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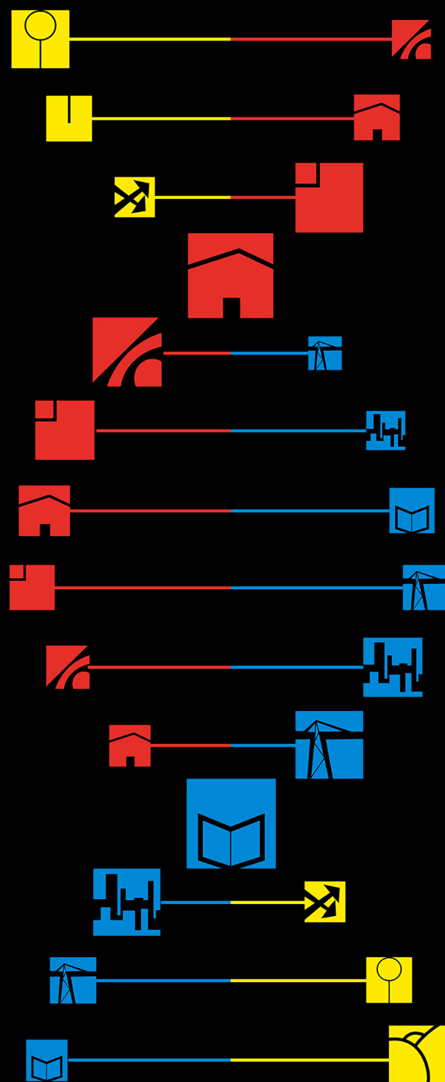

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8th International Congress

September 27-29 2023 Trabzon **TÜRKİYE**

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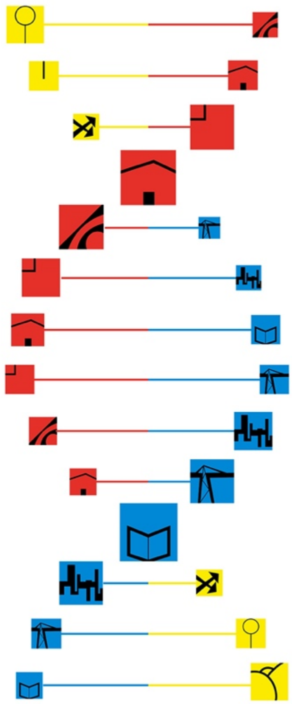

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RE/DE/GENERATION(S) IN ARCHITECTURE

september 27-29 / 2023, Trabzon – Türkiye
karadeniz technical university, faculty of architecture, department of architecture

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KEYNOTE SPEAKERS *

Carlo RATTI *"Senseable Cities: Towards the Integration of Natural and Artificial"*	Massachusetts Institute of Technology Cambridge, Massachusetts, USA
Jose Pareja Gomez *"Fostering Resilient Architecture"*	Zaha Hadid Architects London, England
Styliani LEFAKI *"Urban Regeneration in Words And Praxis: The City in Crisis"*	Polytechnical Collage of Aristotle University of Thessaloniki Thessaloniki, Greece
Vahid GHOBADIAN *"Sustainable Traditional Buildings of Iran: A Climatic Analysis"*	Islamic Azad University Tehran, Iran

** in alphabetical order*

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ACKNOWLEDGEMENTS

We have successfully concluded our eighth LivenARCH (Livable Environments & Architecture International Congress) Congress, which we organized this year under the roof of Karadeniz Technical University Faculty of Architecture, Department of Architecture. First of all, I would like to say that I am honoured to chair this year's meeting of our congress, which has been going on since 2001. For three days, participants presented and discussed their original research under the congress theme. The observations I obtained from the thematic presentations, each of which was interesting from each other, and the sessions I was able to attend as much as possible, showed me that our Congress achieved its main purpose.

As it is known, the most important widespread effect of every congress that has a strong scientific background and addresses current problems based on the needs of the society is that it produces solutions to these problems. In this context, our LivenARCH Congress, which has been organised periodically and with certain current themes for 22 years, has been contributing for years to produce solutions at the theoretical level within the framework of the field of architecture and planning and other related disciplines and within the scope of the determined theme.

So far, our Congress has been organised under the themes of "Nature-Cities-Architecture", "Contextualism in Architecture", "Re/De Constructions in Architecture", "Rejecting / Reversing Architecture", "Replacing Architecture" and "Other Architect/ure(s)". The theme of this year's congress was "Re/De/Generation(s) in Architecture".

As is well known, our world has been witnessing rapid changes in recent years, perhaps more than ever before. Wars, migrations, terrorism, poverty, inequality, lack of education, climate change, pollution, health problems growing with pandemics and economic crises are among the main factors that deeply affect human life and force the transformation of ordinary patterns in all areas of life. The generations that are new to these transformations and whose expectations are shaped according to the new world conditions they live in, create environments suitable for the system in order to capture the dynamics brought by these transformations and to sustain their existence. The generations evolve situations that have disintegrated, deteriorated, and degenerated. Thus, the damaged parts return to their initial states, to their essence, the lost or damaged ones are restored.

In biology, regeneration can be defined as the natural process of replacing or restoring damaged or missing cells, tissues, organs to full

function in living things, in other words, it is the regeneration of a body part that has been lost. By considering the definition of regeneration outside the field of biology, it can be said that all the mental (knowledge) construction processes of human is generated through regenerations, and all the historical actions of human are shaped by regenerative fictions. When this (historical based mental and active) reproduction is evaluated in the context of architecture, it is seen that all the renewed architectural actions are produced through the part of the architectural thoughts and acceptances that are considered as damaged, corrupted or have lost their functions or characteristics. The main goal of our congress, which was held between September 27-29, 2023, was to discuss the phenomena of "generation", "degeneration" and "regeneration" in the context of the act of "architecture" within the framework of the theme "Re/De/Generation(s) in Architecture".

In this framework, 60 papers carefully selected by 34 members of the Scientific Committee met with the audience within the scope of this congress. On this occasion, we are grateful to the esteemed members of the Scientific Committee Göksun Akyürek (Bahçeşehir University, Türkiye), Müjde Altın (Dokuz Eylül University, Türkiye), M. Beatrie Andreucci (Sapienza University of Roma, Italy), Jasim Azhar (King Fahd University, Saudi Arabia), Aydan Balamir (Middle East Technical University, Türkiye), Beatriz Bueno (University of Sao Paulo, Portugal), Gökçen Firdevs Yücel Caymaz (İstanbul Aydın University, Türkiye), Shuva Chowdhury (Southern Institute of Technology, New Zeland), Pelin Dursun Çebi (İstanbul Technical University, Türkiye), Polat Darçın (Yıldız Technical University, Türkiye), Yüksel Demir (İstanbul Technical University, Türkiye), G. Deniz Dokgöz (Dokuz Eylül University, Türkiye), Sıla Durhan (Işık University, Türkiye), Özlem Eren (Mimar Sinan Fine Arts University, Türkiye), Mine Esmer (Fatih Sultan Mehmet Vakif University, Türkiye), Aslı Sungur (Yıldız Technical University, Türkiye), Onur Erman (Çukurova University, Türkiye), Şengül Öymen Gür (Beykent University, Türkiye), Tayfun Gürkaş (Özyeğin University, Türkiye), Ferhat Hacıalibeyoğlu (Dokuz Eylül University, Türkiye), Orhan Hacıhasanoğlu (Özyeğin University, Türkiye), Badiossadat Hassapour (Eastern Mediterranean Univesity, North Cyprus), Pınar Dinç Kalaycı (Gazi University, Türkiye), Carlos Machado e Moura (Univesity of Porto, Portugal), Esma Mıhlayanlar (Trakya University, Türkiye), Ahmet Vefa Orhon (Dokuz Eylül University, Türkiye), Zafer Sağdıç (Yıldız Technical University, Türkiye), Gökçeçiçek Savaşır (Dokuz Eylül University, Türkiye), Semra Arslan Selçuk (Gazi University, Türkiye), Murat Sönmez (TOBB ETÜ Univesity of Economics & Technology, Türkiye), Marc Aurel Schnabel (Victoria University of Wellington, New Zeland), Levent Şentürk (Eskişehir Osmangazi University, Türkiye), Fatih Terzi (İstanbul Technical University, Türkiye), and Belkıs Uluoğlu (İstanbul Technical University, Türkiye).

For three days, we listened to thematic presentations, each of which is interesting and engaging. In his opening presentation, Carlo Ratti, through the projects of the “Senseable City Laboratory”, a research initiative of MIT, and the design office Carlo Ratto Associate, critically examined a new generation of practice defined as the “Internet of Things” or “IoT” in the context of architecture. The reviews we listened to under the main title of “Senseable Citys” were quite interesting.

Manuela Gatto from Zaha Hadid Architects was scheduled to give the second thematic presentation. However, Gatto expressed his regret and made an excuse, stating that someone else would make the presentation instead. In his thematic presentation titled “Zaha Hadid Architects: Fostering Resilient Architecture”, Jose Pareja-Gomez emphasized the importance that Zaha Hadid Architects, a globally recognized pioneer in the field of innovative architecture, attaches to research and development. He noted that the projects are supported by information from ongoing academic research. And he showed very striking examples of this.

The third thematic presentation was made by Styliani Lefaki from Polytechnical College of Aristotle University of Thessaloniki. In her presentation titled “Urban Regeneration in Words and Praxis: The City in Crisis”, Ms. Lefaki evaluated urban transformation practices through selected examples in contexts such as the aims, objectives and characteristics of renewal plans.

We listened to the fourth thematic presentation titled “Sustainable Traditional Buildings of Iran” from Vahid Ghobadian from Islamic Azad University. In his presentation, Mr. Ghobadian talked about a series of rational solutions offered by traditional builders in Iran, which is located in a wide geography with different climatic zones, which can be an example for today's architects. It revealed what kind of ways and means Iran's traditional masons and builders designed for human well-being and comfort in various climatic conditions and without using modern technologies, resorting exclusively to natural resources such as soil, sand, stones, water and plants.

We were going to listen to the last thematic presentation from Sofia Aleixo from University of Évora. But this was not possible. I would like to thank all the keynote speakers for their seminal presentations to the theme of the congress. We listened to them all with pleasure and interest.

The content of 60 presentations made in 16 separate sessions planned in parallel shows that the researches are generally collected under the main headings of philosophy, theory, history, discourse, urban, city, landscape, rural, criticism, method, politics, policies, laws, regulations, ethics, design, education, conservation, transformation, re-use, technology, material, and sustainability. However, it was interesting to see that about a third of the research presented at the Congress was concentrated in the sub-headings "urban, city, landscape, and rural". It was meaningful that various urban and rural practices that occupy the architectural agenda of Turkey were opened to discussion in this Congress whose theme was "regenerations / degenerations". I would like to thank all the paper owners who contributed to our Congress with their valuable researches.

The sessions were conducted smoothly thanks to the selfless efforts of the session chairs. Endless thanks to Asu Beşgen (Karadeniz Technical University, Türkiye), Gökhan Hüseyin Erkan (Karadeniz Technical University, Türkiye), Serap Durmuş Öztürk (Karadeniz Technical University, Türkiye), Beyza Karadeniz (Karadeniz Technical University, Türkiye), Serdar Aydın (Mardin Artuklu University, Türkiye), Aygün Erdoğan (Karadeniz Technical University, Türkiye), Zafer Sağdıç (Yıldız Technical University, Türkiye), Ayhan Karadayı (Karadeniz Technical University, Türkiye), Aktan Acar (TOBB ETÜ Univesity of Economics & Technology, Türkiye), Selin Oktan (Karadeniz Technical University, Türkiye), Şölen Köseoğlu (Atatürk University, Türkiye), Ersin Türk (Karadeniz Technical University, Türkiye), Murat Tutkun (Karadeniz Technical University, Türkiye), Aysun Aydın Sancaroğlu (Karadeniz Technical University, Türkiye), Çağlar Aydın (Karadeniz Technical University, Türkiye), and Muteber Erbay (Karadeniz Technical University, Türkiye) for accepting our invitation.

It is not possible to realise any congress without institutional support. I would like to thank especially our rectorate, dean's office and the head of the Department of Architecture. I would also like to thank the Scientific and Technological Research Council of Türkiye (TÜBİTAK) for supporting our congress.

However, the biggest thank you goes to the members of the Congress Organising Committee. Endless thanks to Nilgün Kuloğlu, Asu Beşgen, Nihan Engin, Nilhan Vural, Hare Kılıçaslan, Özlem Aydın, Aysun Aydın Sancaroğlu, Semih Yılmaz, Kıymet Sancar Özyavuz, Gürkan Topaloğlu, Çağlar Aydın and Selin Oktan, who have contributed to every stage of the congress organisation with great devotion for the last one and a half years.

I would also like to thank graphic designer Cansu Beşgen, who has been preparing the thematic visuals of the congress for a long time. This year, the visual editing of the congress was entrusted to him. I would also like to state that we are happy to see the valuable academic and administrative staff of our Department of Architecture and our students among us.

And finally, endless thanks to Merve Tutkun, Büşra Topdağı Yazıcı, Mehmet Ali Otyakmaz, Güray Yusuf Baş, Barış Çağlar, Tayfur Emre Yavru, the valuable Research Assistants of our Department of Architecture for their extraordinary contributions to the remote execution of the congress and to Beliz Büşra Şahin, who undertook the presentation of the congress.

In 2025, I would like to extend my regards to all of you with the hope of meeting face to face at our Congress in Trabzon (Türkiye), which we will organise for the ninth time.

Prof. Dr. Ömer İskender TULUK
LivenARCH-VIII 2023 Congress Head

VOLUME 2

LIVENARCH VIII

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8th International Congress

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DESIGN/EDUCATION

RE-FRAMINGS IN LONG EXPOSURE: CAPTURING THE GENERATIVE FORCES OF THE MIDDLE EAST TECHNICAL UNIVERSITY CAMPUS COMPETITION[2]

Öncü ÖZALP[1]

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ABSTRACT

Design development and realization stages of Altuğ Çinici and Behruz Çinici's first winning prize for the Middle East Technical University Campus Competition in 1961 integrate one of the most challenging, comprehensive, multifaceted, and complex postwar competition histories in Turkey. Analyzing the influential open archive of Çinicis provides invaluable insights into the design process of the competition and its further articulations in its development phases. Architects' great enthusiasm for the project reveals itself in the multiple stages of drawings including design alterations, revisions, and absolute start-overs in certain circumstances. By embracing qualitative analysis and developing a pattern of interpretive inquiry among the open digital archive of the Architects, this paper engages with the METU Campus Competition proposal of Çinicis as an inherent, generative, and regenerative force, which intensely shaped the forthcoming articulation stages of the selected architectural works, including The Cafeteria, the Department of Physics, and the Main Library. Similar to the traces of the continuous design explorations in the proposal, further development of the three units mentioned above present particular design narratives. As discussed in this paper, exploring the second stage extension of those three Campus buildings suggests that in order to reach an organic yet strictly planned spatial development for the unity of architectural compositions and to take a critical position against standardization, architects explored a unique design vocabulary at the very beginning of the architectural design stages, and designerly explored the idea of a planned growth in the compositional and aesthetic features.

Keywords: Middle East Technical University; campus competition; architectural design as a generative force, postwar architecture; architectural modernism.

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[2] This paper is further developed from the author's continuing Ph.D. dissertation at the Department of Architecture, Middle East Technical University. The author's Ph.D. dissertation is being supervised by Prof. Dr. Güven Arif Sargın. The author expresses his gratefulness to Prof. Sargın for his invaluable contributions and guidance on his Ph.D. research.

INTRODUCTION

Figure 1. The main entrance of the METU Central Library.
Source: The author's photography archive.

The author has been professionally photographing and documenting aesthetic features of the METU Campus since 2014, the time his master's degree started at the Middle East Technical University. Following his great excitement of being on the Campus for the first time and visiting all of the extremely influential Campus buildings in his first week at METU, he scheduled regular visits for more extended examinations since 2014. Closely engaging with all of the Altuğ-Behruz Çinici works on the Campus, the author's process of photographing started with the METU Coastal and Port Engineering Building, which integrates one of the most poetic uses of materials in the Campus architecture (Özalp, 2022). Living inside the Campus, having the invaluable opportunity to be present without interruption, and contemplating the depth of the Campus Architecture during his long walks in different atmospheric conditions, the author could experience Çinici architecture closely for a long time. Photographing the Campus Architecture in different years and re-framing all of the buildings repeatedly were also informed by the highly influential open archive of Altuğ and Behruz Çinici in Salt Research. It enabled the author to re-discover new features and aesthetic values inherent in the design elements and materials.

Also, with respect to the representational and archival values of the METU Campus, the author enrolled two very influential courses during his postgraduate studies, titled "ARCH524-Architecture and Different Modes of Representation" (in 2015-2016 Spring semester) and "ARCH723-Advanced Architectural Design Research II" (in 2018-2019 Fall semester), which were given by Prof.Dr.Ayşen Savaş at METU. (Savaş, 2019).

METU Competition Panels as a Generative Force: 90306

While the main jury members of the international competition for some of the METU Campus Buildings in 1960 were documented as Holmes Perkins, Sir Hugh Casson, Steen Eiler Rasmussen, Kemal Ahmet Aru, Mustafa İnan, and Sedat Hakkı Eldem (Yarışmalar Dizini, 2004); some of the jury members of the METU Campus Competition in 1961 included John von Spreckelsen, Tulû Baytin, Holmes Perkins, Gündüz Özdeş, Sedat Gürel (Sargın & Savaş, 2013).

Turgut Cansever design was awarded with the first prize in the first competition. Following some of the competition panels of Cansever in Uğur Tanyeli and Atilla Yücel's comprehensive work on the architect informs the reader about the emphasis on verticality, presence of the natural landscape, emphasis on the open spaces, and elongated facades of the postposed units (Tanyeli&Yücel, 2007). Also, the use of materials in the proposal reminds one of the previous works of the architect. Hayati Tabanlioğlu seems to attend the same competition as there exists two drawings about this competition in his archive at Salt Research. His proposal includes very pure and simple geometries, which recall the embrace of the international style aesthetic. With distinctive emphasis on the roads, the prismatic units were located alongside the site contours (Salt Research, Hayati Tabanlıoğlu Archive). Competitions, which bring architects' proposal close to each other become very important because analyzing their work in relation to each other can reveal "subjective ways of exploring modernist design thinking" (Özalp, 2023 p.33). For instance, in a hypothetical situation, without architects' names among those limited archival resources, it would had been possible to trace the touch of Cansever on his competition proposal. However, this would had been rather hard to identify the proposal of Tabanlıoğlu without his title provided on the resources.

Also, even previous to the above-mentioned first competition in 1960, Aydan Balamir's study uncover Jaakko Kaikkonen's works on the design of the METU Campus and suggests that some of the archival documents (colored renderings of a school project) found at the Faculty in 2004 might possibly be the archival materials belonging to the first stages of the METU Campus planning before the realization of two Campus competitions (Balamir, 2014).

Altuğ and Behruz Çinici's proposal, which had the entry number 90306 won the first degree in the METU Campus Competition in 1961. Thanks to the open archive of Çinicis, METU Competition panels can be accessed by researchers for a closer examination in a good quality resolution without any alterations. The importance of open archives can be followed from the postwar architectural magazines. *Arkitekt* and *Mimarlık* act as one of the primary sources to follow the results of the postwar architectural and city planning competitions in Turkey. Following the sections about the competitions reveals a general idea about the panels of the competition entries. Inevitably, the publications in those magazines include a process of editing, rescaling and sometimes cropping of the large original panels. The intact METU Competition panes of Çinicis, without any missing parts, give a great insight into the architects' process of preparing, organizing and presenting a design idea, and also provide glimpses the culture of the postwar competition processes.

Also, following the archival photographs from the METU Library Digital Collection enables personal readings, further interpretations, and leads to creating new meaning making processes. The significance of the documentation of the Campus provides remarkable information because the process of documentation can also be interpreted as a leading action of preservation (Savaş & Gürsel Dino, 2019).

Alley **as a Timeframe of the Sequential Realization Stages of the Campus and as a Generative Force**

In the original competition drawings of Çinicis, the definition of the central architectural entity solely for pedestrian use appears as the *alley*. In their articulation on the formation and emergence of the METU as an institutional epistemic entity with multiple dimensions, including social, cultural, intellectual, and architectural programs, Güven Arif Sargın and Ayşen Savaş engage with the transformation of the METU environment, such as the forestation of the vast land; and also focus on the immaterial qualities including the architectural design of the Campus (Sargın & Savaş, 2013). As the writers underline, the alley was very significant for the Campus because "the alley, was designed as the prime instrument for the regulation of the Master Plan to bring order to what was visible on the surface" (Sargın & Savaş, 2013, p. 97). Also, following the competition boards suggests the strong connections between the buildings and the *alley* at the early stages. For instance, in the competition panels, the *alley* not only extends from the north to the south but also makes a presence from east to the Agriculture Department in the west direction. The stages of the campus plan indicate serious evolvements in different stages and one of the most significant changes appear as the scale relationships between the Campus buildings and the coverage of the *alley* as an imprint on the ground.

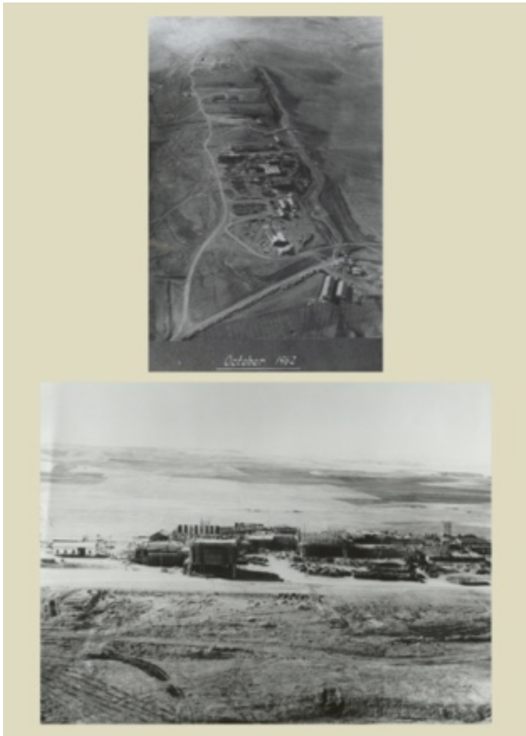

Figure 2. Strong traces of the *alley* accompany the early stages of the formation of the Faculty of Architecture in October, 1962. Source of the first image: METU Library Digital Collection-ODTÜ BELLEK, METU GİSAM Collection, https://bellek.metu.edu.tr/handle/11511/104224. The second image: METU Library Digital Collection-ODTÜ BELLEK, METU Collection, https://bellek.metu.edu.tr/handle/11511/104165. The photographs were gathered by the author.

As clearly can be seen in the Architects' book that was published by the initiation of the architects themselves (Çinici & Çinici, 1970), and in the open archive of the METU Library Digital Collection, the presence of the alley appears at the very early stages of the Campus. In the figure 2, elongated and diagonal traces on the left are the very first and accurate imprints of the alley on the campus land. The same line is also visible on the below image, which can be traced just in front of the Faculty of Architecture. It is exciting to see that the powerful presence of the *alley* in the Competition reflected itself on the very early stages, and witnessed the realization of the Campus units. As seen in the figure 3, alley's partial development in stages (top-right, middle-left) or its traces (top-left, middle-right) are visible alongside the formation of the spatial units of the Campus.

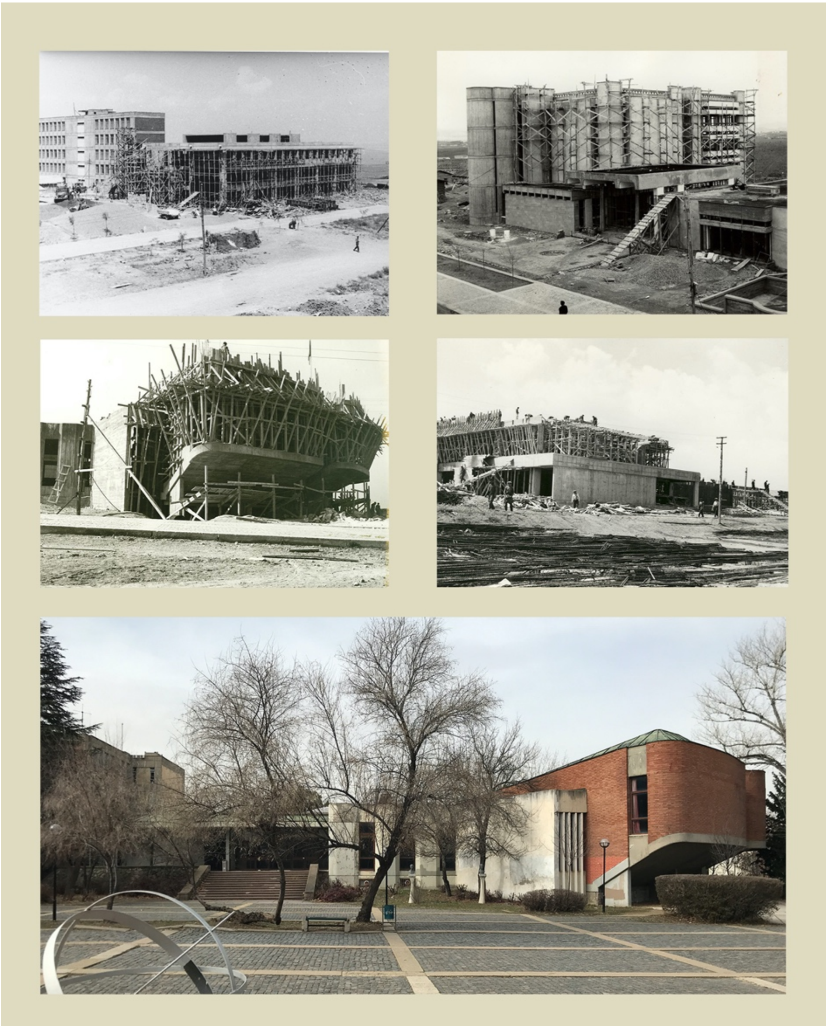

Figure 3. The *alley* became a timeframe, which accompanied the stages of Campus architecture.
Source of the images in the first and the second row: METU Library Digital Collection - ODTÜ BELLEK. The First row: https://bellek.metu.edu.tr/handle/11511/103085, the second row left: https://bellek.metu.edu.tr/handle/11511/103177, the second row right https://bellek.metu.edu.tr/handle/11511/103821. The third row: The photograph was taken by the author.

Figure 4. Temporality of the Campus. Specific dates appear as the inscriptions of the very significant locations. Source: The photographs were taken by the author.

The realization stages and temporality must be very important for the architects. Like artists who include very specific details of the dates on personal and highly significant artworks; the architects noted the date, month, and year of the construction dates onto some of the architectural elements on the Campus. In the figure 3, the Library (left), the Faculty of Architecture (middle), the stages of the Physics, the Clasrooms, and the Auditorium (right) can be followed as some of the remarkable examples having the construction dates as signatures and traces of the architects.

Temporality: Further Articulation Stages of the Cafeteria, the Department of Physics, and the Main Library

After discussing the *alley* as a timeframe for witnessing the sequential formation of the Campus and revisiting the magnetic force of the *alley* in the composition of the METU Competition, this section very briefly engages with the Cafeteria, the Department of Physics, and the Main Library Buildings as they were specifically designed to be competed in stages, and formed a complete unity after their stages were completed.

While the growth of the Cafeteria drawings in the Çinici Archive was dated as December 1968, the Department of Physics follows October 1969, and the growth of the Main Library was noted with January 1972 (Salt Research, Altuğ-Behruz Çinici Archive). As indicated in the figure 5, the compositions of the Central Library and the Physics Department perfectly became one with the further articulations. They responded greatly to the planned growth of Çinicis. It should be emphasized that the first stages of those spatial units were perfectly in use and responded the needs of its users till their planned growth started. Following the modifications between the photographs reveals that architects designed the specific places of expansion with the minimum destruction of the pre-existing unit, primarily via circulation zones.

Figure 5. Temporality of the planned growth. The Main Library and the Physics Department with related photographs before and during the planned growth phases.
Source of the first row: METU Library Digital Collection-ODTÜ BELLEK, https://bellek.metu.edu.tr/handle/11511/103874. The second row, left: Currently, this image is not available to online access, the image was downloaded by the author in the previously shared website of the library archive in 2020. The second row, right: METU Library Digital Collection-ODTÜ BELLEK, https://bellek.metu.edu.tr/handle/11511/103168. The third row, left and right: Photographs were taken by the author. Prepared by the author.

Following the figure 6, the modification in the METU Cafeteria seems to be the most challenging one among those three examples. The second growth unit was indicated with the crimson red. It included the grand "Dining Hall for the Guests" on the ground floor plan. The traces of the yellow dotted lines intersect where the expansion happened on the ground floor plans for all examples. While the pre-existing wet spaces partly remained, a new core was built and re-defined the servant spaces (including the installation shaft) in the second stage. One of most impressive design decisions in the first stage follows the inclusion of an "alternate- spare room" at the core of the expansion area for the further transformation stage.

The METU Central Library also elongated on a continuous axis. As followed in the figure 7, the very first stage integrated the construction of the core, which was indicated as blue in the left section of the figure. This core included the circulation and the wet spaces, which were also used for the same functional purposes after the expansion stage. Demonstrated with crimson red, the second stage articulation completely enclosed the core. The architects achieved unity by completely integrating the core (indicated with blue) into the new composition and designing a new sculptural circulation core for the stairs, which mimicked the one on the first stage. After the second stage, the ventilation openings of the wet spaces in this core directly overlooked the blind walls of the "B" and "C" units and well-articulated the wet space ventilation without any obstacles.

The expansion of the METU Physics Department also partially aligns with the spatial logic behind the Library. By designing a unit corresponding to the main prismatic mass with the same dimensions, and incorporating two circulation cores, the Physics department very much depend on reflecting its first stage.

Very impressively, all of those buildings, which the author considers as artworks, the aesthetics of the architectural compositions intensified with further articulations. However, in their first stage, the buildings also seemed "complete" as a spatial unit without any need of development.

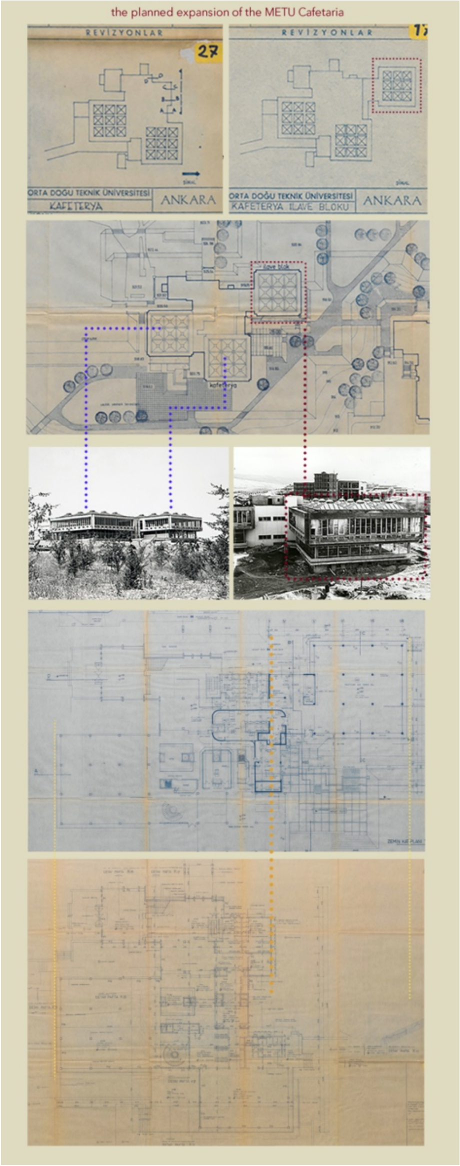

Figure 6. The documents trace the temporality of the planned growth of the METU Cafeteria in two different stages in a sequential order. Source of the first, the second, the third (left), the fourth, and the fifth row: Salt Research, Altuğ-Behruz Çinici Archive. The third row right: METU Library Digital Collection - ODTÜ BELLEK, retrieved from: https://bellek.metu.edu.tr/handle/11511/103203. Prepared by the author.

Figure 7. The documents trace the temporality of the planned growth of the METU Central Library in two different stages in a sequential order.
Source of all of images except the third row-left: Salt Research, Altuğ-Behruz Çinici Archive. The third row-left: Currently, this image is not available to online access; the image was downloaded by the author in the previously shared website of the library archive in 2020. Prepared by the author.

Figure 8. The documents trace the temporality of the planned growth of the METU Physics Department in two different stages in a sequential order.
Source of all of the images except the second row: Salt Research, Altuğ-Behruz Çinici Archive. Second row left: METU Library Digital Collection - ODTÜ BELLEK, the second row-right: Photograph was taken by the author. Prepared by the author.

