors. The vapor barrier and windproof membranes were created from camping tents left behind at summer festivals. In the interior, the walls were covered with modular floor mats from an exhibition installation and re-used laminate floors from renovations. We glued the remaining PVC

covering from the demolition to the floor and folded it up to a height of 10 cm on the walls for easier cleaning. The building's modern wooden doors and windows with insulated glazing were donated by one of the city hotels under renovation. The low-pitched roof was covered with an expired bituminous sheet from a building materials store. A slightly rusty rain gutter removed from an outbuilding can feel useful here for quite a few more years.

Fig. 4. Fachwerk framework filled with reused wainscoting and heat insulation. The window came from a hotel under refurbishment.

4. THE MINIMUM LEVEL OF OFF-GRID COMFORT (NOT-A-HOUSE, BUT HOME)

An important part of the project was to ensure the residents' minimum comfort in an environment where there is no piped drinking water, piped natural gas, or electricity. There is a drilled well on the property, the water of which is used not only by the family living here, but also by the people in the neighborhood who are not so lucky to have their own well on their property. The family members had no information about the quality of the water, so our colleagues from the university's department of environmental engineering inspected it and determined that it was suitable for human consumption.

The lack of electricity was mostly a problem in the operation of mobile phones. They had to go to a public place with an accessible socket with the dead devices. They used candles and lamps powered by AA type batteries for lighting, but it often happened that they did not have the money to buy new batteries, and the use of AA type batteries caused an unreasonably high environmental impact, see Fig. 5. The solution was provided by two used solar panels dismantled from our university. The system put together by construction engineering colleagues charges a high-performance car battery received as a donation, which can even be used to operate a small camping cooler box in the summer. In addition, it is suitable for lighting, charging

phones and powering all devices that we would use at a campsite.

The family uses a gas stove for cooking. The hot water needed for dishwashing, washing and cleaning is also produced using it. Hygiene includes the yard latrine.

For heating, we placed the family's old wood-burning stove in the center of the building. We used non-combustible cladding on the wall around it and non-combustible thermal insulation inside the wall. To avoid the fatal consequences of possible incomplete combustion, we placed an alarm device measuring the carbon monoxide content in the interior. Despite the fact that the building cannot be considered a residential building, we tried to design structures that ensure the minimum comfort. Thus, for example, the thermal insulation value of the walls (disregarding the heat loss along the edges) meets the regulations for residential buildings in Hungary, see Table 1.

Table. 1. The calculated thermal insulation capacity of the walls meets the standards in force in Hungary (0,24 W/m^{2}K)

wainscoting	2cm	λ=0,29
mineral fiber insulation	14cm	λ=0,036
chipboard	2cm	λ=0,19
U = **0,235** W/m2K λfa = 0,29 *W/mK* , Ufa = 0,29 / 0,02 = 14,5 *W/m2K* $\lambda kőzetgyapot$ = 0,036 *W/mK* , Ukőzetgyapot = 0,036 / 0,14 = 0,257 *W/m2K* $\lambda faforgács$ = 0,16 *W/mK* , Ufaforgács = 0,16 / 0,02 = 8 *W/m2K* U = 1 / (1/hi + 1/Ufa + 1/$Ukőzetgyapot$ + 1/$Ufaforgács$ + 1/he) = 1 / (1/23 + 1/14,5 + 1/0,257 + 1/8 + 1/8) = 0,235 *W/m2K*		

lives and was finished with donated curtains and carpets that contribute to increasing the feeling of warmth.

Fig. 5. Lighting with candles before installing the solar panels

5.Conclusion

The changes often referred to as "economic development" in many areas (e.g. environmental protection, social inequalities) appear not only as progress, but as regression in everyday life.

In fact, in most of the garden shelters that neighbor this intervention, development is lacking. There are no available utility services at all. There is no paved road, no piped drinking water and sewage system, no electricity and no piped natural gas. The lack of organized waste collection has the biggest impact on the state of the immediate environment.

In rural Hungary fifty years ago, there was no waste collection, yet the yards were not full of garbage. The rapid spread of economic development particularly since the change of economic regime has resulted in pre-packaged, processed food and plastic packaging has significantly changed the lifestyle of households. The spread of gas stoves instead of solid fuel appliances contributed to this, so the possibility of disposing of combustible materials at home was eliminated.

The response of a society aware of the looming problems to these challenges is the implementation of the idea of economic and environmental sustainability. The small-scale project presented in this study, realized with a broad collaboration, illustrates that it is possible to create a human environment that is socially sustainable on the basis of solidarity. It offers a more humane solution than the currently available options to people living in homelessness and affected by the housing crisis. It is quite certain that the 99 students participating in the program will make decisions as shapers of the future in a sensitive way, in the spirit of social sustainability, whether they are social psychologists, engineers, or architects.

Fig. 6. A living space designed according to the residents' own taste with donated furniture and personal decorations

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"SPATIAL REPRESENTATIONS IN BEHZAD'S MINIATURES: THE MEANING AND EXPRESSION FORMS OF SPACE IN IRANIAN ART"

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Abstract

In Iranian miniatures, there are many visual features, and space is one of the significant and attention-grabbing characteristics of this art. Iranian artists have employed various visual arrangements to create this atmosphere and achieve the desired outcome. In this study, alongside examining and introducing a sample space, the creation process, other types of spaces, and their presence within the "Herat" painting school are discussed, focusing on a selection of works by Kamaluddin Behzad. Renowned artists like Kamaluddin Behzad made significant advancements in the art of painting towards the end of the 15th century, closely related to architecture. Artists began depicting the architectural structures and embellishments surrounding grand and magnificent buildings, indicating a strong connection between painting and architecture. During this period, symmetry was avoided, allowing artists to visualize and depict different spaces. In the works of artists from this period, including Kamaluddin Behzad, space is both two-dimensional and has depth; it is both complete and discontinuous among elements. Each part of the space is specific and often the site of independent events. The selected works discuss the creation of different types of spaces through expressive and emotional lines and colorful surfaces. The study introduces the Herat school and examines the concept of space and its types in Behzad's selected works.

Key Words: *Architecture, Herat Style, Kemalludin Behzad, Miniature*

1. Introduction

The exploration of traditional architecture in Iran, particularly predating the Safavid era, presents a challenge due to the scarcity of remaining structures from that period. Urban areas and architectural works have been lost over time, leaving only a few remnants for study [7]. Historical and literary sources in Iran offer limited insights into the architecture of this era, further complicating our understanding of spatial use, architectural principles, and behavioral patterns. However, Iranian miniatures emerge as a pivotal resource, providing a visual narrative of past events and representing both real and imaginary worlds [3]. Miniatures offer a unique perspective that written texts cannot fully capture, making them indispensable in architectural history studies. Despite variations in types and qualities, miniatures serve as significant historical documents, highlighting the importance of visual sources in the absence of written records [6].

In parallel, Iranian art exhibits distinctive characteristics, often drawing inspiration from Persian poetry infused with mysticism. These paintings depict diverse spaces and events simultaneously, resembling storytelling and expanding the visual realm. This feature is evident across Iranian painting schools, including the renowned Herat school, where subtle variations in composition and spatial qualities contribute to the evolution of artistic expression over time. Understanding the Iranian artist's approach to space creation and the portrayal of idealized, mystical realms in paintings can enrich our comprehension of Iranian art. By delving into the construction of imaginary spaces and the fusion of architectural elements, particularly within the Herat school exemplified by the rare artist Kemaladdin Behzad, this research aims to shed light on the intricate relationship between architecture and art in Iranian cultural heritage [5].

2. Methods

As an important visual document to examine Iranian architectural history, three works of Kamal al-Din Behzad are considered. In this context, a focused analysis will be conducted on the works of the renowned Iranian painter Behzad, particularly in association with architectural structures from the Timurid era. The architectural details frequently observed in Behzad's paintings draw attention to the mosques, palaces, and baths of the period. This research will undertake an analysis of selected examples from Behzad's works,

namely "Begging at the Mosque Door" from Saadi's Bustan in the Egypt Library, "Harun al-Rashid with the Barber" from Ganjavi's Askeri Beşlisi, and "The Flight of Joseph from Zuleikha" from 15th century Herat. These artworks represent significant architectural structures of the era, with a focus on spaces such as mosques, palaces, and baths. The study will commence with the analysis of architectural structures depicted in the selected works of Behzad, followed by a detailed examination of the spatial arrangements. Subsequently, the functions and symbolic meanings of architectural elements in both interior and exterior spaces will be explored. Further steps will involve the examination of decorative elements, perspective, and the use of color in these artworks.

3.The Herat Style and KAMALLUDDIN BEHZAD

The Timurid period of miniature art in the 15th century stands out as one of the brightest periods in the history of miniature art. During this era, new values emerged that were not seen in previous artworks. The Herat School made impressive progress, combining the evolution of the Ilkhanid School experiences with new features of Gothic art. Under the reigns of Shahrukh and Baysonqor, miniatures gained distinctive characteristics. Shahrukh established a workshop and directed painters to depict historical texts. After becoming the ruler of Herat, Baysonqor Mirza established a large library-workshop in his city and gathered leading masters to his palace. In this school, miniature painting, illumination, and bookbinding reached their peak. Among the features of this school are differences in the precision and delicacy of painters' works, the diversity and harmony of colors, the use of gold color, and the covering of the background with vegetation and white color [14]. The most famous painter of this period is Kamal al-Din Behzad, who often rejected past beliefs and transferred the art of Herat painters to the Safavid period. Behzad, born around the mid-15th century, grew up under the supervision of the Great Master Mirak. When we look at the origins of Behzad's mastery, it is clearly seen in his work depicting flowers in Saadi's Gulistan, found in the Durham University Library. Behzad was one of the rare Iranian painters who signed his name on his works [23].

One significant characteristic of traditional Iranian painting is its connection to architecture, and it is possible to find and explain examples of this connection using semiotic science. There are many similarities between the spatial arrangement in paintings and the visual features in Iranian miniature art. Gardens and contemporary structures commonly depicted in paintings hold significant places in contemporary Iranian architectural history [16]. Among other notable examples, the similarity in recurring elements in the overall volume and appearance of structures can be counted, which shapes the general composition of the structures and is sometimes used abstractly in painting. However, one of the most important similarities is the very harmonious and similar use of basic principles of beauty such as "color," "composition," "detailing," and most importantly "proportions"; this means that even an observer not very familiar with the history of Iranian art can trace back to the common origins of these two art forms based on these similarities. Examining Iranian miniature art is important in providing surprising answers to questions about the nature of art and understanding art pieces, as after many challenges and research, understanding the nature and artistic achievements of these works is remarkable. These works are composed of a synthesis between imagination, symbolism, and a blend of concreteness and abstraction [15].

4. Harmony between Architecture and Miniature Art

An important characteristic of traditional Iranian painting is its harmony with architecture, and it is possible to find and explain examples of this harmony using the science of semiotics. Creating space in Iranian painting and miniature art is one of the significant visual features. Among the spaces commonly depicted in paintings are gardens and domed structures, which constitute an important part of contemporary Iranian architecture [4]. Another important example is the similar use of architectural elements and features, which shape the overall volume and appearance of structures and can be used concretely or abstractly in the art of painting. However, one of the most important aspects of harmony is the consistent and similar use of fundamental principles of beauty such as "color," "composition," "detail work," and most importantly, "proportions"; this means that even an observer less familiar with Iranian art history could infer from these

similarities the shared origins of these two arts [19].

5. Analysis of Works

The purpose of Iranian miniatures is to create a spiritual, divine, and ideal environment in painting. Different areas such as colored areas, concurrent areas, and low-depth areas aim to change the elements of the artist to create depth perception. There are different types of areas such as full and empty spaces or ornamented and unornamented spaces. The aim is to first show positive elements and then negative areas and to emphasize visual emphasis on them. It is possible to observe these various types of areas in the following works.

During Iran's Safavid period, the peak and grandeur of Iranian painting art were experienced, and one of the leading painters of this period was Kamal al-Din Behzad. Painters often depicted their own architectural environments and reflected local architectural elements and spaces in their works. The miniature artist typically used real and concrete spaces as models [13]. By comparing traditional paintings with architecture and analysing the data, notable points of harmony and convergence between these arts emerge, particularly the influence of architectural elements on the art of painting. Some of the characteristics include great importance given to details and patterns, the use of decorations and decorative arts, especially from plant and animal motifs to abstract patterns, the use of Islamic motifs, and the use of similar colors such as turquoise, lapis lazuli, yellow, brown, dark green, and earth tones, the use of the golden ratio, geometric patterns, symmetry, and centrality [1].

There is not much information about the baths of the Timurid period. An example of a bathhouse dating back to the ninth century was found in excavations around Balkh, indicating the existence of bathhouses from this period. When Timurid bathhouses in Iran are mentioned, examples such as the Khosrow Agha Bathhouse in Isfahan and the Shah Reza Bathhouse in Mashhad can be given. Additionally, the Shah Bathhouse in Mashhad has survived to the present day with additions from the Safavid period. Monochrome tiles, mosaic tiles, seven-colour tiles, gold tiles, and combinations of brick were generally used in the decorations of bathhouses from this period, often utilizing turquoise colour. One of the prominent works in this regard is known as the "Harun al-Rashid in the Bathhouse" painting. This painting, made for Nizami's poem "Harun al-Rashid and the Barber" in the year 15ths century, is located in the storage of the Al-Asr. The painting depicts all the activities inside and outside the bathhouse; from the barber washing the owner's back to the person drying customers' feet, from towels hanging on hooks to the person pulling down towels with a plank in hand. Eleven people take part in this painting [2] [17]. The manners and traditions reflecting the atmosphere of the bathhouse are seen in this painting. Additionally, although there is illumination in the painting, the source of light is uncertain. Cold and warm colours are compared for the depth effect. Therefore, it is said that when considering Behzad's efforts in this regard, the first steps were taken to create realism (some of which have not yet departed from literature). All the features and elements of Islamic period bathhouses are regularly included in this painting. After entering the bathhouse, one enters the dressing room and reaches the heating room after the blue-coloured entrance [10].

Fig. 1. Kamalludin Behzad's "Harun al-Rashid and the Barber" is from Nizami Ganjavi's quintet work, 1489. (Url 1)

In this painting, the observer is depicted as if they have passed through the entrance and entered the building, accessing the areas within. Behzad seems to have created a cross-section to place people and activities within the viewer's field of vision and to eliminate obstructive walls. Considering the removed walls, it can be determined that the painting is octagonal in shape. Seating areas and shelves for clothes are shown at the end and left side of this area. The clothes and crown of Harun al-Rashid are placed on the last clothing shelf, indicating their placement on the shelf [12]. The floor of this bathhouse, like in other bathhouses, is covered with marble stones. These marble stones are assembled in hexagonal patterns. Timur was a leader who took the first steps and declared his city of Kesh as his capital, giving it the name "Green City." The White Palace (also known as Aq Saray or Khaneh Sefid), built in this city, was one of the magnificent structures, with only the ruins of an entrance remaining today. Since residential architecture in Iran before the Safavid period is limited to rare examples, works like this one serves as valuable visual documents of such architectural structures [9].

Yusuf and Zuleikha, one of Behzad's most important works, is a structure encompassing all the features of a Timurid palace or mansion. In the philosophy of house or palace construction, preserving privacy is a crucial issue in Islamic thought. This focus is clearly stated in the Quran, as in Surah An-Nur, verse 27: "O you who have believed, do not enter houses other than your own houses until you ascertain welcome and greet their inhabitants. That is best for you; perhaps you will be reminded." Islamic architecture, as a clear response to this divine law, makes a clear distinction between the interior and exterior, and the "entrance" is a prominent sign of this inward-oriented architecture, demonstrating the value of privacy. Islamic societies' architecture provides an open response to this religious-social environment by making a clear distinction between the interior and exterior, and therefore, the "entrance" clearly emphasizes inward-oriented architecture and highlights the importance of privacy in Islamic societies. As expected, Islamic and especially Iranian architecture is always inward-oriented, and therefore, while interior spaces are decorated,

exterior spaces are designed quite simply. From this painting, we can deduce the general form of Timurid palaces. Palaces from this period are generally three-storied, with entry through the courtyard leading to the first floor, followed by stairs to the second and third floors. The most intricate and eye-catching architectural embellishments are typically found on the third floor. A part of the courtyard is located on the third floor of the building, and in this painting, we witness an event taking place on this floor [20].

In Iranian painting, especially starting from the Herat school and Behzad's works, visual artworks frequently exhibit a kind of metaphorical and symbolic narrative through the symbolic use of colours. In terms of colouring, the artist has employed the contrast of complementary colours quite effectively in this work. The emerald and blue colours in the artwork depict the noble atmosphere of the palace. Joseph's garments, according to his inherent beliefs and faith, are painted in the spiritually significant light green colour, which encompasses the highest Sufi meanings, while Zuleika's garments are painted in the passionate red colour (the only warm colour in the painting), considered symbolically significant as it is associated with the planet Mars, symbolizing the turbulent world, war, and the sign of struggle, revolution, and rebellion. To represent Joseph's inner world and beliefs, two pale-coloured doors are vertically placed. The fire around Joseph's head is depicted in a golden or yellow colour, which is considered an auspicious colour and interpreted as light in Sufism [23].

Fig. 2. Kemalludin Behzad's, “The Escape of Joseph from Zuleikha" from Saadi's Bustan, Herat, 1487. (Url 2)

Among Behzad's works, the miniature "Begging at the Mosque Gate" showcases a more prominent architectural setting. In this artwork, the structural features, decorations, and beliefs influencing the mosque architecture of the Timurid period are appropriately depicted. The interior and exterior of the mosque are displayed in a single view in this artwork; the mosque entrance is entirely designed according to the

architectural features of this period, with intricately designed arches, decorations related to the entrance courtyard, which are in harmony with the narrative [18]. At the mosque entrance, five and seven types of domes are used inward from the courtyard, which can be observed in all buildings of the Timurid period. In this miniature, the mosque has an area where a domed courtyard terminates with an balcony, and education and teaching take place here. Particularly around the balcony, wooden-columned porticos placed on stone columns and decorated capital stones can be observed. Mosaic tiles are placed over the domed spaces, surrounding the balconies and panels [11].

In this miniature, Behzad brings extraordinary scenes to life and showcases his unique style, particularly emphasizing the importance of details. A complete view of buildings with a courtyard surrounded by a street was widely used in the first half of the fifteenth century. However, Behzad did not settle for depicting the existing structure but instead expanded the layout of elements. In this miniature, almost an entire mosque complex is depicted, and the complex can be divided into two parts, the exterior and interior of the mosque, over the wall, with the mosque entrance playing a connecting role between these two areas [8].