CONCLUSION

Among the extensive number of postwar competitions in Turkey, revisiting Çinicis' Middle East Technical University Campus competition proposal, its alterations, and the stages of its realization generate extensive design narratives about the Campus design. The competition's extensive program, the complexity of the vast and empty site, the formation of a campus life for both students and academics, and the budget for the project brought about a challenging long-term realization process that was realized in different and long stages. As the title of this paper suggests, re-framing the METU Campus in different stages reveals that Çinicis closely engaged with developing new design vocabularies at the very early stages of their proposals to enable further spatial articulations. Similar to the ideas in the METU Campus Competition boards inscribed as "inkişaf", the architects implemented a similar idea as a generative force in further articulating compositions of the Cafeteria, the Department of Physics, and the Main Library.

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REFERENCES

Balamir, A. (2014). Bir Mimari Proje Yarışmasının Paftaları: Spreckelsen, Akalın, Elbruz Ekibi, 1961. Ankara: ODTÜ Mimarlık Fakültesi.

Çinici, A. & Çinici, B. (1970). *Altuğ-Behruz Çinici: Architectural Works*. Ankara: Ajans-Türk Matbaacılık Sanayii.

Özalp, Ö. (2022). Orta Doğu Teknik Üniversitesi Kıyı ve Liman Mühendisliği. In *Türkiye Mimarlığında Modernizmin Yerel Açılımları XVIII Poster* Sunuşları *Bildiri Özet Kitabı* (p.20).

Özalp, Ö. (2023). Unfolding New Approaches in Modernist Design Thinking Through the Post World War II Architectural Competitions in Turkey. In Duyan, E., & Šmits, R.D. (Eds.). (2023). *Imagined Thing – I. RIXARCH Conference Proceedings* (pp. 26-34).

Salt Research, Altuğ-Behruz Çinici Archive, retrieved from

https://archives.saltresearch.org/handle/123456789/60

Sargın, G. A., & Savaş, A. (2013). A University Is a Society: An Environmental History of the METU Campus. *The Journal of Architecture* 18(1), 79-106. retrieved from: https://doi.org/10.1080/13602365.2012.751806

Savaş, A. (2019). The METU Campus Documented V: Representing Itself. *METU Journal of the Faculty of Architecture* (36) 1, 285-295.

Savaş, A., & Gürsel Dino, İ. (2019). Constituting an Archive: Documentation as a Tool for the Preservation of the METU Faculty of Architecture. In M. Melenhorst, U. Pottgiesser, T. Kellner, F. Jaschke (Eds.) *3rd RMB And 16th Docomomo Germany Conference* (pp. 319-329). Berlin, Germany: Hochschule OWL (University of Applied Sciences) & DOCOMOMO Deutschland e.V.

Tanyeli, U. & .Yücel, A. (2007). *Turgut Cansever: Düşünce Adamı ve Mimar*. Istanbul: Osmanlı Bankası Arşiv ve Araştırmalar Merkezi ve Garanti Galeri.

Yarışmalar Dizini: 1930-2004. (2004). Ankara: TMMOB Mimarlar Odası Genel Merkezi and TMMOB Mimarlar Odası Ankara Şubesi

HOW TO SHAPE POST DISASTER TEMPORARY EDUCATIONAL BUILDINGS: EduTube

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ABSTRACT

Disasters occur quite frequently in the world and bring along many problems besides the loss of life they cause in the region where they occur. These problems, which we witnessed closely after the Kahramanmaraş earthquake in Turkey, revealed how badly the post-disaster life of people who survived such disasters can be affected. Since children's cognitive copying mechanisms are developing, they are more likely to be affected by traumas such as disasters than adults. In this process, it is very important to provide a place where children can continue their normal lives and their routines will not be interrupted in order to improve the negative effects of the disaster. In this study, a temporary educational structure design proposal is presented in order to continue educational activities in the disaster area without long-term interruptions. Within the scope of this design, user-oriented, high quality and environmentally friendly, sustainable solutions are aimed by developing temporary education structures and planning the process steps of the module. Thus, post-disaster education requirements can be met in a short time, life can quickly return to normal conditions and a safe education and rehabilitation area can be created especially for children. In this context, first of all, national and international literature on temporary education buildings is reviewed and examples are examined. In the next stage, the design parameters for the module were determined and then the temporary education structure "EduTube" project was developed according to these parameters.

Keywords: Disaster; sustainability; post disaster temporary educational buildings; temporary disaster shelter; universal design principles.

INTRODUCTION

Disasters not only result in the loss of life in the area where they occur, but they also seriously affect the built environment where the survivors dwell. Structural damages in the places where people spend most of their time bring many problems in the short and long term. These problems, which we witnessed closely after the recent earthquake centered in Kahramanmaraş that affected eleven provinces of Turkey simultaneously, revealed how badly the post-disaster life of people who survived can be affected. In areas with heavy user traffic, structural deterioration is directly tied to the disruption of housing, health, education, and other infrastructure services. Considering the conditions of the post-disaster period, it is possible to say that the primary needs of people are health, rehabilitation, food and shelter (Yüksel and Limoncu,2013). The spatial needs of disaster victims in this area should be met as a priority in order to overcome the crisis process with the least damage. Therefore, the units that should be established during the emergency relief phase can be listed as collective shelters, crisis management centers, places for health services, warehouses where relief supplies will be stocked, kitchens and dining halls, and temporary education structures. (Yüksel, 2012). After the physiological needs of disaster victims are met and their access to areas where they can fulfill their vital activities, even if minimal, is ensured, it is a natural consequence that the psychological effects of the disaster emerge. In this context, there is a need to establish various rehabilitation areas in disaster areas. The aim of the temporary structures to be built during the rehabilitation phase is to meet the psychological, sociological and physiological needs of the people during the period until the construction of permanent structures is completed (Yüksel, 2012). Education inevitably becomes a need that must be satisfied in this process.

In the aftermath of a disaster, school facilities are often damaged, destroyed or used as emergency shelters, resulting in prolonged disruption of education and ultimately reduced quality of education. In addition to the loss of life in the region where disasters occur, they also cause great damage to the structured environment in which the surviving people live. Structural damages in the places where people spend most of their time bring along many problems in the short term and long term (UNICEF,2013). Therefore, disaster damage to educational spaces has a devastating impact on children and youth. Since children's cognitive copying mechanisms are developing, they are more likely to be affected by traumas such as disasters than adults (Enginöz, 2005). Since children are one of the most vulnerable populations in a society, it is a natural consequence that they are more traumatized than adults in situations with multifaceted damages such as disasters. Education is important for children who are affected by these negative factors as a result of earthquakes and similar disasters because of its healing power. While everything around the children is going against the flow of their daily lives, providing a place where they can continue their normal lives and where their routines will not be interrupted is very valuable in terms of healing the wounds of the disaster. A correct and quality education to be provided in spaces created in line with the needs of disaster-stricken students can prevent psychological, social and economic problems experienced as a result of the earthquake before they begin (Faiz, 2009). For education to be of a certain quality, spatial needs and standards are extremely important. Since the need for education is frequently not seen as a priority there, it wouldn't be unfair to say that temporary structures where learning activities are done are similarly disregarded in disaster situations. Numerous instances from throughout the world demonstrate that this need is not being given sufficient attention or serious consideration. The fact that the educational structures are started to be built long after the disaster occurs and the construction period of the units takes a very long time leads to significant disruption of the education of the students (Yüksel, 2012). In addition to the impact of these disruptions on the cognitive development of children and young people, it is also possible to talk about their negative psychological effects. In order to maintain education activities without long-term interruptions, it is critical to provide temporary education structures to the disaster area as quickly as possible so that people can return to their normal lives.

It is possible to talk about different requirements and criteria for the design of temporary educational buildings to be used by disaster victims. Therefore, it is a necessity for the designer to consider these criteria when making spatial decisions. It is possible to associate the concept of sustainability, which we have heard frequently in recent years, with these structures.

> *The concept of sustainability in the creation of temporary educational structures after disasters includes the resumption of education of disaster-affected students in places that can meet their needs as soon as possible, without harming the environment and ensuring the conservation of resources (Yüksel, 2012, p.17).*

Therefore, when an educational building is proposed, the fact that it is energy positive, environmentally friendly, contributes to the circular economy and is cost-effective is included in the scope of sustainability of the space. One of the issues that should be considered in the design of these structures is to ensure robustness and to make the structure as durable as possible in order not to adversely affect the psychological state of the users who are badly affected by the disaster. On the other hand, since users spend a significant part of the day in educational buildings, it is important to consider the spatial characteristics of these buildings in the design process (Tönük, Görgülü and Tuncer Gürkaş,2011). In this context, one of the concerns of the designer should be to develop a scenario on the suitability and adaptability of the proposed building for different uses during the day and to prioritize the flexibility of the building.

> *Consequently, in the design phase of a sustainable temporary education structure after a disaster, construction systems that can be built in a short time, are lightweight, easy to store and transport, easy to disassemble and reassemble, do not require specialized labor, have spatial reproducibility, do not emit noise to the environment, are low cost and durable should be selected (Yüksel and Limoncu, 2013, p.14).*

In this study, a design proposal for a temporary educational structure that can be used after a disaster is presented to solve the problem defined by taking the mentioned design criteria into the center. The developed modular structure is designed in such a way that it can be used both after a disaster and evolve for different needs. Within the scope of sustainability, a structuring that emphasizes energy efficiency is proposed, while photovoltaic panels are used on the upper cover of the building. The building material of the space was determined as cardboard tube system, which stands out with its lightweight, durable, economical, easily applicable, superior insulation and recyclable material properties. The interior fittings to be used in this building, which is designed based on universal design principles, have been developed within the scope of equitable use and flexibility in use. Thus, the proposed modules are intended to serve different user profiles simultaneously. By using different colors on the outer shell of the modules, different functions are defined based on the principle of simple and intuitive use. Color coding was used to facilitate the installation, as the number of functions and the way in which they can come together will vary depending on the area and location where the temporary education structures will be used. The modules are also designed to be adaptable to changes in the number of users by extending and expanding with transverse and longitudinal articulation. The design of the study utilizing qualitative research methods was determined as a case study. While this proposal for temporary education structures was shaped in the light of interviews with experts, the opinions of experts from different disciplines were utilized. As a result, the research focuses on the educational issues facing children in disaster areas—the population that is most affected by disasters—and suggests an educational framework based on the principle of not interrupting students' education.

Problem Definition

Today, the design of post-disaster temporary education structures in Turkey is not at the desired level. Besides, they do not carry the principles of sustainability and universal design. The problems encountered in these structures are related to issues such as lack of space and area, insulation (heat, moisture, fire), transportation, installation, dismantling and reusability. The fact that temporary education structures are generally not among the priorities after the earthquake, delayed installation, insufficient number, non-functional and not designed for every child delays the rehabilitation and recovery stages of children after the earthquake. This leads to prolonged disruption of students' cognitive education and continued psychological impact. For this reason, in line with the identified deficiencies, it is of great importance to conduct a study and present a design proposal especially for Turkey, which is an earthquake zone.

Purpose of the Study

This research focuses on the educational problems of children, who are the most affected group in the post traumas of disasters, and aims to propose an educational structure based on the idea of not interrupting their education. The study also aims to design interior fittings based on the universal design principles of equitable use and flexibility in use. In this way, a modular structure that can serve every child after the disaster will be designed both as an educational space and as a modular structure that can evolve for different needs. In addition, it is aimed to draw attention to recycling and sustainability by choosing sustainable materials for the upper cover of the building and the structure of the space.

METHOD

In this study, the "Case Study" design, one of the qualitative research methods, was used. This design is descriptive and uses one or two cases to provide information about a situation. This helps to interpret other similar data, especially if there is a reason to suggest that the reader has little knowledge about a program (Yıldırım and Şimşek). Within the framework of this design, the following methods were used: literature review, examining master's and doctoral theses and scientific articles and designs, and collecting information by conducting research on the internet.

The Research Process

The researchers created this study based on a project conducted by researchers Feyza Mendi and Nursena Koyutürk within the scope of the "Specialized Interior Design Studio" course in the Design Master's program of TOBB University of Economics and Technology, Institute of Social Sciences, with Ahmet Fatih Karakaya as the director and consultant. In this project-based course, students are asked to identify a universal design problem for earthquake victims by considering universal design principles. It is aimed to develop alternative designs in accordance with this problem. The EduTube project, which is the subject of this research, is a post-disaster temporary education structure project shaped on the basis of universal design principles.

The EduTube project includes the design process of a temporary educational structure and interior fittings to serve the purpose of this research. In the first phase of this study, information based on the literature review on the necessity and importance of temporary education structures in Turkey and in the world after disasters was provided. In the second phase, a temporary education module was designed based on universal design principles, which can be used both after a disaster and evolve to meet different needs. Along with the module, interior fittings were developed based on the universal design principles of equitable use and flexibility in use. It was determined that there was a deficiency in this direction in Turkey, and a draft design emerged in the context of the EduTube project. During this study, examples of post-disaster temporary education buildings in Turkey and all around the world examined. In according to universal design principles, interior fittings elements developed and structural decisions of the model given.

EduTube Design Development Process

As previously indicated, the research of existing post-disaster shelters and structures served as the first step in the design process. Examining the shelters and determining the advantages and disadvantages of their designs were the main objectives. This analysis helped identify key design elements that were effective in providing safety and comfort to survivors, as well as areas that needed improvement. Additionally, studying the existing shelters allowed for a better understanding of the specific needs and challenges faced in post-disaster situations, informing the development of innovative and practical solutions.

In the light of all this information, it was decided to create a module in order not to interrupt post-disaster educational activities. Within the scope of the research, the educational problems of children, who are the group most affected by disasters, in disaster areas have been focused on, and an educational structure proposal has been presented by centering on the idea of not interrupting their education. Although the proposed module design's target audience was disaster-affected children and their education, it was also one of the primary considerations to address the requirement for shelter in the disaster area. The module design aimed to provide a comprehensive solution by incorporating both educational and shelter components. By integrating these two aspects, it would ensure that disaster-affected children not only receive the necessary education but also have a safe and secure environment to live in during the recovery period. This holistic approach would greatly contribute to their overall well-being and aid in their long-term recovery process.

Design Principles of the Model

Universal Design Principles

The module design was guided by universal design principles. One of the crucial points during the design process was making the use of modules simple and intuitive. Thus, the use of different colors on the outer shell of the modules for different functions is an important point. As an example, blue modules identify wet areas where sanitary equipment is located. In the same way, red symbolizes the heating module, yellow represents the electricity cables, and lastly, green represents the natural ventilation function. These color-coded modules not only enhance the visual appeal of the design but also serve as a practical way for users to quickly identify and locate specific functions within the space. By incorporating these distinct colors, users can easily navigate and understand the layout of the modules, promoting efficiency and ease of use. Additionally, this color system also allows for easy maintenance and troubleshooting, as any issues or repairs can be quickly identified based on the corresponding color code.

Moreover, the modules are designed to be adaptable to changes in the number of users by extending and expanding through transverse and longitudinal articulation. This adaptability and flexibility ensure that the modules can easily accommodate an increasing or decreasing number of users without requiring significant modifications or replacements. The transverse and longitudinal articulation allows for seamless integration and scalability, making the modules a flexible solution for evolving user needs.

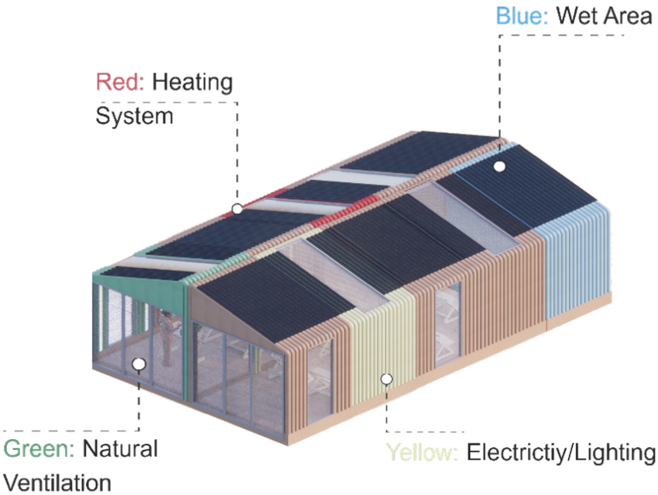

Figure 1. EduTube Color Coding Scheme

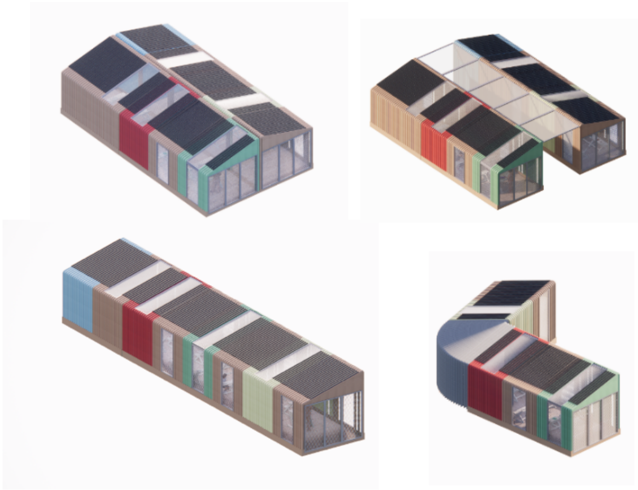

Figure 2. EduTube Module Options

In addition to the exterior structure of the modules, the interior fittings are designed in line with the universal design principles of flexibility and equitable use. Tables and chairs used in the space should be adjustable, easy to set up, light, and durable. Thus, it is ensured that the indoor equipment can serve all age groups and different purposes of use. For example, the tables can be easily raised or lowered to accommodate individuals in wheelchairs or those who prefer to stand while working.

Additionally, the chairs can be adjusted to provide optimal comfort for people of varying heights and body types. This ensures that the space is inclusive and accessible for everyone, regardless of their physical abilities or preferences.

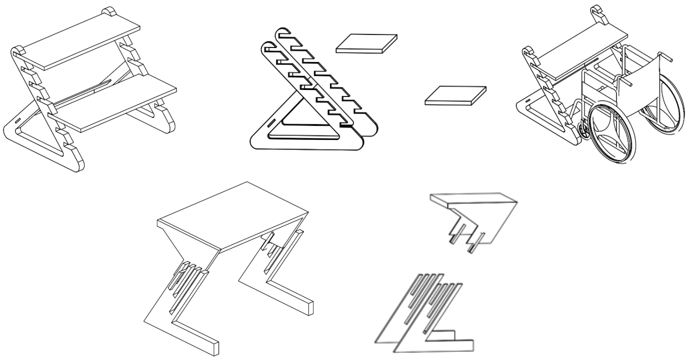

Figure 3. EduTube Adjustable Furniture

Sustainability

In the design phase of sustainable temporary education structures after the disaster, construction systems that can be constructed in a short time, are lightweight, easy to store and transport, easy to disassemble and reassemble, do not require expert labor, have spatial reproducibility, do not emit noise to the environment, are low-cost, and are durable should be selected (Yüksel and Limoncu, 2013, p. 14). These criteria are essential for ensuring that the temporary education structures can be quickly deployed and provide a safe and conducive learning environment for affected communities. Moreover, incorporating sustainable materials and energy-efficient design features can further enhance the long-term viability of these structures, minimizing their environmental impact and promoting a more sustainable recovery process.

Within the context of sustainability, it was intended to present a building that emphasized energy efficiency, and photovoltaic panels were used on the upper cover of the building to achieve this. These panels fulfill the module's energy needs for both its electricity and heating requirements. The integration of photovoltaic panels not only reduces the building's reliance on fossil fuels but also helps in minimizing its carbon footprint.

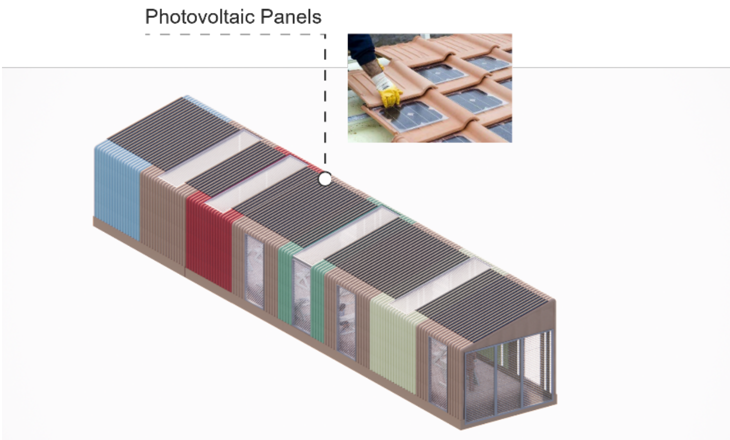

Figure 4. EduTube Photovoltaic Panels

In line with sustainable design criteria, the structural material of the space was determined to be a cardboard tube system. Cardboard tubes are elements in the form of cylinders made of wood pulp. The lightweight, durable, economical, easily applicable, superior insulation, and recyclable material properties of the building system are a serious alternative for the urgent and safe building need that arises after the earthquake. Cardboard tubes are also used as structural elements such as columns and beams. These tubes can be easily cut and assembled to create various shapes and sizes, making them highly versatile in construction (Tütüncü and Ökten, 2021). Besides, the use of cardboard tubes as structural elements allows for quick and efficient assembly, reducing construction time and costs. As Tütüncü and Ökten mentioned (2021), considering the frequency of damaging earthquakes in our nation and the requirement for quick-build temporary homes, cardboard tube systems are an alternate building material for the country.

In addition to the structure of the modules, the materials to be used in the interior design should be sustainable and easy to apply. For this reason, the main material of the interlocking floor tiles used on the floor of the space was determined to be rubber. In addition to complying with the universal design rules of simple and intuitive use in terms of installation, the advantages of interlocking rubber tiles can be listed as being waterproof, ensuring a soft finish, easy cleaning, providing sound and heat insulation, and being waterproof. Furthermore, rubber tiles are known for their durability and resistance to wear and tear, making them a long-lasting option for high-traffic areas. Likewise, the rubber material used in these tiles is eco-friendly, as it is often made from recycled materials, contributing to the overall sustainability of the interior design.

Figure 5. Cardboard Tubes

Figure 6. Interlocking Rubber Floor Tiles

This understanding of sustainable materials is reflected not only in the scale of the outer shell and floor material of the space but also in the furniture proposed to be used in the interior. The tables and chairs, which are intended to be adjustable, easy to set up, and lightweight, are proposed to use a material obtained from recycled paper scraps. This material, known as papercrete, is a mixture of recycled paper and cement that offers durability and strength while minimizing environmental impact. Besides, the use of recycled paper scraps in the furniture promotes the concept of a circular economy by giving new life to waste materials.

Figure 7. EduTube Interior Perspective

Design Components of the Model

The EduTube project is a post-disaster temporary education module that is functionalized by joining the modules formed by combining cardboard tubes with each other. The modules, which are formed in determined standard dimensions, are designed to be easily and quickly installed and serve in the disaster area in case of need, and they are set out with the aim of providing many advantages in terms of transport, sustainability, reusability, and cost.

The pre-shaped cardboard tube elements are designed in such a way that they can be easily transported to the area of need in case of disaster, and then they can be easily assembled and installed in the area without the need for a qualified labor force. While natural ventilation and the use of daylight are taken into consideration with the openings provided on the facades and ceilings of the modules, solar panels on the top cover are used to neutralize the energy needs of the module.

Since the modules which can be combined in different ways in different scenarios, flexibility is provided in the design, allowing the space to grow and expand or shrink and narrow. It provides easy installation and sustainability not only with its outer shell but also with its interior fittings and materials. These modules fulfill many of the requirements of post-disaster temporary structures with the use of furniture that can be easily modified depending on the intended use and the use of interlocking rubber tiles that can be installed in a simple way. Moreover, the modular design of these structures allows for easy transportation and assembly, making them ideal for emergency situations where time is of the essence. The use of durable and sustainable materials ensures that these temporary structures can withstand harsh environmental conditions and provide a safe and comfortable living space for those affected by disasters.

Figure 8. EduTube Exterior Perspective

Figure 9. EduTube Interior Perspective

Figure 10. EduTube Interior Perspective

Figure 11. EduTube Interior Perspective

CONCLUSION

Besides the loss of many lives after the disaster, as a result of the structural damages, the areas that can fulfill the functions necessary for daily life are also damaged. Damage to the structures where functions such as shelter, health, and education are provided negatively affects the post-disaster lives of disaster victims. In this study, the focus is on education, which is one of the activities disrupted after a disaster, and how education can be sustained after catastrophic disasters. Children are more impacted by disasters and the traumas that follow than adults, which is one of the key reasons why education was chosen as the research's main focus.

In this sense, national and international standards regarding temporary education and sheltering structures after disasters have been investigated in the research, and as a result of the inferences made, a temporary education model has been proposed. This temporary education structure proposal, which will support the rehabilitation processes of disaster-stricken children and serve their right to receive education, is designed in a way to meet the need for shelter at the same time with its flexible and transformable structure. The EduTube project, which was created with universal design principles and sustainability goals at the center, aims to respond to the need for post-disaster education and shelter with its adaptability to different scenarios.

Consequently, while EduTube creates a model for the continuation of the education process of children after the disaster without interruption, it is also able to meet the basic shelter needs of not only children but also disaster victims of all age groups with its adaptable features. This model, which has been developed in order to overcome the process after the devastating earthquake disaster that our country, which is located in the earthquake zone, has recently faced, has been proposed in order to respond to the needs of both children, who are the future of the country, and all disaster victims.

Figure 12. EduTube Exterior Perspective

REFERENCES

Enginöz, E.B., (2005). Afet konutlarında mimari tasarım sürecinin kullanıcı ihtiyaçları bağlamında irdelenmesi (Analysis of architectural design process of post-disaster houses in the context of occupants' needs summary). Doktora Tezi (Ph.D). İstanbul Teknik Üniversitesi, Fen Bilimleri Enstitüsü, Mimarlık Anabilim Dalı, İstanbul.

Faiz, M., (2009). 17 Ağustos ve 12 Kasım 1999 depremlerinin Gölyaka (Düzce) ilçesine bağlı ilköğretim okulları öğrencileri tarafından algılanışı (Of August 17 and 12 November 1999 earthquake Gölyaka (Düzce) adhere to county elementary school students by perception of interconnections). Yüksek Lisans Tezi (Thesis of Master). Abant İzzet Baysal Üniversitesi, Sosyal Bilimler Enstitüsü, Sosyal Bilgiler Eğitim Anabilim Dalı, Bolu.

Gibbs, L., Block, K., Harms, L., MacDougall, C., Baker, E., Ireton, G., Forbes, D., Richardson, J. and Waters, E. (2015). Children and young people's wellbeing post-disaster: Safety and stability are critical. International Journal of Disaster Risk Reduction, 14, 195-201.

İlhan, H.B., (2010). Afet sonrası rehabilitasyon aşamasında barınma uygulamalarının sürdürülebilirlik doğrultusunda irdelenmesi (Studying of post-disaster housing in rehabilitation stage in accordance with sustainability). Yüksek Lisans Tezi (Thesis of Master). Yıldız Teknik Üniversitesi Fen Bilimleri Enstitüsü, Mimarlık Anabilim Dalı, İstanbul.

Limoncu S. and Atmaca, A.B. (2018). Çocuk Merkezli Afet Yönetimi (Child-Centered Disaster Management). Megaron, 13(1), 132-143.

Tönük, S., Görgülü T. and Tuncer Gürkaş, E. (2011). Yarı nemli iklimli marmara bölgesi için sürdürülebilir temel eğitim okul binaları tasarım yaklaşımları, Ilıman-Nemli İklim Kuşağı İçin Sürdürülebilir Temel Eğitim Binalarının Tasarım Kriterleri, Yıldız Teknik Üniversitesi Basım-Yayın Merkezi, İstanbul.

Tütüncü B. and Ökten, M.S. (2021). Taşıyıcı Karton Tüp Sistemler ve Shigeru Ban Mimarlığı (Load-Bearing Cardboard Tube Systems and Shigeru Ban's Architecture). Journal of Architecture and Life, 6(3), (793-817).

UNICEF. (2013). Compendium: transitional learning spaces (tls)- resilient design and construction in emergencies 2013. Retrieved from https://reliefweb.int/report/world/compendium-transitional-learning-spaces-tls-resilient-design-and-construction

Yıldırım, A. and Şimşek, H. (2021). Sosyal bilimlerde nitel araştırma yöntemleri (Qualitative research methods in social sciences). Ankara: Seçkin.

Yüksel, E. (2012). Afet sonrası geçici eğitim yapılarında yapısal sürdürülebilirlik (The structural sustainability of post disaster temporary educational buildings). Yüksek Lisans Tezi (Thesis of Master). Yıldız Teknik Üniversitesi Fen Bilimleri Enstitüsü, Mimarlık Anabilim Dalı, İstanbul.

Yüksel, E. and Limoncu, S. (2013). Afet Sonrası Sürdürülebilir Geçici Eğitim Yapılarının Yaşam Süreçlerindeki Eylem Adımları ve Öneriler (The Activity Steps on the Life Process About the Post Disaster Sustainable Temporary Educational Buildings and Suggestions). Megaron, 8(1), 8.

LEARNING WITH A LIVE PROJECT: THE POST-OCCUPANCY EVALUATION OF AN ACADEMIC BUILDING

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ABSTRACT

Embodied carbon emissions from building operations and construction accounted for 37% of worldwide energy and process-related emissions in 2022. To meet climate goals, emissions must decrease by over 98% from 2020 levels by 2050. This urgency has led industry stakeholders, including architects, to focus on retrofitting existing buildings. In this context, Post-Occupancy Evaluations (POE) play a crucial role. POE helps assess how well a building meets the needs of its occupants and identifies opportunities to save resources and enhance indoor environmental quality (IEQ). However, the existing architectural curricula often do not adequately address the evaluation of existing buildings and retrofitting practices, which are essential skills for architects in the face of the climate crisis.

To address this gap, this paper reports on a final project undertaken as part of an elective course entitled 'sustainable architecture.' In this course, students in the 4th grade worked collaboratively to conduct an investigative post-occupancy evaluation (POE) of the Foreign Language Department (FLD) Building at TOBB University of Economics and Technology (TOBB ETU). Their objective was to identify passive and active interventions to enhance energy efficiency, eliminate on-site fossil fuels, and improve indoor environmental quality (IEQ). This paper details the course activities, POE results, and the design interventions proposed by the students, offering insights into how architectural education can adapt to the pressing sustainability challenges of our time.

Keywords: Sustainability; architectural education; retrofitting; post-occupancy Evaluation (POE); energy performance

INTRODUCTION

CO_2 emissions from the operational and construction (also known as embodied carbon) phases of buildings are estimated to account for approximately 37% of global energy and process-related emissions in 2022 (International Energy Agency, 2022). Buildings and the construction sector are far behind regarding decarbonization, which includes all new and existing buildings' entire life cycles (operational and embodied emissions). By 2050, emissions must fall by more than 98% from 2020 levels (United Nations Environment Programme, 2022). This urgency has brought the retrofit of existing buildings to the attention of sector stakeholders, including architects. Yet schools of architecture are seen as reluctant to address retrofitting practices (Özgenç, 2021). Only a few studios or courses in architectural education are devoted to looking at existing buildings (Grant, 2020).

Beyond leveraging building sustainability tools to accelerate the rate of energy upgrades, buildings must also provide comfortable living environments to achieve the Sustainable Development Goals. (Boissonneault & Peters, 2022), while acknowledging that the concept of comfort remains elusive (Sipahioğlu, 2013). In assessing the existing building stock, post-occupancy evaluations (POE) are essential to ascertain the provision and maintenance of users' needs. POE determines how a building performs after completion and what improvements may be needed to reduce resource demands and increase IEQs (Lolli et al., 2022). Yet evaluating the user side of buildings is missing from the program outcomes of existing architectural curricula.

Courses built on theoretical, teacher-centric lecture models fall short of equipping students with the competences required for innovative collaborative team design processes (Induja et al., 2022). This paper posits that students' design and research studies, like 'live projects', carried out for a building where they have experience, also trigger students to be more motivated in the learning process and promote their competencies. To this end, this study is built upon an elective course entitled 'sustainable architecture,' taught in 4^{th} grade, that aims to foster action-centric learning beyond the classroom in a real-world physical setting.

The research adopts a case-study approach. In this context, students undertook a final project involving a post-occupancy evaluation (POE) of the Foreign Language Department (FLD) Building located on the TOBB ETU Campus. The primary objective of this evaluation was to assess the building's performance and user satisfaction and pinpoint areas for enhancement in terms of energy efficiency and indoor environmental quality (IEQ). The students worked collaboratively to identify potential passive and active intervention points, with the overarching aim of bolstering energy efficiency, curbing fossil fuel consumption, and elevating IEQ within the building.

This paper begins by offering a succinct introduction to the primary objectives of a post-occupancy evaluation (POE). It then presents a detailed account of the course activities, highlights the outcomes derived from the POE conducted on the FLD building, and outlines the design interventions proposed by the students.

POST OCCUPANCY EVALUATION (POE)

Post-Occupancy Evaluation (POE) involves evaluating a building or space after it has been occupied for some time. The aim of POE is to collect information about how effectively the area meets its intended purpose and user needs. By analyzing the data collected through POE, areas of the space that can be improved or modified for better performance can be identified. Additionally, this data helps to comprehend how occupants' satisfaction in buildings is influenced by factors like thermal, acoustic, and visual conditions, air quality, as well as other aspects of the workspace and building, such as views, furniture arrangement, privacy, cleanliness, and control over the internal environment (Altomonte & Schiavon, 2013).