Behzad creates depth and provides a balanced structure by proportionately reducing human figures and structures, making fine adjustments on how these elements should be placed, while creating a space for other elements such as the pulpit, and avoiding depicting side walls and setting aside the previous pulpit to show the depth of the courtyard. There is a logical relationship between vertical and horizontal lines, and the elements and decorations are carefully placed. The overall composition and spatial arrangement in the miniature can be compared to the "Joseph and Zuleika" miniature in the same manuscript [21].

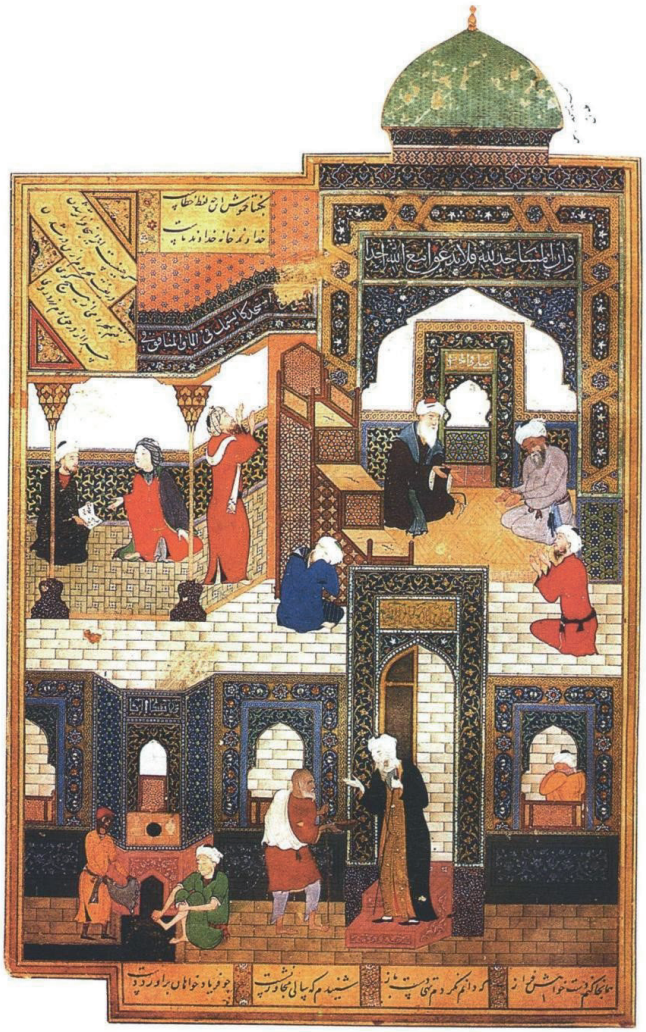

Fig. 3. Kamaleddin Behzad, "Begging at the Mosque Gate," Saadi's Divan, Egypt Library, 1488. (Url 3)

The intricate craftsmanship in wall decorations evokes a sense of distance and proximity, and the application of geometric patterns and ornamentation is emphasized not only as mere decoration but also highlighted on specific surfaces (especially, the pulpit with its entire ornamentation consisting of geometric patterns and warm colours). What contributes to the rich colouring of the buildings is the combination of different colour tones and ample use of gold colour, creating a striking brightness effect. In this miniature, the combination of geometric patterns, floral motifs, and inscriptions is observed, and Behzad successfully depicts the atmosphere of a real mosque space by using geometric patterns more extensively and applying them delicately [11]. The blue tones in the artwork represent tranquillity, simplicity, and the religious context. The blue colour on the walls and doors of the mosque symbolizes worship and spirituality. The green in the beggar's clothes represents hope and life, while the yellow tones express abundance and brightness. The brown and gray tones in the artwork symbolize worldly difficulties and poverty. The brown tones in the beggar's clothes emphasize poverty and hardship. The white tones on the mosque walls express purity and sanctity, while the black tones in the beggar's clothes reflect challenges and darkness. The architectural details in the artwork are depicted in proper scale and proportion with the correct use of perspective. The size of the mosque door and other details convey the scale and breadth of the space to the viewer. The lines and figures in the artwork create a sense of movement that leads the viewer away from the mosque door and towards the outdoor space [22].

6. Conclusion

When analysing Behzad's works, it is observed that he carefully separates structures into private zones in accordance with the rules set by Islam. This helps us understand how these rules were applied in the architectural structures of that period. Kemaluddin Behzad's works stand out as shining examples of this art form. During the Safavid period, Iranian painting underwent significant development and was heavily influenced by architectural elements. Behzad masterfully depicted detailed environmental and traditional architectural elements in his works, often accompanied by embellishments. The interior spaces of baths, palaces, and mosques were captivatingly visualized with the artist's skill. Overall, Iranian miniature art stands out with its choice of colours, emphasis on details, and skilful use of architectural elements. The works of Kemaluddin Behzad, one of the leading representatives of this art, represent the pinnacle of this art form, while Safavid and Timurid period structures constitute an important part of this art's rich heritage. In the three works covered by the research, the vitality and dynamism of the figures are highlighted with intricate details. Colours with a tendency towards blue tones are predominantly used in the paintings. The presentation of dry and formal compositions, the use of very bright colours, and the introduction of a new spatial concept where both interior and exterior spaces are depicted in a single painting personalize Behzad's works. The use of complementary colours, the lesser use of red family colours replaced by brown tones, the effect of white and black colours, carefully arranged compositions, carpet decorations, and intelligent portrayal of architectural details, all lead to the extensive use of architectural elements in these paintings, driven by a special interest in human figures and their surroundings. Additionally, the establishment of perspective based on the proportions of human figures results in architecture being a prominent feature in the paintings. This research provides a general overview of paintings in architectural history studies and offers an external perspective on this document. Therefore, it will serve as a guide and aid for researchers.

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ARCHITECTURE WITHOUT ARCHITECTURE: INTERIOR DESIGN OF KESE VILLAGE HOUSES

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Abstract
There are architectural structures defined in the literature with different names such as architecture without an architect, vernacular architecture, vernacular architecture, indigenous architecture, rural architecture, etc., which an architect did not build, but by the collaboration of the user and local craftsmen. These buildings, which have not been the focus of architectural studies for a long time, have created a simple, functional, economical, and sustainable architecture in complete harmony with nature, fully responding to people's daily works, built with readily available materials. There are examples of this type of architecture all over the world. In Turkey, it is essential to document the rich examples of architecture without architecture that have emerged under different geographical conditions but are rapidly disappearing and bringing them into the literature. Traditional Ottoman-Turkish houses built during the Ottoman Empire are impressive examples of architecture without architects. It is crucial to identify and preserve traditional vernacular architecture. This study aims to bring an example of traditional houses built by the people and craftsmen in Turkey to the literature. This essay traces how the interior space of a traditional vernacular house in Central Anatolia was formed. Çankırı is where Ottoman-Turkish culture is best preserved because this region has not been invaded and occupied throughout Ottoman history. Therefore, this area has been chosen as the study area. The scope of this study is to examine traditional houses built in Kese Village of Ilgaz district of Çankırı. This study will analyze lifestyle, construction techniques, and material use and how they affect the interior of the room.

Key Words: *architecture without architects, vernacular architecture, cultural heritage, Ottoman-Turkish house, tradiotional house*

1. Introduction

In the historical process, there are architectures in which the architect was not involved and were built by ordinary members of the society on their own. For these structures, which architectural historians ignored for a long time, definitions such as vernacular, indigenous, rural, and anonymous were used. Bernard Rudofsky first used the term architecture without architects in the text he wrote for the catalog with the same title for the *Architecture without Architects* exhibition held at the Museum of Modern Art (MoMA) in New York in 1964-65. In the text, Rudofsky mentions the admirable adaptation to climate and topography in architectural products built by untrained builders. In contrast, he describes contemporary architects as those who make buildings to " conquer" nature. In the exact text, Rudofsky argues that the technical know-how and craftsmanship of the building artisans are a rich source of inspiration for modern architects. In the exhibition catalog, which was later published as a book, he gives a wide range of examples, from floating village houses in China, Italian townhouses, tribal buildings in Sudan, arcaded town squares in Spain, shaded streets in Africa, and food warehouses in Egypt [1].

Architecture without architects refers to non-monumental structures built by societies with their own capabilities, knowledge, and experience. The process that started with primitive huts constructed in the early ages is still being continued today by communities that produce their structures without an architect. When it comes to architecture without an architect, housing is the most common type of building. Housing is one of the first building types built due to the basic human need for shelter and protection. This study discusses the Ottoman-Turkish House, which was formed as architecture without an architect in Anatolia.

The Ottoman-Turkish House is a housing type that was used for about 500 years and emerged in Anatolia, Rumelia, and the Balkans where the Ottoman Empire ruled. Some researchers say that this housing type first appeared in Istanbul and then spread to other Ottoman geographies [2], as well as researchers say that it was first formed in Anatolia and then spread to other regions [3]. The Republic of Turkey, the inheritor of the

Ottoman Empire, and especially Turkish minorities in the Balkans have tried to preserve this housing type. The generally accepted view on how the Ottoman-Turkish house emerged is as follows: Turks, who came to Anatolia as a nomadic society from Central Asia, started to live in the existing Byzantine dwellings here. They then had their own houses built by local craftsmen [4]. Therefore, it is possible to say that the existing housing tradition influenced them. However, it is also seen that they carried the habits of nomadic life to their new dwellings. The Turkish room's interior arrangement, an important component of the Turkish house, is very similar to the interior arrangement of the tent. Another influential factor in the formation of the Turkish house is Islamic culture. With the acceptance of Islam by the Turks, there have been differences in the way of life. These life routines also affected the formation of houses. The Ottoman-Turkish house combines these three elements: the existing building tradition in Anatolia, nomadic culture, and Islamic culture. The Ottoman-Turkish house was formed by gathering rooms around the sofa in various ways.

The houses of a village in Ilgaz district of Çankırı were examined within the scope of this study. The houses, which help us to understand the traditional rural architecture of the Ottoman-Turkish period, which is a product of architecture without architects, are discussed in terms of interior space layouts. The walls, floors, ceilings, doors, windows, cupboards, hearths, and ornaments that make up the interior were examined individually.

2. Two Fundamental Architectural Components of the Ottoman-Turkish House

2.1. Sofa/Hayat

In Ilgaz, our study area, the term "Hayat" is used instead of a sofa. Hayat is the common-use area that provides the relationship between the rooms and connects them to each other. In some examples, the Hayat opens to the outdoors from one side, while in others, it is surrounded by rooms (Fig. 1).

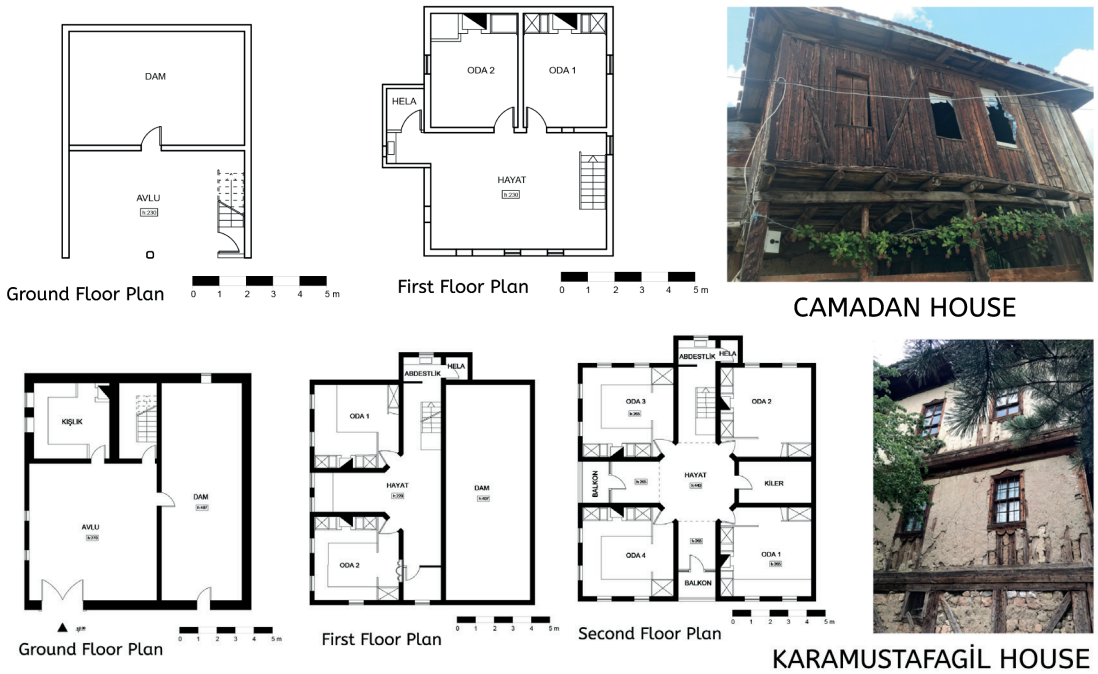

Fig. 1. (a) plan type with outer sofa (Camadan house)[1]; (b) plan type with inner sofa (Karamustafagil house); drawn by the author

Hayat is a transitional space and a functional area where some daily work is done. For example, in some houses, the iwans between the rooms were raised with pavement, and seating areas called sekilik were created (Fig.2). In the sekilik, family members would come together, guests would be entertained, or women could

[1] The house names are named after the family names of the owners.

do their daily work. It is seen that the spaces between the rooms were used as a sekilik, toilet, staircase, or cellar.

Fig. 2. Sekilik (Karamustafagil house)[2]

2.2. The Room

Together with hayat, the room is one of the two fundamental elements of the Ottoman-Turkish house. There is no functional distinction in the Turkish room. Each room is organized to fulfill many different functions. Since there are few fixed equipment in the rooms, the room's interior is suitable for various functions with movable equipment according to the need during the day.

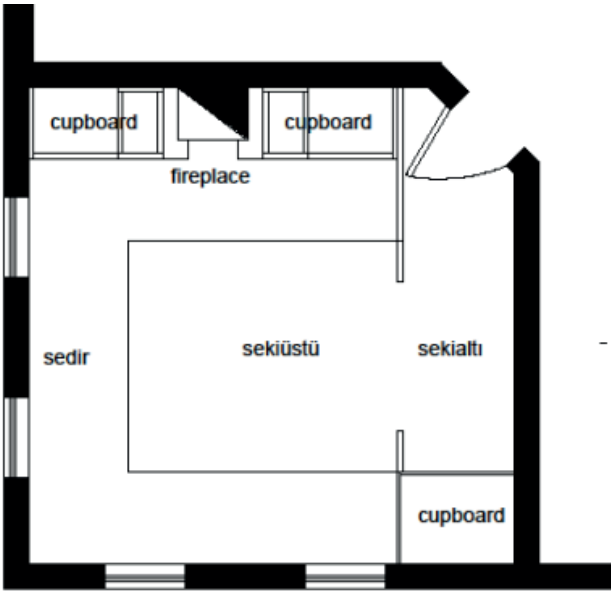

Fig. 3. Room plan (Karamustafagil house); drawn by the author

[2] All photo credits belong to the author

In some houses, the rooms are divided into sekialtı and sekiüstü (Fig. 3). Sekialtı is organized as the room entrance and service area. This area is like a passageway to enter the room. Sekiüstü is the main space and is surrounded by divans and a hearth. There are divans, a fireplace, and cupboards on the sekiüstü. This space has a more elaborate layout. The ceiling and cupboard surfaces are decorated with a decorative program. The wooden vaulted dividers sekialtı and sekiüstü emphasize separating the two spaces.

3. Analysis of the Interior Space Organization of the Ottoman-Turkish House through a Village House in Central Anatolia

3.1. The Wall

The walls were generally built with adobe filling technique between wooden frames (Fig. 4). In rare examples, the space between the wooden posts was also filled with wood. These wooden surfaces were sometimes left open and sometimes covered with plaster.

Fig. 4. (a)Adobe filling technique between wooden frame (Medinegil house); (b) timber infill wall between timber frame (Camadan house)

The wall surfaces are mostly divided by cupboards, fireplaces, windows, and door spaces (Fig. 5). The few surfaces between these elements are painted over plaster. There are plenty of window spaces on the walls facing the exterior of the rooms. It was intended to let in as much light as possible. The hearth and cupboard surfaces on the solid walls, and the walls are almost covered with wood.

Fig. 5. (a) Karamustafagil house; (b) Abuşgil house

3.2. The Ceiling

The more unelaborate the floors are, the more elaborately the ceilings are designed. The ceilings are usually square in plan. Ceiling applications created using different techniques with wooden materials are observed. Open floor ceiling, flat ceiling and caisson ceiling applications were detected. Open floor ceiling is a practice made by leaving the lower surfaces of the beams forming the wooden floor slab exposed. It is seen that the ceilings in very simple rooms are made by leaving the beams exposed without covering them. Flat ceiling: It is obtained by substituting the lower floors of wooden beams with wood. This wooden covering can be decorated by combining wooden slats in different ways. Plain or decorated flat ceilings were applied in more elaborate rooms (Fig. 6).

On the other hand, caisson ceilings are combined with the wall by gradually descending in layers from the sides of the flat ceiling. Different ornaments were applied in the center of the caisson ceilings. Caisson ceilings are seen in the houses of wealthy families due to the high use of materials and the need for mastery.

Fig. 6. (a) . Open floor ceiling; (b) decorated flat ceilings

More detailed and elaborate ceiling application is seen in the "hayat" ceiling of the main floor and the headroom ceiling. Ceilings are one of the most essential decorative surfaces. The most prominent decorative element of the ceilings is the wooden roses. The ceilings are like a display area for the Turks' ability to abstract the forms they saw in nature. Forms such as flowers, stars, and passionflowers are seen in the decoration of wooden roses. The Turks depicted their mystical relationship with the sky and nature on these ceilings. The endlessly repeating motifs also show their relationship with infinity (Fig. 7).

Fig. 7. (a) caisson ceiling; (b) decorated ceiling rose

3.3. The Cupboards

Cupboards are used for different functions. Some cupboards function as loaders where mattresses, blankets, and pillows are stored. Some cupboards are areas where kitchen utensils are stored. One of the most exciting features of the Turkish room is hidden in the cupboards. There are small closets in the rooms where you can take a shower (Fig. 8). When you enter the room, you are surprised when you open the door of these cabinets, which are no different from other wooden surfaces. It is possible to bathe here with the water heated on the fireplace in the room.

Fig. 8. Cupboards next to the fireplace and a washbasin cupboard

These cabinets are called "bucak". The wooden surface formed by the cupboards is formed with fixed parts at the top and bottom and movable parts in the middle up to human height, i.e., cupboard doors. It is seen that the wooden doors were decorated by wealthy homeowners. In this respect, cupboard doors are one of the critical decorative surfaces in the room. There are two or three rows of niche-shaped shelves called "terece" on both sides of the fireplace (Fig.9). There are wooden ornaments created with ajur technique on the surfaces of the terece.

Fig. 9. Wooden cupboard doors and terrace

3.4. The Divans

They surround the room adjacent to the wall, sometimes in one, sometimes in two or three directions (Fig. 10). They are usually 30 cm high and 80-100 cm deep. The divans are made comfortable with cushions, pillows, and covers placed on top. Although the primary function of the divans is sitting, they also fulfill the function of lying down when needed. Guests are entertained on the divans.

Fig. 10. Divans

3.5. The Fireplaces

Fireplaces are architectural elements that fulfill heating and cooking functions in every room. The fireplaces are placed on the central axis of the wall with symmetrical cabinets on both sides (Fig. 11). While in some examples, they are simply solved, in others, they are relatively ornamented. Above the hearth is a protrusion with a wavy form that can also be used as a shelf. The fireplaces and chimneys are built of mudbrick. The surfaces of the fireplaces were plastered and painted white.

Fig. 11. Fireplaces

3.6. The Doors

Each room has a single door that leads to "hayat". Room doors are wooden, single-leaf, and single lintel. The doors are placed in a corner of the room. The room is entered from one corner. When the door is opened,

one enters into the staircase, which is partially covered with a wooden curtain that prevents direct view of the room.

Door leaves are one of the decorative surfaces. The decoration program varies according to the financial situation of the owner. In simple houses, a 5-panel door is formed with horizontal and vertical sashes. In more elaborate doors, the door is decorated with various geometric shapes by interlacing wooden pieces. One of the different examples of doors is the door with a hood (Fig. 12). The entrance is customized with a wooden cover extending downwards from the top of the door.

Fig. 12. (a) 5-panel door; (b) the door is decorated with various geometric shapes; (c) the door with a hood

3.7. The Ornament

Decorations are seen on wooden surfaces. The main decoration areas are cupboard surfaces, wooden separating surfaces, ceilings, doors, window jambs, window lattices, and shelf surfaces [5]. In the ornaments, stylized forms of elements of nature and the sky, such as the sun, moon, stars, flowers, and geometric shapes, are seen. The moon and star forms were especially found to be widely used. The moon and star also found on the flag of the Turks, have been important figures for Turks since ancient times. The ornamentation details are essential in showing the relationship of the people living in these houses with nature and how they kept nature alive in their homes. In addition, the ability of these people to think abstractly and transform this thought into architectural forms is also seen.

Fig. 13. (a) shelf surface; (b) niches; (c) wooden separating surfaces

4. Conclusion

In the Traditional Ottoman-Turkish houses examined in Çankırı region, it was determined that two types of plan typologies, namely outer and inner sofas, were used. These houses were small and medium-sized. In these houses, which are examples of traditional rural architecture, it has been observed that there is no difference from urban houses in terms of interior layout. The difference between the houses in the urban and the countryside is proportional in size, ornamentation, and decoration. There is generally no difference between the house plan and the room plan. Differences occur in the scale of decoration of doors, windows, ceilings, and cabinet surfaces. In the rural examples, it has been observed that a few families with wealthy financial situations pay attention to the ornamentation details of their houses. This shows us that the inhabitants' cultural, economic, and hierarchical status is of little importance in forming the room's interior as an essential feature of the Turkish house; the difference is in proportional size, ornamentation, and decoration.

However, functionality, simplicity, modesty, abstract design/thought, human proportion, and modularity are the prominent concepts in the interior layout. The room is organized to fulfill many functions, such as eating and drinking, living, sleeping, entertaining guests, cooking, and washing. There is no unnecessary equipment in the room. Everything is where it should be and as much as it should be. The most important criterion considered in the creation of these surfaces is human. Cabinets are made as far as the human can reach. The height and depth of the ottoman are determined in the most appropriate way for human proportions. There is a space design that is wide enough to allow the movements and actions of people sitting, eating, working, standing, or sleeping but limited enough to allow necessary space to be used. With all these features, the traditional Ottoman-Turkish house has a unique and vital place in the world of architecture regarding interior organization. This interior arrangement, created about 500-600 years ago by considering concepts such as functionality, simplicity, modesty, abstract design/thought, human proportion, and modularity, has parameters that remain valid today.

It has been established that Traditional architecture without architects buildings is shaped by taking into account the natural and socio-cultural environmental factors, is formed as a result of cultural continuity, and responds to the needs in this way. Architecture without architects constructions in Turkey should be preserved and carried to the future.

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EVALUATION OF ARTIFICIAL LIGHTING CONDITIONS IN ACADEMIC EDUCATION ENVIRONMENTS IN TERMS OF ENERGY EFFICIENCY

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Abstract
Artificial lighting is needed in buildings where natural lighting is not sufficient. Integrated lighting needs must be provided at an optimum level, especially in educational environments. In some educational environments, the need for lighting may become relatively more important depending on its function. Examples of these environments are workshops where architectural education is given. In these environments, it is a necessity to ensure the optimum level of visual comfort of the student. For this reason, the need for lighting should be provided by natural lighting, and artificial lighting should be utilized in cases where it cannot be provided and in the evening hours. In terms of energy efficiency of buildings, artificial lighting design is expected to be made depending on the geometry, dimensions, number of users, transparency ratio, window sizes, equipment layout, etc. of each space in the building. In the standards, the level of illumination required for educational environments is expressed as lux. The type, location and number of luminaires should be determined in accordance with this level of illumination. Studies in the literature draw attention to the fact that the artificial lighting levels of these environments are generally lower than the national standard values and need to be improved. In this context, energy simulation programs are often used in the improvement phase. By means of these programs, the existing environment can be modeled in real conditions, energy consumption due to artificial lighting can be calculated and improvement proposals that will reduce this consumption can be analyzed. In this study, the criteria that are important in optimizing artificial lighting design, especially in terms of energy efficiency and visual comfort, are emphasized and a simulation-based situation determination and improvement study was carried out in workshop environments where architectural education is given. As an academic learning environment, the 37-person IM2 workshop with an area of 9 m x 12 m, 108 m2 and a transparency ratio of 100% on the north and south façades and 70% on the west façade, located in Karadeniz Technical University Faculty of Architecture, was selected. The current state of this workshop volume was modeled in the DesignBuilder program. Scenarios were created by changing the type, location and number of luminaires in order to reduce the energy consumption values obtained from lighting. The energy consumption values of each scenario were compared and the optimum option was proposed. As a result of the study, it was concluded that although fluorescent luminaires are preferred in schools due to their economic value, more than 80% of energy can be saved by reducing the luminaire radius or using LED luminaires with the same radius.

Key Words: *Artificial Lighting, Energy Saving, Learning Environment, Designbuilder, Dynamic energy simulation*

1. Introduction

Lighting is the thoughtful use of light to achieve a functional or attractive effect that can be accomplished by natural or artificial means [1]. The term "lighting" describes the way in which a space or environment is made visible to the human eye, either naturally or artificially. Depending on the requirements of a space, lighting allows light to produce a range of effects [2].

The term "artificial lighting" usually refers to light from an electrically powered source, such as a lamp, bulb or tube, which can be modified to achieve the final effect needed. Artificial lighting used in spaces can be reduced, increased, focused, directed or colored depending on what is needed [3]. Artificial lighting can also be used to systematically delimit spaces, create a sense of ambience and influence the psychology of the users of a particular space or environment. Lighting is an important part of interior design as it can add aesthetic value and create a livable space atmosphere [4].

There are parameters to be considered in interior lighting design. These are glare, light intensity, luminance, brightness and intensity [5]. These parameters and their definitions are shown in Figure 1. The parameters shown in Figure 1 are used to measure the effect of artificial lighting during the interior design phase. Apart from these, the light source (luminaire) that provides artificial lighting has 4 basic qualities that can be changed. These are intensity, color and direction [6].

Artificial lighting fixtures can emit light of different intensity and color depending on the way they are produced. Accordingly, electric light sources, also known as artificial lighting elements, are divided into two main groups that differ according to the processes applied to convert electrical energy into light. One group includes thermal radiators, incandescent lamps and halogen lamps. The second group includes discharge lamps, which comprise a wide variety of light sources such as all types of fluorescent lamps, mercury or sodium discharge lamps and metal halide lamps [7]. These classifications, which are still valid today, can also be shaped according to the function of the spaces in which they are used and the location in which they are used.

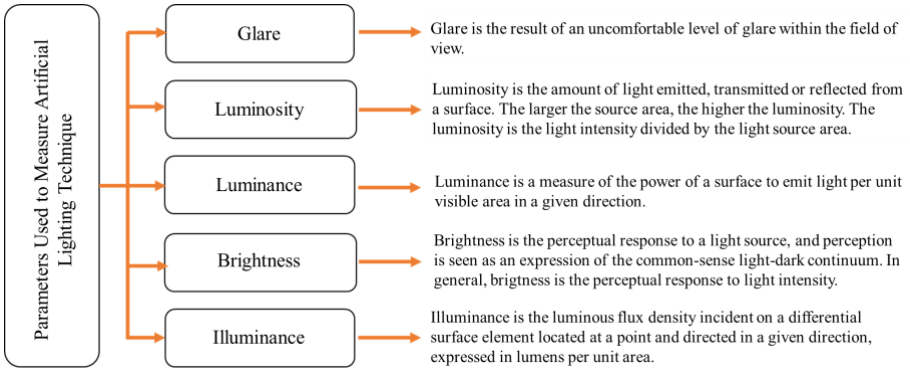


Fig. 1. Parameters and definitions used to measure the effectiveness of artificial lighting [5- 8]

Artificial lighting fixtures can be designed as portable, mounted on a piece of furniture, recessed or surface mounted pendants, recessed or surface mounted recessed skylights or wall mounted [9]. The classification of the lighting fixture according to its location and type in the space is given in Figure 2. These characteristics of artificial lighting fixtures vary according to the function they are used for.

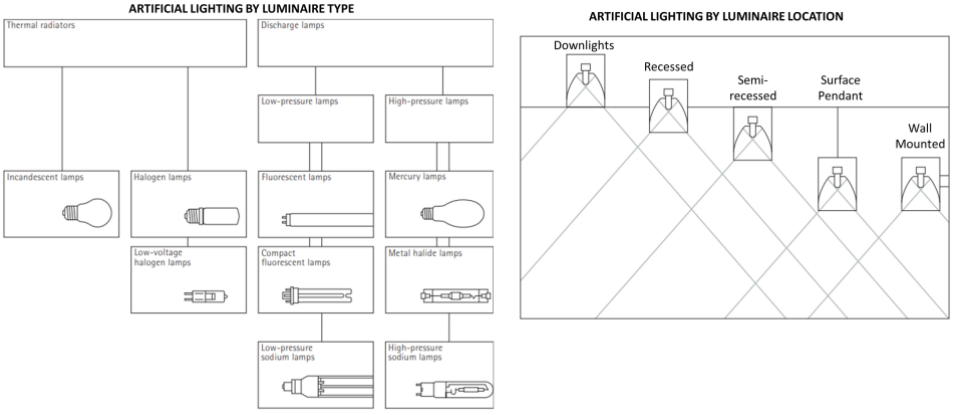


Fig. 2. Classification of artificial lighting by location and type [9]

In terms of lighting, a school is a very complex environment as it consists of many spaces with different uses and therefore different requirements to be met. However, if academic learning environments, which are the learning environments where students and teachers spend the most time and where long hours of education are provided, do not provide the necessary comfort conditions, it causes eye fatigue, restlessness and many other physiological and psychological disorders [10]. For this reason, this study examines the criteria that are important in optimizing the artificial lighting design of academic learning environments, especially in terms of energy efficiency and visual comfort.

1.1. Lighting Standards for Educational Buildings

In Turkey and other countries, there are numerous standards and regulations that include clauses regarding lighting. Typically, these standards revolve around the concept of illuminance, which is defined as “the

luminous flux received by an infinitesimally small portion of a surface surrounding a point on that surface, divided by the area of that portion," with lux (lx) being the unit of measurement. The design of lighting systems should be optimized based on the illuminance levels necessary for the activities conducted in each area of a building. The Illuminating Engineering Society of North America (IESNA) is recognized for setting the benchmark for suitable illuminance values. IESNA issues a detailed Handbook along with Recommended Practice Guides that offer tables of recommended illuminance levels. Nonetheless, for the purposes of this study, it would be more precise to review the specific regulations and standards applicable to the chosen location.

In terms of lighting in Turkey, the most comprehensive standard covering educational buildings is "TS EN 12464-1: Standard for Lighting of Workspaces" [12]. This standard covers lighting rules that meet the visual comfort and performance needs of people with normal eye capacity for people in indoor workplaces. The minimum illuminance level values determined according to the standard are shown in Table 1.

Table 1. Minimum illuminance level values for different spaces [12]

Area	Minimum Illuminance Level (lux)
Classrooms, tutoring rooms	300
Evening classes and adult education	500
Conference Hall	500
Art rooms	500
Technical drawing rooms	750
Practice rooms and laboratories	500
Computer application rooms	300
Halls	200
Circulation areas, corridors	100
Stairs	150
Rooms shared by students	200

2. Methodology

The aim of this study is to identify the criteria that are important in optimizing artificial lighting design, especially in terms of energy efficiency and visual comfort. The methodology of the study consists of three steps. In the first step, the literature on the subject was reviewed, the values in the standards were determined and the necessary data were obtained by selecting the learning environment to be examined and the climatic data were determined. In the 2nd step, in addition to the existing lighting system, lighting scenarios to be examined were created and input files were created by modeling the learning environment to be examined in the simulation program. In the last step, the current situation and the created scenarios were simulated, annual heating, cooling and lighting energy consumption values were calculated and compared for all scenarios. Necessary recommendations were made. Figure 3 shows the workflow diagram of the study method.

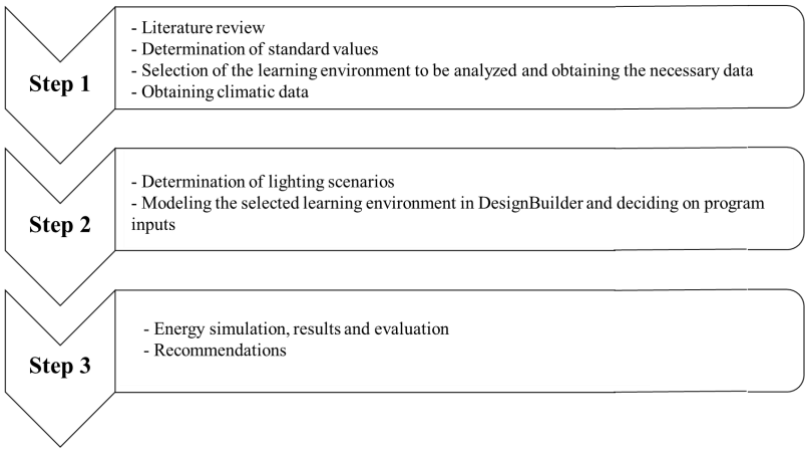


Fig. 3. Working method workflow chart

As a result of the calculations, the total annual energy consumption per m2 of the academic learning environment was analyzed. Then, the heating, cooling, lighting and total energy consumption values (W/m2)

and energy savings (%) of the scenario were evaluated. In the last step, the simulation results were evaluated by descriptive statistical analysis. The scenario was visualized with 2D and 3D graphs and the relationships between heating, cooling and lighting energy consumption were analyzed.

2.1. Climatic Data

This study was conducted in Trabzon, Turkey (41° 0′ 19″ North, 39° 43′ 4″ East). According to the Koppen Climate Classification, the city shows Mediterranean climate characteristics (Csa). Climatic data for Trabzon province for the period 1950-2022 are given in Table 2.

Table 2. General statistical data for Trabzon province [13]

TRABZON	Yearly
	Measurement Period (1927- 2022)
Average Temperature (°C)	14.8
Average Highest Temperature (°C)	18.1
Average Lowest Temperature (°C)	11.8
Average Insolation Time (hours)	4.5
Average Number of Rainy Days	137.2
Average Monthly Total Precipitation (mm)	828.0
Highest Temperature (°C)	38.2
Lowest Temperature (°C)	-7.4

2.2. Academic Learning Environment

The workspace is a workshop module measuring 9 m x 12 m x 3.5 m. The space receives natural light from the north, south and west facades, while the east facade is closed. The classroom has 42 tables and chairs, 1 projector and 1 computer (Figure 4).

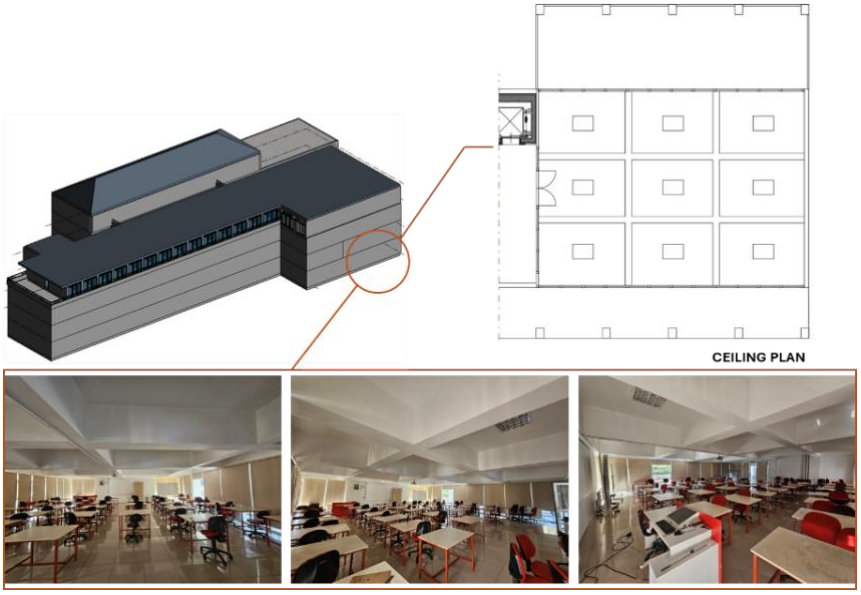


Fig. 4. Academic learning environment ceiling plan and visuals

Table 3 shows the external wall, floor and ceiling characteristics of the workshop. The thickness of the floor and ceiling is 29 centimeters. Expanded polystyrene (EPS) was used as insulation material. It is assumed that there are no cracks in the walls and that the doors and windows have a high level of airtightness. The U-values of the learning environment constructions were not higher than the limit value specified in the Turkish Standard TS 825 for the climate zone. It was observed that heat-retaining aluminum frames were used in the joinery system of the windows.