The aim of POE extends beyond merely establishing a methodology to collect information about sustainability concerns arising during the post-occupancy phase. In accordance with Whyte and Gann's (2001) suggestion, it also aims to improve the application of design skills more effectively. As anticipated, this process not only enhances the understanding of design guidelines and regulatory processes but also provides insights for refurbishment. In addition to its benefits in conceptualizing new procedures on paper, POE aids in enhancing users' awareness and capacity to exclusively utilize efficient devices.

POE encompasses two primary components: subjective methods, which involve occupants' perceptions of the built environment, and physical measurements that quantify specific characteristics of the space. These two components are interconnected, as the effective management of buildings depends on accurate physical measurements to optimize energy consumption and minimize material waste.

In previous studies that conducted POE, subjective methods were commonly employed, including occupant survey questionnaires (81.51%), focus-group or structured interviews (45.89%), and walkthroughs (37.67%). For physical measurements, the assessment covered energy (26.03%) and water usage (9.59%), as well as indoor environmental quality (IEQ) aspects such as thermal comfort (42.4%), lighting (24.66%), indoor air quality (22.60%), and acoustics (13.70%). Recent additions to POE include visual recordings, technical inputs to the building structure, service, or system, window opening sensors, and GPS-assisted mobility tracking (Asojo et al., 2021).

POE studies can be effectively categorized into three distinct types: indicative, investigative, and diagnostic (Preiser, 1995). Indicative POEs involve swift walkthrough assessments that encompass structured interviews with key personnel, group meetings with end users, and thorough inspections. Investigative POEs delve deeper into the analysis by incorporating interviews, survey questionnaires, photographic or video recordings, and physical measurements. Diagnostic POEs can take months or years and require highly sophisticated data gathering and analysis techniques focused on a wide range of performance evaluation aspects (Göçer et al., 2015).

A user engaging in POE should anticipate benefits spanning short, medium, and long terms from the process. Over the short term, the active engagement of building occupants in the evaluation process is likely to result in improved attitudes. In the medium term, substantial cost savings throughout a building's lifecycle and increased accountability for its performance by design professionals and owners should become evident. Looking ahead to the long term, improvements in building performance are expected, contributing to enhancements in design databases, standards, criteria, and guidance literature. Additionally, advancements in measuring building performance through quantification are anticipated.

Conversely, it's also anticipated that gaps may arise within the system where the prerequisites of the building, the occupants, and the POE system might not align effectively. Building problems encompass challenges occurring across the building’s lifecycle due to design and technology deficiencies, which hold the most potential for optimization. Occupant issues mainly result from clients' use of construction equipment during the operational phase. Meanwhile, problems with the POE system stem from shortcomings in existing systems, including subjectivity and regional inapplicability (Li et al., 2022).

RESEARCH METHODOLOGY

This research utilized a case study methodology. In the context of their final project for the "Sustainable Architecture" elective course, which is part of the fourth-grade curriculum at TOBB ETU, student teams collaborated to conduct a comprehensive post-occupancy evaluation (POE) of the FLD Building situated on the TOBB ETU Campus. The evaluation encompassed a range of subjective methods and the collection of physical measurements, including data related to energy consumption.

The FLD building was constructed in 2008, and the project's design and construction phases were relatively brief, lasting approximately 8 months. It was built using a tunnel formwork system and has a total construction area of 9000 m^2 with a floor height of +3.60 meters. The building comprises a basement, ground floor, and four stories.

The FLD Building's layout consists of the following:

- Ground floor: This floor houses two cafeterias, exhibition areas, an entrance hall, a photocopy room, four lecture rooms, an information desk, restrooms, and a kitchen.
- Basement: The basement includes refuge areas, archive rooms, a technical room, a water reservoir, and a system control room.
- Upper four floors: These floors each contain 11 classrooms located in the northern and southern wings, while offices on each floor primarily serve teachers and administrative staff of the FLD in the east-west wing. There are four foyer zones, and the foyer on the 4th floor has a two-story height. Additionally, there is a reading room on the first floor, and TOEFL exam rooms are located on each floor.
- Heating and Cooling: The building is heated using a boiler with a capacity of 880 kW. However, there is no established air conditioning (A/C) system in the building. Due to height limitations, installing an HVAC system is not feasible. TOBB ETU's academic calendar includes three terms in a year, so the classrooms are in use during the summertime as well.

The evaluation studies adhered mainly to the POE stages defined by RIBA (2016), but the main evaluation focusses on the IEQs:

(1) Collecting client experience: This involved conducting interviews with the building manager and the head of the FLD to gather their insights and experiences.

(2) Building Layout Analysis: The building's layout, including the examination of its fabric and detailing, was analyzed through multiple walkthroughs.

(3) Collecting users' feedback (students, academic, technical, and administrative staff) on IEQs: Feedback from various user groups, including students, academic staff, technical staff, and administrative staff, was collected through several methods:

a) A POE customized questionnaire created by the teaching staff and students (TOBB ETU Human Research Evaluation Board registry number: 2023-06):
The online-administered questionnaire included 15 indoor IEQ categories measured on a 7-point Likert scale (1-very dissatisfied to 7-very satisfied) for assessing occupants' perceptions of the offices, reading hall, and foyer. Additionally, there were 13 indoor IEQ criteria (also on a 7-point Likert scale) for evaluating the classrooms. The IEQ categories covered aspects such as acoustic quality, thermal conditions, indoor air quality, daylighting conditions, electric lighting conditions, furnishings, and space adequacy.
It's worth noting that data about the floors of each evaluated classroom and office was collected, but the analysis was not conducted, with only the façades being taken into consideration. Participants were specifically asked to evaluate the classrooms during the fall season because student interviews and pilot surveys revealed that participants couldn't recall the indoor environmental quality (IEQ) of the classrooms for other seasons.
Due to the limited knowledge of students in statistical analysis, instead of conducting parametric tests, the distribution of ratings for each question is tabulated on a chart, and the mean rating, including the range of responses, is visualized.
(b) focus group meetings with students (all the students enrolled in the course had previous experience in this building, making them interview participants as well);
(c) one-to-one interviews with administrative and academic staff

(4) Collection of utility bills: Natural gas and electricity bills for the building were collected over the course of a year.

The goal of these evaluation steps was to identify both passive and active intervention points that could enhance the building's energy efficiency, eliminate on-site fossil fuel usage, and improve IEQ for its occupants.

The retrofit studies conducted by students consisted of two stages:

(1) BIM model of the existing building (Life Cycle Analysis, Energy analysis) to oversee the correlation between POE results and the building parameters;

(2) Energy efficient/passive design proposals developed by student groups.

Due to restrictions on accessing the basement floor, these zones were excluded from the survey. Additionally, the cafeteria zone was not assessed.

RESULTS

Post-occupancy evaluation of offices, classrooms, reading and foyer halls

The invitation for the POE survey was sent out on March 23rd, 2023, and a reminder was sent on March 31st, 2023. In total, 86 responses were received. While personal data such as age and gender were collected from respondents as part of the evaluation, this paper does not include any correlation analysis related to these details. The respondents held the following positions: 15 preparatory students, 50 undergraduate students, 14 academics from the FLE Department, and 4 administrative personnel.

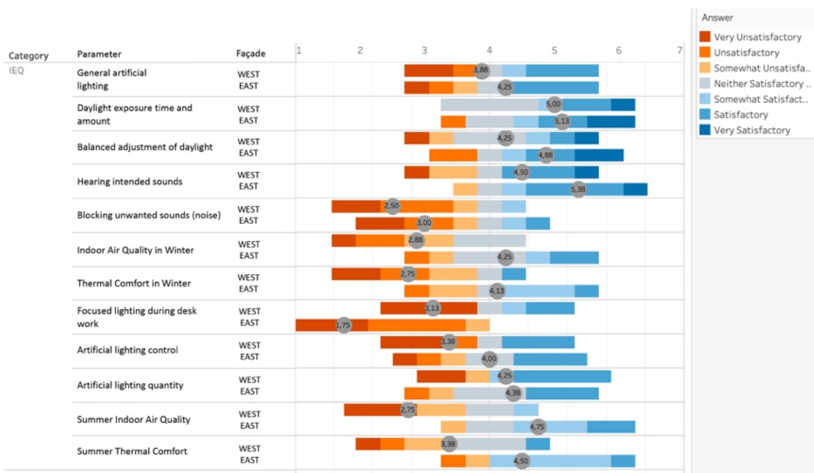

Figure 1. POE survey results for the offices (east/west façades)

The west and east façades of the building are designed to have the same features. The office rating evaluation table is visualized based on the facade orientation and indicates that satisfaction and dissatisfaction rates vary more significantly between summer and winter times for the indoor air quality and thermal comfort categories, with the east façade performing better than the west façade. Not only the questionnaire, but the interviews also indicated the impossibility of working during the summertime in the offices for both façades. Thermal comfort in the wintertime is also rated relatively lower.

The ratings suggest that focused lighting for desk work is relatively problematic (2.44/ ~ 50%). Additionally, while there is a notable demand for preventing unwanted sounds (noise), there is no significant issue with hearing desired sounds. Although occupants rated daylight exposure and balance positively, interviews indicated that there is a glare problem in offices, especially on computer screens. In addition, according to the visual comfort evaluation, the most disturbing condition is glare. It appears that the level of 'Dark' and 'Low artificial lighting' deteriorates less. In the data on space adequacy in offices, results show that the most disturbing situation is the 'Ergonomics of the chair and table'. Looking at the rate of 'equipment availability', it is understood that this situation deteriorates less. Moreover, the analysis of the number of office users reveals that the general satisfaction rate for offices accommodating 2 to 3 people is low. This highlights that office planning and layout can significantly impact satisfaction.

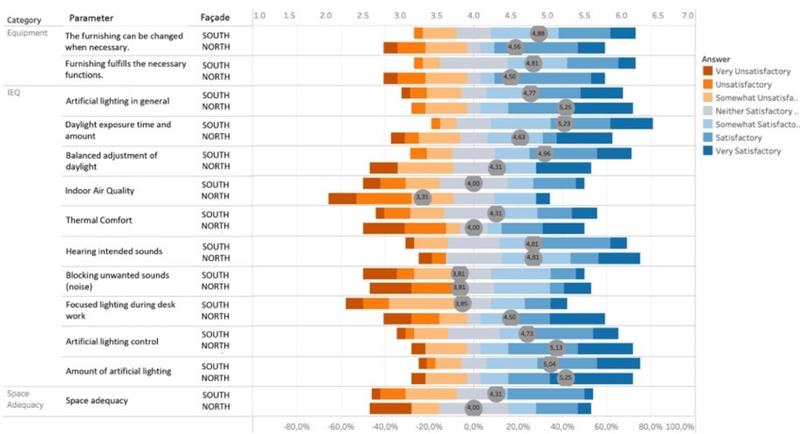

Figure 2. POE survey results of the classroom (south/north façades)

When examining the class evaluation data in terms of satisfaction averages, it is evident that the rate of users dissatisfied with the indoor air quality of the classroom is higher than other categories. Another area of dissatisfaction is the focused lighting on tables. In terms of satisfaction rates, the most positive aspects are the amount of artificial lighting in the classroom and the duration and amount of daylight in the classroom. Concerning thermal comfort in the classrooms, the data shows that the rate of "sometimes too hot" and the rate of stuffiness in indoor air quality are high. Additionally, in the visual comfort data for classrooms, the glare rate is high. Regarding space adequacy, the data indicates that the rate of ergonomics of the chair and table is acceptable. This suggests dissatisfaction with the size of the classroom space, the adequacy of the circulation area, and the flexibility of the space.

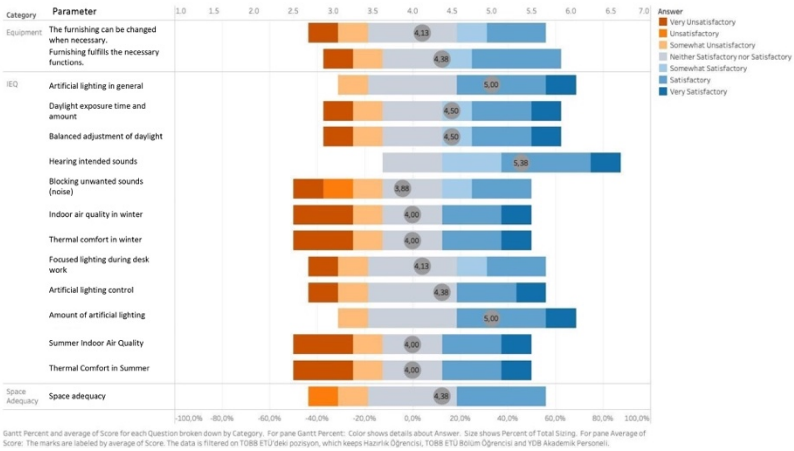

Figure 3. POE survey results for the reading hall

The reading hall is situated at the south-western corner of the building, featuring glass curtain walls on each façade. Students were tasked with providing façade recommendations to enhance interior comfort in this area. Regarding thermal comfort, occupants reported discomfort during summertime due to excessive heat from the curtain walls. They also noted feeling cold during wintertime. Additionally, some occupants mentioned a lack of control over artificial lighting. Dissatisfaction was expressed regarding the ergonomics of the chairs and tables, as well as the availability of equipment.

The foyer halls are situated at the south-eastern façade of the building. When evaluating the foyer areas based on satisfaction averages, it appears that they do not effectively prevent unwanted sounds. During summertime, the thermal comfort rate is low, prompting students to provide façade recommendations and suggestions for improving indoor comfort in this area.

Analyzing the utilization patterns of the foyer and reading halls, it's apparent that students do not primarily use these spaces. Particularly, the indoor environmental quality (IEQ) and furnishings in the foyer halls do not meet user expectations.

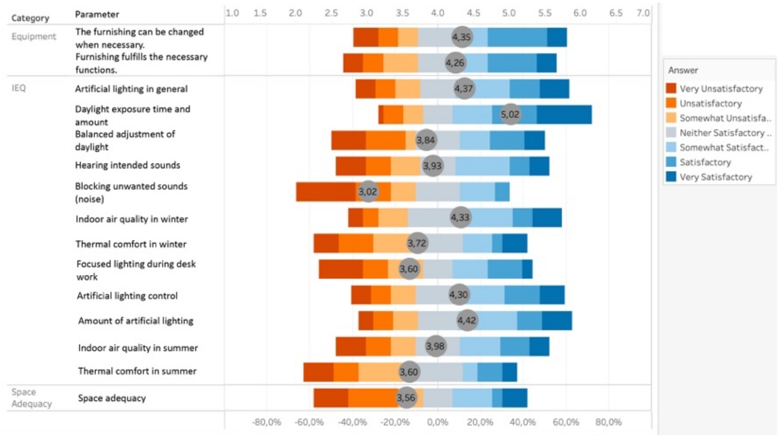

Figure 4. POE survey results of the foyer

In summary, the foyer area was mostly used by TOBB ETU department students, but it lacked adequate thermal and acoustic comfort. The Reading Hall faced issues with low thermal comfort, making it less appealing to students. Offices had challenges with thermal comfort in both summer and winter, and the room layout was not suitable for addressing this issue. Classrooms had problems with indoor air quality and glare. As a result, the teaching staff encouraged students to prioritize façade design and acoustic interventions in their proposals.

Student Proposals

Students were organized into groups of six, and each group was assigned a specific area of the building, which included classrooms (south and north), offices (east and west), foyer halls, and the reading hall. The need to complete the assignments within the limited duration of the term, compounded by the challenges of remote teaching following the earthquake in southeastern Turkey, led to these specific assignments rather than considering the building as a whole.

Using the POE results and feedback from occupants, each group performed a range of analyses. They utilized building information modeling (BIM) platforms and supplemented their analyses with Climatestudio, which is available as a plug-in for Rhino. These analyses included assessments of solar radiation, daylight level, glare, U values of building façades, illuminance, radiance, and daylight factor. Subsequently, each group devised interventions and conducted further analyses after implementing these interventions.

FLD Offices (east and west façade)

The proposed interventions for the eastern façade include the implementation of suitable shading elements to maximize the utilization of solar energy. Double-glazed windows, along with Low-E glass to maximize solar heat utilization, have been adopted to enhance energy efficiency. Shading elements on the façade are also used to balance daylight values. Solar, glare, and daylight analyses were conducted to evaluate these recommendations comprehensively, aiming to provide users with control over lighting and internal comfort while improving energy efficiency and well-being.

For artificial lighting control on both façades, students focused on allowing occupants to have flexible lighting options. The group working in the eastern part suggests a chain apparatus affixed to the glass. This apparatus can be easily removed and tilted, providing insulation from heat, sunlight, and sound and allowing for daylight management, easy cleaning, and control. The group working in the western part proposed spotlights and a suspended light distribution system.

To address acoustic issues and reduce unwanted noise between offices and corridors on the eastern façade, recommendations include using gypsum panels with insulation properties for the walls separating offices and durable, natural linoleum material for the flooring. These materials offer thermal insulation, environmental friendliness, sound absorption, and echo prevention.

For the western offices, acoustic improvements included the installation of stone wool insulation material in the gypsum walls. A more functional and aesthetically pleasing flooring material has been chosen over carpets.

For the western offices, to improve natural ventilation, the suspended ceilings in corridors, classrooms, and office spaces have been redesigned to provide ventilation opportunities. Ceiling heights have been raised uniformly, and a 25 cm gap has been created above the doors to allow for ventilation.

For the western offices, heat and solar control, a button-operated louver system has been proposed for thermal and solar control between double-pane windows, allowing users to adjust interior conditions to their preferences. Shading elements have been added to the eastern facade to mitigate the sun's adverse effects. In winter, improved thermal comfort is achieved by partially opening the upper sections of radiators for more effective heat distribution. Vertical sunshades have been added to the facade to reduce excessive light penetration, enhancing interior comfort and energy efficiency.

Classrooms (north and south façades)

To address glare issues, the proposal suggests replacing windows with louvered windows. Louvered windows effectively control horizontal sunlight, allowing for adequate natural light while minimizing glare. They also offer hygienic properties, making them a suitable solution for north-facing classrooms.

For the southern façade, a closed-cavity, naturally ventilated curtain wall system with a suitable shading element is suggested.

For sound insulation and acoustic performance, the proposal recommends the use of single-frame double-layer partition walls and a suspension system-based double-frame suspended ceiling. These design modifications are intended to not only enhance sound insulation within interior spaces but also improve overall acoustic quality. To improve ventilation, the proposal suggests replacing existing doors with ventilated doors equipped with a louvre system. This change is expected to significantly enhance indoor air quality.

Foyer Halls

The proposed interventions address various issues affecting the building's thermal comfort, interior comfort, and aesthetics. These include:

Façade Improvement: The introduction of a fabric mesh facade for the Northeast and Southeast facades is intended to mitigate thermal comfort issues caused by the glass cladding. This solution is noteworthy as it addresses thermal comfort without adding significant weight to the building.

Furniture and Equipment: Recognizing the insufficiency and lack of ergonomic features in the existing furniture and equipment, the proposal suggests the adoption of modern and sustainable design approaches. This includes next-generation office furnishings and green wall cladding to enhance interior comfort and aesthetics.

Interior Finishes: The proposal encompasses a range of solutions for interior finishes, including panels, suspended ceilings, and flooring alternatives. These recommendations take into account interior acoustic considerations to improve overall comfort.

Lighting: To enhance functionality, supplementary equipment such as extra desk lighting or wall-mounted illumination is recommended.

Overall, these proposed interventions are designed to create a more comfortable, visually appealing, and functional interior space while also improving thermal comfort through strategic facade improvements.

Reading Hall

The student group's initiative to redesign the interior of the hall with a focus on the façade design is a commendable effort to enhance the utilization and functionality of the space. This approach considers both aesthetics and practicality in transforming the hall into a more inviting and comfortable environment for occupants.

Furthermore, their consideration of Life Cycle Assessments (LCA) for the recommended materials demonstrates a commitment to environmental sustainability. By evaluating the environmental impact of materials throughout their life cycles, the group ensures that their choices align with principles of eco-friendliness and resource efficiency. This approach is in line with contemporary sustainability practices, which seek to minimize the carbon footprint and ecological impact of building materials.

Overall, their comprehensive approach to interior redesign, coupled with sustainable material selection, reflects a forward-thinking perspective on architectural design that prioritizes both user experience and environmental responsibility.

DISCUSSION AND CONCLUSION

The introduction of Post-Occupancy Evaluations (POE) into architectural education is indeed crucial, especially given the growing urgency to address climate change and reduce carbon emissions in the building sector. Retrofitting existing buildings is a sustainable approach to significantly decrease energy consumption and carbon emissions, and it requires architects to possess specific knowledge and skills in assessing and improving building performance.

By incorporating POE into architectural curricula, students can develop a better understanding of the real-world performance of buildings, identify areas for improvement, and learn about sustainable retrofitting strategies. These skills are essential for architects to play a significant role in transforming the built environment to be more energy-efficient and environmentally friendly.

As part of this study, the user experiences and performance of a university building based on investigative POE with student teams. Based on POE results, student groups proposed various interventions, to enhance the FLD building's functionality, interior comfort, energy efficiency, and user experience. However, the feasibility of each recommendation must be considered, factoring in elements such as cost-effectiveness analyses and user feedback. Consequently, this study serves as an example of how architectural education can adapt to the evolving demands of sustainable design and prepare future architects to address the pressing environmental challenges of our time.

The research had certain limitations. Due to the distance learning implemented in the aftermath of the February earthquake, the students were unable to analyze the typical occupant patterns in the building, particularly in classrooms and corridors. The POE questionnaire only examined the classrooms used during the fall term because the pilot studies revealed that users could not recollect their earlier terms' experiences. As a result, it is necessary to conduct longitudinal evaluations for three terms (there are three terms in a year at TOBB ETU). Due to a shortage of equipment, the study did not capture the primary IEQ components by monitoring physical characteristics with data loggers. The course quality as it relates to the teaching–learning processes evaluation will be part of future studies.

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REFERENCES

Altomonte, S. & Schiavon, S. (2013). Occupant satisfaction in LEED and non-LEED certified buildings. *Building and Environment*, 68, 66–76.

Asojo, A., Hoa V. & Suyeon B. (2021). The Impact of Design Interventions on Occupant Satisfaction: A Workplace Pre-and Post-Occupancy Evaluation Analysis. *Sustainability, 13*(24): 13571.

Boissonneault, A. & Peters, T. (2023). Concepts of performance in post-occupancy evaluation post-probe: A literature review. *Building Research & Information*, *51*(4), 369-391.

Induja, V., Nair, M. G. & Suryan, A. (2022). Transdisciplinary learning exercise on post occupancy evaluation and retrofitting of built spaces. Environment, Development and Sustainability. https://doi.org/10.1007/s10668-022-02531-z

International Energy Agency. (2022). World Energy Investment 2022. https://www.iea.org/reports/world-energy-invest-ment-2022.

Lolli, F., Marinello, S., Coruzzolo, A. M. & Butturi, M. A. (2022). Post-Occupancy Evaluation's (POE) Applications for Improving Indoor Environment Quality (IEQ). *Toxics*, *10*(10), 626.

Göçer Ö, Hua, Y. & Göçer, K. (2015). Completing the missing link in the building design process: Enhancing post-occupancy evaluation method for effective feedback for building performance. *Building and Environment*, 89, 14-27

Özgenç, Ö. (2021). *Mapping the Interaction between Research and Education Fields of Sustainability in Architecture: A Retrospective Timeline* [Master Thesis]. TOBB University of Economics and Technology.

Preiser F.E. & Wolfgang. (1995). Post-occupancy evaluation: how to make buildings work better. *Facilities, 13*(11), 19-28.

RIBA. (2016). *Post Occupancy Evaluation and Building Performance Evaluation Primer*. https://www.architecture.com/knowledge-and-resources/resources-landing-page/post-occupancy-evaluation

Sipahioğlu, I.R. (2013). Pratiklerimizi Şekillendiren Teknoloji. *Proceedings of the Akıllı ve Yeşil Binalar Kongresi*, 286–291.

THE ROLE OF IN-BETWEEN SPACES TO SUPPORT INFORMAL LEARNING ACTIVITIES IN EDUCATIONAL BUILDINGS

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ABSTRACT

Educational buildings are the basic institutions that affect the development and socialization of children and have an important place in children's lives. Spaces in educational buildings should be supportive so that children can develop their capacity to express their creative potential.

Various international studies show that there are negative effects such as the lack of diversity in children's space type and activities, and restrictive school rules imposed on the use of spaces in educational buildings. These studies show that children cannot benefit from informal education spaces as they wish and that these environments do not sufficiently support children's self-directed activities.

In this study, it will be tried to analyze how the organization of in-between spaces, which can best support the informal learning activities of alpha generation students, affects learning and social interaction in primary education structures. In the context of the literature review, it has been determined that there is a limited number of researches about the in-between spaces that will support informal education, although it is generally focused on the research of formal education spaces in primary education buildings. In the context of this study, the aim is to investigate the methods used in studies related to in-between spaces by scanning the existing literature on intermediate spaces and informal learning spaces. Behavioral mapping, walking tours and focus group interviews are the main methods used in research in this field. It is thought to contribute to future research on the theoretical framework to be created with the findings to be obtained within the scope of this study.

Keywords: Informal education, alpha generation, in-between space, social interaction

INTRODUCTION

Education has been evaluated as an ongoing phenomenon from the history of humanity. This process is of great importance for both the personal development of individuals and their contribution to society. The greater the impact of effective teaching, qualified teachers and enriched curriculum in education, the more critical the educational buildings that enable these elements to be realized. Such that, according to Güzer (2014), educational buildings "It is one of the environments in which the average person spends the most time and takes part in about a third of your life" In this context, the design of educational spaces stands out as a critical factor affecting educational efficiency and any deficiency in this area negatively affects the performance of students.

When examining studies conducted on educational buildings in the literature, it can be observed that there are comprehensive environment-behavior studies regarding the physical environments of schools. However, there is very little research available concerning the role and nature of in-between spaces. In this context, it is important to uncover the potential qualities of in-between spaces to support informal education as spaces that need to be studied and understood so that they can be designed to meet children's needs more effectively. It is thought that the study will contribute to studies focusing on investigating formal education spaces.

THE CONCEPT OF INFORMAL LEARNING

Informal learning refers to the knowledge and skills gained through experiences, interactions and personal interests in daily life, which usually takes place without a structured education program. This type of learning goes beyond traditional classroom settings and offers individuals practical experiences and real-world contexts. In-between spaces designed to support informal learning in educational buildings help to encourage, facilitate and enrich this type of learning.

Based on pedagogical theory, informal learning processes are becoming increasingly vital, and learning is now occurring more frequently outside the classroom than ever before (Brown & Lippincott, 2003).

The number of empirical studies focusing on whether the design features of informal learning spaces improve the informal learning process is very few. As an interdisciplinary research area, the design of learning spaces is located at the intersection of different disciplines such as pedagogy, architecture, politics and management (Wu,2018).

The design of learning spaces is always updated depending on developments in pedagogical theory. Historically, it has been clearly stated that the structuring of space affects human activities in general (Hillier, 2007).

The assessment of learning spaces, despite the evident connection between space and learning theories, has received limited attention, with the theories of learning themselves often neglecting the significance of space (Jamieson, 2003; Neary vd., 2010).

Furthermore, although the intentional design of third spaces has subsequently been explored in early education practices (e.g., Cook, 2005; Nair and Gehling, 2010), there is little research focusing on the design of informal learning space.

In 2006 DEGW started to use the term 'Learning Landscape' to describe the diversity of areas where learning takes place.

This term covers formal and informal areas, including private and public areas. These spaces include places such as libraries and cafe areas (Neary et al., 2010). However, Temple and Fillippakou (2007) define the Learning Landscape as spaces that can help create a sense of belonging and facilitate peer group discussions and informal learning.

Even if in-between spaces are considered to be part of the whole learning environment, the most important point of planning the learning landscape is to create informal learning spaces where informal learning takes place. Therefore, informal learning spaces are seen as key to the development of any informal pedagogical interaction in educational buildings.

CHANGING LEARNING SPACES AND IN-BETWEEN SPACE

Technological, scientific and social changes throughout history have led to the transformation of education systems and educational buildings. This transformation has brought different perspectives to both the physical size and characteristics of educational buildings and the spatial opportunities offered.

In the historical process, it is seen that educational structures have developed as of the 19th century. With the Industrial Revolution, some reforms were realized in education. In this context, school and classroom spaces were modernized. The design of school buildings has changed, with one-room school buildings becoming larger and more complex designs.

In an arrangement prepared by Horace Mann, referred to as an early education reformer, students in a standard classroom are seated in a row-like arrangement, while the teacher is positioned behind a desk. There are windows on both sides of the room and spaces for various other needs (Baker, 2012: 4).

In the 20th century, typical schools with long corridors and closed classroom scheme established a hierarchical relationship where students were passive, and teachers were active (Işıker and Bölük, 2016).

With the 21st century, as a result of the advancement of technology, physical needs have changed and new spatial requirements have emerged. In educational institutions, designing spaces that allow students to explore and have various uses has become one of the primary objectives in school architecture.

In-between spaces such as corridors, terraces and courtyards in school buildings have become an integral part of learning processes.

The concept of "in-between space" has been used in various disciplines today, and it has been defined differently in the literature.

Deleuze discussed the concept of the "in-between" as a transitional zone between inside and outside and analyzed this idea especially in Baroque architecture. According to him, the interior space is the result of the folding of the exterior space. This folding is determined by the building surfaces that form the boundaries of the interior space. According to Deleuze, building facades not only play a separating role, but also function as an "in-between space" between the interior and the exterior (Deleuze, 1992).

When Zsuzsanna describes "in-between space" on an urban scale, she defines it as areas that emerge naturally, in contrast to being planned within the city, and that contradict the traditional urban planning principles ((Zsuzsanna, 1997).

According to Zizek, in-between spaces are planned as multifunctional open spaces but access to these areas has an invisible filter. This filter is stated to transform intermediate spaces into more robust and secure areas, while temporary purposes emerge in the in-between areas, allowing for the emergence of new functions in the midst of uncertainty.

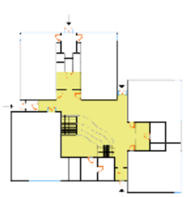
As an example of designs aimed at creating in-between spaces, one can point to Aldo Van Eyck's playgrounds located within the city, which serve as examples of spaces generating in-between areas.

Figure 1. Playgrounds designed by Aldo Van Eyck in Amsterdam (URL 1)

Hertzberger's designs are also examples of in-between spaces. In Hertzberger's designs, he likens the circulation order to a "micro-city" and considers in-between spaces as a significant part of the design (Şensoy,2019). In the design of school buildings, Hertzberger paid attention to the social interaction between students after education and took care to design spaces in this context.

In school buildings, in addition to functional spaces such as classrooms and workshops, he has also designed areas such as circulation and galleries to allow for social interaction among children.

Table 1. Circulation areas in Hertzberger designs (İslamoğlu and Usta, 2016)

		
Anne Frank Okulu	De Spil Okulu	Raffaello Okulu

For example, Hertzberger (1993) designed the gallery space in the Amsterdam Montessori School to provide social interaction and designed each section for learning (Şensoy, 2019).

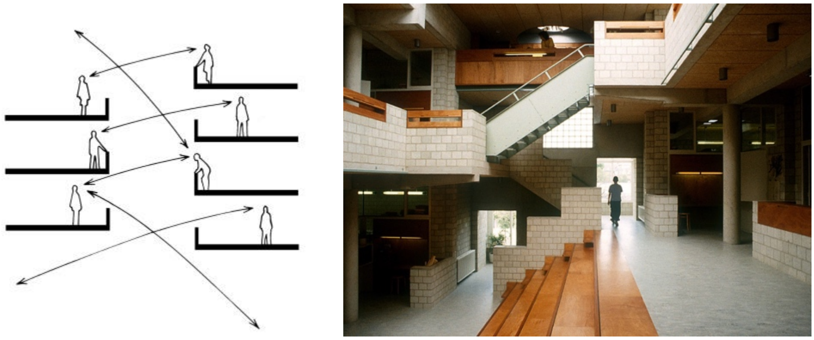


Figure 2. Amsterdam Montessori School (URL 2)

Raffaello Basis-En Middelbare School was designed and built in Italy by Hertzberger between 2005 and 2012. Hertzberger's concept of informal learning has encouraged the creation of multi-purpose outdoor spaces in addition to interior design. Terraced seating areas accessible via stairs have played significant roles in both learning and social interaction as spaces where students can gather. This approach can be shown as an example that emphasizes the importance Hertzberger gives to social interaction in learning spaces (İslamoğlu and Usta, 2016).