Table 3. Construction of structural components

EXTERIOR WALL				
	Thickness (m)	λ [W/(mK)]	ρ [kg/m^3]	c [J/(kgK)]
Exterior Plastering	0,02	0,5	1300	1000
Insulation Layer (EPS)	0,05	0,04	15	1400
Reinforced Concrete	0,2	0,77	1900	840
Interior Plastering	0,02	0,4	1000	1000
U- Value [W/(Mk)]	0,300			
FLOOR AND CEILING				
	Thickness (m)	λ [W/(mK)]	ρ [kg/m^3]	c [J/(kgK)]
Exterior Plastering	0,02	0,5	1300	1000
Insulation Layer (XPS)	0,07	0,03	35	1400
Reinforced Concrete	0,2	0,77	1900	840
Interior Plastering	0,02	0,4	1000	1000
U- Value [W/(Mk)]	0,386			

2.3. Energy Simulation

When performing energy simulation, it is necessary to make assumptions and limitations about the thermal and visual comfort levels required depending on how the building is operated, the type of building, the activity performed and the user profile. If the building is hypothetical, the materials should be determined according to the building type and thermophysical values should be introduced into the program. These values can be the default properties included in the program or can be obtained from standards or previous studies. The inputs used in energy simulation in this study are given in Table 4.

Table 4. Designbuilder energy simulation inputs

Simulation Inputs		
Number of Users	40	
User Density (person/m^2)	2,7	
Thermal Bridge	Yok	
HVAC System	Radiator heating, Boiler HW, Natural Vent.	
Cooling	Fuel	Electricity from grid
	Upper Setpoint Temperature (◦ C)	26
	Lower Setpoint Temperature (◦ C)	28
Heating	Fuel	Natural Gas
	Upper Setpoint Temperature (◦ C)	20
	Lower Setpoint Temperature (◦ C)	18
Optimized Hot Water	Fuel	Natural Gas
	Temperature (◦ C)	65
	Consumption Rate (1/m^2-day)	0,02
Ventilation	Natural Ventilation	Yes
	Mechanical Ventilation	No
	Model Infiltration	Yes
	Air Tightness	3
Equipment	Heat Gain (W/m^2)	Computer (1): 3,20
Activity	Working Days	Pazartesi-Cuma
	User	08:30-17:00
	Equipment Computer	08:30-17:00
	Lighting	08:30-17:00
Thermal Insulation of Clothing	Winter (clo)	1
	Summer (clo)	0,5
Convection Algorithm	TARP	
Conduction Algorithm	Chrank-Nicholsan	
Calculation Method	ASHRAE Heat Balance Metod	
Time Interval	3	
Output Range	Yearly	

2.4. Lighting Scenario

Lighting systems should be designed to be most effective based on the light levels or illuminance required by the tasks performed in each building space. The ratio of natural lighting windows to wall surface area is

100% on the north and south façades, while on the west façade it drops to 70%. There are no windows on the east façade of the learning environment. "TS EN 12464-1: Standard for Illumination of Workspaces" was accepted for appropriate illuminance values. Accordingly, the window and artificial lighting scenario information in the current learning environment is given in Table 5.

Table 5. Lighting scenario information

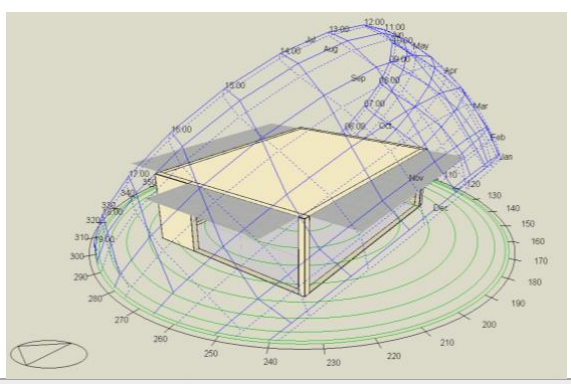
					Natural Lighting / Window
	North		**South**	**East**	**West**
WWR	%100		%100	%0	%70
Glazing Type	Double Clear 6mm/12 air		Double Clear 6/12 air	-	Single Clear 6 mm
	Ug (W/m²K)		**g (SHGC)**	**T_{sol}**	**T_{vis}**
Double Clear 6mm/12 air	2,665		0,703	0,604	0,781
Single Clear 6 mm	5,778		0,819	0,775	0,881
					Artificial Lighting
		Luminous Flux		1.000 lm	
		Color Coding		Cold Daylight	
		Color Temperature (Nom.)		12000 K	
		Power Consumption		18 W	
		Energy Consumption (kWh/1000 h)		22 kWh	
		Lighting Power Density (W/m²-100 lux)		5	
		Lighting Intensity (lux)		500	
Compact Fluorescent / Surface Mount	**D (max)**	**A (max)**	**B (max)**	**B (min)**	**C (max)**
TL-D 18W Snow White TR 1SL/25 (reference)	28 mm	589,8 mm	596,9 mm	594, 5 mm	604 mm

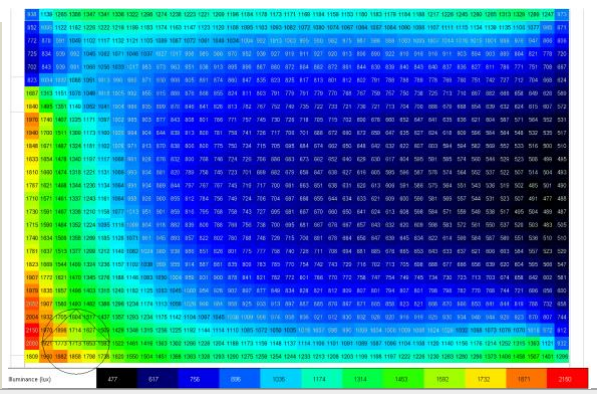
Luminaire Types and Control Systems Examined

Scenario	**Luminaire Type**	**Code - Thickness**	**Linear Control**
Scenario A	Compact Fluorescent (reference)	TR-28mm diam	Off
Scenario B	Compact Fluorescent	TR-28mm diam	On
Scenario C	Compact Fluorescent	T8-25mm diam	Off
Scenario D	Compact Fluorescent	T8-25mm diam	On
Scenario E	Compact Fluorescent	T12-37mm diam	Off
Scenario F	Compact Fluorescent	T12-37mm diam	On
Scenario G	LED	ST8E-28mm diam	Off
Scenario H	LED	ST8E-28mm diam	On

3. Findings

Natural lighting contributes to achieving recommended lighting comfort levels, correct light distribution and glare reduction [14]. Figure 5 shows the distribution of the lighting intensity of the academic learning environment examined in the study.





Floor Area Within Limits (m²)	**Average Daylight Factor (%)**	**Minimum Daylight Factor (%)**	**Maximum Daylight Factor (%)**	**Uniformity ratio (Min / Avg)**	**Uniformity ratio (Min / Max)**	**Min Illuminance (lux)**	**Max Illuminance (lux)**
96,156	9,558	4,776	21,491	0,5	0,222	477,91	2150,32

Fig. 5. daylight distribution and parameters of the academic learning environment

Trabzon city receives the sun's rays from the south side at the steepest angles. However, the learning environment cannot receive enough direct sunlight due to the eaves on the south façade. This situation causes both the sunlight not to reach the depths of the space and the desired brightness levels in front of the windows

cannot be reached. Looking at Figure 2, sufficient daylight cannot reach the center of the learning environment and dark areas are formed. Artificial light sources are used for long hours in learning environments where adequate natural lighting and therefore adequate illuminance levels cannot be provided. Therefore, energy consumption and costs increase.

Scenarios have been created by changing the type and thickness of luminaires in order to reduce the energy consumption values of learning environments where academic education is given. Therefore, the lighting power density (LPD), which defines the lighting load per area of a building, is an important metric representing the impact of a light source on the energy consumption of the entire building. Since the type of light source is one of the main variables in the study, energy calculations were made in the Designbuilder program for compact fluorescent (CFL) and LED (Light Emitting Diode) luminaires, which is the existing lighting fixture. Lighting energy consumption was obtained as follows:

$$E1 = LPD \times U \times T \quad (1)$$

Where E1 is the lighting energy consumption (Wh m-2), LPD is the installed lighting power density (Wm-2), U is the lighting utilization, U takes the value 0 when the lighting is off, 0.5 when half of the lighting is on and 1 when all of the lighting is on. T is the time the lighting is on in hours.

Table 6. Energy consumption related to the learning area

	JANUARY	*FEBRUARY*	*MARCH*	*APRIL*	*MAY*	*JUNE*	*JULY*	*AUGUST*	*SEPTEMBER*	*OCTOBER*	*NOVEMBER*	*DECEMBER*
a	60,16	52,31	54,92	57,54	60,16	52,31	60,16	57,54	54,92	60,16	54,92	57,54
b	338,37	294,24	308,95	323,66	338,37	294,24	338,37	323,66	308,95	338,37	308,95	323,66
c	33,23	28,9	30,34	31,79	33,23	28,9	33,23	31,79	30,34	33,23	30,34	31,79
d	60,16	52,31	54,92	57,54	60,16	52,31	60,16	57,54	54,92	60,16	54,92	57,54
e	1666,8	2360,8	2405,1	2815,6	3409,6	3740,2	4066,1	3708,6	3300,2	2633,6	1885,2	1104,7
f	1,43	1,61	1,69	1,95	2,06	1,98	2,17	2,1	2,03	1,97	1,68	1,45

a. Room Electricity (kWh)
b. Lighting (kWh)
c. DHW (Electricity) (kWh)
d. Computer + Equip (kWh)
e. Solar Gains Exterior Windows (kWh)
f. Mech Vent + Nat Vent + Infiltration (ac/h)

According to Table 6, the highest energy consumption was used in lighting energy. In addition, the highest "Solar Gains Exterior Windows (kWh)" values are quite high due to the inefficiency of sunlight. The highest energy consumption is observed in January, May, July and October for all parameters. It has been reported that the integration of artificial lighting with energy efficient luminaires, daylight harvesting schemes and artificial lighting control can help reduce electrical energy demand and improve the visual efficiency of building occupants [15]. Another issue that needs to be addressed when designing artificial lighting in the Designbuilder program is lighting control. There are 3 different options for lighting control. In the first option, "Linear Control", as the daylight brightness increases, it dims continuously and linearly from maximum electrical power, maximum light output to minimum electrical power, minimum light output. When the daylight brightness increases further, the lights remain at the minimum point. For the linear control option, the Minimum input power fraction is the lowest power that the lighting system can dim. For this reason, "Linear Control" system was used as the control system in artificial lighting scenarios. In order to compare the energy consumption of the artificial lighting scenario designed in the study area, changes in the artificial lighting luminaire type and control system were made and shown in Table 7.

Table 7. Artificial lighting fixtures type and control system comparison

Lighting (kWh)	**S-A**	**S-B**	**S-C**	**S-D**	**S-E**	**S-F**	**S-G**	**S-H**
JANUARY	338,37	67,25	330,85	65,76	375,97	74,72	187,99	37,36
FEBRUARY	294,24	37,25	287,7	36,43	326,93	41,39	163,47	20,7
MARCH	308,95	31,1	302,08	30,41	343,28	34,55	171,64	17,28
APRIL	323,66	32,37	316,47	31,65	359,62	35,96	179,81	17,98
MAY	338,37	33,84	330,85	33,09	375,97	37,6	187,99	18,8
JUNE	294,24	29,42	287,7	28,77	326,93	32,69	163,47	16,35
JULY	338,37	33,84	330,85	33,09	375,97	37,6	187,99	18,8
AUGUST	323,66	32,37	316,47	31,65	359,62	35,96	179,81	17,98
SEPTEMBER	308,95	30,9	302,08	30,21	343,28	34,33	171,64	17,16
OCTOBER	338,37	46,25	330,85	45,22	375,97	51,39	187,99	25,7
NOVEMBER	308,95	65,21	302,08	63,76	343,28	72,45	171,64	36,23
DECEMBER	323,66	72,78	316,47	71,16	359,62	80,86	179,81	40,43
Average Annual Energy Consumption (kWh)	319,9825	42,715	312,8708	41,76667	355,5367	47,45833	177,7708	23,73083
Energy Saving	-	87%	2%	87%	-11%	85%	45%	92%

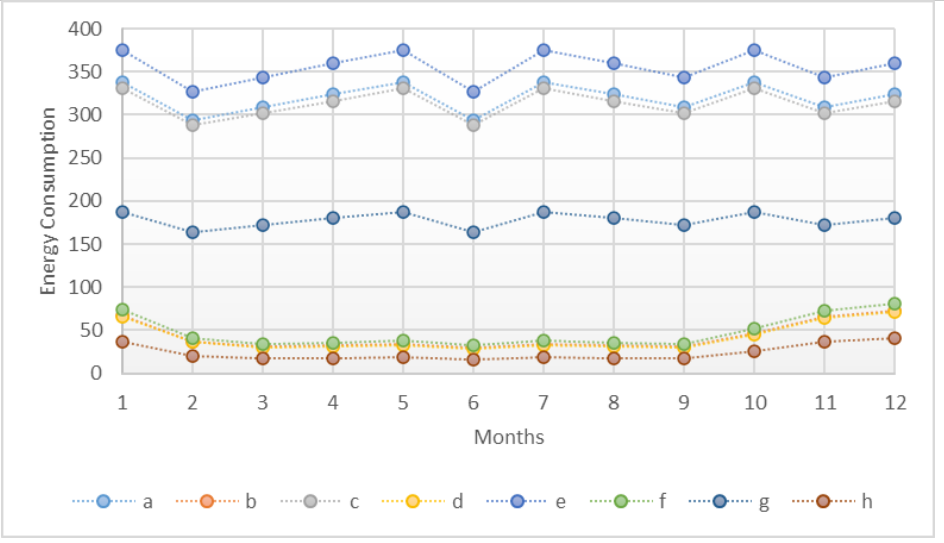


Table 7 shows that energy consumption is below 100 kWh in all scenarios where the control is on. In these scenarios, LED luminaire consumes the least energy and compact fluorescent luminaire with 37 mm diam consumes the most energy. It is observed that the LED luminaire consumes less energy than other types of luminaires with the control system turned off. Energy consumption is also higher in January, May, July and October compared to other months.

While the annual energy consumption of the current scenario (S-A) is 319 kWh, the annual energy consumption of the S-C and S-E scenarios with the same luminaire type but different thicknesses are 312 and 355 kWh. The fact that the luminaire thickness of the S-C scenario is less than the current scenario has also led to a reduction in annual energy consumption. However, in S-E, which has a higher luminaire thickness, annual energy consumption increased by 40 kWh. In this case, there is a linear relationship between luminaire thickness and energy consumption. As a result, it can be said that energy savings decrease as the diam diameter of the fluorescent lamp luminaire increases. On the other hand, even if the diam diameter of fluorescent lamps increases, energy savings of more than 80% are achieved in all scenarios where the control system is used. In the S-B, S-D and S-F scenarios where linear control is turned on in the fluorescent

luminaire type, it is observed that there is a linear relationship between the luminaire thickness and annual energy consumption, but there is not as much difference between the energy consumption of S-B and S-D as S-F and S-H. Among the scenarios where the control is on, the S-H scenario provides the highest savings in annual energy consumption.

4. Results and Conclusions

Fluorescent lamps are preferred in learning environments for several reasons. First, their cost-effectiveness makes them a popular choice for schools [16]. Secondly, fluorescent lamps provide a bright and homogeneous light distribution, which is important for creating an optimal learning environment. Furthermore, studies have shown that the use of fluorescent lighting in learning environments can improve task performance and increase test scores. Finally, fluorescent lamps with different color temperatures were compared and it was found that the choice of color temperature can affect students' visual performance and study efficiency [17]. Therefore, fluorescent lamps are preferred in learning environments for reasons such as cost-effectiveness, the ability to provide bright and uniform illumination, and to improve students' performance and productivity. The type of fluorescent lamps used in learning environments can cause different effects on lighting conditions. Studies have shown that the light spectrum emitted by fluorescent lamps can affect circadian rhythm, body temperature, alertness, and even student attitudes and behaviors [18].

The type of fluorescent and LED lamps significantly affects the lighting energy. As a result of the study, 45% energy saving was achieved by using LED instead of fluorescent lamps in academic learning environments. If the control system is turned on in fluorescent lamps, 87% energy saving is achieved. In this study, the relationship between artificial lighting systems used in academic learning environments and building energy consumption is examined according to the type of lighting and whether the control is on or off. This study confirms that the design of buildings and lighting systems is a determining factor in reducing lighting energy demands and that utilizing daylight in buildings can provide significant savings in lighting energy demands. In particular, the use of systems with the potential to offset the energy savings generated, such as lighting control, is shown to have a significant impact on artificial lighting.

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SUSTAINABLE DESIGN STRATEGIES TO INCREASE THE DAYLIGHT PERFORMANCE OF EMU RECTORATE BUILDING IN GAZİMAĞUSA / NORTH CYPRUS

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Abstract
Daylighting has often been recognized as a useful source of energy savings and visual comforts in office building. Building users required appropriate lighting in their work environment. Daylighting supports staff members to be more comfortable and productive in workstations. Effective use of daylighting in office buildings has the potential to maximize the benefits of visual comfort, reduce energy usage, and achieve a qualitative building environment in terms of thermal comfort for the building users. Even though the number of possible alternatives that can be generated for integrating daylighting in buildings architecturally is challenging. Allowing direct daylight into building space will also affect the thermal comfort of the space. This research will analyze the use of daylighting design to improve the visual comfort, energy efficiency and thermal comfort of EMU Rectorate building located at the Eastern Mediterranean University in Gazimağusa / North Cyprus. The daylighting performance of this base case study was evaluated based on the observation on the site and survey methods as research methodologies. Findings and results of the survey with staff members show a majority of user discomfort with the indoor thermal levels, which corresponds to higher shading demand, while a high daylighting performance for office buildings is quite effective in order to achieve a comfortable working environment for the office staff. As a conclusion, this research is suggesting sustainable design strategies to optimize the daylight performance in EMU Rectorate office building for the occupants in the working hours and giving recommendations for future buildings on the campus.
Key-Words: *Daylight Performance; Energy Efficiency; Visual Comfort; Thermal Comfort; Sustainable Design Strategies*

1. Introduction

Nowadays, most of the buildings are designed without considering the sustainability or responding to natural conditions which becomes a noticeable international trend. It is commonly preferable to design building in response to natural light and site potentials as views [1]. Daylighting is used by occupant or building users for the comfort of their lifetime living in the building. As humans, visual comfort and psychology were adjusted by developing to natural daylight and therefore it is needed as a basic alternative in buildings during daytime. Its dynamical change is a stimulus for human's day and night cycle and it can control human's mood and health, respectively [2]. Minimum lighting requirements for visual performance described earlier reference to artificial lighting and daylighting as well. Since 1973, the interest in daylighting has increased as a result of oil crisis and the understanding that artificial lighting represents a major energy consumer. Energy savings are achieved through the use of daylight by energy cost savings from less electricity consumption for lighting and cooling, as well as, from reduced needs during peak demand periods in many buildings [3]. Improved lighting conditions for higher visual comfort and performance can be reached by integrating the design of daylighting without increase of energy use consumption and CO2 emission of the built environment. The view from the indoor to the outdoor spaces is an important and significant requirement for natural daylighting design as well. The need for daylighting in the designs of buildings cannot be overemphasized [2]. Moreover, different ways of using daylighting have been created which rely on the development of technology and new materials. Therefore, the purposes of daylight technologies have shifted from the simple improvement of the illuminance level in the perimeter zone to increased illuminance deep into spaces, improved uniformity and the control of glare [2]. It is significantly important to consider lighting while designing indoor spaces. In office buildings, it is even more significant to pay considerations to light, especially sun light, due to high level of visual activities. Effective use of daylighting in buildings has the potential to maximize the benefits of natural day lighting and visual comfort, reduce energy usage, and achieve a good building environment in terms of thermal comfort for the building users. Even though, the number of possible alternatives that can be

generated for architecturally integrating daylighting in buildings is challenging. To acquire a good energy efficient performance in building [3], it is necessary to assure the environmental comfort for users.