Like the designs above, there are schools in Turkey that are designed in accordance with similar characteristics. Given the fact that our country is a significant earthquake-prone region, in recent years, the redesign of schools to be earthquake-safe has gained great importance. t is stated that as a result of the studies carried out within the scope of the Istanbul Seismic Risk Mitigation Project (ISMEP), educational buildings, including some public buildings, were reconstructed and this project sets an example for the design of modern educational buildings. The schools designed within the scope of ISMEP are not only safe but also aesthetically pleasing, modern and in harmony with nature. The main philosophy of the projects has been to produce new solutions to the education and training experiences that are being replicated by opposing type projects. Circulation areas in educational buildings are conceived as spaces for transition and transportation, as well as areas that will increase social interaction among students and teachers (URL 4).

The aim of this study is to conduct a literature review on in-between spaces and informal learning spaces, with the goal of identifying the methods used in studies related to in-between spaces and informal learning spaces, with the goal of identifying the methods used in studies related to in-between spaces.

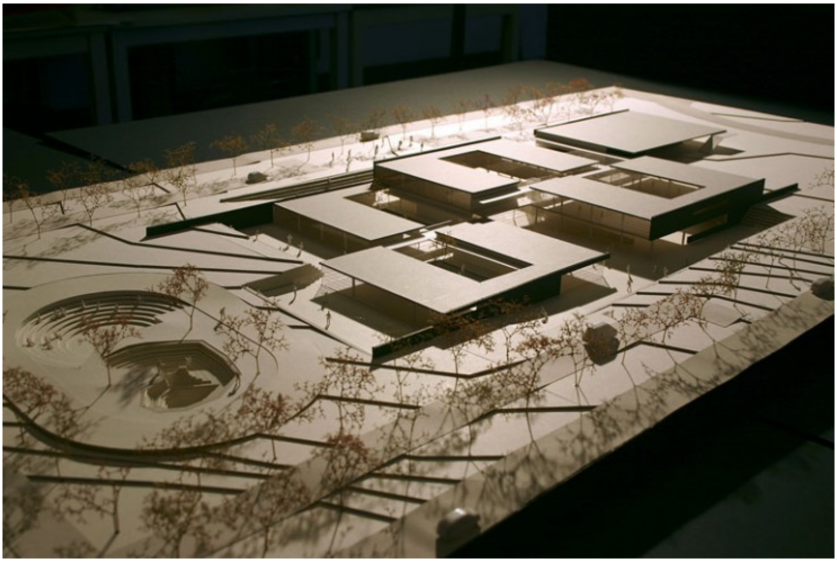


Figure 3. Raffaello Basis- En Middelbare School, site plan (URL 3)

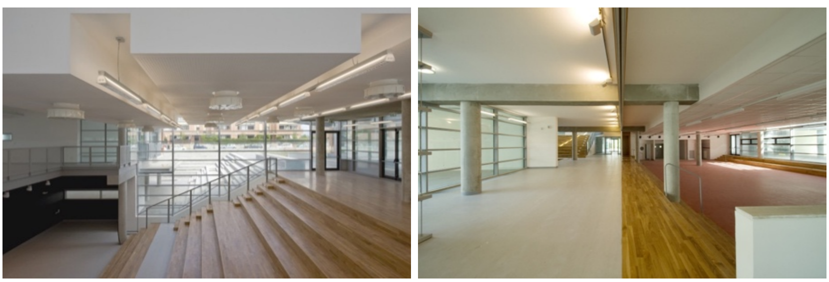


Figure 4. Raffaello Basis- En Middelbare School, in-between space (URL 3)

Figure 5. Beşiktaş Primary School (URL 4)

LEARNING SPACES AND METHODS USED IN IN-BETWEEN SPACE RESEARCHES

When the existing researches on in-between spaces in the literature are examined, behavioral mapping, walking tours and interviews with focus groups come to the fore as methods. Below are explanations and evaluations of these methods.

3.1 Behavior Mapping

Behavior mapping is a method used to explore the location of in-between spaces and physical, social and organizational environmental characteristics. The main research areas in the behavior mapping protocol are the location of in-between spaces, physical, social and organizational features, and children's activities.

The location of in-between spaces: For the researcher, in-between spaces are defined as informal spaces that children frequently use and out-of-bounds spaces that they use secretly.

Physical characteristics: Behavior mapping describes the physical characteristics of the in-between spaces. It is used to determine the boundaries, possibilities, components, and qualities that influence children's use of this space (Zeisel 2006). The maps developed for each space show the dimensions of the spaces, the quality and function of the surrounding buildings, the spatial arrangements of these buildings, the location of the spaces in the school map relative to each other, and the physical characteristics of the surrounding borders (Aminpour, 2018).

Social characteristics: Behavior mapping also identifies the social characteristics of in-between spaces. It records how children exist in the space depending on factors such as different gender and age (Roberts et al. 2012). Recording time intervals is also important in terms of determining social characteristics. The activities of each space affect each other over time (Zeisel 2006). The time of each observation is recorded to help analyze the flow of activity. The order of activities is also shown on school maps to determine the social continuity of children's activities and the impact of activities on each other. The number of participants in each setting is recorded to determine the extent of social activities and the nature of peer relationships (Aminpour,2018).

Organizational characteristics: Behavioral mapping records the behavioral outcomes of school rules that regulate children's use of each space. It shows the influence of school personnel in different parts of the school area.During behavioral mapping, there is a higher likelihood of recording rule-breaking activities that may not be addressed during walking tours and focus group discussions (Zeisel 2006).

Children's activities: Behavior mapping records what children do in each environment, their behavior patterns and movement patterns in space (Aminpour, 2018).

Table 2. Behavior Mapping Process Schedule

1	Mapping in-between spaces
2	Introduction of the task to the participants
3	Determining the time and duration of behavior mapping
4	Taking photographs
5	Determining of the number of observation sessions by the researcher

In Aminpour's (2018) study "The role of in-between spaces within outdoor school environments in children's expression of agency", the regions determined in the school selected for Behavior Mapping are indicated in the figure 6.

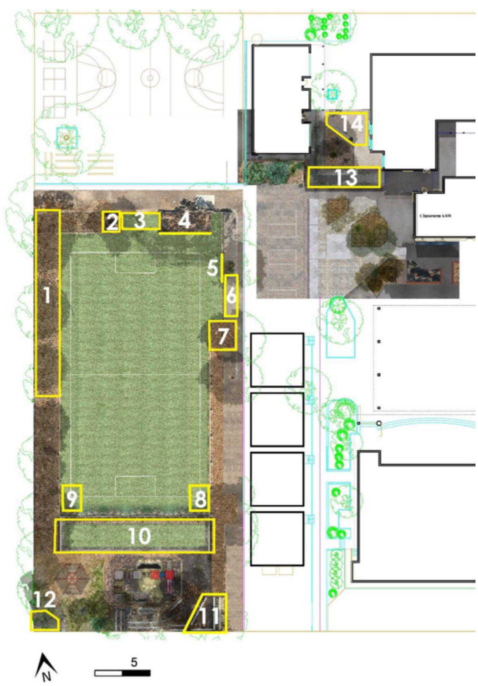


Figure 6. In-between spaces revealed by the behaviour mapping in School 1 (Aminpour, 2018)

3.2 Walking Tours

Walking tours are another method used in studies in this field. This is a mobile method in which the researcher walks with the interviewees as they go about their daily routines and asks them questions (Clark 2005; Evans & Jones 2011). Children visit many areas of interest and answer interview questions.

The walking tours method uses a participatory approach. Positioning children as tour guides highlights their actions and allows them to have a level of control over the research process. Most children express excitement when someone visits them to learn more about their ideas and perspectives.
In addition to showing visitors the in-between spaces, they feel their perspectives are respected by sharing their stories and enjoyable activities (Green 2012).

The main research areas in the walking tour interview questions include:

The location of in-between spaces: Children are asked to identify the areas they choose to play during recess and lunchtime. If these areas are not included in the design, they are defined as in-between spaces.

Physical characteristics: Walking tours enable the exploration of the physical environment and its features from the perspective of children.

Social characteristics: During the walking tour, questions are asked to children about the positive or negative impact of their in-between space choices, aiming to uncover social relationships.

Organizational characteristics: During the walking tour, questions are asked to children about the school rules that regulate the use of in-between spaces, aiming to understand how the administration influences children's behavior (Aminpour, 2018).

Table 3. Walking Tour Process Schedule

1	Introduction of the task to the participants
2	Determining the number of participants and the frequency of walking tours
3	Determining the time and duration of the walking tours

4	Taking photographs

Walking tours reveal the perspectives of children based on their direct experiences with in-between spaces (Aminpour, 2018).

3.3 Interviews with Focus Groups

Focus groups are discussions conducted within a group of participants who share common attitudes regarding the topic of discussion. It is a method used to explore the perspectives of participants (Krueger and Casey 2014; cited in Aminpour, 2018).

Research areas in focus group interview questions include:

Location of in-between spaces: Children are asked to indicate their preferred spaces on school maps, allowing the determination of which intermediate spaces they use.

Physical characteristics: Questions about the physical features of in-between spaces posed to focus groups help identify issues in current spaces and enable children to have ideas about what they want to change or suggest in the school environment.

Social characteristics: Focus groups encourage children to think about the social features of significantly problematic activity spaces. This research method helps identify similarities and differences between the social characteristics of in-between spaces and formal spaces within the school environment.

Table 4. Schedule of the Focus Group Interview Process (Yıldırım and Şimşek, 2021)

1	Reviewing the research objective in terms of the chosen method
2	Developing focus group interview questions based on the research questions
3	Space and Technology Planning
4	Pilot testing of the whole process
5	Identification of participants
6	Manager characteristics and realization of the study
7	Organization and analysis of data

Organizational characteristics: Focus groups also prompt children to reflect on the influence of school rules that regulate their use of different areas within the school premises (Aminpour, 2018).

EVALUATIONS BASED ON EXISTING STUDIES ON LEARNING SPACES AND IN-BETWEEN SPACES RESEARCH.

The analyses conducted using the methods mentioned above emphasize content analysis and graphical presentations. Content analysis of the notes taken during behavioral mapping, walking tours, and focus group interviews is performed, and the data collected on maps during the interviews are presented graphically.For content analysis, all interviews are recorded and transcribed into written form. The study is categorized based on its main focus areas, and the primary research areas are thematically analyzed. Concepts derived from common terms representing ideas among themes are expressed.

In schools designed by Herman Hertzberger, the focus is on how the spaces should be to support learning and teaching. In these schools, it is observed that the spaces support the educational process and that learning extends beyond the boundaries of classrooms. Hertzberger emphasized the importance of threshold areas that establish a connection between classrooms and corridors, highlighting their presence (Şensoy, 2018).

In this context, the concept of "in-between space" has emerged, and this concept is considered as a threshold.

In order for students to ensure continuity in their educational lives, it is of utmost importance that they feel a sense of belonging to the physical educational environment and establish a bond with this space. When the student can intervene in the space, a sense of belonging is created and transforms it into a living space by identifying it with its own identity. In this sense, the concept of in-between space emerges (Yalgın, 2016).

Aminpour (2018) stated that there are accidental areas of experience in in-between spaces. Emphasized that this experience needs to be understood. It allows for actions that support both the socio-organizational and physical environment of children in educational buildings. In this context, he emphasizes that it is important to take children's views on the use of the physical environment.

Anıktar (2017) stated that learning is not limited to walls and that learning and social interaction can take place in in-between spaces.

In Tankut and Zengel's study on the criteria for intermediate spaces in buildings converted into university buildings, it was observed that "in-between spaces" are a critical concept for the flexibility and functionality of university education spaces among spaces that can meet various needs, allow for various forms of use and encourage innovation and diversity.

In the reorganized university education buildings, the active in-between spaces defined to support students learning and facilitate their interaction with each other were determined as entrance, courtyard, corridor, niche, staircase and gallery areas (Tankut & Zengel, 2020).

CONCLUSION

This study discusses how the organization of in-between spaces that can best support the informal learning activities of alpha generation students affects learning and social interaction in primary school buildings. Within the scope of the study, "The Concept of Informal Learning" and "Changing Learning Spaces" are explained under sub-headings in the text.

Within the scope of the paper, the existing literature on "In-between Space" and "Informal Learning Spaces" was reviewed and the methods of the studies on intermediate spaces were revealed.

Behavioral mapping identifies the physical characteristics of the space and children's activities, while walking tours and focus group interviews are research methods that emphasize children's participation to express their perspectives.

The findings focus on the idea that learning extends beyond the boundaries of classrooms, increasing the sense of belonging for students who can intervene in the use of space, the importance of serendipitous experiential areas, and the significance of design approaches that are not confined by walls.

It is expected that the method suggestions put forward for the studies on in-between spaces within the scope of the paper will contribute to the future studies.

REFERENCES

Al Şensoy, S. (2019). Mekân ve Öğrenme İlişkisi Üzerine Üreten Bir Mimar: Herman Hertzberger. Mimarlık, (405).

Aminpour, F. (2018). The role of in-between spaces within outdoor school environments in children's expression of agency (Doctoral dissertation, UNSW Sydney).

Baker, L., (2012). A History of School Design and its Indoor Environmental Standards, 1900 to Today, National Clearinghouse for Educational Facilities, National Instifues of Building Sciences.

Brown, M. B., & Lippincott, J. K. (2003). Learning spaces: more than meets the eye. EDUCAUSE quarterly, 26(1), 14-17.

Clark, A 2005, 'Talking and listening to children' in M Dudek (ed.), Children's Space. Routledge, Oxford.

Cook, M. (2005). 'A place of their own': Creating a classroom 'Third Space' to support a continuum of text construction between home and school. Literacy, 39, 85–90.

Cosco, NG, Moore, RC, & Islam, MZ 2010, 'Behaviour mapping: a method for linking preschool physical activity and outdoor design', Medicine & Science in Sports & Exercise, vol. 42, no. 3, pp. 513-519, DOI: 10.1249/MSS.0b013e3181cea27a.

Green, C 2012, 'Listening to children: exploring intuitive strategies and interactive methods in a study of children's special places', International Journal of Early Childhood, vol. 44, no. 3, pp.269-285, DOI: 10.1007/s13158-012-0075-9.

Güzer, C. A. (2014). Küresellikle yerellik arasında bir çatışma ve süreklilik ortamı olarak eğitim yapıları. B. Binat ve N. Şık (Dizi Ed.), Vitra Çağdaş Mimarlık Dizisi: Cilt 3. Eğitim yapıları(s. 28-35)

Hillier, B. (2007). Space is the machine: a configurational theory of architecture. Space Syntax.

Işıker, F. ve Bölük, M. F. (2018). Okul tasarımlarında mekânsal olasılıklar. G. Aras (Ed.), Uluslararası Mimarlık ve Tasarım Kongresi: 2. Tam ve özet metin kitabı(s. 142-152)

İslamoğlu, Ö. ve Usta, G. (2016). Herman hertzberger okullarında esneklik anlayışı. *Mimarlık Dergisi*, 390.

Jamieson, P. (2003). Designing more effective on campus teaching and learning spaces: A role for academic developers. International Journal for Academic Development, 8(1-2), 119-133.

Krueger, RA & Casey, MA 2014, Focus groups: a practical guide for applied research. Sage publications, Singapore.

Nair, P., & Gehling, A. (2010). Life between classrooms: Applying public space theory to learning environments. Reshaping Our Learning Landscape. A Collection of Provocation Papers, 27-33

Roberts, S. J., Fairclough, S. J., Ridgers, N. D., & Porteous, C. (2013). An observational assessment of physical activity levels and social behaviour during elementary school recess. Health Education Journal, 72(3), 254-262. DOI: 10.1177/0017896912439126.

Tankut, B., & Zengel, R.(2020). Eğitimde Ara Mekân Tasarımlarının Etkisi: Üniversiteye Dönüştürülmüş Yapılarda Ara Mekân Kriterleri.

Temple, P., & Fillippakou, O. (2007). Learning spaces for the 21st century. Higher Education Academy

Thomson, S 2005, '"Territorialising" the primary school playground: deconstructing the geography of playtime', children's geographies, vol. 3, no. 1, pp. 63-78, DOI: 10.1080/14733280500037224.

URL 1. https://www.arkitera.com/haber/tum-sehir-dev-bir-oyun-alanina-donustugunde/)(Access date: 01.08.2023)

URL 2. https://www.ahh.nl/index.php/en/projects2/9-onderwijs/113-apollo-schools) (Access date: 01.08.2023)

URL 3. https://www.ahh.nl/index.php/nl/projecten2/9-onderwijs/25-raffaello-basis-en-middelbare-school-rome-italie) (Access date: 02.08.2023)

URL4.https://www.uygurarchitects.com/media/docs/101_Yapi_EK_Dergisi_2015_istanbul_da_44_Okul.pdf (Access date: 02.08.2023)

URL 5. https://www.arkiv.com.tr/proje/besiktas-ilkokulu/4824) (Erişim tarihi: 02.08.2023)

Wu, X. (2018). The design qualities and spatial organisation for higher education informal learning spaces (Doctoral dissertation, University of Nottingham)

Yalgın, V.Y. (2016). Mimarlıkta programın çözünmesi: ara mekânlar(Yüksek Lisans Tezi)

Yıldırım,A. Şimşek, H. (2021). Sosyal Bilimlerde Nitel Araştırma Yöntemleri Güncelleştirilmiş Geliştirilmiş 12. Baskı, Ankara: Seçkin Yayıncılık.

Zeisel, J 2006, Inquiry by Design: Environment/behaviour/neuroscience in architecture, interiors, landscape and planning, WW Norton, New York.

United Nations Environment Programme (2022). *2022 Global Status Report for Buildings and Construction: Towards a Zero‐emission, Efficient and Resilient Buildings and Construction Sector.* Nairobi.

EDUCATION

METAMORPHOSIS OF FIRST-YEAR ARCHITECTURE STUDENTS: INSIGHTS FROM SHELTER AND DESIGNER CHESTS

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ABSTRACT

This research explores the development of first-year architecture students at Tobb University of Economics and Technology over two academic years in the Basic Design Studio. The Basic Design Studio values individuality and personal growth, aiming to enhance independence and self-assessment skills. The research method involves weekly analysis of 'Designer's Chest' content and its relationship with 'Shelter' projects, tracking changes over time. 'Shelters' are created in Minecraft Education Edition, offering self-organization space for students to gather and review experiences. 'Designer's Chests' serve as a logbook for students to document reflections and store information for future review.

The study draws from educational theories like Piaget, Vygotsky, and Dewey, emphasizing the influence of preparedness, prior experiences, and the social environment on learning. The study identifies different developmental stages, such as Assimilation, Experimentation, Accordance, Chaos, Excitement, and Integration, as students adapt to architectural education. It illustrates how students evolve and adapt to architectural challenges, using various tools and software to express their ideas. The findings reveal individual trajectories and common reactions among students, shedding light on the dynamic nature of learning in design education. The study emphasizes the importance of tools like 'Designer's Chest' and 'Shelter' in monitoring student growth and provides insights for educators to enhance design education.

Keywords: Basic Design Education, Implicit Learning, Digital Game-Based Learning, Minecraft Education Edition, Cognitive Development

INTRODUCTION

In this research, the focus is on understanding how first-year architecture students at Tobb Economics and Technology University developed over one year within the context of the Basic Design Studio. This research spans the academic years 2020-2021 and 2021-2022. Within the scope of this research, the aim is to track the progress and transformations of students by analyzing their ‘Designer's Chests,’ ‘Shelters,’ and studio work. To achieve this, two fundamental questions arise:

- Is it possible to observe changes in skills and abilities by closely examining students' ‘Designer's Chest’ and ‘Shelter’ projects during the course?
- How can we effectively monitor and understand changes in students by analyzing the various activities they undertake throughout the one-year research process within the course?

To answer these questions, the research method involves weekly analysis of the content created in the students' 'Designer's Chests' and its relationship with their 'Shelter' projects. This content is organized chronologically to allow tracking of changes and developments in students over time. The aim is to identify common patterns and shared characteristics among students, highlighting moments of transformation and significant milestones in their learning journeys. The ultimate goal is to reveal the learning cycles and the development experienced by these students ‘Shelters’ and ‘Designer Chests’ play a crucial role in this study. Students are expected to build a ‘Shelter’ in Minecraft Education Edition (M: EE) game every week. Students ‘Shelters’ have never faced criticism and it was emphasized that students would not have a negative impact on their final grades. ‘Shelters’ offer self-organization space. They help students gather and review experiences and vital information, facilitating effective strategies for future goals.

Minecraft, a popular sandbox video game by Mojang Studios, gained educational popularity through Minecraft: Education Edition. This classroom-focused version encourages critical thinking and problem-solving skills, utilizing the open-world sandbox environment (Minecraft, 2023). In the gaming world, especially survival games like Minecraft, having a secure shelter is vital. In these games, a chest holds significant practical and symbolic value, serving as a storage space for important items that endure over time (Egersdorfer, 2016; Duncan, 2011). 'Designer Chests' functions as a logbook, urging students to document reflections upon encountering fresh insights or acquiring new knowledge. ‘Designer Chest’ encourages students to ‘store’ information in their metaphorical chests and revisit it from time to time for review. This helps students give themselves feedback as they learn on their journeys.

The Basic Design Studio aims to monitor student progress and to accelerate and enrich learning without disregarding their previous experience and learning. It values each student's unique qualities, readiness, and instructor’s role in personalized learning, leading to increased independence and self-assessment skills (Acar, Koç, Bancı, & Abbas, 2022) The study also includes a theoretical framework that draws from prominent education theorists such as Piaget, Vygotsky, and Dewey. Modern development and learning theories propose that learning is a personal progression influenced by one's preparedness, prior experiences, and drive. These factors are upheld and take place within a social environment (Shaffer, 1999; Miller, 1997). Piaget's perspective emphasizes active knowledge acquisition in children, influenced by factors like adaptation, maturation, experience, organization, and equilibration. His theory outlines four developmental stages, each building on the previous one, and suggests that tailoring teaching methods to students' cognitive abilities is crucial (Senemoğlu, 2005; Lindberg, 2011; Miller, 1997). Lev Vygotsky's theory emphasizes the role of social and cultural interactions in cognitive development. He introduces the Zone of Proximal Development (ZPD) concept, suggesting that cooperative learning and guidance from knowledgeable individuals are important for learning (Doolittle, 1995). Dewey stresses practical experiences and relevance in education, advocating for active learning and problem-solving. His ideas highlight the need for integrating knowledge with real-world applications (Bender, 2005).

These theories provide a foundation for understanding how students learn and develop their cognitive and creative abilities, helping to explain the observed changes in students' work. Ultimately, this study aims to provide insights that can enhance the approaches of educators and students to design education. From the standpoint of learning, this study distinguishes itself by adopting a perspective that not only regards game-based learning and developmental environments as a design tool, but also transforms it into an open arena where the student's growth and transformation can be tracked. The emphasis is particularly placed not on a design process per se, but rather on the creation of an environment that facilitates the demonstration of learning and development.

UNCOVERING PATTERNS: DATA ANALYSIS RESULTS

Design studios are learning environments that encourage continuous interaction, adaptation, and exploration. An inclusive and interactive learning environment values students' prior learning and unique skills (Acar, 2021). Recognizing and incorporating students' past experiences fosters independence and critical thinking. The Basic Design Studio focuses on valuing individuality and creating an environment that encourages independent thinking and design (Acar, Koç, Bancı, & Abbas, 2022). Examining an example from studio studies is critical at this stage for understanding the scope of the work. 'Manifold Garden' is a video game that reimagines physics and space. In the game, geometry repeats endlessly in all directions, and falling downward loops back to the starting point. Gravity is manipulated to shift perspectives and see the world in new ways (Steam, 2020).

Table 1. Instructions for assignment 'Manifold Garden'

MANIFOLD GARD∃N

MINDCRAFT_0.3
25/01/2022

Manifold Garden,
fizik ve uzayı yeniden tasarlayan bir video oyundur.

'Geometri her yöne doğru sonsuza kadar tekrarlar ve aşağı düştüğünde başladığın yere geri dönersin. Perspektifini değiştirmek ve dünyayı yeni yollarla görmek için yer çekimini yönlendir. Evrenin kurallarında ustalaş ve çorak bir dünyayı bitkiler ve yaşam ile iyileştir.'

ISTENILENLER

25/01/2022 Salı gününe kadar 'Manifold Garden' oyunun ilk bölümüne kadar oynanmış olması gerekmektedir.

+ Maket malzemesi (karton, yapıştırıcı, maket bıçağı vb.) getirilmesi beklenmektedir.

Sizden,
Oyunun içerisinde yer alan elementlerin ölçekli bir maketinin ve eş zamanlı olarak 1/1 ölçekte bir modelinin yapılması istenmektedir.

Yapacağınız maketin ve modelin Google Cardboard'larınızda deneyimlenebilmesi amaçlanmaktadır.

+Yapacağınız maketin sınırı 50cm x 50cm x 50cm olacaktır.

28/01/2022 Cuma gününe yapacağınız maketin ve modelin,

+Ana kütlelerinin bir eksende en az bir kere döndürmeniz

+İki noktadan yere degecek sekilde ayakta durabilmesi

+Güneşin hareketine göre her noktadan ışık alması

+Başladığı yerde bitmesi

gerekmektedir.

NOT

Van Gogh
Mark Rothko
Maide Arel
Etel Adnan

Belirtilen ressamlardan birini seçerek, dört renkten oluşan bir renk paleti oluşturmanız beklenmektedir.

Oluşturduğunuz renk paletini kullanarak modelinizi renklendirmeniz istenmektedir.

+Aşağıda verilen görseldeki agacin oldugu yapi dahil olmak uzere maketinizin ve modelinizin yapılması istenmektedir.

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The 'Manifold Garden' assignment (Table 1) in the architectural studio requires students to create scaled and 1:1 models of elements from the game, using Google Cardboard for the virtual experience. These models must demonstrate stability, self-support, interaction with sunlight, and return to the starting position. By translating abstract game concepts into tangible models and documenting their efforts, students engage in creative problem-solving, critical thinking, and hands-on exploration of design ideas. This assignment exemplifies the dynamic and experiential nature of architectural education. OneNote is a versatile digital notebook for collecting, organizing, and sharing notes. Students only see their pages. The studio instructor sees all the students and their work (Microsoft, n.d.).

A Tentative Measure for Zone of Proximal Development and Implicit Learning: 'Shelter'

The weekly 'Shelters' posted by students on their OneNote sites were analyzed. The analysis involves identifying and grouping common elements in all 'Shelters'. 'Shelters' play a crucial role in this study. Students’ 'Shelters' have never faced criticism and It was emphasized that students would not have a negative impact on their final grades. 'Shelters' offer self-organization space. They help students gather and review experiences and vital information, facilitating effective strategies for future goals. To summarize the observed student situations with a few examples,

Table 2. The first and final ‘Shelters’ created by several students demonstrate development.

	First ‘Shelter’	Last ‘Shelter’
1		
2		

For instance, the first student (Table 2) started with a ‘Shelter’ lacking an opening and designed a flat-surface dream house using random materials. Yet, as the process advanced, the student linked material choice to a mountain context, aligning circulation areas with it. The student elaborated on proportional elevation distances and staircases, accommodating specific step counts. Considering another case, it's evident that the second student (Table 2), influenced by course activities, is endeavoring to apply construction techniques from model creation to their 'Shelter'. It utilized various computer programs to convey its envisioned 'Shelter' and aimed to grasp the human-scale experience.

Reflections on Learning: 'Designer Chests'

Using the 'Shelter' analysis outcomes, the weekly 'Designer Chests' written by students were examined. By comparing 'Designer Chests' with 'Shelter' evaluations, chronological progress trajectories for each student were determined. These 'Designer Chests' function as journals, urging students to document reflections upon encountering fresh insights or acquiring new knowledge. Looking at the example (Table 3), the first student who had prior experience with Minecraft and encountered design challenges, showed rapid progress in expressing design ideas and architectural presentation. It improved its skills in various programs, experimented with different scales, and demonstrated sensitivity to surroundings. The second student (Table 4), lacking prior Minecraft experience or design challenges, began with enthusiasm but gradually decreased submissions and progress. Their architectural terminology and presentation skills improved, yet assignments remained incomplete. Progress was hindered by the lack of material, scale, structure, and lighting experimentation. Active engagement in design tasks led to significant advancement, with students catching up when retaking the course.

Table 3. The developmental trajectory of the first student

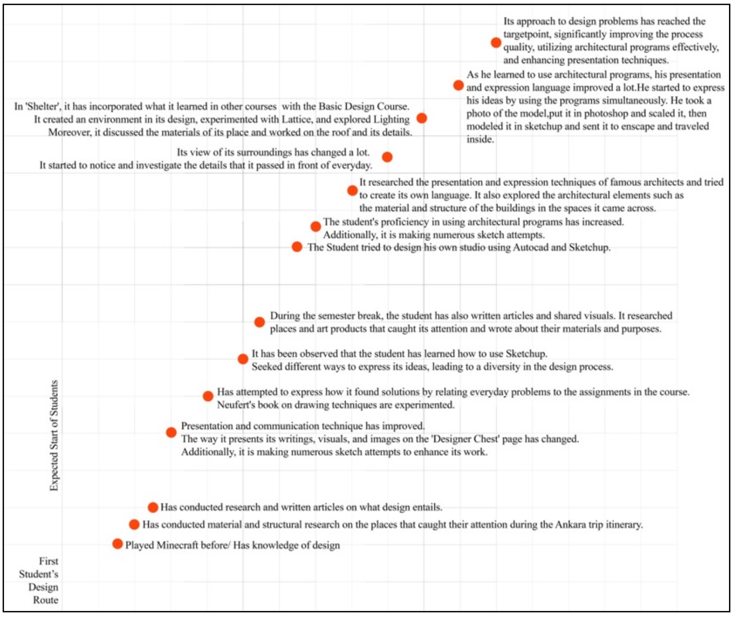
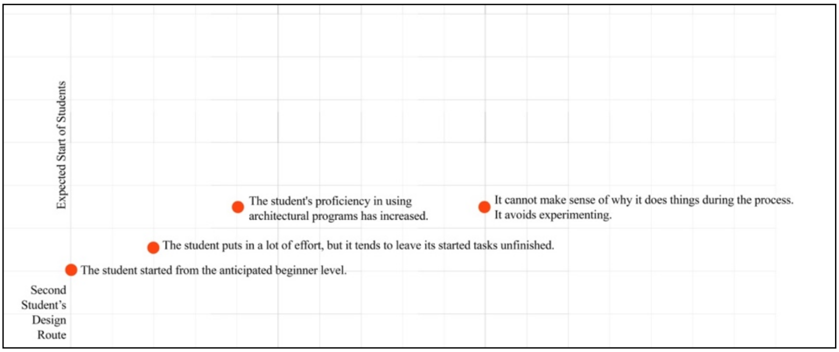


Table 4. The developmental trajectory of the second student



INSIGHTS AND IMPLICATIONS: FINDINGS, CONCLUSIONS, AND DISCUSSION

By comparing individually prepared progress trajectories for each student, common differentiations, responses, and changes have been observed in students at four-week intervals. These differentiations have been grouped under common headings and listed. These headings have been named as follows: Assimilation, Experimentation, Accordance, Chaos, Excitement and Integration.

Assimilation

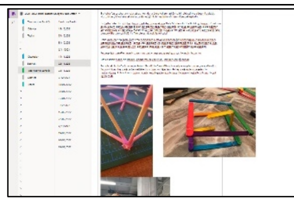
The assimilation process spans the initial 4 weeks. According to Miller (1997), assimilation is the process of fitting new information into existing cognitive structures (Miller, 1997). In line with Piaget's concept of assimilation, this stage is named to represent students integrating new experiences into their mental schemas. To summarize the observed student situations with a few examples (Table 5), the first student revised their initial shelter, drawing inspiration from churches observed in their art history class, resulting in a new ‘Shelter’. Looking at another example, the second student continued with their initial 'Shelter' for the first four weeks by adding modifications. It changed the positions of the windows, altered the shape of the roof, and mentioned that it added a garden to its 'Shelter'. All selected students initially created a house in their first 'Shelters'. In the following weeks, the students applied the mentioned changes. It is observed that the students did not specify what the action in their 'Shelters' would be, but they no longer gave the description of a house.

Table 5. Differences in students' shelters during the first four weeks

	First week's 'Shelter'	After the fourth week's 'Shelter'
1		
2		

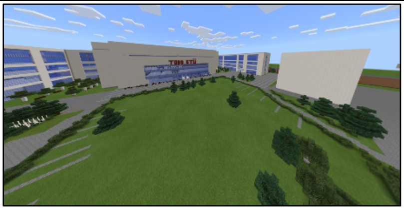
During the initial four weeks, students conveyed themselves only through writing. Therefore, The analysis also centered on commonly used words. From the fourth week onwards, students began combining visuals with their writing (Table 6). An instance of this transformation is noticeable in a selected student's 'Designer Chest' uploaded before and after the fourth week.

Table 6. The example of the Design Chest uploaded by the student during the initial weeks and beyond

First week's 'Designer Chest'	The fourth week's 'Designer Chest.'
	

Initially, students commonly used words with negative connotations. However, as the adaptation phase progressed, their word choices began to change. For the students who passed the adaptation period, terms related to design tools and techniques were frequently used and they used expressions with more positive meanings. During the assimilation, group assignments led students to form friend groups. Over time, these groups engaged in peer learning, as seen in a Minecraft assignment where a skilled student taught coding to peers. Afterward, students who learned to code applied it in their own 'shelters'.

Table 7. The group assignment project and a student's 'Shelter'

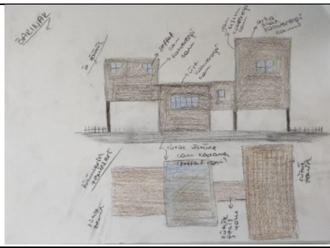
Group homework assignment	'Shelter' made after group homework
	

This assignment centered around the reconstruction of various structures in Ankara and was assigned to a group of students from TOBB University of Economics and Technology. An examination of the 'Designer's Chest' of one student within this group revealed that the student in question had taken the initiative to teach coding to their fellow group members. This collaborative effort led to a more efficient completion of the assignment (Table 7).

Experimentation

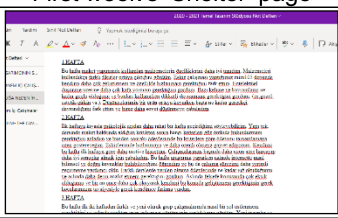
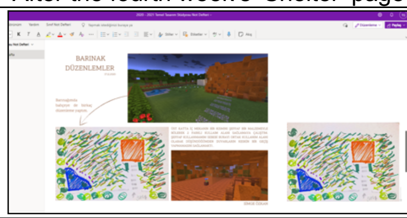
During the time interval spanning 5 to 8 weeks, it has been observed that the reflexes and actions involved in the process of assimilation exhibit differentiation. According to the Oxford University Dictionary, experimentation is defined as 'the activity or process of trying or testing new ideas, methods, etc. to find out what effect they have.' (Oxford, n.d.). This stage is named 'Experimentation' to express the process where the student attempts to adapt their existing schemas to new information by generating numerous response-seeking attempts. Examples of changes observed in students are given in the table below. The first student (Table 8) asserted that it constructed its Shelter using a sketch and adhering to the proportions based on the M: EE unit. The second student (Table 8) expressed that it modified the material of the shelter it constructed, as it believed 'Shelter' should be more harmonious with its surroundings. The students are observed trying different scale experiments in their designs with the help of various software programs. They are seen placing human silhouettes on different scales within their designs to achieve different expressions.

Table 8. A compilation of students' works.

First Student's Work	Second Student's Work
	

It can be observed that the students are attempting to narrate the construction process of their 'Shelters.' (Table 9). They have tried to express themself by creating sketches and using commands in OneNote, and they have also attempted to design their page.

Table 9. A student is attempting to narrate the construction process of its 'Shelter.'

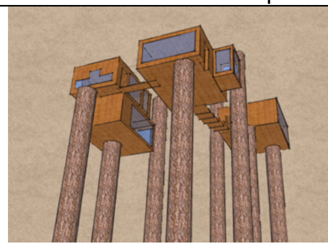
First week's 'Shelter' page	After the fourth week's 'Shelter' page
	

In Table 9, the student primarily used written text in the 'Designer Chest' during the initial weeks. Table 9 reveals a transformation post the fourth week, as the student endeavors to narrate the construction process of its 'Shelter'.

Accordance

Students who have completed the assimilation and experimentation phases are transitioning to the Accordance phase, which covers the last 4 weeks. According to the Oxford University Dictionary, accordance is defined as 'according to a rule or the way that somebody says that something should be done' (Oxford, n.d.). This stage is called Accordance to express that students have become accustomed to the intensive pace of architectural education and to indicate that they have reached an awareness that there is no single, absolute correct answer in architectural education. In this stage, it is observed that these students are adapting well to the pace of architectural education. They have started using architectural software to express their ideas effectively. When examining the contents of their 'Designer Chests', it can be seen that students take photos of their sketches and create collages using Photoshop, attempt to draw plans and sections in Autocad and engage in modeling using Sketchup.

Table 10. The 'Shelter' example was created using different programs.

‘Shelter’ in M: EE	‘Shelter’ in Sketchup
	

When looking at Table 10, it is evident that the student is attempting to recreate the 'Shelter' they made in M: EE using the Sketchup program. Compared to the assimilation phase, the increase in the number of uploads, where they share their collages, drawings, and models, indicates that they have gained sufficient self-confidence. When examining the 'Shelters' of the students in this stage, it is observed that the students make material changes compared to their initial shelters, trying different contextual experiments, altering the function of the ‘Shelter’, and creating different voids for light and shadow experiments. When looking at Table 13., the student has expressed their attempt to create a different context, change materials, and explore various interior arrangements.

Chaos

The first four weeks of the second semester have been defined as the Chaos stage. According to the Oxford University Dictionary, chaos is defined as ‘a state of complete confusion and lack of order’ (Oxford, n.d.). This stage is named 'Chaos' to express the shared state of confusion, tension, and panic that the students are experiencing during this phase. The difficulty level of the work carried out in this stage has increased. In this stage, the re-interpretation of the game ‘Manifold Garden’ in the M: EE game was requested. It is stated that the student started to recreate the assignment again due to incorrect proportions (Table 11). It can be seen that before attempting the new iteration, the student tried to produce it with the help of sketches and a model (Table 12).

Table 11. The attempts made by the student for the 'Manifold Garden' assignment.

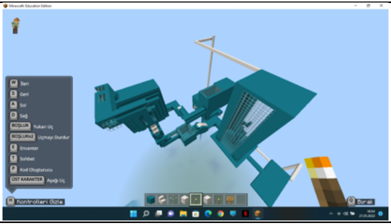
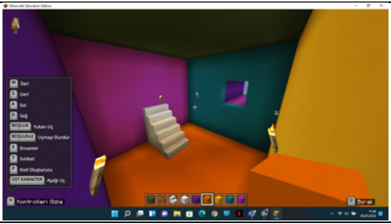
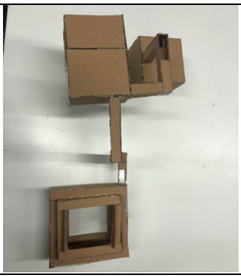
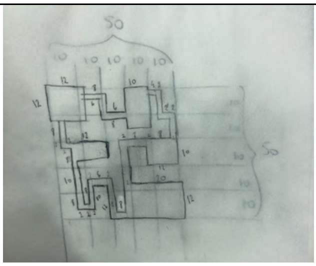
The initial attempt at 'Manifold Garden	The repeated attempts at 'Manifold Garden
	

Table 12. A student who attempts to experiment in the design process by creating models and sketches.

Model	Sketch
	

During this period, students aid each other based on their strengths, evident in 'Designer Chests' where skilled students assist peers. One student, while skilled in Sketchup, sought assistance from classmates to place a person in a scene. In their 'Designer Chests', students reported that they stayed up all night to complete the assignments given during this period. This state of panic created an environment for peer learning among the students. While there was a static developmental trajectory at this stage, there was a noticeable increase in progress over the following four weeks. As a result, the reflex of finding the one correct answer has undergone a change. Various 3D models, sketches, and model attempts made by the student for the same assignment can be observed in their 'Designer Chest.'

Excitement

The period following the Chaos phase is referred to as the Excitement phase. According to the Oxford University Dictionary, excitement is defined as 'the state of feeling or showing happiness and enthusiasm.' (Oxford, n.d.). This stage is designated as 'Excitement' to represent the collective confidence, enthusiasm, and eagerness to create that the students are experiencing during this phase.

Table 13. Students use various programs to express their ideas.

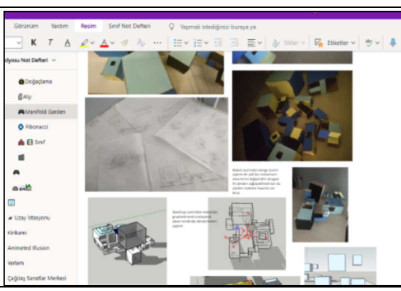
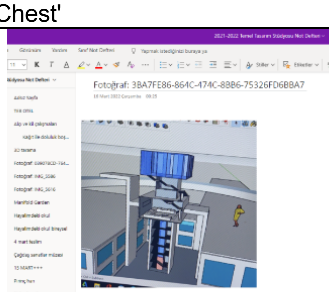
Experimenting with different scales	1:1 scale experiment
	

Table 13 highlights students' proficiency in utilizing various programs effectively, perceiving work from a human scale, and presenting ideas through drawings. Students effectively use various programs to express ideas, perceiving work at a human scale through drawings. They explore virtual reality for better comprehension.

Integration

The last four weeks of the Basic Design Studio have been defined as the Integration phase. According to the Oxford University Dictionary, integration is defined as ‘the act or process of combining two or more things so that they work together.’ (Oxford, n.d.). This stage is named the 'Integration' phase as students collectively demonstrate the targeted awareness towards the architecture profession and education within the studio, allowing them to integrate their understanding effectively. It is observed in this phase whether the developments and changes seen during the Excitement phase are permanent or not. In this stage, two different situations have been observed among the students.

Table 14. The final submissions of students

First student's 'Designer Chest'	Second student's 'Designer Chest'
	

In the first situation, As seen in the example 'Designer Chests' in Table 14, students approach weekly design problems rationally, as seen in 'Designer Chest'. Reviewing their 'Designer Chests,' their use of architectural software and explanations for design decisions are apparent. Drawings and visuals are transformed into sheets. In the second scenario depicted in Table 14, some students struggle to initiate or advance design processes when faced with diverse weekly design challenges.

CONCLUSION

The Basic Design Studio aims to help students track their growth and learning, offering personalized feedback through tools like 'Designer's Chest' and 'Shelter'. Recognizing individual differences is crucial here. Unlike formal critiques, the focus is on discussing the students' creative process—how they approached their work and made decisions. The study doesn't assess design concepts directly but rather highlights moments of change in students, which could be a separate study. Enabling students to trace their progress using tools like OneNote is vital. The study identifies unexpected transformative moments that hold organic value. This study doesn't just catalog changes but reveals internal transformations, developmental stages, and transitions. Identifying these turning points and shared attributes can enhance future design exercises for better learning and growth opportunities.

Based on the conducted analyses and the emerging findings, it is observed that students' development can be traced through the 'Designer Chests' and 'Shelters'. It is deduced that each student can be individually monitored, and the areas where they have shortcomings can be identified. Therefore, it is anticipated that their development will increase when this tracking is done in real time during the process. The presence of spaces like the 'Designer Chest' and 'Shelter', where students can express themselves individually, is essential within the course content. It is concluded that each student's development trajectory is unique, but they exhibit common reactions within certain time intervals. Observing the initial three stages reveals a transition as students comprehend design as a process, understanding the rationale behind their choices. The shift from seeking a single right answer to generating diverse possibilities is evident. Currently, when assessing students in the Basic Design studio, evaluating their designs could result in unfair judgments. The focus should be on how students showcase their progression throughout the process. Drawing from Dewey's educational philosophy, ranking active learning over passive knowledge acquisition in Basic Design Studio benefits students' design problem-solving skills.

Considering the last stages, it has been observed that, regarding Piaget's concepts of adaptation, assimilation, and accommodation, chaos arises in students due to the change. It is concluded that students develop in a balanced exciting environment following this chaos. It has been deduced that the environment of peer learning emerges within the chaos they experience. According to Vygotsky, learning and development are strongly influenced by social interactions and guidance from others (Vygotsky, 1978; Wertsch & Tulviste, 1992). At this point, the creation of an environment where students can collaborate with different groups is anticipated to positively influence their development based on the findings. The assessments have resulted in the conclusion that there are two separate student profiles. Students who can finish each phase step-by-step and employ the steps they have accomplished in the subsequent phases pass the course with average to above-average grades, according to their final grades (Table 15). Students who pass through the phases of developmental stages in a variety of ways contribute to the second student profile.

Table 15. Student diagram of developmental stages completed in order.

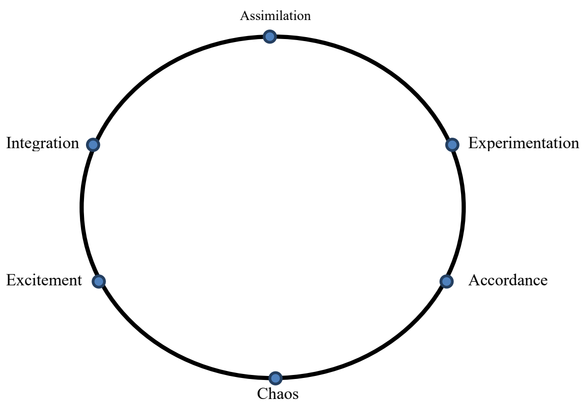
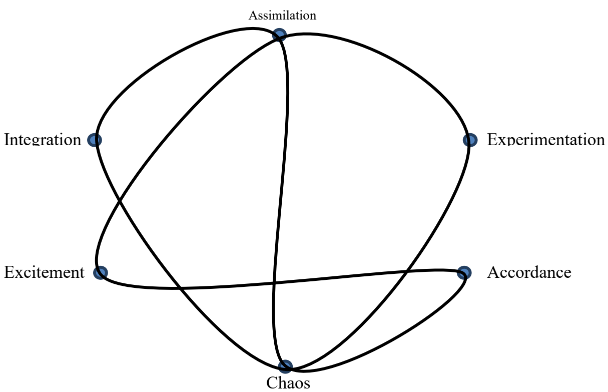


Table 16. Student diagram of developmental stages completed in mixed order.



Due to the more complicated way they finished the phases, it is challenging to comprehend what and when they learned it. It can be noticed from the final grade of the students in this profile that they received below-average grades. It was noted that every student who fit these criteria retook the course (Table 16) It is observed that they complete the steps of developmental stages in order when they take the course again. The most significant conclusion to be made from this is that each student may require a different amount of time to complete their developmental stages. This does not constitute grounds for declaring the student ineligible or incapable. Just the length of time for learning is variable. In this situation, the student should not be approached negatively.

REFERENCES

Acar, A. (2021). Mimarlık Öğrencisi: Küçük Kara Balık mı? Çirkin Ördek Yavrusu mu? 1st International Architectural Sciences and Applications Symposium (pp. 36-41). Isparta: ISPEC Publishing House.

Acar, A., Koç, M., Bancı, S., & Abbas, G. M. (2022). Borderline: An Interdisciplinary Spatial Installation. 2nd AE International Symposium (pp. 76-84). IKU Department of Architecture.

Bender, M. T. (2005). A New Interpretation about John Dewey's Opinion of Education. Gazi University Kırşehir Faculty of Education, 6(1), 13-19.

Doolittle, P. E. (1995). Understanding Cooperative Learning Through Vygotsky's Zone of Proximal Development. Lilly National Conference (pp. 2-4). Columbia

Duncan, S. C. (2011). Minecraft, Beyond Construction and Survival. Well Played, 1, 1-22.

Egersdorfer, D. (2016). Using Digital Game-Based Learning to Engage Science Students: The Case of Minecraft. Investigating Our Practices Conference (s. 1-19). Vancouver: University of British Columbia. 2022 tarihinde alındı

Lindberg, E. A. (2011). Piaget and Cognitive Development in Adolescence. Kastamonu Education Journal, 19(1).

Microsoft. (n.d.). What is OneNote? Retrieved 2023, from Support Microsoft: https://support.microsoft.com/tr-tr/office/video-onenote-nedir-be6cc6cc-3ca7-4f46-8876-5000f013c563

Miller, P. H. (1997). Theories of Developmental Psychology (5th Edition ed.). NewYork: W.H. Freeman and Company.

Minecraft. (2023). What Is Minecraft: Education Edition? Retrieved 2023, from Minecraft Help Center: https://help.minecraft.net/hc/en-us/articles/What-is-Minecraft-Education-Edition

Oxford. (n.d.). Accordance. Retrieved 2023, from Oxford English Dictionary: https://www.oed.com/dictionary/accordance

Oxford. (n.d.). Chaos. Retrieved 2023, from Oxford English Dictionary: https://www.oed.com/dictionary/chaos

Oxford. (n.d.). Excitement. Retrieved 2023, from Oxford English Dictionary: https://www.oed.com/dictionary/excitement

Oxford. (n.d.). Experimentation. Retrieved 2023, from Oxford English Dictionary: https://www.oed.com/dictionary/experimentation

Oxford. (n.d.). Integration. Retrieved 2023, from Oxford English Dictionary: https://www.oed.com/dictionary/integration

Senemoğlu, N. (2005). Gelişim Öğrenme ve Öğretim (11th edition ed.). Ankara: Gazi Bookstore.

Shaffer, D. R. (1999). Social and Personality Development. Wadsworth Publishing.

Vygotsky, L. S. (1978). Mind in Society. Cambridge: MA: Harvard University Press.

Wertsch, J. V., & Tulviste, P. (1992). L. S. Vygotsky and Contemporary Developmental Psychology. Developmental Psychology, 28(4), 548-557.

FROM PROJECTIVE METHODS TO REAL-TIME DIGITAL CONSTRUCTION OF ARCHITECTURAL SPACE IN FIRST-YEAR ARCHITECTURAL EDUCATION

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ABSTRACT

This research delves into an exploration of the boundaries and prospects inherent to traditional orthographic projection as a medium for the representation, comprehension, and exploration of space, particularly in light of approaches like collaborative spatial production within virtual reality environments. The core objective of this study is to foster a deeper understanding of projective techniques among students engaged in the creation and immersion of architectural spaces in virtual reality. Additionally, it endeavors to illuminate the potential benefits of spatial learning through the lens of embodied cognition. To this end, the study embarks on a multifaceted trajectory. It initiates with a historical overview of orthographic drawing methodologies and seeks to unravel the enduring rationale behind the continued application of a method born in the 18th century. Subsequently, the study shifts its focus towards the significance of embodied cognition in the context of spatial comprehension. In light of the observed limitations of projective methods in comprehending, representing, and exploring space within the prevailing educational landscape, there arises an imperative to contemplate the potential enrichment engendered by alternative working environments. This study presumes the utilization of the virtual reality (VR) environment as a viable solution. By immersing students within this digital space, the research endeavors to ascertain whether engaging in design activities grounded in embodied cognition can subsequently enhance students' proficiency in the domain of orthographic drawing. Finally, the research presents and interprets the outcomes derived from a series of experiments conducted among undergraduate and graduate students, anchoring its findings within a robust empirical framework.

Keywords: Architectural Education; Embodied Cognition; Orthographic Projection; Architectural Representation; VR Technology

INTRODUCTION

Architectural education is a discipline that requires constant refinement and improvement of its approaches. The methods and tools of education are about connecting a student's creative urges and the developable ability to see the world as a fabric of interwoven social, political, and environmental concerns (Malecha, 1988). One of the basic issues of education is about the diverse modes of representation of that fabric and its elements. Orthographic Projection has been the key form of representation for centuries due to its standardized principles, and rational and objective features. As a result of being "parts of a dissected whole relying on syntactic relations," the orthographic set, comprising a plan, elevation, and section, is considered to be "reductive" (Pelletier & Perez-Gomez, 1992). Those reductive and abstractive conventions of orthographic projection are at the center of most of the criticism. This study discusses the limits and future of conventional orthographic projection in representing, comprehending, and exploring space in comparison with novel methods particularly collaborative spatial production in virtual reality.

This study claims that the projective methods introduced to students are insufficient in representing, comprehending, and exploring space. Why a method that emerged in the 18th century still is in use in architectural education and production today is questioned. As a discipline, design manifests inherent periodicity in its normative paradigms, undergoing perpetual rejuvenation, and is fundamentally mediated through modes of representation. The pedagogical methodologies of these modes of representation necessitate a continuous process of revitalization within the architecture domain, ensuring contemporaneity with the prevailing temporal milieu. The possibility of a better understanding of projective methods by students producing and experiencing architectural space in virtual reality is brought forth. The potential positive outcomes of spatial learning from an embodied cognition perspective are presented. The embodied cognition perspective claims that the mind and body play a crucial role in shaping thoughts and cognition. This led us to learn by doing in which students learn best when they are actively engaged in the learning process and can apply what they have learned practically. From a wider perspective, it is important to discuss embodied cognition and learning by doing in architectural design and architectural education for a better understanding, production, and representation of space in 2D and 3D using conventional and novel methods such as virtual reality.

This research project aims to explore how designers begin their creative process and then examine how one method of representing ideas, called orthographic projection, relates to design. In the next phase, the study will discuss how virtual reality can be used to improve how designers understand and visualize spaces. Finally, the research will describe an experiment involving 10 graduate students in architecture and 9 first-year architecture students. These participants will share their experiences of using different virtual reality tools (like Open Brush, and Arkio) for design work.

From Sketch to Building

This research contends that projective techniques, which transcend mere sketching and enable the communication of designs in a universal language, may prove insufficient in comprehending and articulating spatial constructs. Subsequently, the study delves into the intricacies of orthographic drawing and explores the reasons for its continued use in contemporary contexts, akin to its original inception.

Drawing has been a form of expression since early human history, with early humans using drawings on caves and stones to express their basic needs (Gombrich, 1950). While drawing has been a means of communication for people, it has become more important for architects. The architect or designer uses the drawing tool to explain his design to someone else. However, using drawing as a tool requires standardization and customization. Therefore, the orthographic projection used by architects is a different tool from a sketch and a form of representation. These drawings are created using descriptive geometry principles to ensure that they accurately represent the drawn object. For centuries, architects have utilized precise tools such as the compass and ruler to produce drawings that capture the outlines of the plane surfaces of buildings, as described by Vitruvius in his 'Ten Books on Architecture' (Vitruvius, Pollio, & Morgan, 1914). Descriptive geometry is a theoretical framework that provides the mathematical principles for projecting three-dimensional objects onto a two-dimensional surface, which is essential for creating technical drawings. On the other hand, technical drawing is the practical application of these principles to produce precise depictions of the drawn item. The importance of hand drawing in architectural education has been recognized, and it is considered a tool that sets "processes of cognition in motion." (Jones, 2011). Standardized rules are used to ensure uniformity and clarity in technical drawings that employ descriptive geometry. These rules include the use of standardized symbols as well as certain line weights and types. The rationale underpinning the forthcoming part resides in the description of the genesis and rationale undergirding the inclusion of descriptive geometry—an essential pioneer to orthographic drawing—within architectural pedagogy. The basic motivation for this endeavor is to bring light to the underlying utility of drawing as a communication tool. Notably, orthographic drawing, a time-honored conduit of representation and design, has persisted across ages. However, the inquiry indicates how the long-dated employment of this method in its fundamental configuration over extended temporal terms produces a complicated dynamic in shaping the spatial perceptual acumen of architectural students. Thus, the ultimate goal of the current study endeavor is to elucidate the impact of adhering to an unchanged strategy across centuries on students' cognitive apprehension of spatial components under the realm of design.

Descriptive geometry, created by the French mathematician Gaspard Monge in 1798 (Javary, 1881), is a mathematical system used to represent and describe three-dimensional objects in a two-dimensional plane through the use of projections. Descriptive geometry aims to express it in a two-dimensional representation from the physical space in which the three-dimensional object is located. Thus, it is possible "to recognize using an exact description the forms of the bodies and to deduce all the truths that result, either of their forms or their respective positions." (Monge, 1798). It is necessary to thoroughly investigate the history of descriptive geometry to critically assess the drawing approaches used in the twenty-first century. Although Gaspard Monge systematized and defined descriptive geometry, its origins and usage may be traced back much further.

> *Je ne savais pas que je savais la géométrie descriptive !*
>
> *("I didn't know I knew descriptive geometry").*
>
> *The discourse of Joseph Louis Lagrange, who reassesses Monge's work during the French Revolution (Migliari, 2012)*

As far as is known, the development of descriptive geometry may be traced back to antiquity and the discovery of perspective in the Renaissance. The importance of technical drawing for architects was underscored by Vitruvius, a renowned figure from the 1st century BCE. In his influential work, "De Architectura," also known as "Ten Books on Architecture," he highlighted the crucial role of technical drawing as a core competency for architect (Cigola, 2016). Vitruvius' contributions to architecture and engineering can be seen as part of the broader historical context that led to the development of descriptive geometry and other related fields. This early acknowledgment of technical drawing's value set the stage for the evolution of various geometrical concepts and techniques, including descriptive geometry, which Gaspard Monge would later systematize and formalize (Gasca, 2019).

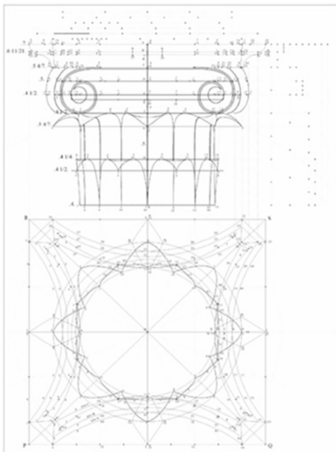

Figure 1 This drawing, which is readable only in in-folio format, Represents the graphic transcription of operations related to the construction of the capital, meticulously described by Piero from fol. 49v to fol. 52r of the manuscript preserved.

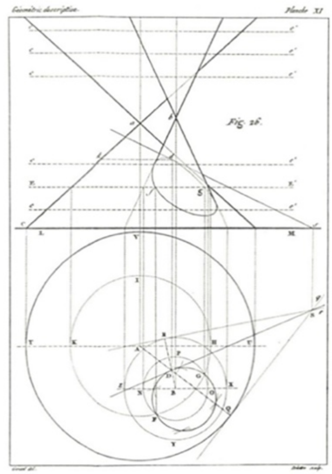

Figure 2 Plate XI, from Monge's Géométrie Descriptive, 1795, shows the method used for determining the curve of the intersection of two cones.

Piero della Francesca, an Italian master, is credited with producing the first systematic study of perspective in the 1470s. His work, De Prospectiva Pingendi, was written before the Renaissance. In this work, Francesca drew the object by placing it on the plan and in front of the façade, a technique that was later adopted by Piero Monge three centuries later. This approach to perspective drawing was groundbreaking and marked a significant shift in the way artists approached the representation of three-dimensional space on a two-dimensional surface. Piero's treatise includes drawings where the plan and elevation of an object are linked by lines known as 'reference lines' (Figure 1). This demonstrates that Piero connected the two 'projections' based on his understanding of the reference line, rather than just intuition. Figure 2 depicts the method employed by Gaspard Monge in 1795 to ascertain the curve of the intersection of two cones. Despite the significant time gap between the two images, their objectives remain identical, namely, to describe a three-dimensional object in a novel space. Just as Piero used in his experiment, the geometric body and its construction phase are simultaneous in descriptive geometry. The designer imagines the object in his head, and when he molds it, the object takes shape. Piero Della Francesca applied descriptive geometry logic to perspective centuries before Monge (Migliari, 2012).

Gaspard Monge's goal was to build an autonomous three-dimensional ideal space. The abstracted space would absorb the information coming from the "object" of the representation, that is, it would take the projection of the object on its surfaces and present it in two dimensions. Its descriptive geometry was a science of representation' through the 'objectification of space', regardless of the shape, size, or orientation of the 'object' to be represented.

Pérez-Gómez and Pelletier argue that descriptive geometry serves as the precise link between a representation and its corresponding object (Pérez- Gómez & Pelletier, 1997). Monge's descriptive geometry is important because it distinguishes spatial configurations from orthographic projection. It uses orthographic projection, but just two fixed and perpendicular "reference planes." According to Evans (Evans, 1995), descriptive geometry is concerned with determining the relationships between mathematically specified bodies and surfaces rather than describing the look of objects. Monge proved this could be accomplished only with points and lines, making everything clear. As a result, only two projection planes are necessary, and two points on two surfaces can be used to calculate a third, distinct point in space from which they were projected. For this reason, the fundamental set of drawings in descriptive geometry differs from that of architectural drawing can be said.

Monge's demonstration showed that by using points, lines, and two projection planes, descriptive geometry can accurately represent three-dimensional objects. This serves as the foundation for teaching descriptive geometry in architectural education, where students learn about the production of geometric shapes, projections, and image construction through these essential elements. Descriptive geometry is related to space elements such as points, lines, and planes, which represent diverse three-dimensional structures and forms when combined. In architectural education, descriptive geometry is taught through courses that cover the fundamentals of geometry formation, orthogonal and other projections, and image construction. The teaching technique is based on a modified design-analog method linked with educational and professional architectural practice. These classes aim to improve three-dimensional design thinking and connect art and architecture through observation, analysis, and composition.

In the twenty-first century, descriptive geometry education has expanded to embrace new technologies and instructional approaches. While the fundamental concepts and principles remain the same, technological improvements have made complex 3D geometry easier to grasp and understand. This made it easier for students to understand complex geometry and develop the skills they need to become architects. Students were able to develop and alter 3D models on the computer, making difficult geometry easier to comprehend and grasp, due in part to computer-aided design (CAD). Traditional methods of architecture have been questioned for many years. All design schools, which overlap with each other and seek different ways for the same purpose, have tried to produce different methods on a new axis. Drawing and projective methods formed the basis of modern architecture. The purpose of this research is to reveal the methods that are suitable for changing student profiles in the teaching process and that have developed over time. In other words, different educational needs among generations also should result in different educational models (Bates, 2005). Developing technologies will inevitably create new discourses for representing, comprehending, and discovering space in architecture.

Spatial Relationships in Design

One of the interpretations given by Khine (2016) says that spatial ability is "the capacity to perceive the visual images accurately, construct mental representations and imaginary of visual information, understand and manipulate the spatial relations among objects", characterizing it as a "powerful indicator of personal quality and individual differences". Architectural design is a multifaceted discipline requiring diverse abilities, in particular creativity and spatial ability. One of the goals of architectural education is to nurture students' capacity to generate creative solutions. In addition, because architectural design aims to build three-dimensional structures, the ability to read, interpret, and visualize spatial information – spatial ability – is important (Mckim, 1972). Since one of the aims of this research is to search for methods of mentally visualizing spatial transformations, the contributions of embodied cognition to real-scale design should be discussed.

Spatial skills, the idea of embodied cognition, where the mind and body are not separate and instead play a crucial role in shaping thoughts and cognition, argues that our sensory and motor experiences are not just a by-product of thoughts, but play a crucial role in shaping cognitive processes. The physical experience of being in a space can impact cognition and understanding of that space. For example, the way that light, sound, and temperature are experienced in a building can affect how we feel and think about that space. Pedagogical approaches involving body involvement and concrete architectural design efforts significantly improve architectural students' spatial understanding and design intelligence. Learning by doing can be effective for a wide range of subjects, including technical skills, problem-solving, and critical thinking. Learning by doing appears as a method that has almost become a "law" for architectural education, which has been valid since Vitruvius' definitions of the architect's theoretical and practical knowledge in de Architectura / Ten Books on Architecture, which is the oldest known architectural text that has survived to the present day (Acar, Eskiçag'da Yedi Özgür Sanat ve "Mimar"ın Egitimi, 2021). Learning by doing can be an effective approach to teaching architecture, as it allows students to practically apply their knowledge and skills. Through these hands-on activities, students can learn about the various aspects of architecture, including design, materials, and construction techniques. The method of the study must investigate the impact of the virtual realm, exemplifying contemporary technology that actively engages the body in learning.

Constructing Spaces in Virtually Reality

New technologies are being used in architectural education, including virtual and augmented reality, 3D modeling and printing, and simulation software. These technologies can help students visualize and manipulate three-dimensional spaces in a way that is highly difficult with traditional drawing and modeling techniques. For example, virtual reality headsets can allow students to "walk" through a virtual building and experience it as if they were there. However, 3D printing technologies offer new perspectives on the relation between material, construction, and form. They provide simulation possibilities about the structural and mechanical properties of the product during the modeling phase. 3D additive manufacturing technologies are not a type of substitute for conventional physical models. According to Dillenbourg, virtual educational environments can be defined as designed "spaces of knowledge" where students become not only active participants but also "actors" during education. These spaces employ various information exchange methods ranging from plain text to Immersive Virtual Reality in 3D Spiral (Dillenbourg, Schneider, & Synteta , 2002). This study endeavors to scrutinize architectural designs executed at a real scale, leveraging the cognitive maturation of students as they traverse and comprehend spatial realms across all dimensional facets. To that purpose, the current study investigates the virtual reality (VR) milieu, given its dual potential to provide the necessary milieu while also speedily channeling the technical breakthroughs emblematic of the twenty-first century to the student cohort.

Virtual reality (VR) technologies are increasingly being used in the field of architecture, as they provide a powerful tool for visualizing and manipulating three-dimensional spaces. The virtual environment is generated by the computer, and the interactive visual scene simulation of immersive feeling is made by the interaction of visual, auditory, and tactile effects on users (Youshuang, Xianglong, & Fei, 2004). This technology can provide architects and designers with a powerful tool for visualizing and manipulating three-dimensional spaces and can help to improve the design process, collaboration, and communication with clients. A new way of visualization with immersion in virtual reality is improving communication in the coordination of construction projects between designers, contractors, and investors (Milovanovic, Moreau, Siret, & Miguet, 2017). One of the key advantages of using virtual reality (VR) technology in architectural education is that it allows for life-size and real-time design. This technology enables students to experience their designs in a more immersive and realistic way and can help them better understand their designs' spatial relationships and scale. By allowing students to "walk" through their virtual buildings, VR technology can provide a valuable tool for enhancing architectural education and improving students' understanding of design principles and concepts. Hence, in consideration of these rationales, the methodological approach adopted for this investigation entailed the utilization of a virtual reality (VR) environment. Within this framework, diverse VR applications were administered to the participants as part of the experimental protocol.