Nomenclature	
ACM	Aluminium Composite Material (ACM)
EMU	Eastern Mediterranean University
ERC	Externally Reflected Component
IRC	Internally Reflected Component
SC	Sky Component
WWR	Wall to Window Ratio

1.1. Research Problem

Insufficient internal lighting has ever been a problem faced by architects who tried to provide the natural lighting in indoor spaces without depending on artificial lighting depending on fossil fuels as energy sources. So, the most difficult issue in building design is the determination of opening's design aspects that influence the amount and distribution of the daylight in indoor spaces". The architects supposed to take into consideration the orientation of the building, windows (size, place orientation and glazing type) as well as the reflectivity of materials in indoor and outdoor spaces and shading devices as daylight control. Since EMU Rectorate Building is one of the buildings in EMU Campus that depend on daylight, the unawareness of these principles and measures has negatively impacted the building envelope design, energy efficiency, visual comfort, user's performance and user's satisfaction related to daylight conditions.

1.2. Research Aim and Objectives

In this study, main aim and objectives of the research is to optimize the daylight performance in EMU Rectorate Office Building for the occupants in the working hours by adopting daylight design strategies and to improve the visual and thermal comfort for the staff members and the energy saving in the office rooms. The main research questions of this research are as follows:

- Is the amount of daylight in all indoor spaces of the EMU Rectorate Office Building sufficient for the visual tasks of the users (staff members)?
- Are office users facing visual problems in indoor spaces mainly due to daylighting quality?

1.3. Research Methodology

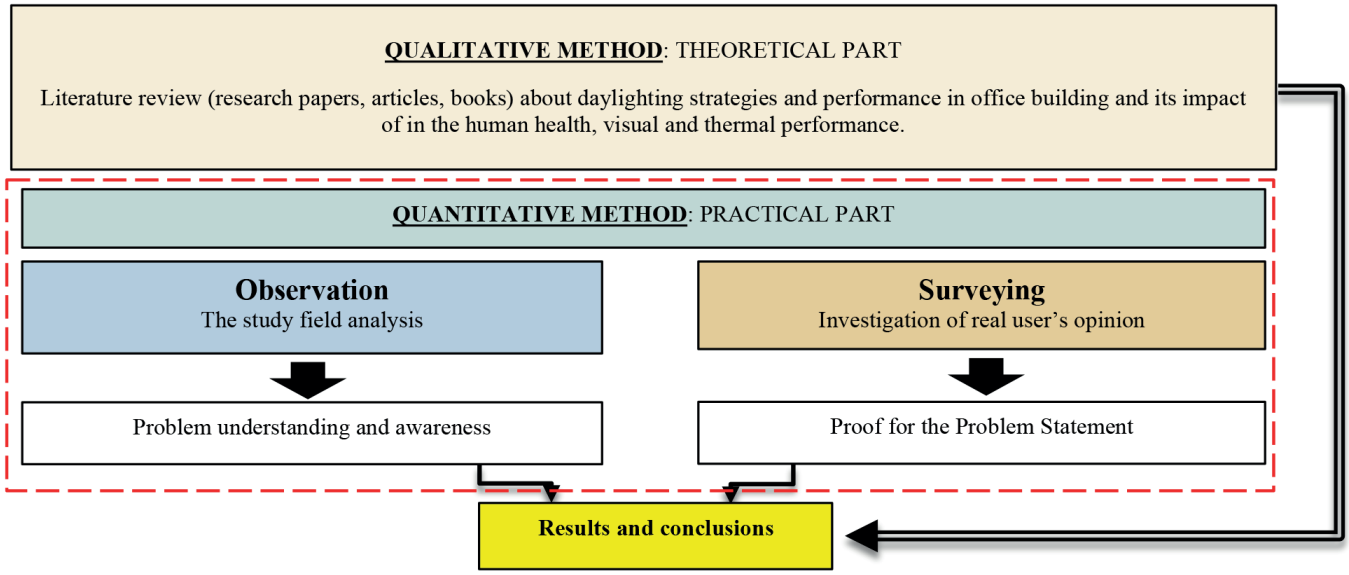


Fig. 1. Research Methodology as flowchart (author)

Observation and surveying are the methods that were used as quantitative methodology after literature review (qualitative methodology).

A qualitative methodology (literature review) was used to understand and to have an awareness about the daylighting strategies and performance in office building and its impact on human health, visual task and thermal performance.

The quantitative methodology as practical part combines observation and surveying to achieve results and conclusion, while observation as study field analysis discovers the problems. Surveying investigates the real user's opinion to prove the observed problems which were summarized under problem statement.

2. Theory

The daylight components, daylight factor, daylight quality/visual comfort, daylighting strategies and daylight performance in office building and its impact on human health, visual task and thermal performance will be introduced in theoretical part of the study.

2.1. Daylight Components and Daylight Factor

The Illuminating Engineering Society defined daylighting, "Daylighting refers to the art and practice of admitting beam sunlight, diffuse skylight, and reflected light from the exterior into a building to contribute to lighting requirements and energy saving through the use of electric lighting controls" [4]. "The daylighting has some components system are designed to transport natural light into a building in some way that artificial lights can be turned off or dimmed for a portion of the day, whereas preventing occupant from increasing of discomfort or other building loads" [5]. The components of daylighting are as follows (Fig.2):

- **Sky Component (*SC*)** - Directly from the sky, through an opening such as a window
- **Externally Reflected Component (*ERC*) -** Reflected off the ground, trees or other buildings
- **Internally Reflected Component (*IRC*) -** The inter-reflection of 1 and 2 off surfaces within the room

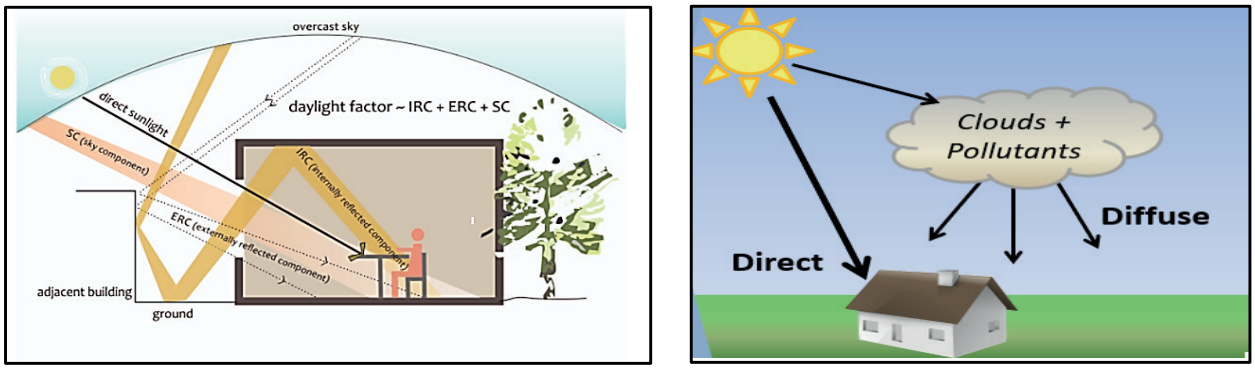
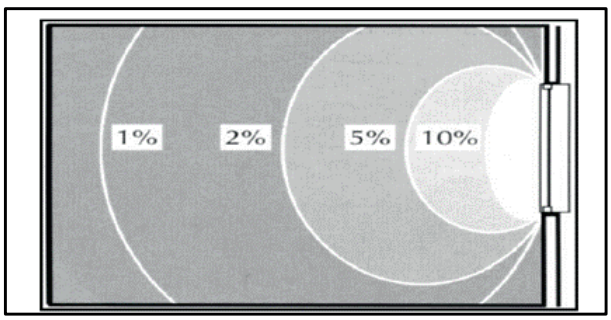


Fig. 2. (a) The components of daylighting, (b) Daylight Available type Direct - Light shining directly from the sun. Diffuse -Light given off by the sky [5]

Daylight Factor defined as "the ratio of daylighting illumination on a horizontal point indoors to the horizontal illumination outdoors, expressed as a percentage. Steady Distributed Daylight Factor from Rectangular Window" (Fig. 3) [2].



Space	Minimum (%)	Average (%)
Lounges in dwellings	0.5	1.5
School classrooms	2	5
Offices: general	2	5
Hospital wards	1	5

Fig. 3. (a) Daylight Factor average, (b) Daylight Factor for indoor spaces [2]

2.2. Daylight Quality and Visual Comfort

Frequently, lighting levels considered as a "major factor affects the experience of visual performance. In both cases of too much brightness or dimness, the human eye strain and feel discomfort. The design of a building targeting to use daylight to illuminate its spaces raises the question of how much light is appropriate and sufficient for occupant and their requirements. The amount of daylight appropriate for use in space light rely on multiple parameters. It depends on the activities, tasks that have to be performed, on the users and their age, people's culture and even on the utilization of the building" (Fig. 4) [2]. The primary principles and strategies for good daylighting in office are:

- Prevent direct sunlight, "because it is a quite strong source of heat and light. Therefore, it must be prevented because it can cause: Glare, thermal discomfort through solar heat gain, visual discomfort, worsening and fading of fabrics, equipment and carpets due of its high UV light content" [1].
- Prevent over-glazing which can create major heat-loss in winter and excessive solar heat-gain in summer for new buildings careful expert design for daylighting will ensure windows are the right size and in the right place. The mount of light and heat can be controlled by: Methods explained above for eliminate direct sunlight, proper window placement, size and glass for solar control and solar coatings or films [6].
- Confirm light sources are balanced to give interesting lighting.
- Supply windows with a view
- Remove glare
- Users control when they needed [2]

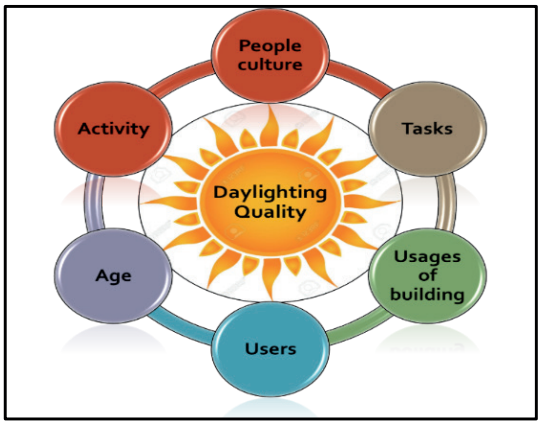


Fig. 4. The amount of daylight quality based on multiple parameters [2]

2.3. Daylighting Strategies

Many but not all existing daylighting systems are designed to capture sunlight and admit it to the building. The challenge in each daylighting strategy is to optimize the efficiency of the distribution system and, therefore, minimize the size of the collecting area. Therefore, the size of the collecting area is linearly proportional to the efficiency of the system. Daylighting strategies may be divided into two groups [3].

- Side lighting systems, where light is brought from the sides of a building into the interior space.
- Top lighting systems, where light is brought from the top of a building and distributed into the interior.

A successful daylighting strategy is one that maximizes daylight levels inside the building but optimizes the quality of the luminous environment for the occupants. Daylighting design is not only about maximizing light levels. Excessive sunlight in an interior can be extremely uncomfortable for its occupants. The key word in daylighting design is control, not only of light levels but also of the direction and the distribution of light [3].

2.4. Daylighting Performance

All daylighting strategies to increase the daylighting performance of a building make use of the luminance distribution from the sun, sky, buildings, and ground.

Daylighting strategies are also affected by climate; thus, the identification of seasonal, prevailing climate conditions, particularly ambient temperatures and sunshine probability, is a basic step in daylight design [7]. Following parameters are influencing the daylight performance:

- Latitude of the building location: The amount of light striking the earth's surface varies by latitude due to the angle of incidence and amount of light absorbed by the atmosphere [7].
- Obstructions and reflections on site: These are external reflections and obstructions from surrounding elements on the building site (buildings, vegetation, ground surface etc. [7].
- Building orientation: In hot humid climate, the length of the building is oriented in an east-west axis, it will allow penetration of passive heating or cooling within the building on a seasonal basis [8].
- Geometry and form of the building: The geometry and form of a building influences its capacity to deliver adequate levels of daylight to the interior building [9].
- Absorber (material property): The color and reflectance of room surfaces are part of the daylighting system. Dark surfaces reflect less light than bright surfaces, and the result is likely to be an unsatisfactory luminous environment [1].
- Window location, size and shape: The positioning of windows, size and shape will influence the distribution of daylight in the room and determine the amount of daylight. Window position should also take into account the relation between the view to the outside and the eye level of the occupants [7].
- Glass transmittance: The main purpose of glazing is for daylight admission to inner spaces and to connect interior with exterior environments. However, human nature appreciates the natural surrounding components, with all variation of color, light and shade, through form of glass applied to windows or facades [10].
- Wall to Window Ratio (WWR): The amount of daylight entering a room is linked to the total glazing area of windows of the daylight space. The larger the windows the more daylight and solar gain will enter - but the larger the heat losses will be. Recommended wall to window ratio (WWR) are generally between 25- 50% of the external wall of the daylight space [11].
- Shading strategy (exterior and interior shading devices): Shading and sun screening are just as important to good daylighting performance as the window itself. The most efficient shading solution to prevent direct solar radiation into the building is to use external shading devices [12].

3. The daylighting performance of EMU Rectorate Office building in Gazimağusa – North Cyprus as case study

In the practical part of the study, the daylight performance of the EMU Rectorate building will be analyzed by means of study field analysis (observation) and investigation of real user's opinion (surveying) as case study.

3.1. Location and Climate

Cyprus is the third largest island in the Mediterranean with the total surface area 9,250 km2 [13], whereas 3,355 km2 in the North is inhabited by the Turkish Cypriot community with a population of 290,000. Cyprus is located between 32, 34 and 35 East longitudes and 34, 35 and 36 North latitudes. It is 95 kilometers away from Syria, 65 kilometers from Turkey, 750 kilometers from Greece and 350 kilometers from Egypt (Fig. 5). The climate of Cyprus can be described as hot-humid and composite, because of hot-dry summer seasons and rainy winter seasons [14]. Gazimağusa, in the eastern part of Northern Cyprus, has long, warm and dry summers from mid-May to mid-October which require cooling and ventilation; mild and wet winters from December to February which require heating. The autumn and spring seasons are short and most comfortable months. Famagusta has an average of 3328 hours of sunlight in a year and an average of 9 hours of sunlight each day (range from 5.5 to 12.5 hours daily), and the temperature of Famagusta rises to more than 34 °C in the summer months and drops to a low of 2 °C in the winter months (Fig. 6).

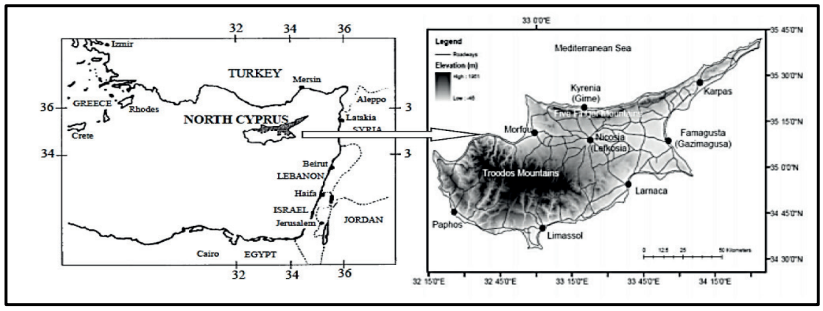


Fig. 5. (a) Map of Cyprus, (b) Location of Gazimağusa – North Cyprus (developed by author)

The relative humidity of Gazimağusa is between 33% to 72% throughout the year whereas October has the lowest, and January the highest humidity in the year [15].

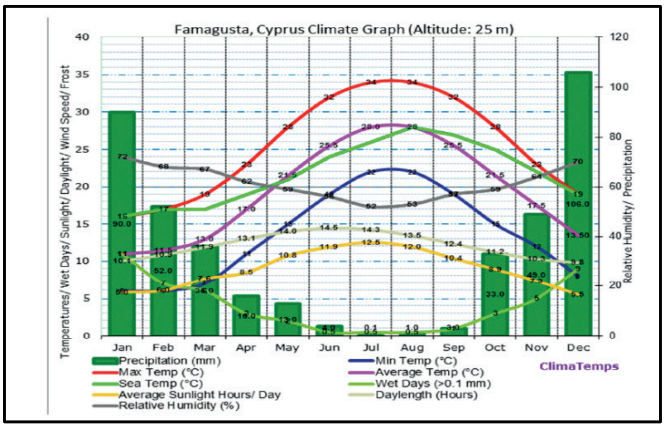


Fig. 6. Annual climate chart of Gazimağusa (Famagusta) [15]

3.2. Annual Sun Path of EMU Rector Office Building

The geographical information for the location of the EMU Rectorate Office building in Gazimağusa (North Cyprus) is 33.84 N longitude and 35.29 E latitude. The rector office is located in hot-humid climate zone, the sunlight preference is quite diverse between seasons, particularly summer and winter [16]. It is more desirable in winter due the slight angle it takes and the warm feeling it provides. In view of the sun altitude and azimuth, the sun movement is representing an environmental aspect that should be considered for the daylight performance. In case of EMU Rectorate office, this movement will shape the reaction to these environmental aspects and the selection of the solutions for different faced challenges. Considering Stereographical diagram window azimuth angel is amongst 80 – 260 degrees, while the overheated period dates of Gazimağusa in summer season can be summarized as 21st of June, 21st of July and 21st of August (Table 1). This building has the maximum solar optimum depth in 21st of December, since the sun radiation height is fewer and oblique. The most significant façades in contact with sun radiation in the overheated period in summer are the south, east and west facades (Fig. 7) [13], [15].