In 2001, Alvarado, Parro, and Vildosolo conducted an experiment on the development of a Virtual Reality system for modeling wooden structures and their evaluation with students on its contribution to the architectural project (Alvarado, Marquez, & Vıldosola, 2001). The experiment was carried out with senior students from two different universities, and two teams of 15 people were formed. One team designed 1/1 using the VR system, while the other team designed using purely traditional methods. At the end of the activity, each student presented a page with the plan, view, and perspective of the proposed design. The professors then evaluated this with a blind comparison, and finally, a questionnaire was taken from the students. The designs were schematized to count the differences in spatial volumes, environmental divisions, and other groupings (Figure 3). Synthesized in plan and facade. However, looking at the plans of the designs, the group working 1/1 with VR was much more complex and diverse. In the surveys, students noticed that the system working with VR had good functionality and was used to explore possibilities at the beginning of the design process rather than defining the design at the end of the design process. When they looked at the result, the design qualities of both teams were very close to each other.

Drawing upon an experiment conducted over two decades ago, it becomes apparent that engagement within a virtual reality milieu engenders novel avenues of exploration for students. Implicit within this inquiry lies a fundamental question: Amidst the current chronicle of 2023, what underpins the persistence of conventional approaches in design education?

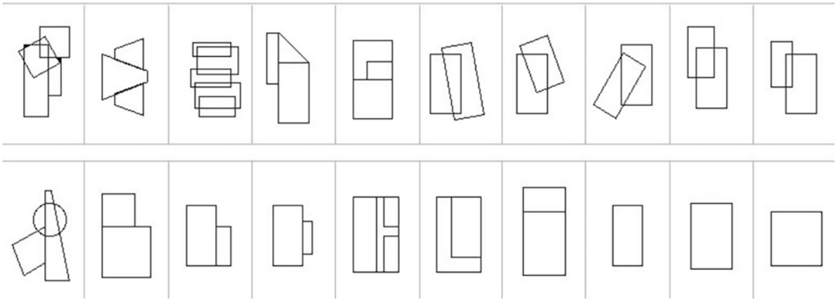

Figure 3 Schematic Plans (Up Designs with Vr Systems, Down Control Designs) Source; Qualitative Contribution Of A Vr-System To Architectural Design: Why We Failed?

The Methodology of This Study

Notably, the number of quantitative studies based on the psychometric evaluation of visual-spatial cognition and visual-spatial skills of architecture students is scarce. Acar, Soysal Acar, and Ünver (2019) used neuropsychological tools and psychometric assessment of the relationship between art education and visual-spatial skills. Schnabel and Kvan (2003) compared the perception and understanding of spatial volumes using real two-dimensional environments and a computer screen virtual reality headset. The participants they studied using real two-dimensional environments achieved the highest accuracy in volume reconstruction. However, they reported that students using virtual reality headsets gained a better three-dimensional understanding of volume and its components. The authors concluded that the use of virtual reality headsets is more effective in perceiving complex volumes. They also found that students using a two-dimensional environment learned more about volume configuration rather than gaining a three-dimensional understanding. The findings of the study suggest that it is necessary to investigate whether virtual reality headsets give better results in studies involving complex volumes, as they allow for greater body movement. A study conducted by Passig and Eden (2002) investigated whether mental rotation abilities can be supported using virtual reality technology. The study reported that three-dimensional (3D) stimuli supported mental rotation ability. Hu, Zhu, and Wu (2017) also investigated the effects of 3D and computer-assisted visual-spatial training on visual thinking and found that this 3D animation-supported training significantly affected mental rotation.

This research is continuing with experiments carried out in the context of the thesis prepared within the scope of the TOBB Economy and Technology University Architecture Graduate Program. The method is based on the findings of the study. In this study, the place of a design tool that activates embodied cognition in architectural education is discussed. It is argued that current projective drawing methods are insufficient in representing, comprehending, and exploring space and that the use of embodied cognition can improve the learning process of students. The thesis explores the potential benefits of using a design tool that engages the body and mind in the design process and presents arguments as to why such a tool could be effective in improving architectural education.

To investigate the benefit of the search for space on a real scale on the representation of it with the orthographic method, A pilot trial was conducted with 9 undergraduate students who took the TOBB Economy and Technology University Architecture first-year basic design course with the code Mim102, and 10 graduate students who were taking the Mim527 course, New Realities in Spatial Design. Students who had no previous experience with VR were selected for this experiment. The goal of this pilot experiment is to distinguish between an experienced and inexperienced designer. Two different VR applications were used as tools for this study. The first of these was Arkio. Arkio is a virtual reality tool that is designed to facilitate collaboration and idea-sharing among architects and designers (Arkio , 2022). It allows users to quickly sketch and review architectural designs in a VR environment and can be used by a group of people to discuss and evaluate different design options in real time. Arkio is a virtual and augmented reality tool that is designed for use by architects and designers, as well as video game-level designers. The platform allows users to collaborate and design together in a VR environment, with support for up to 24 people working in the same scene across VR headsets, PCs, tablets, and phones (Figure 4). Arkio enables users to design interiors, buildings, virtual spaces, and game environments and even allows them to mix realities using Passthrough on Quest. Arkio also includes experimental hand tracking, which allows users to use their own hands instead of controllers to work with a selection of volumetric modeling tools (Figure 5). Instead of being limited by flat-screen devices, Arkio allows users to work with 3D models in a way that feels more like physical modelmaking, where they can pick up and manipulate objects naturally and intuitively. One of the key features of Arkio is its focus on collaboration and accessibility. The program allows for more inclusive and flexible design sessions, where multiple people can contribute and build on each other's ideas. Additionally, Arkio enables users to work at any scale and even allows them to "jump inside" their models at a human scale to experience and modify their designs more realistically.

Figure 4 Pass through modeling in Arkio Source; https://www.roadtovr.com/arkio-vr-architecture-collaboration/

Figure 5; People draw in the Arkio program Source; Authors' archive.

Another application is Open Brush. Open Brush strives to be an open-source tool to help everyone create their art. Developers say, 'We believe in the preservation of art, and the freedom of artists.' Open Brush is a free fork of Tilt Brush, a room-scale 3D-painting virtual-reality application available from Google, originally developed by Skillman & Hackett (About Open Brush, 2021). Open Brush can be likened to a boundless 3D canvas, offering a rich array of versatile tools that empower boundless creativity within an expansive virtual space (Figure 6). Users can craft and manage various surface volumes using the intuitive controller at their disposal. More importantly this application, further establishes a collaborative workspace, facilitating the convergence of diverse individuals within shared virtual rooms. Hence, the selection of Arkio and Open Brush applications for this experiment was predicated upon their capacity to furnish a verisimilar and immediate design milieu, one that substantially engages the body and intellect within the design framework. These tools are instrumental in facilitating a comprehensive exploration of production and representation processes within 3D immersive domains where the entirety of the body is intricately involved, thereby aligning with the principles of embodied cognition.

Figure 6 Screenshots from Open Brush Control Center Source; Open Brush Tutorial https://openbrush.app

Using these experiment tools, Basic Design students are allowed to explore this environment and are allowed to redesign. Basic design students were first asked to explore Open Brush and Arkio. In the first lesson of this two-week experiment, they tried the Oculus Quest 2 headphones and discovered this new environment and its benefits. In the subsequent instructional session, students were assigned the task of formulating a shelter tailored to the parameters of the Open Brush virtual universe. At this point, the important thing was that the students could design a living space at the simplest level. To commence this endeavor, students initiated the design process within the virtual reality (VR) environment during the class session. Subsequently, they were tasked with translating their virtual creations into tangible manifestations within their physical reality. In pursuit of this objective, in the other lesson, students endeavored to realize their designs through the production of physical models and drawings, employing various materials that aimed to encapsulate the spatial essence of the VR environment. Upon reconvening in the subsequent class session, students conducted a comparative analysis of their physical models and drawings vis-à-vis their designs within the VR. This deliberative examination engendered discussions about the strategies for designing the physical environment in harmony with the digital spatial. Following the last session, students were tasked to articulate their experiential reflections and insights stemming from their engagement in the creative process within the physical after their work within the virtual reality (VR) environment. This was accomplished by soliciting written reviews wherein students conveyed their experiences and observations regarding the transition from the VR design platform to the tangible world of architectural creation. For architecture graduates currently pursuing their master's degrees in architectural design, a distinct trajectory was instituted. Similarly, to the basic design students, these advanced learners were allowed to engage with the environments of Arkio and Open Brush. Within these immersive platforms, students, like their counterparts in basic design courses, attempt exploratory journeys, acquainting themselves with diverse surface modalities and dynamic brush utilities, thereby discovering novel insights through the adept deployment of various tools. Subsequently, in the other lesson, a comprehensive discourse transpired, focusing on traditional design methodologies in light of the experiences derived from these immersive environments. To consolidate these reflections, students were tasked with the preparation of comprehensive reports, thereby elucidating their reflections and insights.

In this immersive digital environment, participants are tasked with improving their designs and expanding them to a tangible scale. Covering the traditional and VR domains, both phases are meticulously documented, capturing the sequential evolution of participants' design methods. This report records and covers participants' sequences of procedures and choices to navigate in each setting. Moreover, the framework of the study includes a longitudinal assessment; here, the design routes of the participants are followed as they transition from the VR field back to the psychical field. For this reason, the study seeks to reveal the dynamic interaction between traditional and virtual design environments, aiming to illuminate the changes in design perception and innovation accelerated by immersive VR interaction.

After completing student explorations within this novel environment, comprehensive assessment reports concerning design activities within this context were procured. The analysis of these reports describes astonishing observations. Experienced architects understand and discern that engaging with virtual reality transcends their pre-existing limitations. In contrast, a minority faction of graduate students, apprehensively asserts that these innovative tools cannot supplant the age-old employment of pencil and paper. However, even for these students, if the problems that the VR environment creates in terms of technology (battery time, pain in the ligaments in long-term use, etc.) are solved over time, due to both the possibility of designing with people in different places at the same time and the rapid transitions between different scales in an unlimited space. Most of the nine graduate students expressed highly favorable assessments regarding using a VR environment, citing its capacity to afford a 1:1 scale view of designs and enable rapid transitions to smaller scales. Nonetheless, a divergent perspective was articulated by a student identified as YL3, who raised critical points concerning the perceptual experience within the VR apparatus. YL3 likened the navigational experience within the VR environment to perusing two-dimensional representations and conventional fiction. This student contended that such an experiential juxtaposition might induce a perceptual disconnection from the architectural context. However, it is noteworthy that all students uniformly acknowledged the substantial advantages of VR. Their appreciation extended beyond the collaborative possibilities of remote design sessions to encompass the seamless transition capabilities across varied scales within an expansive virtual realm. This medium expedites the assimilation of tridimensional comprehension and architectural schematics, consequently underscoring the profound significance of VR-driven investigations.

The situation is notably disparate among the cohort of undergraduate students who lack prior design exposure. In a cohort of 9 students, virtually all acknowledge the profound distinctiveness and innovation inherent in operating within this environment. However, the unlimited scalability of the architectural constructions is an extraordinary problem, proving to be a cognitive challenge. The reports illuminate a discernible pattern: 5 of the 9 students, having engaged in preliminary sketching and designing within the virtual realm, exhibited a propensity to acclimate swiftly. Conversely, the remaining 4 encountered significant difficulties, gravitating towards the familiarity and spatial constraint of traditional scale-oriented drawing techniques. The assertion made by student L2 presents a thought-provoking perspective, albeit initially perplexing. L2 posits that the optimal utilization of the VR environment lies not within the primary phases of design conception but rather within the subsequent stages of design evolution and adaptation. In essence, the student contends that, for the present, the role of VR remains confined to that of a representation tool. This perspective, while intricate, underscores the nuanced potential of VR as a transformative instrument. L2's viewpoint accentuates the incremental value that VR can contribute to the iterative refinement and mutability of architectural design. At the same time, the subsequent mock-up experiments conducted by first-year students immediately following their exposure to Open Brush proved particularly intriguing. In the aftermath of this study, it is noteworthy that none of the students engaged in VR opted for traditional architectural materials such as cardboard or balsa wood, which constitute prevalent choices in contemporary architectural education. Instead, students selected modes of expression in their models predicated upon their anticipated impact within the spatial domain. For instance, one student, identified as L6, embarked on, crafting a presentation characterized by the intricate folding of colored transparencies. In doing so, L6 sought to investigate the detailed interplay of light, its reflective properties, and its consequent impact on spatial perception within a model. This deviation from conventional materials underscores the transformative influence of VR exposure, which not only shapes design perspectives but also informs material choices in architectural experimentation. While it may initially appear enigmatic, the notion of VR as a tool for design maturation opens avenues for exploring its latent capabilities in ways that extend beyond the conventional confines of design genesis.

CONCLUSION

Commencing with the premise that projective methodologies may exhibit limitations in their capacity to comprehend and articulate space, this study attempts to evaluate this claim empirically within the student body. The study theorizes that production and representation processes conducted within 3D immersive environments, characterized by active embodied cognition, hold substantial promise in augmenting spatial understanding and comprehension. This study undertakes a critical examination of orthographic methods, contending that these techniques, which have remained largely unchanged since their 18th-century inception, have primarily assumed the role of representation rather than fostering a comprehensive understanding of space. The study does not propose to supplant orthographic methods but rather seeks to clarify avenues for enhancing the perception and development of spatial understanding. Consequently, within the framework of this study's objectives, an experiment was conducted to address the limitations of orthographic techniques in the realms of spatial comprehension, exploration, and representation. This investigation introduced innovative methodologies grounded in embodied cognition, alongside novel tools. The outcomes revealed that adept designers adeptly engaged with these approaches, seamlessly envisioning, and maneuvering through the architectural space on a real scale. However, the perceived difficulties faced by less experienced designers in acclimatizing to this novel environment appear rooted more in their unpreparedness stemming from inadequacies in orthographic drawing, rather than any inherent shortcomings of the new paradigms. Still, it can be asserted that the influence of VR technology has manifested a notable divergence in modeling and representation techniques employed by undergraduate students, even after undergoing virtual reality coursework. This influence has notably contributed to their educational development.

This experiment sought answers to the question claimed in this study, which was prepared within the scope of the thesis, and brought it closer to the goal. Prospective investigations, aimed at examining the spatial representations of students engaged in virtual environments, through testing among architecture students spanning various stages of their academic progression, hold promise for enriching the breadth of knowledge in this domain in the future.

REFERENCES

About Open Brush. (2021). Open Brush: https://openbrush.app adresinden alındı

Acar, A. (2021). Eskiçag'da Yedi Özgür Sanat ve "Mimar"ın Egitimi. *Mimarlık, 418*, 72-76.

Acar, A., Soysal Acar, Ş., & Ünver, E. (2019). Mimarlık Bölümü Birinci Sınıf Öğrencilerinin Görsel-Mekânsal Becerileri Üzerine Bir Araştırma. *ODTÜ Mimarlık Fakültesi Dergisi, 36*(2), s. 73-92.

Ackerman, J. S. (1991). *Palladio.* Penguin.

Alvarado, R. G., Marquez, J. C., & Vıldosola, G. V. (2001). *QUALITATIVE CONTRIBUTION OF A VR-SYSTEM TO ARCHITECTURAL DESIGN: WHY WE FAILED?* QUALITATIVE CONTRIBUTION OF A VR-SYSTEM.

Arkio . (2022, November 22). Steampowered: https://store.steampowered.com/app/1053760/Arkio/ adresinden alındı

Bates, T. (2005). *Technology, E-Learning and Distance Education.* Routledge: Psychology Press.

Behzadi, A. (2016). Using Augmented and Virtual Reality Technology in The Construction Industry. *American Journal of Engineering Research (AJER), 5*(12), 350-353.

Bielefeld, B., & El Khouli, S. (2007). *Basics/Design Ideas.* Basel: Birkhäuser.

Cigola, M. (2016). *Distinguished Figures in Descriptive Geometry and Its Applications for Mechanism Science From the Middle Ages to the 17th Century.* Cassino, Italy: Springer Cham.

Dillenbourg, P., Schneider, D., & Synteta , P. (2002). Virtual learning environments. *In 3rd Hellenic Conference Information & Communication Technologies in Education* (s. 3-18). Greece: Kastaniotis Editions.

Evans, R. (1995). *The Projective Cast: Architecture and Its Three Geometries.* Cambridge, Massachusetts: The MIT Press.

Fuchs, P., Moreau, G., & Guitton, P. (2011). *Virtual Reality: Concepts and Technologies.* London: CRC Press.

Gasca, A. M. (2019). Descriptive Geometry in Spain as an Example of the Emergence of the Late Modern Outlook on the Relationship Between Science and Technology. *Descriptive Geometry, The Spread of a Polytechnic Art* (s. 81–96). içinde Rome, Italy: Cham Springer.

Gombrich, E. (1950). *The Story of Art.* Phaidon Press.

Hara, K. (2021). *Designing Design.* Lars Müller Publishers.

Hu, Y., Zhu, J., & Wu, B. (2017). Scaffolding Spatial Thinking with Visualization and Embodiment: A 3D Multimedia Approach. *2017 IEEE 17th International Conference on Advanced Learning Technologies (ICALT)*, (s. 322–324)).

Javary, A. (1881). *Traité de géométrie descriptive.* Paris: Delagrave.

Jones, W. (2011). *Architects' Sketchbooks.* Thames & Hudson.

Juzwa, N., & Krotowski, T. (2018). Sketch - Computer - Imagination Reflections on Architecture Education Methodology. *DESIGN CONCEPTS & STRATEGIES*, 583-588.

Kahn, L. (1957). Architecture is the thoughtful making of spaces. *Perspecta*, 2-3.

Khine, M. S. (2016). *Visual-Spatial Ability in STEM Education.* Springer.

Malecha, M. J. (1988). Architectural Education. (55), 121-132.

Mark, J. J. (Encyclopedia of Ancient Egypt. (n.d.). Papyrus. Ancient History Encyclopedia. https://www.ancient.eu/papyrus/). *Papyrus*. Ancient History Encyclopedia: https://www.ancient.eu/papyrus/ adresinden alındı

Mckim, R. H. (1972). *Experiences in Visual Thinking.* Monterey: Cole Publishing Company,.

Migliari, R. (2012). Descriptive Geometry: From its Past to its Future. *Nexus Netw Journal*, 555-571.

Milovanovic, J., Moreau, G., Siret, D., & Miguet, F. (2017). Virtual and Augmented Reality in Architectural Design and Education An Immersive Multimodal Platform to Support Architectural Pedagogy. *Future Trajectories of Computation in Design.* İstanbul: 17th International Conference, CAAD Futures 2017.

Monge, G. (1798). *Géométrie descriptive*. https://www.e-rara.ch/ doi/10.3931/e-rara-4796. adresinden alındı

Niemojewski, L. (1947). *Uczniowie cieśli.* Warszawa: Trzaska, Evert i Michalski.

Oculus Blog. (2022). *Get Hands On Wıth Spatıal Desıgn Tool Arkıo, Now Avaılable On The Quest Platform*. Meta Quest: https://www.oculus.com/blog/get-hands-on-with-spatial-design-tool-arkio-now-available-on-the-quest-platform/ adresinden alındı

Passig, D., & Eden, S. (2002). Virtual Reality As A Tool For Improving Spatial Rotation Among Deaf and Hard-Of-Hearing Children. *CyberPsychology & Behavior: The Impact Of The Internet, Multimedia and Virtual Reality On Behavior And Society*, 681-686.

Pelletier, L., & Perez-Gomez, A. (1992). Architectural Representation Beyond Perspectivism. *Perspecta, vol 27*, 20-39.

Pérez- Gómez , A., & Pelletier, L. (1997). *Architectural Representation and the Perspective Hinge.* Cambridge, Mass: The MIT Press.

Rowe, P. (1987). *Design Thinking.* Cambridge: MIT Press.

Schnabel, M., & Kvan, T. (2003). Spatial Understanding in Immersive Virtual Environments. *International Journal of Architectural Computing, 1*(4), 435–448.

Shaw, I. (2003). *The Oxford History of Ancient Egypt.* Oxford University Press.

Smith, R. R. (2020). *Hellenistic Architecture.* Routledge.

Tumkor, S. (2018). Personalization Of Engineering Education With The Mixed Reality Mobile Applications. *Computer Applications in Engineering Education, 26*(1), 1734–1741.

Vitruvius, Pollio, & Morgan, M. H. (1914). *Vitruvius: The Ten Books on Architecture*. New York: Dover Publications. Vitruvius, Pollio, and M H. Morgan. Vitruvius: The Ten Books on Architecture. New York: Dover Publications, 1914. Print. . adresinden alındı

Wai, J., Lubinski, D., & Benbow, C. (2009). Spatial Ability for STEM Domains: Aligning Over 50 Years of CumulativePsychological Knowledge Solidifies Its Importance. *Journal of Educational Psychology, 101*(4), 817-835.

Youshuang, W., Xianglong, Y., & Fei, W. (2004). *Virtual Reality and System Simulation [M]. Beijing: National Defense Industrial Press, 2004.* Beijing: National Defense Industrial Press.

AN ELDERLY FRIENDLY LIFE WORKSHOP" EXPERIENCE

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ABSTRACT

Architectural structures are formed and shaped according to social requirements. Nursing homes, which were referred to with negative concepts such as elderly dormitory and nursing home in the past, are now called geriatric life and care centers. Geriatrics is a health field that makes it possible for the elderly to receive the necessary support, treatment and adaptation to the diseases and changes that people face as they age. "Geriatric Life Centers" are also centers that provide housing for the elderly, provide solutions to health problems, and provide them with social and cultural activity areas. Undoubtedly, our task as architects is to design structures where elderly people can spend the last periods of their lives happily. For this purpose, it is aimed to design a care and living center where the elderly can feel at home and receive the necessary care and treatment at the Studio 7 Workshop in the Fall Semester of 2022-2023 under the direction of Asist. Prof. Zafer Kuyrukçu. In this study, student projects, architectural design process and final products of the 2023 Fall Semester-Studio 7 Workshop will be presented. Students were asked to design a 'visitor-friendly' elderly living and care center consisting of outdoor, semi-outdoor/semi-indoor and indoor spaces that are integrated with the environment, meet the individual and social needs of the elderly, provide rehabilitation services. Firstly, in the first weeks of the design process, in order to collect data on the subject and create a needs program, the development of geriatric life and care centers from past to present in our country and around the world was analyzed, and projects designed on this topic were read. Trips were made to the area for environmental analysis purposes, the connection between the land and the environment was analyzed, and the process was supported with in-class criticisms in the following weeks. The project process has been completed as two visas and final delivery. When looking at the projects produced at the end of the semester, it was seen that students approach the subject sensitively; they propose projects that are spatially adequate, connect with the environment, are visitor-oriented, offer areas where elderly people can socialize, integrated with nature.

Keywords: Ageing, nursing home, geriatrics life and care center design, architectural design workshop

INTRODUCTION

Architecture is formed, developing, transforming and taking shape depending on societies and social needs. From this point of view, housing, accommodation and treatment centers for the elderly, which were not needed until 50 years ago, have become a part of normal life today. In this process, it was referred to with negative concepts such as 'Old People's Dormitory' and 'Retirement Home'.

In the past, the logic of the formation of these structures was aimed at meeting only the basic needs of the elderly. However, scientific research and studies conducted today emphasize the importance of meeting the housing, accommodation and care needs of the elderly in these centers, as well as ensuring that they feel at home and meet their socio-cultural needs with their peers. Although there is a decline in the cognitive and physiological abilities of an individual in old age, there is a period when there are losses in areas such as social life, productivity, role and status, social environment, social support, and economic level (Konak and Çiğdem, 2005; Bahar, Tutkun and Sertbaş, 2005). The production of solutions to the problems and needs of the elderly has a very serious social importance. For this reason, it is essential to examine the possibilities and services offered to the elderly (Çavuş, 2013). Therefore, our main task as a designer is to create spaces and design structures where this mass of users can spend the last periods of their lives happily and peacefully. Architecture needs to understand the sensitivity needed in this direction and produce solutions.

As in all developed countries today, life spans have increased with the development of medical conditions in our country and there has been an increase in the elderly population (Uyanık, 2017). As a result of this, elderly care homes appear as an issue that needs to be worked on (Şeker and Kurt, 2018). Geriatrics is a health field that makes it possible for the elderly to receive the necessary supports and treatments they need and adapt to the process against the ailments and changes that people face due to old age, and 'Geriatrics Life Centers' have been established in accordance with these requirements. These centers provide solutions to the health problems of the elderly, meet the housing needs, offer various socio-cultural opportunities and activities.

Accommodation, housing and treatment centers for the elderly, which have become a part of normal life, have been referred to with negative concepts such as 'Elderly Dormitory', 'Nursing Home' in the past. Within the scope of this study, based on the perceptual and functional transformation of these nursing homes, which are currently called 'Geriatric Life and Care Centers', it is aimed to understand this phenomenon, disseminate it and raise awareness of the generation with the goals of 'a studio study aimed at improving the quality of life of the elderly'.

Within the scope of the study, it is aimed to design a care and living center where the elderly can receive the necessary care and treatments, where they will feel almost at home, where socio-cultural needs are provided, at the Studio 7 Workshop of Konya Technical University, Faculty of Architecture and Design, Department of Architecture for the Fall Semester 2022-2023. In this study, the architectural design process and architectural products of the Studio 7 Workshop for the Fall Semester of 2022-2023, which was completed under the supervision of Asist. Prof. Zafer Kuyrukçu, will be presented.

In the first weeks of the design process, in order to collect data on the subject and create a needs program, the development of 'Geriatric Life and Care Centers' in our country and around the world has been analyzed from the past to the present, and projects designed on this topic have been read. The students were asked to design a 'visitor-friendly' geriatrics and living center consisting of open, semi-open/semi-closed and indoor spaces that are integrated with the environment and provide the necessary rehabilitation services. In this direction, trips to the study area were organized, the terrain environment was analyzed and the process was supported by in-class presentations on the subject. In the following weeks, 2D and 3D presentations of the proposed projects were requested and the process was progressed with criticism in the studio.

GERIATRICS AND GERIATRICS LIFE CENTER

Buildings or groups of buildings where elderly individuals are together and where certain services are provided to them are called "Elderly Dormitories". It is still difficult to name these buildings designed for the elderly in our country. A number of names such as elderly dormitory, nursing home, rest house are encountered. But the most widely known among them are nursing homes (Kuzu, 2010). The concepts of "Old People's Dormitory" and "Nursing Home" create a more negative connotation than the concept of "Care Center" due to both negative perspectives on the Turkish family structure and spatial negativities in previous years. There are also those who call nursing homes as "Dormitories for the Weak". It is impossible to accept this. An elderly person may have chosen a quiet life away from society in a care center even though he is in a very good condition both physically and mentally. This is the right of prefer, which is the most natural right of the individual (Kuş, 2019). It is obvious that this has nothing to do with weakness. Not all of the paintings presented to us by life should be considered natural, and expressions emphasizing the tragedy of man should be used in philosophical approaches if necessary, and should not be given as a name to a building (Kuş, 2019).

Nursing homes, which have emerged as a need of modern society, have been formed with the aim of ensuring that the elderly in our country spend the rest of their lives comfortably (Ardahan, 2010). From this point of view, 'Old People's Dormitories and Nursing Homes', which have perceptually negative sensations, have been inadequate in terms of housing-oriented functions related to the logic of formation; the feeling of the home environment that should be provided for the elderly, socio-cultural interactions with peers, necessary health care, high space quality needs (Arpacı, 2005).

The conceptual transition from a negative concept such as an Elderly Dormitory/Nursing Home to a Care Center is actually an indication that this structure will be used more spatially. Along with the concept, the spatial structure of this architectural structure has also undergone change and transformation over the years. While previously it only met basic vital needs, scientific studies conducted today discuss whether the structures used for the same purpose give a sense of home or whether there are sufficient relaxing spaces (Özer Baş, 2022).

Currently, 'Geriatric Life Centers' have been formed that provide care and treatment services for the elderly with the purpose of meeting special housing, accommodation, treatment and other socio-cultural, physical and psychological needs (Bilir, 2018). The concept of 'geriatrics' means elderly medicine (Bölüktaş, 2019). 'Geriatrics in Medicine' is a field of science that aims to protect the health of elderly people, diagnose and treat diseases that are common in elderly people, but also for elderly people to continue their lives as social and independent individuals. In other words, Geriatrics is a health field that makes it possible for the elderly to receive the necessary support, treatment and adaptation to the diseases and changes that people face as they age (Çevik, 2019).

Today, Geriatric Life Centers are care centers focused on providing a sense of home to the elderly, which meet the housing needs of elderly people, as well as the treatment of ailments caused by old age and various individual needs. These centers were formed in England in the late 1950s and early 1960s.

In our country, the centers focused on elderly care are based on a sub-ground extending from the Seljuk period to the present day. The development of these centers in our society over time, they have been established in order to treat the elderly as ancestors in every period and to provide them with the best access to the care they need. With this solid foundation, the transformation process of the Nursing Home phenomenon with negative perception to Geriatric Centers has emerged for the first time in our country since the 1990s (Gürer, Çırpan and Özlen, 2019).

When the formation and development processes of Geriatric Life Centers are examined, it is seen that these structures are formed within the framework of certain main units and subunits (T.C. Cumhurbaşkanlığı Mevzuat Bilgi Sistemi, 2001) (Table 1).

Table 1. Geriatrics Life Centers Main Unit and Subunits

a-Yaşlıların Kullanımına Yönelik Bölümler;	b-Hizmet Bölümleri;
▪ Giriş holü ▪ Oturma salonları ▪ Yemek salonları ▪ Kişisel yaşam alanları (yatak odaları) ▪ Sağlık ve temizlikle ilgili bölümler ▪ Ortak kullanım alanları ▪ Rekrasyon alanları ▪ Atölyeler ▪ Kitaplık/kütüphane ▪ İbadethane	▪ Sağlık hizmetleri bölümü ▪ Hasta yatak odaları ▪ Doktor, muayene odası ▪ Başhemşire, hemşire, nöbetçi hemşire odası ▪ Sosyal hizmet uzmanı ▪ Jimnastik odası, masaj ▪ Genel hizmet bölümü ▪ Mutfak ▪ Çamaşırhane ▪ Terzi ▪ Berber ▪ Teknik servisler ▪ Depolar
c-İdari Bölüm;	**d-Dış Tesisler;**
▪ Ofis ▪ Hizmet personeli lojmanı	▪ Ön bahçe ve tesislere giriş ▪ Bahçe ▪ Sera ▪ Otopark, garaj

2022-2023 FALL SEMESTER STUDIO STUDIES

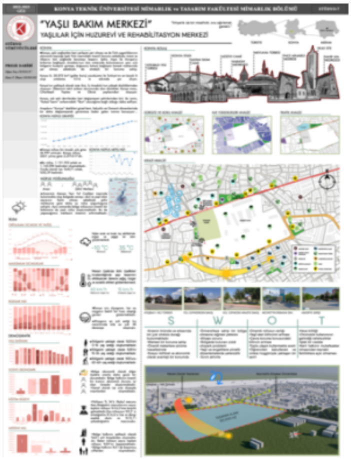
The 2022-2023 Fall Semester Studio 7 Workshop aims to provide a 'Studio Work to Improve the Quality of Life of the Elderly' experience in which the elderly will feel at home, their treatment and care will be provided, they will have various socio-cultural opportunities with age groups, which will improve their quality of life.

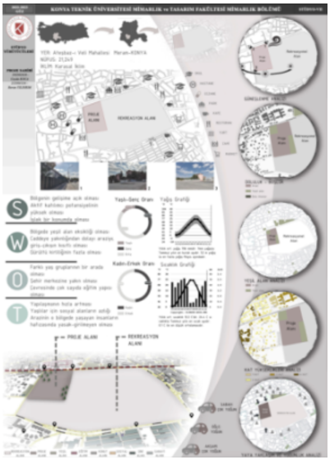
In the first weeks of the design process, the development of geriatric life centers in our country and in the world has been analyzed from past to present along with the concepts of old age, geriatrics and geriatric life centers in order to collect information about the subject and define the needs program. In this regard, students were asked to make presentations and poster studies, a conceptual framework was created with interactive information transfer in the classroom, sample projects were read and the basis for the needs program was created in line with the projects read (Table 2).

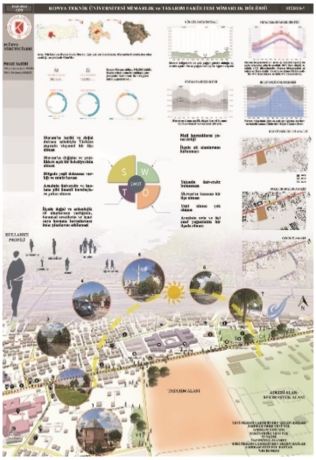
Table 2. Conceptual Framework Sheets of the Students

As the project area, a fairly large area, about 100,000 m² of land has been defined within the boundaries of Meram, one of the central districts of Konya city. The proximity of the defined area to the city center and the intertwining with nature are in parallel with the goals of this studio project, which has both a user-oriented and visitor-oriented design goal. Trips to the study area were organized, the connection between the land and the environment was analyzed together with the students on site. In this context, detailed environmental analysis sheets were requested from the students, in which environmental texture, connections, approaches were read, local and climatic data were taken into account, and which will be further elaborated, presentations were made in the classroom in accordance with the sheets prepared by the students (Table 3).