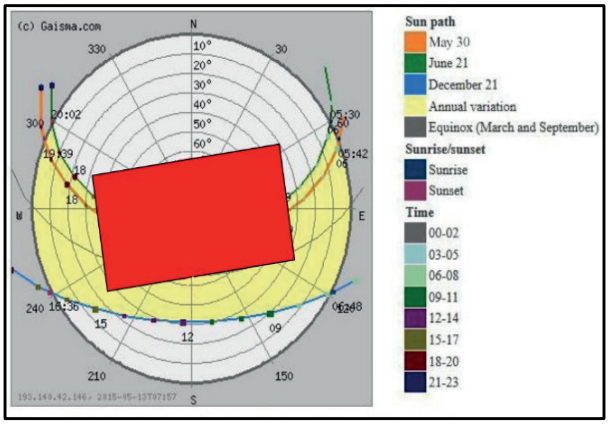


Fig. 7. Sun path diagram of the EMU Rectorate Office building [17]

Table 1. Sun locations of EMU Rectorate Building throughout the year [18]		
Season	Altitude (degree)	Azimuth (degree)
Summer (21 June)	74.60	43.65
Spring (21 March)	53.16	21.83
Autumn (21 September)	54.4	16.24
Winter (21 December)	30.57	11.30

3.3. Field Study Analysis (Observation) of the EMU Rectorate Building

The field study analysis of the EMU Rectorate Office building has been carried out by observations about daylight utilization together with documents such as plans, sections and elevations of the building.

The EMU Rectorate Office building consists of offices and meeting rooms to house the primary administrative functions of the university and is built on a plot of 2400 m2 (40 m x 60 m) with an approximately gross area of 2545 m2. Its geometrically shaped floor plan contains a central courtyard and rises to two suspended floors. The building length to width ratio is 1 to 1.5.

The two-storey building is oriented to south-direction, while the building form extrudes to east and west directions. The building facades are finished with a combination of Aluminium Composite Material (ACM) panels, painted masonry and granite tiling. Large walls of glass siding on the interior courtyards and external facade provide full views and admit natural light.

3.4. Facade Analyses

The general features of EMU Rectorate office building can be summarized as relatively continuous linear facades with few noticeable mass recesses and projections on its exposed to east, west and south orientations. Recesses and projections are of insufficient depth to count as shading devices.

- North Orientation:

Suspended top floor and overhanging porch with suitably shading glazed walls and windows with vertical and horizontal window type are main features of the north facade. Exterior, interior and at the same time both (exterior and interior) are shading device types of the horizontal and vertical windows. The wall to window ratio (WWR) is more than 60%.

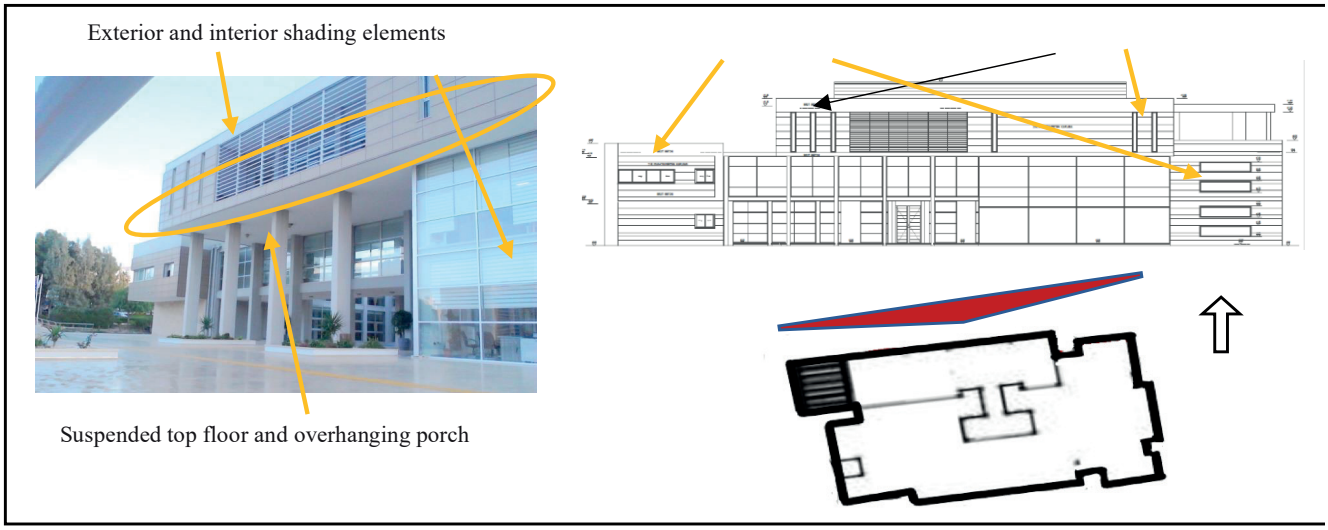


Fig. 8. North facade of the EMU Rectorate building (author)

- West Orientation:

Vertical and horizontal windows types with interior, and at the same time both (exterior and interior) shading elements are defining the west facade of the building. Vertical, horizontal, fixed and moveable shading devices are utilized for the west orientation. Additionally, reinforced concrete pergolas are used for sun control on the roof terrace. The wall to window ratio (WWR) is approximately 35%.

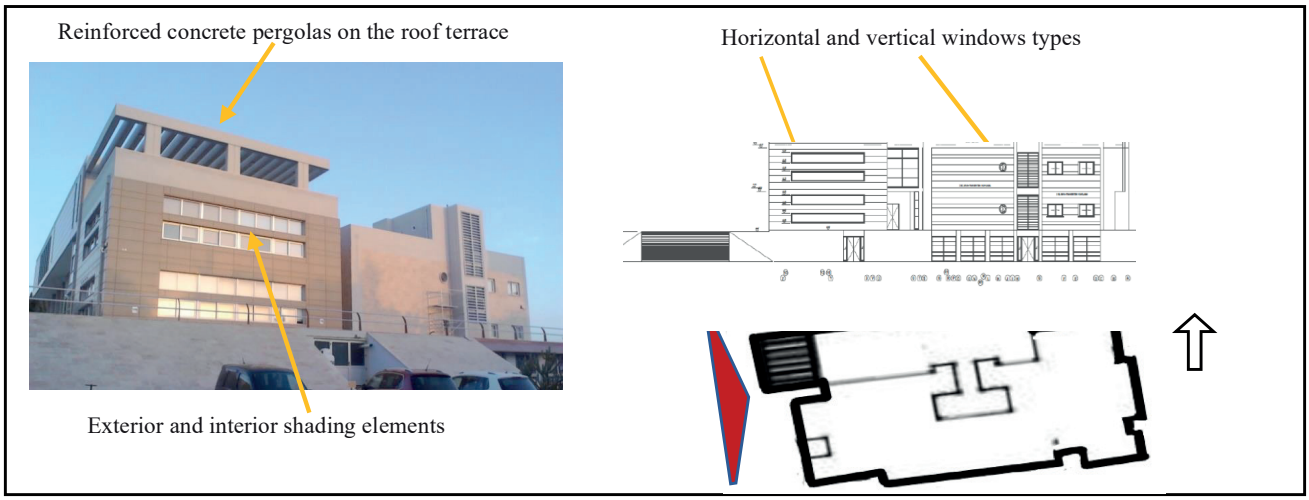


Fig. 9. West facade of the EMU Rectorate building (author)

- East Orientation:

Windows with vertical and horizontal window type, and interior and both (exterior and interior) shading devices types are utilized as vertical, horizontal, fixed and moveable elements. The window overhangs facing to east orientation did not receive any additional treatment for sun control. The wall to window ratio (WWR) is about 40%.

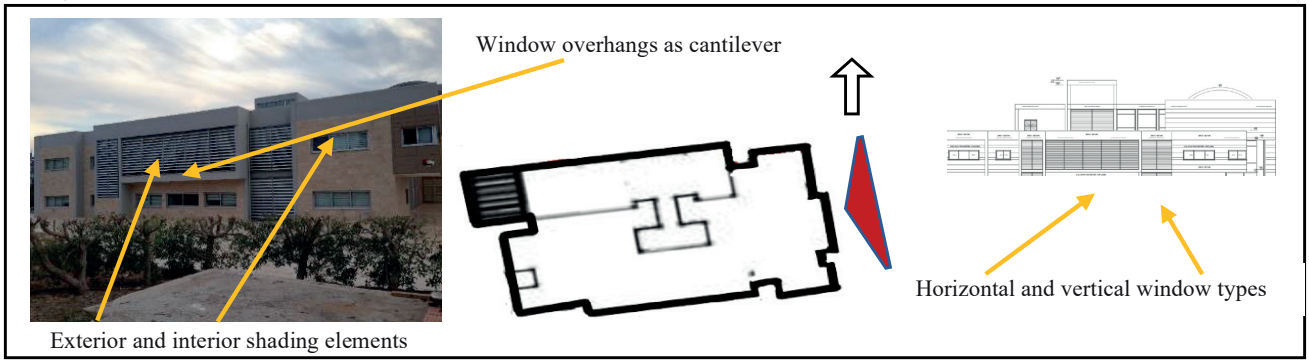


Fig. 10. East facade of the EMU Rectorate building (author)

- South Orientation:

Windows with horizontal window type, interior and both (exterior and interior) shading devices types are utilized as are the main features of the south façade. Cantilevers were employed on the south façade, admitting winter sunlight to the windows (passive solar energy gain) and providing sun control in summer. Closely spaced vertical fins are used as shading elements.The wall to the window ratio (WWR) is about 35%.

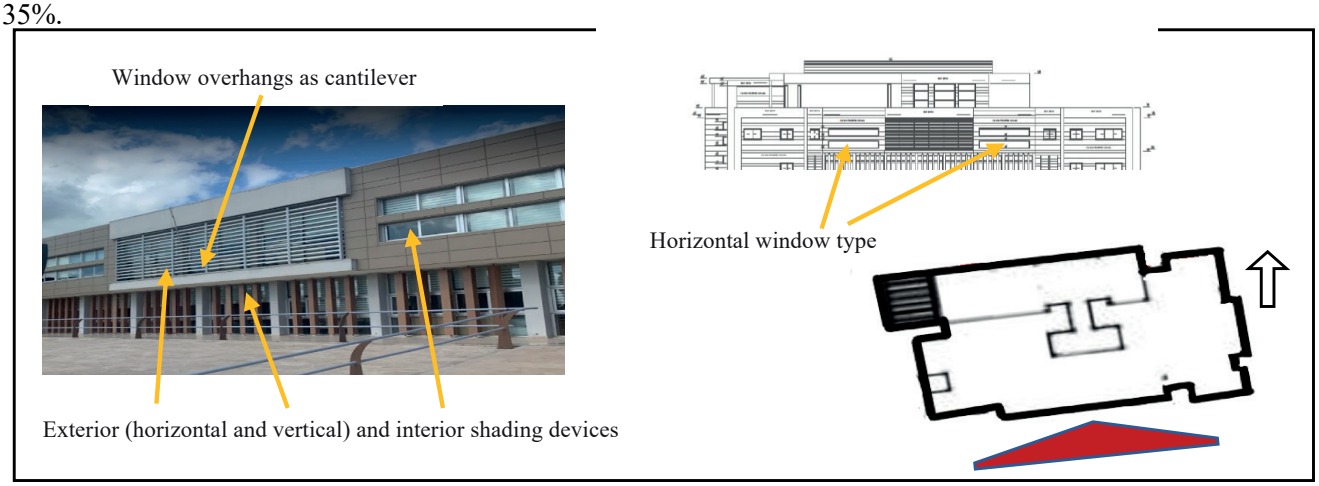


Fig. 11. South facade of the EMU Rectorate building (author)

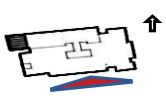
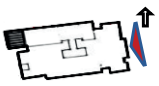
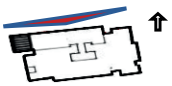
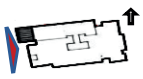
3.5. Investigation of real user's opinion (surveying)

In addition to the field study analysis (observations), the daylight performance of the EMU Rectorate Office building were investigated based on real user's opinion about their workstations. 30 office staff members were selected randomly for the questionnaire survey to understand their individual perception related to daylight quality and daylight control.

4. Results and Discussion

Based on the field study analysis (observations), the following results are summarized for different directions of the EMU Rectorate Office Building (Table 2).

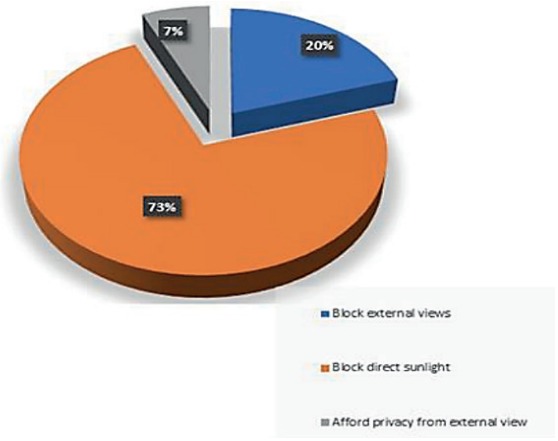
Table 2: Evaluation results of facades analysis (author)

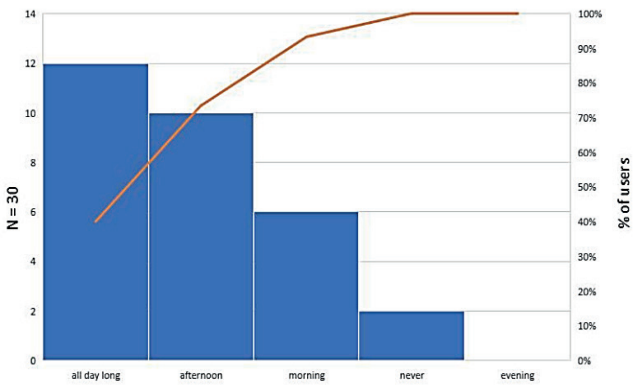
Direction		South	East	North	West
Orientation					
Window type	Vertical	×	✓	✓	✓
	Horizontal	✓	✓	✓	✓
Shading location	Interior	✓	✓	✓	✓
	Exterior	×	✓	✓	✓
Shading type	Horizontal	×	✓	✓	✓
	Vertical	✓	✓	✓	✓
	Fixed	×	✓	✓	✓
	Moveable	✓	✓	✓	✓
	Egg Crate	✓	×	×	×
	None	✓	✓	✓	✓
Roof eaves and overhangs		×	×	×	×
Massing and cantilevers		✓	✓	✓	✓
Porches and pergolas		✓	✓	✓	✓
Glass ratio		About 35%.	About 40%.	More than 60%	About 35%.
Glass type		Double clear glass	Double clear glass	Double clear glass	Double clear glass

The results of the questionnaires are giving an overview about thermal comfort of staff members and daylight quality of the workstations (Table 3).

Table 3. Main findings of the questionnaire survey with office staff members (author)

1	The permanent use of internal blinds proposes a high incidence of discomfiting daylight which is used most of the day. There is a need to block off excess heat and daylight, while 27% of the users indicated satisfied with sun control by use of blinds only.
2	The majority of staff members is requesting more shading elements for the building overall.
3	77% of the users are working in offices with insufficient daylight quality because of North direction.
4	All staff members are permanently using their blinds in summer months because of West and South orientation of their workstations (offices). According to the majority of the users, direct sunlight is a main reason for overheating of their workstations (73%).
5	Slightly, more than half of the users' offices are facing to East, West and South and benefitting from passive solar energy which is keeping comfortable indoor temperature in daytime (passive heating).





5. Sustainable Design Strategies

Based on these results from field study analysis and investigation of real user's opinions, sustainable design strategies are recommended and can be adapted and integrated to optimize the daylighting of the EMU Rectorate Office Building (Table 4).

Table 4. Sustainable design strategies for daylight optimization of the EMU Rectorate Office Building (author)

Orientation	The workstations in the office rooms can achieve a high daylight quality in working hours and benefit from passive heating in winter, if the space organization of the building and furniture are arranged accordingly to the appropriate south orientation.
Obstructions – Landscape design	Visual contact to outdoor spaces around the building without obstacles is needed for the psychological well-being of the staff, while a sustainable landscape design with endemic plants (less irrigation) must be used as a sustainable design strategy.
Wall to Window Ratio (WWR)	Appropriate Window to Wall Ratio (WWR) is needed for each directions to benefit from passive solar energy gain in winter for example based on European Passive House Standard and daylight optimization.
Daylight control	Efficient shading elements for daylight control with correct placement are needed to avoid overheating in summer. The shading device type has to be applied firstly according to the sun orientation and secondly according to the user's working times and weather conditions.
Glare prevention	Glare prevention has to be achieved for workstations near the side windows with efficient glare prevention measures to avoid glare on screens.
Daylight systems for daylight maximization	Light shelves at the exterior walls can maximize the daylight in deeper rooms without overheating of the indoor spaces and glare prevention particularly in North direction.

6. Conclusion

It is commonly preferable to design building in response to natural light and site potentials as views. This has impacts on the several dimensions as passive solar heating, reduction in electrical consumption and affecting the human health and psychology. This study basically considers the analysis of daylighting quality in EMU Rectorate Office building with a view to find some possible solution to the problems of daylight quality. The sustainable design strategies for daylight optimization are recommendations for daylight optimization, and it can be concluded that both research methods (observations and surveying) can be applied to further administration and education buildings on the EMU Campus.

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DESIGN OF A NEW VIRTUAL REALITY STUDIO FOR INDUSTRIAL DESIGN ENGINEERING USING TRIZ APPROACH

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Abstract
Lighting plays a critical role in the success of projects for interior design and engineering studios. Lighting is considered a fundamental design element that affects the ambiance, functionality, and user experience of indoor spaces. When the right lighting design is tailored to the space's purpose and usage, it can enhance both visual appeal and the comfort and efficiency of users. In this study, a new design studio is designed using the Theory of Inventive Problem Solving (TRIZ) approach for undergraduate students of the Industrial Design Engineering department at Gazi University Technology Faculty, where Virtual Reality (VR) integrated modeling applications will be implemented. In the design process, the studio must be sufficiently bright to create a spacious and inspiring environment for the students, yet dark enough to enable the visualization of VR applications for viewers. To solve this physical contradiction problem, the separation technique in space has been utilized.
Key Words: *Virtual reality, design studio, TRIZ, interior lighting*

1. Introduction

Light is primarily used to enable the visibility of objects and to facilitate daily activities [1]. Designers and architects utilize light to highlight the aesthetic and functional aspects of their designed products or spaces, create atmosphere, and improve user experience. Light is employed to determine the visual impact of a design, emphasize colors and details, establish focal points for the eyes, and shape the overall ambiance of a space. Moreover, the psychological and visual effects of light are harnessed to evoke different emotions in [2]. For instance, interior designers craft rooms to emanate a sincere and inviting or a cool and modern atmosphere by using different light sources. Lighting design plays a significant role in various fields, from architectural projects to furniture design. Consequently, designers strive to achieve successful outcomes by combining aesthetics and functionality in this realm.

In lighting design, both technical and aesthetic characteristics should be considered to plan the design process effectively [3]. Lighting is acknowledged as a fundamental design element that influences the atmosphere, functionality, and user experience of indoor spaces. Proper lighting design, when tailored to the space's purpose and use, can not only enhance visual appeal but also improve user comfort and efficiency. Furthermore, lighting is of great importance for the energy efficiency and sustainability of interior spaces. For design and engineering studios, where creativity is paramount, lighting plays a critical role in the success of the projects to be developed. The use of appropriate lighting elements for projects that require long hours and high concentration can increase work efficiency. Therefore, in design and engineering studios, successful projects are produced by optimally integrating aesthetics, functionality, energy saving, and user comfort, taking lighting design into consideration. In the process of creating a new interior design, design methods such as the Theory of Inventive Problem Solving (TRIZ) [4], Systematic Design [5,6], and General Design Theory [7] are utilized to ensure the proper selection of furniture and accessories and to minimize the design process.

In this study, a new design studio has been designed using the TRIZ approach for the undergraduate students of the Industrial Design Engineering department at Gazi University Technology Faculty, where Virtual Reality (VR) integrated modeling applications will be implemented. During the design process, the requirement to make the studio both a bright, spacious, and horizon-expanding environment for students, as well as sufficiently dark to enable visualization of VR applications for viewers, was maintained. The

contradiction of having the studio simultaneously bright and dark was addressed by employing the principle of Separation in Space used in the TRIZ approach's physical contradiction resolution.

2. Material and Method

In this study, the TRIZ approach used in the design process of a new VR studio is an acronym for the Russian phrase "Theory of Inventive Problem Solving" [8]. The TRIZ approach, developed by Altshuller [4], is aimed at facilitating the solution of problems that are time-consuming with traditional methods and accelerating the emergence of innovative ideas [9,10]. According to Altshuller, an engineering design methodology should not depend on psychological factors, should be systematic, and should have an ideal solution space [11,12]. TRIZ presents a structured list of design principles used for solving contradictions in engineering problems [13]. According to this approach, the solution of an engineering problem is based on the principle of wanting to simultaneously satisfy two opposite properties (such as heavy-light, high-low, etc.), or expecting that while one feature of the system improves, another deteriorates [8]. Therefore, for the TRIZ approach, the contradictions present in the problem should first be identified using the contradiction matrix developed by Altshuller. According to this matrix, the ideal ones among the 40 inventive principles of engineering solutions to be used in problem-solving are determined (Fig. 1) [14,15]

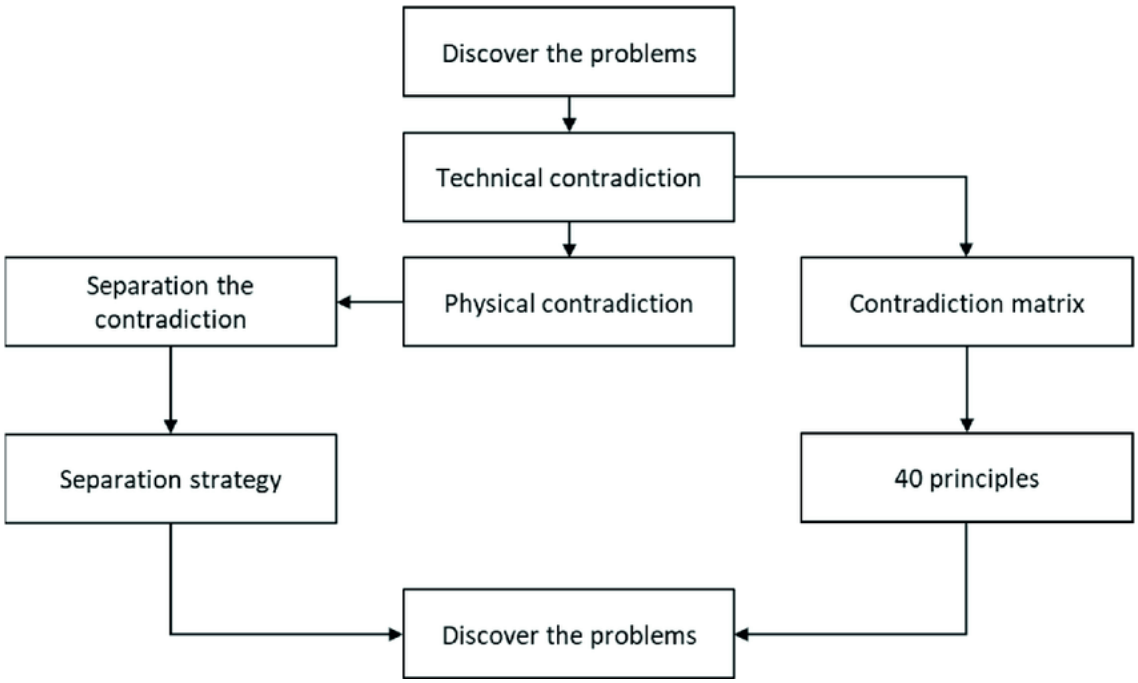

Fig. 1. The problem solving by contradiction matrix in TRIZ methodology [16]

Within the scope of this study, the designed VR integrated design studio should provide a space where engineering students can use Three Dimensional (3D) modeling software and also an environment that allows the use of VR hardware integrated with these software. In addition, this studio should facilitate both group and individual work of the students and have a layout that offers both brightly lit and dimly lit areas at the same time. Accordingly, in this study, the design of the VR studio has been carried out using the situation where a feature of the system exists in two opposite properties (physical contradiction) in the TRIZ approach. The resolution of physical contradictions in the TRIZ approach occurs in four ways: separation in time, separation in space, separation upon condition, and separation between parts and the whole [17]

3. Design of A New Virtual Reality Studio with TRIZ Approach

The expectation for the VR studio to be both bright and dimly lit in the same time frame is a physical contradiction according to the TRIZ approach. Therefore, the solution principles of the space separation method, which include "Segmentation, Taking Out, Local Quality, Asymmetry, Nested Doll, The Other Way Round, Spheroidality/Curvature, Another Dimension, Intermediary, Copying, Membranes and Thin Films, Composite Materials" [18], have been examined respectively. From these principles, initially, the "Taking Out" principle was utilized, resulting in the division of the design studio into two separate sections for 3D modeling and VR applications (Fig. 2).

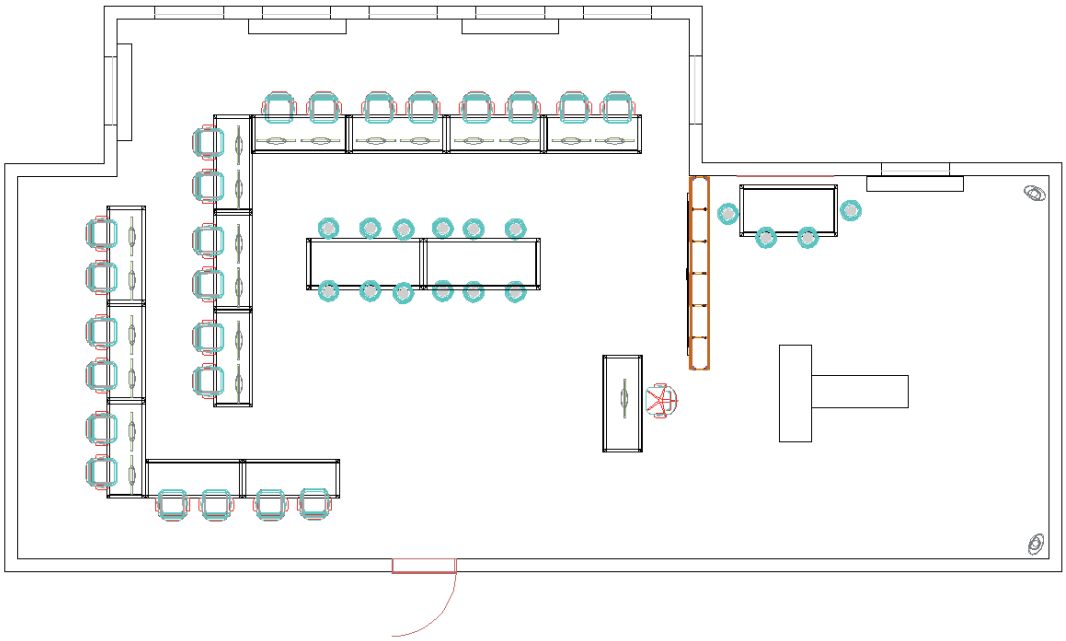

Fig. 2. CAD model of the VR studio

To illuminate these two sections differently in the same timeframe, the "Segmentation" and "Copying" principles from the 40 inventive principles were applied to design a separator at the point where these two sections are divided. This separator is composed of multifaceted and repetitive modules (Fig. 3).

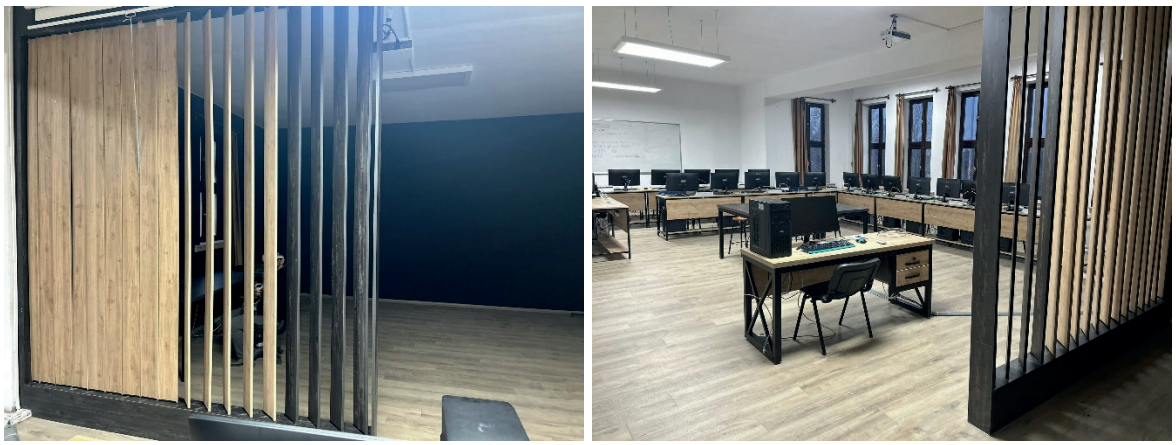

Fig. 3. Separator design that divides the studio into two parts

Lastly, by employing the "The Other Way Round" and "Another Dimension" principles, the modules forming the separator were designed to move independently of each other and in opposite directions (Fig. 4).

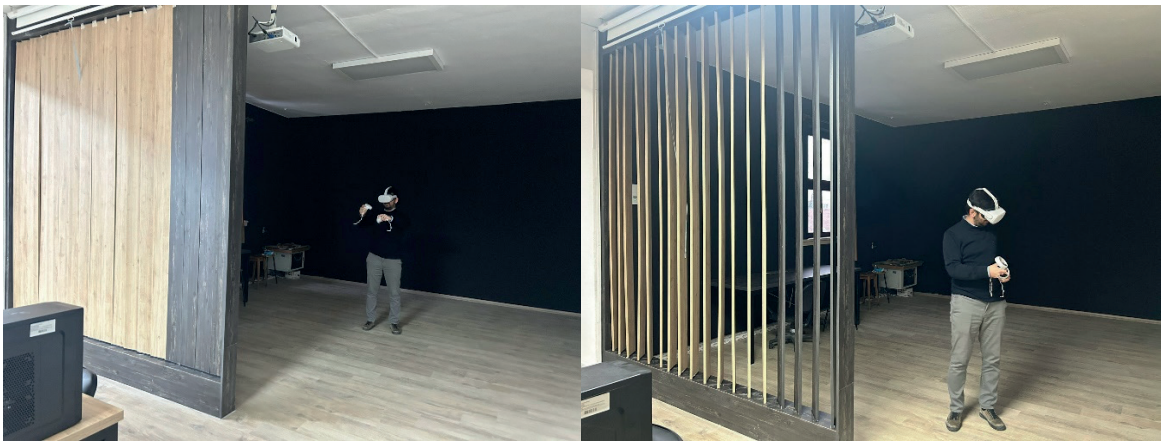

Fig. 4. Different positioning of the chambers that make up the separator

4. Discussion

In this study, the investigation of the integration of Virtual Reality (VR) into a newly designed studio for Industrial Design Engineering students at Gazi University Faculty of Technology highlights a new approach to educational space design. The use of TRIZ methodology facilitated a creative solution to the physical contradiction of needing both light and dark spaces within the same environment. The findings underline the importance of lighting design not only in enhancing the aesthetic and functional qualities of interiors but also in supporting advanced technological applications such as virtual reality.

The application of TRIZ principles, in particular the spatial decomposition technique, exemplifies how design contradictions can be systematically addressed to meet complex requirements. This approach not only solved the practical problem of accommodating VR technology in an educational environment but also contributed to a broader discourse on the role of creative problem-solving in design. The study also demonstrates the potential of TRIZ to foster innovation in areas where traditional design methods may fall short, particularly in the context of rapidly evolving technological environments.

However, this research is not without limitations. The focus on a single design studio and the application of a limited number of TRIZ principles may limit the generalizability of the findings. Future research could broaden the scope by exploring additional TRIZ principles or applying the methodology to different design challenges and environments. Furthermore, empirical studies evaluating the impact of such design solutions on learning outcomes and user satisfaction would provide valuable insights into the effectiveness of TRIZ-based design interventions in educational contexts.

4. Conclusions

In this study, the lighting design process of a new design studio, designed for the undergraduate students of the Industrial Design Engineering department at Gazi University Technology Faculty, was examined. By using the TRIZ approach, a balance was successfully achieved between the need for the studio to create a spacious and inspiring environment for the students and the necessity for it to be sufficiently dark for visualizing Virtual Reality (VR) applications. The research results indicate the effectiveness of the TRIZ approach in resolving physical contradictions. The lighting design of the studio has been optimized using separation techniques based on time, space, and condition to meet the requirements of being both bright and dark.

In conclusion, it has been confirmed that lighting design plays a critical role in the success of interior design and engineering studios. The proper lighting design has been observed to have significant effects on visual appeal as well as user comfort and efficiency. This study underscores the importance of lighting design, particularly for similar projects in education and creative industries, while providing valuable insights into how the TRIZ approach can be an effective tool in solving complex design problems. This research can lay a foundation for developing more innovative and user-centered lighting solutions in the fields of interior design and engineering.

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ECO-BRICKS IN THE FRAMEWORK OF THE INTEGRATION OF THE CONCEPT OF ECO-DESIGN INTO ARCHITECTURE

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Abstract
Energy-related economic and environmental problems continue to be a critical agenda item worldwide. Methods, approaches, and suggestions are being developed in many sectors on how to overcome these problems. It is envisaged that the Eco-design concept, which is among the developed approaches, can make significant contributions, especially in architecture. Eco-design is an approach that reduces a product's environmental impact and cost throughout its life cycle. Building materials have a very important potential for the integration of this approach into architecture. Bricks, one of the most used materials in buildings, can provide considerable environmental benefits when manufactured utilizing Eco-design principles. Eco-bricks are currently an ongoing research topic and are expected to become widespread due to their potential in the coming years. To contribute to this, this research looked at the origins of Eco-bricks, their applications, the materials used in manufacture, the characterization tests applied for performance analysis, and their advantages and disadvantages through a literature review. Based on the data acquired, it has been determined that Eco-bricks are suitable for use in modern buildings when proper processes are applied. Although there are some legitimate concerns about harming nature in the long term, Eco-bricks have the potential to reduce environmental damage by solving the plastic waste problem in the medium and short term, as well as making a positive contribution to building energy consumption and increasing user comfort to the optimum level.

Key Words: *Eco-design;Eco-brick; plastic-sand brick; eco-friendly building material; recycled plastic*

1. Introduction

The design, creation, and continued existence of the built environment have ecological consequences. At the same time, the built environment receives adverse effects from environmental factors throughout its life cycle. With the development of industry, the use of non-renewable building materials in the building and construction sector has increased, with an approach that "contradicts and ignores" the environment in which it is located, and as a result, architectural structures with high carbon footprints have started an unsustainable construction process cycle. In order for this cycle to be healthy and sustainable, the environmental performance of the designed buildings and their main and sub-systems must be improved. To date, numerous approaches and solutions have been proposed for dealing with this issue. eco-design is one of the most prominent of them. It also shows the potential to be adapted to the design and manufacturing process of sustainable building materials in architecture. Yeang [1] likens eco-design to a surgical prosthesis. In this system, bio-integration of the prostheses with the natural main system must be ensured. To achieve this, physical, systemic, and temporal integration must occur. As in this example, buildings must be fully integrated with the natural ecosystem.

There are some misconceptions about eco-design. Examples of these include thinking that advanced technological solutions, such as systems powered by renewable energy and active measures taken to ensure energy consumption, are eco-design products. Although these solutions have some ecological benefits, they cannot fully achieve biointegration [1]. This misperception stems from the fact that engineering and natural and environmental sciences have different approaches and methods. While existing information in engineering is processed for a purpose with focuses such as function, efficiency, durability, and aesthetics, natural and environmental sciences adopt a pragmatic and synthesizing analysis method [2]. In order to successfully implement eco-design, engineering must be identified as the master mind that encompasses and directs the philosophy, approach, realities, and other objectives of the natural and environmental sciences. Instead of focusing solely on singular goals such as adapting to local climatic conditions or simply reducing energy consumption, comfortable conditions for the user and harmless conditions for the ecosystem should be created with a holistic approach, without the need for any electromechanical system. Natural ecosystems do not produce waste; therefore, in eco-design, the system should be completely designed with reusable or recyclable materials that are harmless to the environment [1]. For example, according to Sharp et al. [3],

daylighting systems can be manufactured with recycled products such as plastic, glass, and metal, thus having the potential to be recycled when these systems reach the end of their life cycle. In this case, the system promises the reuse of materials but does not promise biodegradability, and in this respect, it deviates from the definition of Yeang [1]. However, since it envisages the reuse of waste that already exists in nature, it will provide a beneficial solution for the environment in the current situation. Once we stop producing non-biodegradable products, it may be wiser to focus on fully biodegradable materials. However, this cannot be foreseen for the near future. For this reason, targets such as the use of materials with low environmental impact, such as renewable, recyclable, or recycled materials that produce less waste throughout their life cycle, and reducing material use and energy consumption can be included within the scope of eco-design [4].