Table 3. Environmental Analysis Sheets of the Students







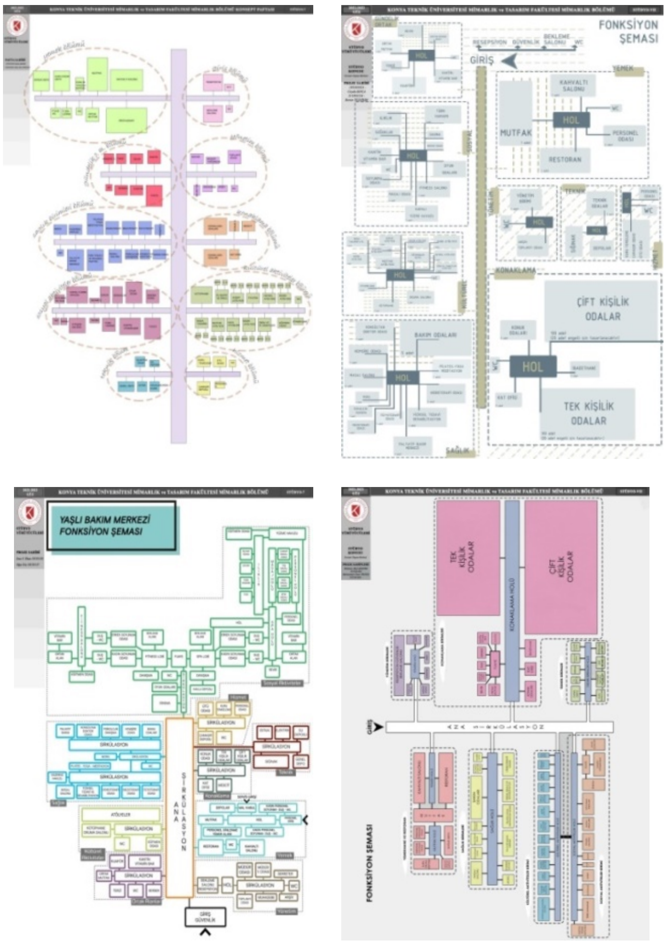
The needs program has been shaped by sample surveys and land data of Geriatric Life Centers located in the world and in our country. The main places of the needs program created within this scope are the Entrance Department, Administration Department, Food Department, Accommodation Department, Casual Common Spaces Department, Health Units Department, Cultural Activities Department, Social Activities Department, Service Department, Technical Department, Shelter and Parking Department (Table 4).

Table 4. Project Requirements Program

MEKÂN İSMİ	adet	m2	Toplam
GİRİŞ BÖLÜMÜ			**300**
RESEPSİYON uygun karakter ve büyüklükte lobi içinde çözülmek üzere tasarımcıya bırakılmıştır.			
GÜVENİK- KAMERA ODASI			
BEKLEME SALONU - Resepsiyon ile birlikte düşünülecektir.			
WC - uygun büyüklük ve sayıda çözülmek üzere tasarımcıya bırakılmıştır			
YÖNETİM BÖLÜMÜ			**236**
MÜDÜR ODASI	1	48	48
MÜDÜR YARDIMCISI (8 kişilik toplantı imkanlı)	1	32	32
SEKRETER	1	24	24
ARŞİV	1	24	24
MUHASEBE	1	24	24
TOPLANTI ODASI	1	64	64
WC - uygun büyüklük ve sayıda çözülmek üzere tasarımcıya bırakılmıştır			
YEMEK BÖLÜMÜ			**1306**
KAHVALTI SALONU – kişi başına 0.80 m2 alana sahip, açık büfe imkânlı, gün içinde kafe gibi kullanıma imkân sağlayabilir yatak kapasitesinin %75ine hizmet verecek	1	256	256
RESTORAN – kişi başı 1,2 m2 asgari	1	384	384
MUTFAK - restoran büyüklüğünün %50-60ı kadar, hazırlama, pişirme, servis ofisi, servis bankosu, bulaşık bölümlerini içerecektir, kahvaltı salonuna, restorana hizmet edecek şekilde düzenlenmelidir	1	250	250
DEPOLAR			
GÜNLÜK YİYECEK DEPOSU	1	40	40
KURU ERZAK DEPOSU	1	120	120
SOĞUK DEPO	1	120	120
PERSONEL ODASI			
Personel için bay/bayan soyunma+duş+wc	2	36	64
Dinlenme bölümü	2	36	72
WC - uygun büyüklük ve sayıda çözülmek üzere tasarımcıya bırakılmıştır			
KONAKLAMA BÖLÜMÜ (40 oda)			**8676**
TEK KİŞİLİK ODA Yatma, çalışma, dinlenme ve ıslak hacim	100	36	3600
%20'si engelli kullanıcılara göre düzenlenecektir. Engelli odaları m² olarak gereksinimlere uygun tasarlanmalıdır.			
*ÇİFT KİŞİLİK ODA Yatma, çalışma, dinlenme ve ıslak hacim	100	48	4800
%20'si engelli kullanıcılara göre düzenlenecektir. Engelli odaları m² olarak gereksinimlere uygun tasarlanmalıdır.			
KONUK ODASI	3	36	108
KAT OFİSİ- konaklamanın olduğu her katta olmalıdır	2	36	72
İBADETHANE- kadın erkek olarak ayrılacaktır. Abdesthane içermelidir.	2	48	96
*sandviç, çay, kahve hazırlama imkanı verecek küçük mutfak içerecektir.			
GÜNDELİK ORTAK MEKANLAR BÖLÜMÜ			**472**
KANTİN- VİTAMİN BAR	1	64	64
FUAYE-wc dahil-bar olacak	1	128	128
KUAFÖR	1	48	48
BERBER	1	48	48
TERZİ	1	36	36
REVİR	1	48	48
DOKTOR-HEMŞİRE ODASI	1	36	36
ORTAK MUTFAK	1	64	64
WC - uygun büyüklük ve sayıda çözülmek üzere tasarımcıya bırakılmıştır			
Dış mekan düzenlemelerinde rekreasyon alanları, hayvanlar için barınak, ziyaretçi çocukar için oyun parkı hobi bahçesi, sahalar ve bol miktarda yeşil alan tasarlanması beklenmektedir.			
TOPLAM ALAN **14.385 m²**			
SİRKÜLASYON %30 **4.315 m²**			
GENEL KAPALI TOPLAM ALAN **18.700 m²**			
SAĞLIK BİRİMLERİ BÖLÜMÜ			**1224**
BAKIM ODALARI- duş tuvalet imkanı, iki yataklı	5	48	240
KONSÜLTAN DOKTOR ODASI	1	36	36
HEMŞİRE ODASI	1	36	36
PSİKOLOJİK DANIŞMA	1	48	48
FİZYOTERAPİ ODASI	1	64	64
MEZOTERAPİ ODASI	1	64	64
MASAJ SALONU	2	64	128
HİDROTERAPİ ODASI	2	64	128
FİZİKSEL TEDAVİ VE REHABİLİTASYON	1	128	128
PİLATES-YOGA-MEDİTASYON ODASI	1	128	128
PALYATİF BAKIM MERKEZİ	1	128	128
EGZERSİZ HAVUZU- spor birimleriyle birlikte çözümlenebilir	1	48	48
MORG- çözümlemesi bodrum katta yapılacaktır	1	48	48
WC - uygun büyüklük ve sayıda çözülmek üzere tasarımcıya bırakılmıştır			
KÜLTÜREL AKTİVİTELER BÖLÜMÜ			**744**
KÜTÜPHANE-OKUMA SALONU	1	128	128
EL İŞLERİ - ÖRGÜ ATÖLYESİ	1	64	64
AHŞAP ATÖLYESİ- alet deposu içermelidir	1	48	48
MODA TASARIM ATÖLYESİ	1	48	48
MUTFAK ATÖLYESİ-depo içermelidir	1	64	64
TİYATRO ATÖLYESİ-depo içermelidir	1	48	48
HALK OYUNLARI- DANS ATÖLYESİ	1	64	64
MÜZİK ATÖLYESİ-müzik aletleri için depo içermelidir	1	64	64
EBRU- EL SANATLARI ATÖLYESİ	1	48	48
HEYKEL ATÖLYESİ	1	48	48
RESİM ATÖLYESİ *Heykel, resim ve seramik içerikli kurslar düzenlenecektir. Resim aletleri deposu içermelidir.	1	48	48
EĞİTMEN ODASI	1	48	48
VİTAMİN BAR	1	24	24
WC- uygun büyüklük ve sayıda çözülmek üzere tasarımcıya bırakılmıştır			
SOSYAL AKTİVİTELER BÖLÜMÜ			**1040**
OYUN ODALARI - masa tenisi, bilardo, internet,satranç…	1	128	128
SİNEMA	2	64	128
KANTİN- VİTAMİN BAR	1	128	128
FUAYE	1	64	64
TÜRK HAMAMI	2	64	128
*SOĞUKLUK	1	64	64
*ILIKLIK	1	64	64
BUHAR ODASI	1	18	18
SAUNA	2	18	36
FITNESS SALONU	1	90	90
KAPALI YÜZME HAVUZU - büyüklüğü tasarımcıya bırakılmıştır			
MASAJ ODASI-lavabo,çamaşırlık vs. olcak	4	18	72
SOYUNMA ODASI+DUŞ+WC	2	60	120
WC- uygun büyüklük ve sayıda çözülmek üzere tasarımcıya bırakılmıştır			
HİZMET BÖLÜMÜ			**208**
KURU TEMİZLEME	1	48	48
ÇAMAŞIR DEPOSU, YIKAMA	1	64	64
ÜTÜ ODASI	1	48	48
PERSONEL ODASI - 2 yataklı 2 oda şeklinde tasarlanacaktır	2	24	48
WC - uygun büyüklük ve sayıda çözülmek üzere tasarımcıya bırakılmıştır			
TEKNİK BÖLÜM			**180**
ISITMA	1	32	32
HAVALANDIRMA - KLİMA (genel mekânların tamamında olacaktır)	1	32	32
ELEKTRİK ODASI	1	32	32
SU DEPOSU	1	24	24
GENEL DEPO	1	60	60
SIĞINAK- yönetmeliğe göre m² düzenlemesi yapılacaktır.			
OTOPARK BÖLÜMÜ			
Yönetmeliğe göre yeterli sayıda açık ve/veya kapalı otopark olarak tasarlanacaktır.			

Within the framework of the needs program created depending on the project requirements, students were asked to work on a Function Scheme for the purpose of creating spatial organizations. At this stage, first of all, it was provided to determine the main unit relationships, and then determine the subunit relationships (Table 5).

Table 5. Function Diagrams of Students



At the next stage, students were asked to work out spatial relationships with environmental analysis, needs program and function scheme, and to work out Stain Studies with land data and analysis in accordance with project requirements (Table 6).

Table 6. Stain Study Sheets of Students

In line with the criticisms given after the interactive presentations of the stain studies in the classroom, students were asked to enter the 2-dimensional and 3-dimensional designs of the "Geriatrics Life Center" projects. In this context, in addition to general mass construction, layout plans and floor plans, students were also asked for sections and views studies in which they could explain their projects more clearly (Table 7).

Table 7. Layout Plan Sheets of Students

Within the scope of the study, in accordance with the concept of a life center project for the elderly, a center that is compatible with the environment, has strong building-garden relations and high spatial quality, that will serve both the user audience, i.e. the elderly, and the visitor is aimed. Accordingly, students were expected to develop a qualified fiction that would allow for various socio-cultural activities in the designs of the layout plan (Table 8).

Table 8. Ground Floor Plans, Sections and Views Sheets of Student

The project process has progressed in line with the criticisms, and the studio works have been finalized as two intermediate jury and final submission.

In the final delivery, final presentation sheets, 3D modeling studies and model studies were taken from the students (Table 9).

Table 9. Final Studies of Students

Table 9.a. Final Studies of Group 1

Table 9.b. Final Studies of Group 2

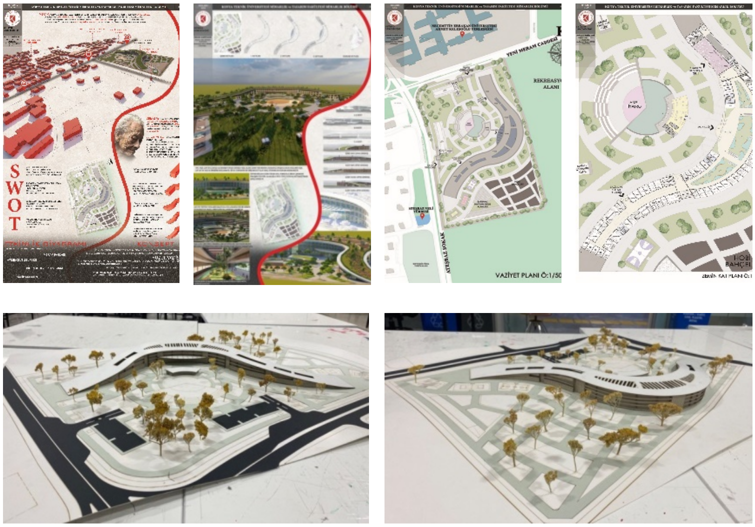


Table 9.c. Final Studies of Group 3

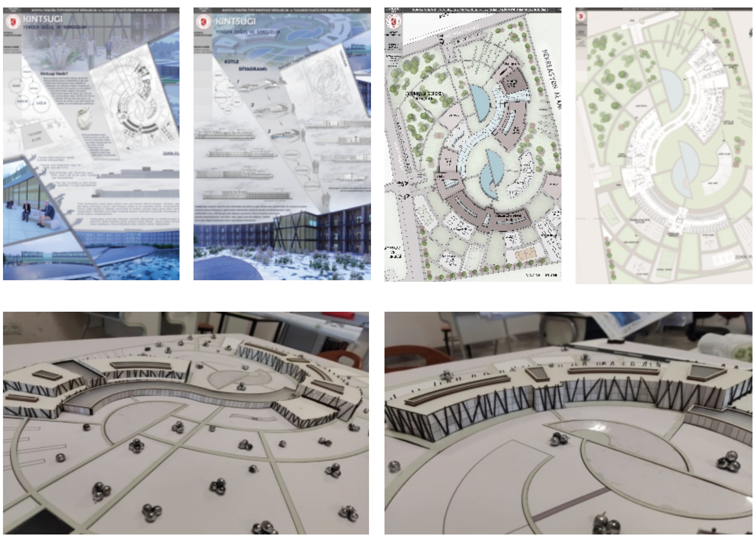


Table 9.d. Final Studies of Group 4

CONCLUSION

Architecture is a discipline that creates healthy, livable and aesthetic spaces for users by evaluating the possibilities and limitations of the natural environment in a way that responds to the wishes and requirements of the user through certain criteria.

As in the educational programs of other disciplines involving design and creativity, the weight of theoretical and applied studio (design) courses aimed at giving students design and creative skills in architecture education programs is quite high. Studio courses in architectural education are conducted in a master-apprentice relationship by criticizing the product designed by the student at the desk. In this educational process, the most important phenomenon that prepares the student for the profession and allows him to focus on the design process is the basic educational studios where basic design and space concepts are given. Although architecture is an individual action, the built environment formed by architectural actions is public. Therefore, education is provided in architecture studios with social benefit in mind.

Based on this awareness, taking into account the recent period when the proportion of the elderly population in the total population has been gradually increasing, students were asked to design a "Geriatrics Life Center" project at the architectural design workshop of the 7. semester of 2022-2023. Because the studies usually conducted on the elderly have been concentrated in the fields of sociology, psychology, social services, geriatrics, public health, nursing, but have been insufficient in the field of space design. However, it is known that many elderly people today cannot fully meet both their physiological and psychological needs as a result of the fact that the spaces they live in do not provide the necessary conditions at a qualitative and quantitative level.

With this sensitivity, the students worked for a semester and prepared presentation sheets and presentations by conducting research on the subject in the first weeks. In the following weeks, the process progressed with environmental analyses, stain studies and spatial analyses, accompanied by the criticisms given to the students. Every week, project criticisms continued by enriching 2-Dimensional project presentations, 3-Dimensional presentations and mock-ups.

When the final project of the students at the end of the semester are examined, it is seen that the students have information equipment within the conceptual framework of old age, geriatrics, geriatrics life centers. When we look at the layout plan designs, it is seen that pedestrian-vehicle circulations that allow various socio-cultural activities are defined, qualified designs with a focus on green space are created in harmony with the environmental texture. When the floor plans are examined, it is seen that the with high spatial quality and strong relationships intended within the scope of the project are provided and the accessibility between floors is easy. As can be read from the presentation sheets and model studies, it is seen that the projects have a design concept that spreads horizontally, intertwined with nature.

As a result, the "Geriatrics Life Center" project for the fall semester of 2022-2023 was successfully completed as a result of interactive information transfer and experience under the coordination of Asist. Prof. Zafer Kuyrukçu. In this context, where students approach the subject sensitively, it has been seen that structures with the expected spatial quality have been created, visitor-oriented, offering spaces for elderly people to socialize, integrated with nature that are suitable for the land structure and have strong ties with the environment.

REFERENCES

T.C. Cumhurbaşkanlığı Mevzuat Bilgi Sistemi (2001). Huzurevleri ile huzurevi yaşlı bakım ve rehabilitasyon merkezleri yönetmeliği.

Ardahan, Y. D. D. M. (2010). Yaşlılık ve huzurevi. Sosyal Politika Çalışmaları Dergisi, 20(20), 25-32.

Arpacı, F. (2005). Farklı boyutlarıyla yaşlılık. Türkiye İşçi Emeklileri Derneği Eğitim ve Kültür Yayınları, Ankara.

Bahar, A., Tutkun H., and Sertbaş G. (2005). Huzurevinde yaşayan yaşlıların anksiyete ve depresyon düzeylerinin belirlenmesi. Anadolu Psikiyatri Dergisi, 6 (4), 227-239.

Bilir, N. (2018). Yaşlılık tanımı, yaşlılık kavramı, epidemiyolojik özellikler. Yaşlılık ve Solunum Hastalıkları. TÜSAD Eğitim Kitapları, İstanbul, 13-31.

Bölüktaş, R. P. (2019). Yaşlılığa genel bakış. Temel gerontoloji.

Çavuş, F. Ö. (2013). Yaşlılara yönelik evde bakım hizmetlerinin değerlendirilmesi [Yüksek Lisans Tezi]. Hacettepe Üniversitesi Sosyal Bilimler Enstitüsü, Sosyal Hizmet Anabilim Dalı.

Çevik, E. C. (2019). Türkiye'de yaşlılara yönelik sosyal politika uygulamaları [Doktora Tezi], Marmara Üniversitesi.

Gürer, A., Çırpan F. K., and Özlen, N. A. (2019). Yaşlı bakım hizmetleri. Sağlık Hizmetleri ve Eğitimi Dergisi, 3(1), 1-6.

Konak, A. and Çiğdem, Y. (2005). Yaşlılık olgusu: Sivas huzurevi örneği. Cumhuriyet Üniversitesi Sosyal Bilimler Dergisi, 29 (1), 23-63.

Kuş, M. (2019). Huzurevi tasarımında kullanıcı faktörleri etkisinin değerlendirilmesi [Yüksek Lisans Tezi]. İstanbul Aydın Üniversitesi Fen Bilimler Enstitüsü.

Kuzu, A. (2010). Yaşlı bakım kurumlarında hizmet kalitesi kavramı ve kavramsal hizmet kalitesi modeli: Servqual Uygulamasi [Doktora Tezi]. Sakarya Universitesi.

Özer Baş, G. (2022). Dönüşen yaşlanma kavramının sosyal ve mekansal çalışmalar üzerinden incelenmesi. Electronic Journal of Social Sciences, 21(83).

Şeker, A., and Kurt, G. (2018). Bir sosyal politika alanı olarak yaşlılık ve sosyal hizmet uygulamaları. Nüfusbilim Dergisi, 40, 7-30.

Uyanık, Y. (2017). Yaşlılık, yaşlanan nüfus ve sosyal politika. İş ve Hayat, 3(5), 67-100.

HARNESSING COLLECTIVE INTELLIGENCE IN THE FIELD STUDY OF ARCHITECTURAL DESIGN STUDIO

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ABSTRACT

The necessity for the development of alternative resilient teaching strategies in response to global pandemic crises and regional earthquake disasters is evident in the field of architectural education. This study aims to enhance the design studio experience by focusing specifically on the students' field study process. Addressing complex project areas requires an understanding of contextual dynamics, actors, and values that can support further design phases. To achieve this, we propose harnessing collective intelligence (CI) and crowdsourcing tools, enabling a collaborative approach to field study.

The paper introduces a CI model consisting of co-sensing, analysis, and co-creation modules. This model was developed using a four-step process based on action research methodology. Over a span of four years, involving approximately 140 architecture students, iterative workshops were conducted to evaluate the process, outputs, and gather student feedback. Findings revealed that the proposed strategy enhances fieldwork, fostering engagement, coordination, productivity, and interaction. The study explores the applicability of the strategy in diverse educational settings, the usability of crowdsourcing tools (Emapic, Ushahidi, and Felt), and students' assessments of collaborative process and co-creation of collective cartography.

This research enriches design studios by unveiling collaborative and resilient learning strategies. Furthermore, the workshops yield comparative insights, thereby fostering continuous refinement within emerging action cycles. However, it is crucial to recognize that this study's scope, limited to a specific neighborhood and workshops with first-year architecture students, constrains the generalizability of findings and underscores the need for broader inclusion in future research.

Keywords: collective intelligence; architectural education; field study; crowdsourcing; collaboration.

INTRODUCTION

Design studios hold significant prominence as the central element in architectural education (Salama, 1995; Goldschmidt et al., 2010; Masdéu & Fuses, 2017). These studios encompass activities such as field studies, project critiques, jury sessions, and group work. Moreover, studios facilitate mutual learning among students through the various forms of interaction. Numerous studies in the literature focus on pedagogical models that employ participatory methodologies, multidisciplinary design studios, informal workshops, and collaborative design process. In a recent study, collaboration is underscored within the potential contributions of a responsive and resilient architectural education based on the theory of social constructivism (Morkel et al., 2021). The Delivery, Interaction, and Assessment (DIA) model (Tregloan & Thompson, 2021), which outlines the fundamental challenges of online education in the post-pandemic era, providing an illustrative example. Furthermore, established studio models like the "Live Project," an ongoing initiative by the Sheffield School of Architecture with 150 projects spanning from 1999 to the present, and the "Rural Studio," maintained by Auburn University with 118 projects from 1994 to the present, exemplify the applicability and potential benefits of collaboration and participation in the architectural education. In current applications, various representation environments are being created to enhance interaction and collaboration within the scope of web-based massive online courses (such as Edx, AVOCAAD, and Coursera) (Schnabel et al., 2021), geographic information system (GIS) based platforms (Pak & Verbeke, 2015), virtual reality (Merrick & Ning, 2011), and augmented reality (Seichter & Schnabel, 2005) based virtual design studios.

However, applications pertaining to the effective harnessing of collective intelligence (CI) in the architectural education are notably limited. Particularly within studio settings, factors such as the originality of design ideas, the emphasis on outcome-driven grading, a lack of awareness about the (dis)advantages of collaboration institutionally amplify students' individuality, thereby impeding the applicability of the collaborative design process. The implementation and dissemination of educational models and theoretical research that foster the effective utilization of CI as an integral component of formal education is hindered by the constraints linked to university infrastructures.

In the context of Turkey, the initial formations of a network emerge through institutions like Mimar Sinan Fine Arts University, with its ‘artist architect’ school rooted in the connection with plastic and visual arts, Istanbul Technical University's ‘master engineer architect’, Yıldız Technical University's ‘intermediate technical person’, and Middle East

Technical University's "new model of architectural education" inspired by the Bauhaus. Apart from these architectural departments that have established themselves within specific schools of thought, it's evident that the rapidly increasing number of departments struggles to develop their own identities. Therefore, the majority of over a hundred architectural departments primarily lack the capability and infrastructure to formulate and implement their own educational models.

On the other hand, the online learning environment that has gained prominence in recent years due to the pandemic and earthquake disasters underscores the need for strengthening practical aspects and fieldwork within architectural education. This emphasizes the necessity to complement studio education with distinct strategies, thereby enhancing its effectiveness and resilience. During the crisis period, factors such as interaction levels, student motivation, and active engagement, coupled with the sudden and mandatory shift to online education, have profoundly influenced the dynamics of studio process. This situation has led to a reassessment of existing paradigms that were considered implausible in the recent history. Many experts refer to this process as the catalyst of the paradigm change (O'Reilly, 2020), the pivot of large-scale transformations (Salmon, 2020), or the turning point (Brown, 2020). In this context, noteworthy topics among the focus areas include collaborative learning and interaction modes, interactive learning and massive online courses, online education during the pandemic era, and assessment methods (2005-2022) (Baggaley, 2007; Zawacki-Richter & Naidu, 2016; Conrad & Witthaus, 2021; Pelletier et al., 2021).

This study was initiated with the objective of developing alternative strategies to address challenges, particularly pertaining to inadequate interaction in online education during pandemic circumstances. The scope of investigation then expanded to encompass hybrid and in-person educational contexts. The research is firmly rooted in a collaborative approach, aiming to enhance the efficacy and resilience of field studies within the studio process. To achieve this, the adopted collective cartography method integrates digital and physical interfaces in participatory and collaborative design proces (Huybrechts et al., 2012) as well as design education (Hutzell, 2012; 2017; Santos et al., 2021)

The primary aim of this study is to develop a CI model for field studies, encompassing process, components, and tools, to facilitate collaborative field study. Our fundamental hypothesis postulates that within a studio environment, whether conducted online or in-person, interaction and collaboration can be augmented through the CI approach in the field studies, thus supporting the subsequent design process. Consequently, in urban contexts, the existing field study practices, often based on the individual efforts and frustrating process due to time constraints, complexity of understanding project area and limited interaction, can be enhanced through a collaborative approach. This enhancement aims to make the process enjoyable, systematic, comprehensive, and enriched, while also ensuring the adaptability of the model to diverse circumstances regarding field scale, course objectives, learning environments, and actors involved.

METHODOLOGY

The methodology is grounded on a well-defined four-step process, adopting action research of Kurt Lewin (Adelman, 1993). Firstly, the process entails identifying the level of interaction between groups during the pandemic period, addressing the challenges encountered by students during field studies, and subsequently formulating an action plan. Secondly, the developed action plan is integrated into design courses, with specific attention given to the incorporation of the proposed strategy within diverse contextual settings for field studies. The third step encompasses the assessment of the modified action plan's effectiveness. This evaluation is conducted through a combination of participant surveys, analysis of workshop outputs, and observations made throughout the process, all with the intention of gathering valuable feedback. Lastly, the insights garnered from the evaluation process are utilized to either adapt the existing co-creation strategy or develop an entirely new approach. This refinement aims to enhance the strategy's utility, adaptability, and overall usability.In this direction, four workshops was systematically conducted at Yıldız Technical University (YTÜ), with the participation of 140 first-year students. These workshops were thoughtfully designed to encompass diverse educational settings, including online, hybrid, and traditional face-to-face learning environments (Figure 1).

The workshop configurations are defined by six distinctive attributes: varying contextual scales, the adoption of two separate collective intelligence (CI) approaches, the dynamic adjustments in learning environment resulting from the convergence of pandemic and earthquake crises, the integration of crowdsourcing tools, participant volume, and the methods of integration within the course framework. The comparative analysis revolves around the following dimensions: the adaptability of CI strategies in learning environments, the usability of the utilized web-based and mobile app platforms, and the differences observed in outcomes. Each of these circles enables us to discern potentials and limitations, thereby facilitating the necessary modification of the strategy.

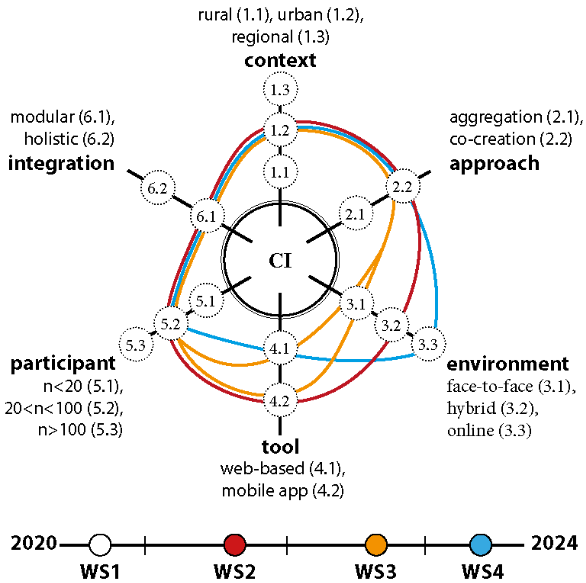

Figure 1. General setting and chronology of the conducted workshops

The proposed model for the field studies, which integrates collective cartography and crowdsourcing applications, were tested through the complementary workshops. Within this context, the workshop process has been carefully planned to enhance interactions both within and among studio groups, as well as with citizens involved in the field. This procedural framework is structured across four sequential phases: co-sensing (1), analysis (2), and co-creation (3). In the initial phase, teams engage in data collection and diagnosis, focusing on specific sub-themes within the field. The subsequent phase entails the analysis of the crowdsourced data within studio groups, aligning with predefined thematic categories. Ultimately, the co-creation phase culminates in the development of a multi-layered collective cartography (Figure 2).

To discern the potentials and limitations of the proposed strategy, the methodology included usability tests that serve as a means to compare the effectiveness of the tools employed, namely Emapic, Ushahidi, and Felt within the workshop settings. Additionally, participants' surveys were administered to comprehensively evaluate the overall impacts stemming from the collaborative field study process. Furthermore, a comparative analysis was conducted to examine the distribution patterns and focal points of the crowdsourcing data collected within the workshops held in the Kuzguncuk neighborhood over the course of four consecutive years (from 2020 to 2023). It's important to note that these workshops involve a relatively similar number of students and a comparable duration of field studies.

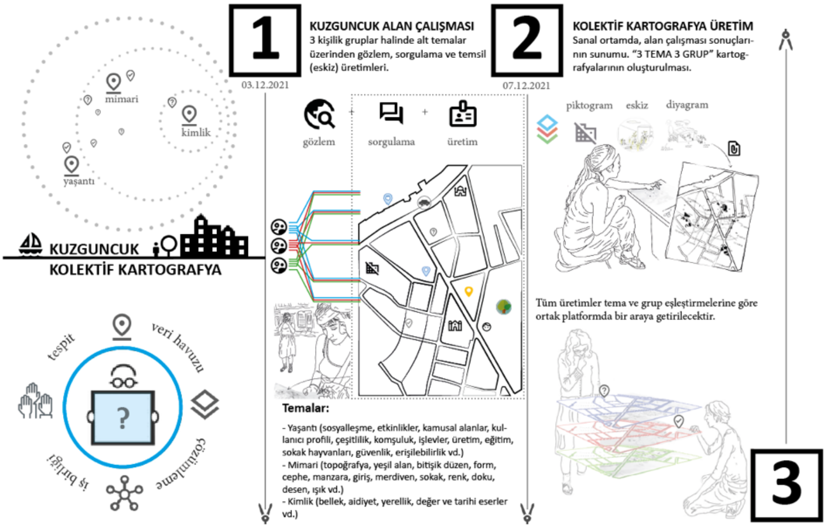

Figure 2. Strategy for field study (co-sensing, analysis, and co-creation)

RESULTS

The research findings encompass the usability of crowd-sourced applications, the applicability of proposed model within the urban context, the co-creation process of collective cartography, namely collective mapping (Ares & Risler, 2016) as a workshop outcome, and the overall effects of the CI approach.

The surveys conducted within the studio groups in the Introduction to Architectural Design (IAD) course to identify students' perceptions for the concept of interaction, the level of interactions, and the factors negatively impacting their active engagement.

The concept of 'interaction' is associated with various terms by the participants: most repeated term is communication (15), and collaboration, and knowledge sharing are common themes. Distinctive terms according to years as follows: wholeness, speaking-communication, dialogue, mutual relationships, idea exchange (2020); question-answer, mutual dialogue, data exchange, self-expression, curiosity (2021); idea exchange, collective efforts, various ideas, originality, design (2022); idea, impact, participation, assistance, relationship, concept (2023). The analysis of responses gathered from annual student surveys spanning the years 2020 to 2023 reveals recurring thematic focuses and distinctive trends in the participants' descriptions of interaction. Notably, the terms "communication," "collaboration," and "knowledge sharing" are pervasive throughout all years, reflecting consistent values across the surveyed groups. In 2020, emphasis was placed on concepts such as "wholeness" and "mutual relationships," whereas subsequent years saw an increased emphasis on "group work" and "sociability." Diverse terms like "impact," "creativity," and "feedback" underscore the multifaceted nature of interaction experiences.