Nowadays, plastic bottles have begun to be frequently used in architecture as recyclable or recycled materials. These waste materials are increasingly being used, particularly in the construction of bricks. Bricks produced using plastic waste materials in this way are called Eco-Brick. Eco bricks can be adapted to every climate type thanks to their properties and other additive materials. For this reason, in this study, eco-bricks are taken into consideration within the scope of the integration of the eco-design concept into architecture, and the ways in which eco-bricks are used from the past to the present are conveyed through a literature review. In addition, based on literature data, the advantages and disadvantages of using eco-brick were determined, and their future potential was discussed.

1.1. Plastic bottles and their architectural applications

Plastic pollution is one of the biggest environmental problems of the 21st century, harming the ecosystem and human health and contributing to climate change. According to the OECD 2022 report forecast, plastic use and waste will triple globally by 2060 due to economic reasons and population growth, with less than one-fifth being recycled [5].

Plastic production has decreased in Europe since 2017. However, it is reported that worldwide plastic production increased compared to previous years and amounted to 367 million tons in 2020, despite the pandemic. Fortunately, the recycling rate has also increased over the years. Approximately 10.2 million tons of post-consumer plastic waste were collected for recycling in 2020 [6]. Almost half of all plastic produced consists of single-use plastics, with the majority consumed in high- and upper-middle-income countries [7]. 583.3 billion PET bottles were consumed in 2021 [8]. According to 2020 data, the rate of recycling of these bottles is 50% across Europe [9]. Disposable plastic bottles (polyethylene terephthalate-PET) are widely consumed due to their advantageous properties such as resistance to high temperatures, clarity, lightness, low cost, resistance to chemical solvents other than alkalis, versatility, tensile, and impact resistance [10–12].

Plastics are not biodegradable and cause serious environmental problems such as plastic leakage, greenhouse gas emissions, resource scarcity, ecotoxicity, and acidification throughout their entire life cycle [5]. Burning plastic waste in recycling processes causes toxic chemicals and soot to be mixed into the air, posing a danger to the health of living things and increasing global warming [13]. For this reason, different and innovative recycling ideas are needed. The widespread production and consumption of plastics around the world and the fact that their life cycle affects the entire ecosystem reveal the need to take serious steps regarding their recycling.

With the support of non-governmental organizations, environmental policies, and increasing public awareness, recycled plastics have begun to be frequently preferred as raw materials in the furniture and household goods industry, clothing and fabric industry, building elements in architecture, etc. PET bottles, which are a thermoplastic material, are widely used because they are easily accessible and cheap. These bottles become molten with the application of heat and can take on a stable shape when cooled [14]. Plastic waste has a wide range of applications in architecture, including external wall materials [12,15–17], non-structural roof and interior partition wall materials [18], ceiling materials [16], facade elements [19], aggregate [20], insulation materials [21], and so on. One of the most prevalent is the manufacturing of bricks from PET bottles. These bricks are commonly referred to as Eco-bricks in the literature (also known as bottle bricks, plastic bricks, and *Ecoladrillo*) and have a variety of applications.

2. Eco-brick

The literature on Eco-bricks contains many definitions. While some studies [16,17,22–24] describe Eco-bricks as bricks made from plastic waste, others [25,26] include bricks made from other wastes. According to the scientific research reviewed, Eco-bricks can be defined as composite bricks in which wastes that are suitable for use or made suitable for use are recycled and included as components. However, there is confusion in the literature due to the interchangeable use of terms such as eco-friendly [27], eco-efficient [28], and ecological bricks [29]. In this study, bricks made with plastic waste were evaluated within the scope of eco-bricks, and bricks produced with other wastes were evaluated within the scope of eco-friendly brick, eco-efficient brick, and ecological brick.

Eco-bricks are more cost-effective than ordinary bricks because they are created from waste. Because of their economic benefits [30], many researchers have focused on them. In addition, the production of traditional materials such as steel, concrete, and brick causes certain amounts of energy and resource consumption and contributes to environmental problems [31]. Compared to traditional materials, Eco-bricks are more environmentally friendly as they reduce the consumption of new resources. Eco-bricks have long been utilized as an accessible and low-cost building material, particularly in regions where the garbage problem is serious and industrial recycling is not yet available or sufficient (e.g., Latin America, Africa, and South Asian countries) [16].

2.1. Manufacturing procedures and performance analysis

Eco-bricks are most commonly produced with plastic waste mixed with sand. These materials are assembled using the Eco-Tec technique (BI4PVS technique), introduced by Andreas Froese, founder of the Eco-Tec company, in 2001. Using this technique, PET bottles are filled with materials such as sand, soil, or garbage sludge and thus function as bricks or blocks [17,24]. The desired form can be easily created with this technique, and construction can be completed in less than three weeks. So far, different types of structures, such as houses, classrooms, religious buildings, rainwater tanks, animal shelters, conference halls, waste containers, playgrounds, ecoparks, and aqueducts, have been built using more than 300,000 PET bottles [32]. These structures can resist lead, fire, and earthquake [33]. Fig 1 shows images of some building examples and assembly details made with the Eko-Tec technique.

Fig. 1. Some structures and their details made with the Eko-Tec technique [32].

In some bricks, only recycled waste is added to plastic bottles (Fig 2a). Following their cutting into little pieces, these wastes are compressed and inserted into the bottle, generally with the aid of basic instruments. Arredondo-Orozco et al. [30] developed a device to facilitate the compression of plastic waste into bottles (Fig 2b). This portable device can operate manually without the need for electricity and provides ease of use.

Fig. 2. (a) Eco-brick samples (from left to right: with tetra pak metal, PET, paper, and cardboard fillers) [16]; (b) The mechanical waste compactor [30].

Antico et al. [16] propose a new recycling concept for materials used as fillers in Eco-brick making. According to the authors, Eco-bricks filled with mixed materials are potentially difficult to recycle at the end of their life cycle. Therefore, in the study, PET bottles were filled with a single type of material, and four different samples were prepared (Fig 3a). Brick samples were stored in the dark under controlled laboratory temperature and relative humidity conditions before testing. The densities of the samples, temperature-related volume changes, and elastic modulus values were measured. The study's findings indicate that Eco-brick's comparable density and elastic modulus values make it a viable substitute for EPS in terms of sustainability.

Plastic waste can also be used in brick-making using different techniques. For instance, in another technique, plastics are cut into small pieces and melted. Then, it is mixed with materials such as clay and sand in certain proportions and molded in the desired dimensions to obtain a building material called plastic-sand brick (Fig 3a) in some studies [12,17] .

As mentioned in the introduction, in some studies, different materials can be preferred instead of recycled plastic waste in brick production. For example, as part of the Ecobrick® project in 1996, Cusido et al. [25] created a novel ceramic material using clay and sludge from urban wastewater treatment plants. It has reduced energy use and increased solar saving fraction compared to traditional ceramics. Furthermore, Ecobrick® (Fig 3b) offers better thermal and acoustic insulation and is lighter. Nonetheless, assessing this brick in the context of the ecological brick definition would be more suitable.

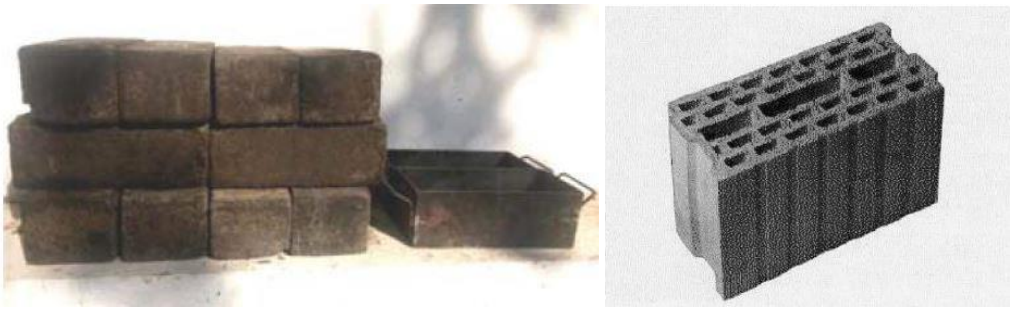

Fig. 3. (a) Plastic-sand brick [17]; (b) Ecobrick® ceramic brick [34].

Maunahan and Adeba [17] aimed to produce hollow bricks using waste plastic (PET bottles and HDPE caps) and river bed sand (Fig 4). All materials were washed and dried before being used. Plastic bottles were cut into small pieces and then melted. Then, 12 samples in cubic form and three different sizes were poured into molds of certain sizes with four different mixing ratios and left for 24 hours. After being left outside the mold for 24 hours to cool thoroughly, all samples were subjected to compressive strength, water absorption, temperature effect, and impact tests separately. The investigation revealed that the hollow brick's compressive strength decreased and its capacity to absorb water increased as the ratio of plastic to sand increased. In addition, it was concluded that recycled waste plastic can be used as a binder agent instead of

cement in the production of hollow bricks and can provide the block with compressive strength and water absorption properties that meet ASTM requirements. Furthermore, it has been noted that these blocks are an environmentally friendly, low-cost, lightweight, sound-proof, and eye-catching alternative.

Fig. 4. (a) River bed sand; (b) Plastic pieces; (c) Manufactured hollow brick and mold [17].

Studies on Eco-brick manufacture follow a similar procedure. This procedure is summarized in Fig 5. First, all materials to be used, such as recycled plastic, sand, and clay, are collected, cleaned, and dried. Afterwards, if the bricks are to be prepared in the desired dimensions, the plastics are cut into small pieces and melted, and all the materials are mixed and poured into the mold of the desired size and properties (wood is generally preferred, but iron mold can be used to provide a smooth surface) and left to dry. After curing, the blocks are removed from the molds and subjected to various tests, such as physical, thermal, and mechanical [12].

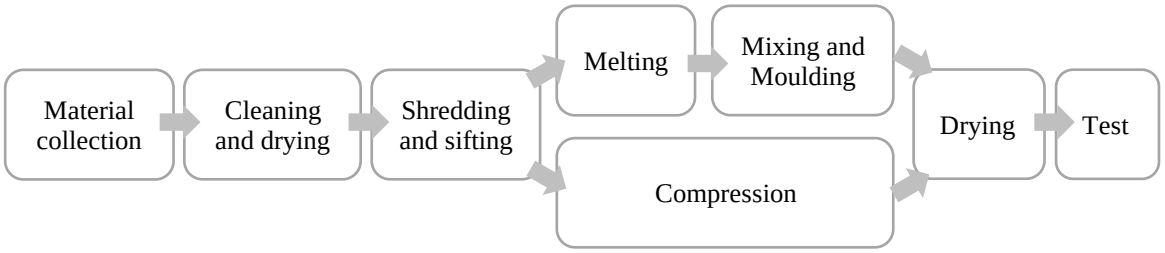

Fig. 5. Procedures for making eco-brick bricks

A thorough examination of the relevant studies reveals that several variables, including different-sized Eco-bricks [18,35–38], various kinds of plastic waste [17,18,37–39], various plastic ratios [17,18,37,39–42], and various sorts of recycling waste [25], are frequently investigated in the analysis of Eco-brick performance. The following characterization tests were commonly applied in these studies [17,18,43–45,35–42]: compressive strength, temperature, water absorption, drop, and efflorescence. Fig 6 shows images of the compressive strength tests of Eco-bricks prepared with different methods. Apart from the tests mentioned, certain studies [36,37,45,46] also conduct cost analysis because of Eco-bricks' economic efficacy.

Fig. 6. Compressive strength tests applied to Eco-bricks prepared by different methods [35,41,47].

The characterization tests and analyses revealed that Eco-bricks provide the limit values that brick building materials must meet. In addition, they show good properties in terms of their physical and chemical composition [17]. Moreover, they often outperformed conventional brick materials in terms of thermal and sound insulation. Thermal shrinkage and elastic modulus vary depending on the filler content [16]. As for the cost analysis results, it was concluded that it is possible to use Eco-brick as a wall material in low-cost building construction [36,37,45,46,48]. PET plastic waste offers the opportunity to be used as a binding agent as an alternative to cement [17], and this significantly reduces the production cost. And as a general result, studies have proven that Eco-bricks have the potential to replace traditional bricks.

2.2. Advantages and disadvantages

Eco-bricks are produced to safely isolate waste plastics from nature. This purpose brings with it the primary and most important advantage of this brick. In addition, there are numerous other advantages.

Following a thorough review of the literature, they can be summed up as follows:

- Easy to make: Materials such as plastic waste, sand, and mud are easily available. The process is straightforward and doesn't require expert-level skills [31].
- High durability: Depending on the construction method and plastic ratio, etc., they show higher compressive strength than conventional bricks [14,18,24,35–37,43,44]. Conversely, several studies make the opposite claim. For example, Thorneycroft et al. [38] state that the addition of plastic material to a concrete mixture causes a decrease in compressive and tensile strength. However, they also state that the decrease in strength can be reduced to acceptable levels with appropriate mixing ratios and different methods. PET is resistant to heat, chemicals [17], corrosion, and UV radiation (its melting point is between 255 and 265 ˚C) [14]. Furthermore, PET bottles can last up to 300 years longer than regular bricks [45].
- Good insulation performance: They have high thermal [18,31] and sound insulation properties [24]. They are resistant to moisture, do not absorb water [37,48], and do not dissolve in water [14]. Moreover, in water absorption tests, they perform better than cement [43].
- Environmentally friendly: They help reduce carbon emissions and environmental pollution both by recycling waste and by being able to replace materials such as cement [17,48]. They save energy and resources [14] and reduce construction waste [14,24]. When melted, only CO_2 and water are produced; they do not release toxic gases [37]. Clay bricks require 1100 ℃ firing during production, while plastics require 220 °C energy if they are to be melted [42].
- Time-saving: They shorten the construction process [24]. The application is 15% faster than standard clay brick with five workers for a 120 m^2 wall [14]. The curing phase takes a short time. Within 12 hours, they recover 80% of their strength [42]. Research suggests that a maximum waiting period of 48 hours is sufficient.
- Cost-effective: They are produced at lower costs than standard bricks, concrete blocks, etc. [36,37,45,46,48]. They provide up to a 50% decrease in construction costs [24,31], and this rate can increase to 75% when labor cost savings are taken in [14]. Because of their insulating qualities, they lower energy consumption and, thus, reduce energy expenditure. Also, they require fewer materials and pieces of equipment, which saves additional expenses.

- Unbreakable: Standard clay bricks are breakable, so their percentage of producing construction waste is higher than plastic bottles [14]. On the other hand, there is almost no material loss in Eco-brick production.
- Light weight: Eco-bricks are often lighter than conventional bricks because they are manufactured from plastic waste. Since earthquake forces are linearly correlated with dead weight, the use of plastic waste reduces building dead weight, which helps reduce seismic risk [40].
- Safety: Especially Eco-bricks made with techniques such as Eco-Tec, etc., have a flexible structure and can absorb sudden shock loads [14,24,46]. They exhibit bulletproof and impermeable properties [14,46].

Despite these important advantages of eco-bricks, they also have disadvantages and risks. The main ones are these:

- Unfamiliar: Since eco-bricks are not widely known, professionals may be skeptical about using them.
- In the ongoing research process: Research and development studies are ongoing, and commercial production is not available or limited.
- Risk of microplastic leakage: It seems likely that it will decompose in the long term and leak microplastics into the natural environment.
- Temporary solution: There is criticism that Eco-bricks offer a temporary solution to the plastic crisis, not a permanent one [49].

Based on this analysis, it is essential to carefully consider the pros and cons of eco-bricks. For this purpose, future research should focus on life-cycle studies of these bricks. It is obvious that further study on this topic is required. But it should also be acknowledged that, given the current rate of plastic manufacture and the growing amount of non-recyclable waste, these methods represent a viable, albeit imperfect, alternative.

2.3. Applications

The first known bottle house was built by William F. Peck in 1902 using ten thousand glass bottles [17,24]. Later, many buildings around the world were built from waste such as glass, plastic, and tetra pak cardboard. Images of such structures are shown in Fig 7.

Fig. 7. Outdoor and indoor images of buildings constructed with waste bottles [50–52].

In the house belonging to the Alfredo Santa Cruz family, shown in Fig 8, waste was used not only in the construction of walls, as in most similar buildings, but also in many places such as reinforcement, doors, and

windows. The use of bottles throughout the building contributes to an increase in the recycling rate and also gives the building a striking and aesthetic appearance.

Fig. 8. Alfredo Santa Cruz bottle house [53,54].

It is understood that these structures, in which recycled bottles were used as building materials, were built with construction methods that do not require much expertise. From this perspective, there are questions about whether this construction method will be suitable for modern buildings. In response, a few instances demonstrate the viability of recycled bottles in contemporary applications. Fig 9 shows the EcoARK pavilion designed by Arthur Huang. It is situated in Taipei, Taiwan, and was constructed to serve as the 2010 Taipei International Flora Expo display hall.

Fig. 9. EcoARK Pavilion [55].

The facade of the building was constructed with recycled plastic bottles. These bottles, called polli-bricks, were created by melting, blow molding, and reshaping more than 1 million recycled plastic bottles. With the reshaping process, the interlocking of the bottles was made easier, and a modular panel system was created. The panels were covered with fire- and water-resistant film, and the system was completed by mounting these modular panels on the structural steel frame. The air inside the bottles acts as thermal insulation, which is another function of the system. Moreover, the entire system is earthquake- and wind-resistant. In addition to these positive features, the transparency of the bottles allows some of the natural sunlight to penetrate [55].

Another example of the ease of application of Eco-bricks to modern buildings is those described as plastic-sand bricks in the literature. As mentioned in Section 2.1, these bricks are made by melting plastic waste that has been broken into tiny bits and then combined with ingredients like sand and clay. The ability to give these bricks the desired size and shape provides ease of application, providing a significant advantage in replacing traditional bricks.

3. Conclusion

The concept of eco-design intersects with architecture in the context of building materials. In this regard, Eco-bricks, made of waste materials that are intended to minimize environmental harm, are a good example. According to the analysis of study results published in the literature, eco-bricks have a great deal of potential to replace conventional bricks because they are flexible enough to accommodate future development, help

save energy, improve user comfort, and—above all—offer adaptable features for contemporary buildings. Overproduction of plastic waste and garbage, low recycling rates, resource waste, potential climate change, energy, and economic crises, and potential resource scarcity make it necessary to use sustainable building element substitutes made of non-toxic, recycled, or renewable materials in developed as well as developing nations. If materials like non-biodegradable plastic waste are to be used, future studies should do additional life cycle analysis of the building components used in these bricks. This is due to the potential for these materials to leach into the environment and eventually cause harm.

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