Based on the 5-point Likert scale, the level of interaction (Li) within-group in the online IAD studio (n: 31) is 4.54 (mean), while Li between-groups is at 2.68 and upper-year AD studio groups is at 1.51. In IAD hybrid studio, Li between-groups is at 3.52. Moving to the year 2022, in the IAD face-to-face (F2F) environment (n: 27), the pre-workshop assessment reveals an Li for within-group value of 3.67 (m), while the Li for between-groups is 2.37, and with upper-year AD groups is 2.44. Following WS3, the Li for within-group incrases to 4.11, accompanied by between-groups increase to 2.74. In the online learning environment, prior to WS4, the within-group Li is at 3.74, whereas the between-groups Li is 3.30, and with upper-year AD groups is 2.40. Subsequent to WS4, the within-groups Li increases to 4.04, accompanied by between-groups Li to 3.37 (Figure 3).

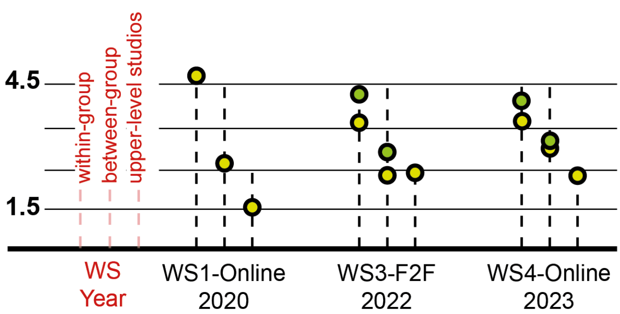

Figure 3. Level of interaction within and between groups

The crowdsourcing tools employed in workshops offer distinct opportunities in field study. Emapic facilitates coordinated, systematic, and easy-to-use field diagnosis through the defined themes. Figure 2 illustrate the mobile interface, the overarching data cloud, and the displaying of data content. Color legends on the map indicate thematic group findings, and filtering option allow to searching based on parameters defined in the contents' structure.

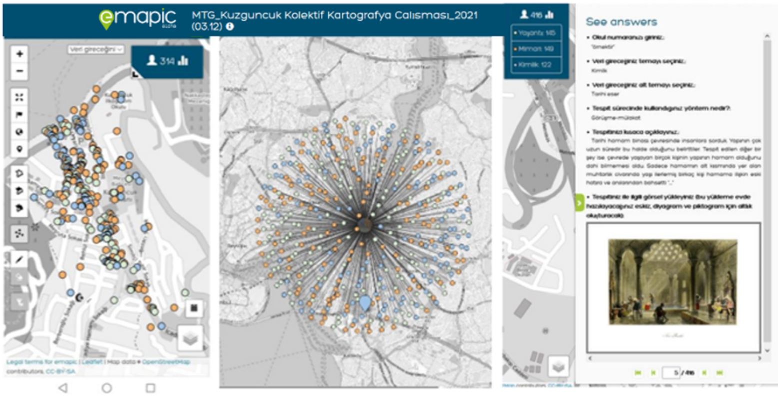

Figure 4. Emapic interface in WS2

Alternatively, Ushahidi empowers students in the field detection process, saving time and facilitating tasks what can be an individually frustrating endeavor. When compared with Emapic, apart from differences in interface and tools, a significant distinction utilized in WS3 is the ability to create diverse content structures (Figure 5).

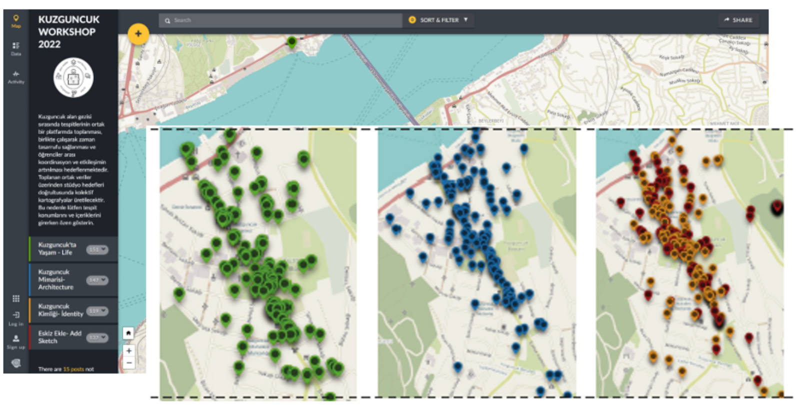

Figure 5. Ushahidi interface in WS3

The participatory GIS usability scale (PGUS) (Ballatore et al., 2019) measures several factors, including user interface, spatial interface, learnability, effectiveness, and communication. Within this framework, the crowdsourcing tools used during WS2 (Emapic), WS3 (Ushahidi), and WS4 (Felt) process were examined. Post-workshop surveys were conducted with approximately the same number of students. The survey consisted of a total of 25 (PGUS) items along with open-ended questions. The findings indicate that in the face-to-face (F2F) environment, the average usability score for Ushahidi is 3.58, while in the hybrid application, the average for Emapic (Em) is 3.13. However, the values for Felt used in the online environment exhibit a significantly higher average of 4.16 (see Table 1).

Table 1. Mean values for usability (PGUS, Ballatore et al., 2019)

Factors	Items	Felt (m)	Ushahidi (m)
(A) User Interface	(1) Clarity of the terms used.	☆ 4,26	4,03
	(2) Transition to different parts within app.	★ 4,11	3,26
	(3) Visibility of errors and alerts.	☆ 3,88	3,78
	(4) Acceptability of delays between operations.	★ 4,22	3,33
	(5) Return to the main page.	★ 4,30	3,67
		4,15	**3,62**
(B) Spatial Interface	(1) Definition of new location on the map.	★ 3,89	3.00
	(2) Map control & navigation.	☆ 4,04	2,85
	(3) Content creation.	☆ 4,15	3,93
	(4) Access to existing content and tools.	★ 4,00	3,04
	(5) Editing & viewing in real-time.	☆ 4,41	2,85
		4,10	**3,13**
(C) Learnability	(1) Usability comfort.	☆ 4,07	3,89
	(2) Recallability of tasks to perform.	☆ 4,33	4,12
	(3) Discovery through trial and error.	★ 4,26	3,54
	(4) Usefullness of guiding resources & activities.	3,70	☆ 4,04
	(5) Recovery of mistakes.	★ 4,16	3,12
		4,11	**3,79**
(D) Effectiveness	(1) Adequacy of platform tools.	☆ 4,04	3,62
	(2) Funct{onality of the platform.	★ 4,15	3,35
	(3) Impact on user engagement.	☆ 4,08	3,62
	(4) Reliability of system.	☆ 4,06	3,65
	(5) Satisfaction and recommendation.	☆ 4,00	3,61
		4,05	**3,57**
(E) Communication	(1) Sharing of ideas and diagnostic findings.	★ 4,30	3,96
	(2) Understandability of the sharing data.	★ 4,33	3,31
	(3) Legibility multi-layered maps across legends.	★ 4,56	3,89
	(4) Interaction with other users' contents.	★ 4,33	3,58
	(5) Utilization citizen interviews.	☆ 4,33	3,96
		4,37	**3,79**

* The filled star indicates that the difference between mean values is highly significant (m > 0.5), while the outlined non-filled star indicates the significant difference (m < 0.5).

The open-ended questions revealed concerns related to image size limits, data location definition, updating existing content, data loss during synchronization, displaying and exploring preliminary content, previewing, map representation techniques, complexity, and interface-related issues. Analyzing feedback regarding the Ushahidi application, positive sentiments are directed towards its effectiveness in data sharing and collaboration. Furthermore, the platform's potential for fostering diverse perspectives and cultivating awareness was acknowledged. On the other hand, users express concerns about irregularities in content display, user interface, and performance issues. In addition, Felt exhibits positive aspects, such as its user-friendly and comprehensible interface, the capability for detailed environmental analysis through sketches, and an intuitive user interface (Figure 6). Conversely, negative feedback pertains to issues regarding overlapping drawings leading to clutter, irregular sketch dimensions and lines, performance concerns including substantial lag during usage, and a limitation on mobile compatibility. The open-ended question response rates for evaluating the applications vary. It's 15% for Emapic, 50% for Ushahidi, and 68% for Felt. These percentages reflect users' willingness to share feedback and express their thoughts regarding usability.

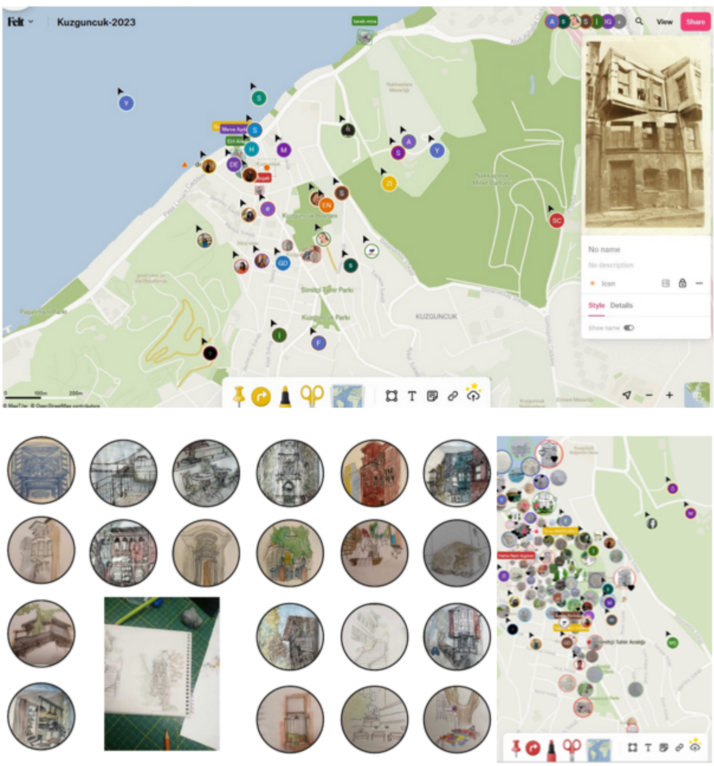

Figure 6. Felt interface in WS4

The collaborative field study was initiated, involving the field teams, each comprising three students from distinct studio groups. The overarching goal was to gain a comprehensive understanding of the project area through the process of co-sensing, citizen survey, and thematic analysis using crowdsourcing tool. Subsequently, the studio groups delved into the scrutiny of the accumulated data, employing a diverse range of techniques including the creation of sketches, diagrams, the synthesis of various viewpoints, and comparative analysis utilizing data from previous years available on the employed platform. This intricate progression yielded resources for the co-creation of multi-layered cartographies, involving the collective efforts of all participants. This process includes joint decision-making and comprehensive deliberations regarding the structure and presentation of these intricate cartographic representations (Figure 7). Another key finding suggests that featuring the work of highly contributing and actively engaged students or teams in the cartography, along with their names, enhances motivation. A critical point is to foster competitive collaboration and build a shared production pool without fully anonymizing them. This approach supports both collaboration and competitive learning.

Figure 7. From field study to co-creation of collective cartography

The workshops were conducted within the context of the Kuzguncuk neighborhood. The neighborhood ascends from the coastline of the Bosphorus through a strong linear avenue and expands into narrower, more organic streets. It encompasses various elements such as green spaces, a commercial axis along the main street, an urban garden, focal points created by historical monuments, a quay, and colorful residential fabrics. Student perceptions of the context in their field assessments and the distribution and concentration points within the triple groups are noteworthy. The coordinated use of crowd-sourced platforms enables real-time observations to be shared with field teams, facilitating synchronized field surveys. This approach allows teams to collectively survey the area through the tasks and themes.

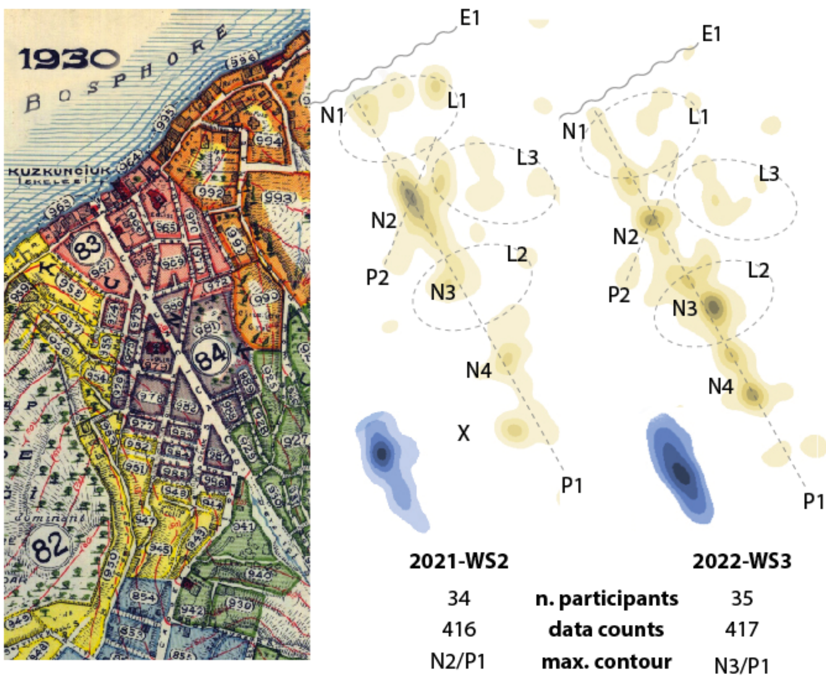

Figure 8. Historical street patterns in Pervititch and data distributions in iterative workshops (P: Path, N: Node, L: Landmark, E: Edge)

When analyzing the distribution of detections during the workshops, a total of 411 data points were entered into the system for the year 2021 (categorized by themes: life - 145, architecture - 149, identity - 122), and 417 data points for 2022 (life - 151, architecture - 119, identity - 119). The data points obtained from workshops with a similar duration and number of participating students are also closely aligned. The distribution of detection data within the area is concentrated along the main avenue and varies at certain points. For instance, in 2021, the quay area exhibits higher concentration, whereas in 2022, the vicinity of the urban garden shows denser data points. The identity theme intensifies around historical monumental structures, while the life theme is more prominent along the commercial axis. The scanned area's extent is delineated by invisible boundaries formed by the coastline, variations in topography, the natural structure of the park and cemetery at the neighborhood's edges, and the connectivity to the main avenue. All of these aspects are systematically investigated through the lens of Lynch's five elements of the city (Figure 8).

DISCUSSION

This section engages with the effects of a collaborative approach on field studies, drawing insights from general observations, workshop outcomes, and participant surveys conducted across four years in diverse learning environments—online, hybrid, and face-to-face. The analysis delves into the influence of the CI approach on field studies, identifying specific dimensions where these effects manifest.

- **Advantages of crowd-sourcing platform:** The utilization of a crowd-sourced data platform stands out as a facilitator for rapid and comprehensive data collection, surpassing individual efforts in efficiency.
- **Parametric and task-oriented fieldwork:** The integration of sub-themes, main themes, and parameters within the platform contributes to systematic fieldwork, enabling archival potential and facilitating comparisons across different years.
- **Diversity of team for interaction:** The formation of triple field teams, each consisting of a student from every studio group, enhances interaction between groups. However, student assessments of the effectiveness of working in teams of three are not notably high according to surveys (rated at 3.18 on a 5-point Likert scale). This situation also highlights challenges in collaboration among the triple groups.
- **Enhanced process by citizen survey:** The field study process, structured with a collaborative approach, fosters dialogue with local residents, enabling comprehensive investigation of real-world issues and fostering deeper engagement with the research field.
- **Competitive collaboration:** The visibility of contributions during data collection encourages competitive collaboration, motivating students to explore uncharted territories and contribute more observations. Likewise, incorporating shared

analysis in collective cartography fosters a competition among groups, inspiring them to strive for better creations (see Figure 7).

- **Collaborative decision-making:** Student evaluations reflect complexity in combining sketches, pictograms, and diagrams in both WS3 (3.85) and WS4 (3.74), indicating challenges in their collective placement decisions.
- **Positive impact of analysis uploads:** Student evaluations indicate positive effects of analysis uploaded by others. Ratings vary: WS2 (3.77), WS3 (3.63), and notably higher in WS4 (4.15), prompting enhanced thinking and creation
- **Learning from past observations:** Ratings indicate the significance of comparing past Kuzguncuk observations. WS3 scores 3.89, while WS4 notably achieves 4.37, showcasing enriched learning through this practice.
- **Complementary structure:** Ratings indicate coherence between collected field data, thematic exploration, and collective cartographies: WS2 (3.81), WS3 (3.62), and WS4 (4.11).
- **Instructive outputs:** Co-creating cartographies offers an instructive space with ratings of 4.00 (WS3) and 4.30 (WS4). Collaborative studio outputs—sketches, pictograms, and analyses—are diverse and sufficient (WS3: 4.04, WS4: 4.07). Collective cartographies aiding project ideas rate 3.67 (WS3) and 3.78 (WS4).
- **Level of interaction:** The collaborative approach significantly enhances interaction levels within groups (3.67-4.11) and between groups (2.37-2.74), as depicted in Figure 3. This impact can be further optimized by addressing issues concerning the platform interface, workshop design, and collaboration methodologies. Furthermore, student evaluations reveal that the studio work and sketch production process have strengthened communication with other groups, with ratings of 3.30 (WS3) and 4.07 (WS4).
- **Augmented interaction:** Exploring digital strategies like incorporating augmented reality into representation tools for collective cartography production holds potential. This experimentation could yield promising outcomes by enhancing interaction and engagement.
- **Scaling approach to different contexts:** The Kuzguncuk-tested approach can be applied to varied urban settings for comparative analysis, broadening the understanding of factors influencing students' spatial perceptions (Figure 8).
- **Adaptability of strategy:** The utilization of CI in various forms, extending beyond the field study, could be investigated within different scenarios, including modular methodologies (Heyik &

Erdoğan, 2022), as well as in the exchange of design concepts among a large number of students during online educational sessions (Heyik et al., 2022).

Consequently, the study presents CI field study strategy that can be refined through iterative workshops implemented in various educational settings based on action circles. The research findings contribute to integrating the CI approach into architectural education, leveraging the potential of crowd-sourced platforms in field studies, understanding factors that influence architectural students' perception of urban space, and facilitating the co-creation of collective cartographies to support subsequent design stages.

CONCLUSION

This research aims to investigate the applicability of the collective intelligence approach in architectural education, specifically field studies through a series of workshops conducted in online, hybrid and face-to-face settings. The findings of the study demonstrate that the collaborative approach effectively enhances students' field study process.

The insights obtained from the iterative workshops reveal the rapid and comprehensive data collection capability of crowdsourced data platforms, with variations in usability values attributed to interface, affordances, and embedded tools. Hence, the testing and comprehensive discussion of three distinct tools (Emapic, Ushahidi, and Felt) within the research context contribute significantly. On the other hand, the multi-layered collective cartographies produced through co-creation bring together diverse perspectives, enabling a deeper understanding of fieldwork outcomes and supporting subsequent design phases. This assertion was confirmed by student evaluations.

Nonetheless, there are limitations to this research. For instance, collaboration levels among student groups and challenges such as platform interface complexities need further developments. Of special significance is the critique concerning the current educational model's heavy dependence on individual evaluations, coupled with the lack of guidance on how students can mutually leverage benefits from collaborative and participatory approaches. Consequently, acknowledging the process alongside the output is critical, especially in design education.

Furthermore, due to the research's confinement to a specific neighborhood, the generalizability of findings is limited depending on the complexity of spatial contexts. Notably, the limitation of all four workshops being conducted with first-year architecture students underscores the necessity of expanding the study across diverse course contexts in the future.

In conclusion, within its defined scope, this research explores the potential of the collective intelligence approach, offering an innovative perspective to enhance the effectiveness of fieldwork with augmented student engagement.

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REFERENCES

Ares P. & Risler, J. (2016). Manual de Mapeo Colectivo: Recursos Cartográficos Críticos para Procesos Territoriales de Creación Colaborativa. Iconoclasistas

Baggaley, J. (2007). Distance Education Technologies: An Asian perspective, Distance Education, 28:2, 125-131, DOI: 10.1080/01587910701439191

Ballatore, A., McClintock, W., Goldberg, G., & Kuhn, W. (2020). Towards a usability scale for participatory GIS. In Geospatial Technologies for Local and Regional Development: Proceedings of the 22nd AGILE Conference on Geographic Information Science 22 (pp. 327-348). Springer Publishing.

Brown, J. B. (2020). From denial to acceptance: A turning point for design studio in architecture education. https://distancedesigneducation.com/2020/05/11

Conrad, D. & Witthaus, G. (2021). Reimagining and reexamining assessment in online learning, Distance Education, 42:2, 179 -183, DOI: 10.1080/01587919.2021.1915117

Heyik, M. A., Gürcan, C. G., Togan, T. O. N. G., & Erdoğan, M. (2022). Measuring the Effects of a Cartography-Based Platform on the Online Design Process. Eskişehir Technical University Journal of Science and Technology A-Applied Sciences and Engineering, 23, 1-16.

Heyik, M. A., & Erdoğan, M. (2022). Tasarım Stüdyosu için Kolektif Zeka Modeli. Journal of Computational Design, 3(2), 27-58.

Huybrechts, L., Dreessen, K., Schepers, S. (2012). Mapping design practices: on risk, hybridity and participation. DOI: 10.1145/2348144.2348155.

Hutzell, K. (2012). Mapping Urbanism, CHANGE, Architecture, Education, Practices, ACSA (Association of Collegiate Schools of Architecture International Conference) in Barcelona, Retrieved Feb 15, 2022, from https://www.acsa-arch.org/proceeding/change-architecture-educationpractice/

Merrick, K., & Ning, G. (2011). Supporting Collective Intelligence for Design in Virtual Worlds: A Case Study of the Lego Universe. http://papers.cumincad.org/data/works/att/cf2011_p016.content.pdf

Morkel, J., Delport, H., Burton, L. O., Olweny, M., & Feast, S. (2021). Towards an Ecosystem-of-Learning for Architectural Education: Reflecting on a network of six pedagogical clusters. Charrette, 7(1), 15-40. https://www.researchgate.net/publication/353958646 "

O'Reilly, B. (2020). Don't Let a Good Crisis Go to Waste. Instead, Use It as a Catalyst for Innovation, Retrieved June 15, 2022, from https://singularityhub.com/2020/05/03/dont-let-a-good-crisis-go-to-waste-instead-use-it-as-a-catalyst-for-innovation/

Pak, B., & Verbeke, J. (2015). Redesigning the urban design studio: Two learning experiments. arXiv preprint arXiv:1509.01876. https://doi.org/10.48550/arXiv.1509.01876

Pelletier, K., Brown, M., Brooks, D. C., McCormack, M., Reeves, J., Arbino, N., & Mondelli, V. (2021). 2021 EDUCAUSE Hori zon Report Teaching and Learning Edition.

Schnabel, M. A., Kobayashi, Y., Pencreach, Y., Bennadji, A., Choi, D., Fiamma, P., & Vital, R. (2021). Virtual World16: virtual design collaboration for the intersection of academia and industry. https://caadria2021.org/wpcontent/uploads/2021/03/caadria2021_318.pdf

Salmon, G. (2020). Covid-19 is the pivot point for online learning. Whonke. https://wonkhe.com/blogs/covid-19-is-the-pivot-point-for-online-learning/

Santos, B., Gonçalves, J., Martins, A.M., Pérez-Cano, M.T., Mosquera-Adell, E., Dimelli, D., Lagarias, A., Almeida, P. G. (2021). GIS in Architectural Teaching and Research: Planning and Heritage. Educ. Sci. 11, 307. DOI: https://doi.org/10.3390/educsci11060307

Tregloan, K. & Thompson, J. (2021). Buckle Up! … BEL+T group learnings from a (very fast) move online. Charrette, 7 (1), pp.59-75 Retrieved from http://hdl.handle.net/11343/281089

Zawacki-Richter, O. & Naidu, S. (2016). Mapping research trends from 35 years of publications in Distance Education, Distance Education, 37:3, 245-269, DOI: 10.1080/01587919.2016.1185079

PHILOSOPHY/THEORY/HISTORY/DISCOURSE

WHAT LIES BENEATH OUR WORDS? ASSESSING THE TEAMWORK-COMMUNICATION COMPETENCE

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ABSTRACT

The architectural design process is inherently collaborative, requiring a team effort where various disciplines contribute their specialized knowledge. Architects, as integral team members, hold the responsibility of designing the entire design process. They oversee a comprehensive examination of this process across all disciplines and design elements, ensuring a holistic approach is maintained at every scale. In contemporary practice, the evaluation of various aspects within the Integrated Design Process (IDP) assumes critical significance. This study argues that effective communication serves as the pivotal linchpin in this process. Architectural education significantly contributes to the development of these competencies. However, an analysis of educational settings in schools reveals a notable absence of collaborative teamwork involving various disciplines within current curricula. To address this gap, this research recognizes the pivotal role of communication in facilitating teamwork across multiple disciplines. It advocates for the inclusion of communication skills development courses within educational environments to enhance effective collaboration among learners from diverse disciplines. To this end, this paper reports on the research that explores the significance of

communication in transdisciplinary environments. It reports the communication analysis of meetings conducted as part of a transdisciplinary project titled "Fog Catcher."

Keywords: Architectural Education; Transdisciplinary; Holistic Approach; Conversation Analysis

INTRODUCTION

The architectural design process is inherently collaborative, involving a team effort. Various disciplines contribute their specialized knowledge in the process. The architect, as a member of the team, is responsible for designing the design process itself. They oversee the comprehensive examination of the design process across all disciplines and design elements, ensuring a holistic approach at every scale. Therefore, architectural design teams must shift/sail between various levels/scales of knowledge/information derived from multiple disciplines when designing (Sipahioğlu & Çağlar, 2020). Zoom-in and zoom-out between layers of information are very crucial for holistic designs. Taking a holistic approach is essential for bringing together knowledge from various fields and crafting solutions that fit into the overall design.

In contemporary practice, especially when considering sustainability imperatives, the appraisal of various facets within the Integrated Design Process (IDP), this study argues, assumes critical significance and effective communication stands as a pivotal linchpin.

Architectural education significantly contributes to the development of these competencies. However, an analysis of educational settings in schools highlights a notable absence of collaborative teamwork involving various disciplines within the current curricula (Kuday, Sipahioğlu and Acar, forthcoming). To this end, this research acknowledges the pivotal role of communication in teamworks involving multiple disciplines. It advocates for the incorporation of communication skills development courses within the learning environments to facilitate effective collaboration among learners from diverse disciplines.

This research[3] endeavors to explore the significance of communication in cultivating a holistic perspective, particularly within the context of transdisciplinary environments through the communication analysis of

[3] This research is conducted as part of a thesis study of the first author at TOBB ETU. The thesis views communication as a guiding factor in the integration of CoDDP into architectural education. The primary goal of the thesis is to put forth a proposed course in alignment with this direction.

the meetings carried out as part of a transdisciplinary project entitled "Fog Catcher." The project, by bringing experts from various disciplines such as architecture, climate, material science, biophysics, and AI[4] addresses the problem of drought caused by the increasing climate crisis.

INTERACTIONS IN TEAMS

> … *For each discipline, there is a natural set of corollaries embracing not only matters tied to the subject, for instance, epistemic or methodological stance, but also such unrelated matters as political affiliation and style of behavior. In other words, each discipline can be aptly viewed as a culture (Bauer, 1990).*

Bauer likens disciplines to cultures, asserting that a field or subject is closely tied to its practitioners. Meanwhile, Trebilcock divides the architectural design process into three phases: intuitive, analytical, and social. He places particular emphasis on the vital role of communication, specifically within the social phase (Trebilcock, 2011). Like the convergence of cultures, diverse experts encounter distinct challenges when collaborating. Communication transcends mere verbal expression; it extends to encompass gestures, drawings, and even silence as modes of conveying messages (Juvancic et al., 2014). However, diverse disciplines often employ distinct communication methods. Hence, comprehending communication dynamics within a complex and diverse interdisciplinary environment holds considerable significance, considering the unique communication styles inherent to each discipline.

THE FOG CATCHER[5]

The Fog Catcher project stands as a transdisciplinary initiative involving experts in meteorology, biomimicry, architecture, materials science, and molecular dynamics to address the escalating drought issue resulting from the growing climate crisis. The Fog Catcher effectively gathers water vapor and moisture from the air.

Project meetings are convened via Zoom, an online meeting application. The Fog Catcher project represents an experimental endeavor led by Dr. Aktan Acar at TOBB ETU. This initiative is conducted

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[4] The project is lead by Asst. Prof. Dr. Aktan ACAR, within the scope of Betül Yazarkan's ongoing master research that aims to integrate communication in transdisciplinary environments with experts into the BIM environment.
[5] Ethics committee approval was obtained for Fog Catcher Project.

as part of a master's thesis, delving into the integration of communication among experts in interdisciplinary settings within the BIM environment. The coordination of these meetings involves both Dr. Acar and the author of the thesis, Betül Yazarkan.

The first meeting took place on March 3, 2022. Subsequent meetings were held on March 17, 2022, April 21, 2022, May 26, 2022, June 16, 2022, and August 4, 2022, respectively (Table 2). The meteorology expert, one of the experts of the meeting, participated through Yazarkan; the molecular dynamics expert participated in the meeting through a biomimicry expert, and other experts participated in the meeting through Acar.

Table 2. Meeting dates and experts

Date	Meetings	Experts
March 3, 2022	1st Meeting	E.1, E.2, E.3, E.4, E.5
March 17, 2022	2nd Meeting	E.1, E.3, E.4, E.5, E.6
April 21, 2022	3rd Meeting	E.1, E.3, E.4, E.6
May 26, 2022	4th Meeting	E.1, E.2, E.3, E.4, E.6, E.7
June 16, 2022	5th Meeting	Not Recorded
August 4, 2022	6th Meeting	E.1, E.3, E.4, E.6, E.7

This meeting series comprises six sessions, of which five were recorded. Unfortunately, the data from the fifth meeting could not be captured. However, this paper is limited to the outcomes derived from the CA of two Turkish sessions and one English session.

CA PERSPECTIVE

This section analyses the Fog Catcher Project data on collective communication competence by using conversation analysis (CA). Conversation analysis (CA) is an approach to the study of social interaction and 'talk-in-interaction' that empirically investigates the mechanisms by which humans achieve mutual understanding, drawing on recordings of naturally occurring interaction (Sidnell, 2013). CA requires an intricate analysis of turn taking organization and allocation; repair sequences which participants use to address troubles of speaking, hearing, and understanding; pauses and silences and verbal/non-verbal action sequences. A close study of these domains in talk is what makes it possible to analytically argue that a collective communication is ongoing, infringed, maintained, mismanaged, etc.

Collective communication competence is defined as a process of one's adaptation of, to, and for a particular situation that enables appropriate and effective interaction in that situation (Omar & Mustaffa cited in (Omar, 2014)). This next part outlines the list of the analytical components used to sketch collective communication (in)competencies out in our data, and detailed information about each is provided through examples in the following section.

Thompson (2009) defines the processes of communication generally as facilitating and hindering processes. He divides facilitating communication processes into two: a foundational communication process and a facilitative process. The foundational processes are determined based on (a) spending time together, (b) practicing trust, (c) task talk, and (d) negotiating meaning through discussions of language differences. The facilitative processes are seen through (a) demonstrating presence, (b) reflexive talk, (c) backstage communication, and (d) shared humor and laughter. Thompson further states the barriers to the development of communication as follows: (a) negative humor and sarcasm, (b) debating expertise, (c) communicating boredom, and (d) jockeying for power (Thompson, 2009).

The corollaries of these conversational tenets and investments have long been studies in the CA tradition and discourse analysis from a linguistic and pragmatic standpoint (Woofitt, 2005). Building on the findings of Thompson's research, and CA-led investigations regarding talk-in-interaction in recent literature, focus group meeting records were analysed using the 15 CA tools, foci and resources identified below.

1. ***Pronouns Accommodation***: 'I, you, we, *ben, sen, siz*' refers to the use of personal pronouns.
2. ***Silence***: Indicates silences of 4 seconds or more.
3. ***Terms***: Express the terms used and repeated in the meeting.
4. ***Language Switch***: It refers to the phenomenon of alternating between different languages or language varieties within a conversation or interaction.
5. ***Turn-Taking***: It represents that experts take the floor and that the speaker has changed.
6. ***Multimodality***: It represents the use of multiple modes of communication such as speech, gestures, facial expressions, and visuals. Also, humor can be considered a multimodality.

7. ***Individualization***: It represents experts' association of the subject with their field.
8. ***Reference***: It represents experts referencing each other during their speeches.
9. ***Questions for Approval***: It demonstrates experts asking other experts questions for approval.
10. ***Approval/Confirming***: It represents the speakers' affirmation of one another.
11. ***Exemplification***: Explain the topics with simple examples.
12. ***Self-Repair***: It is the correction of the expression said during the conversations of the experts.
13. ***Other-Repair***: It refers to one expert correcting another expert's statement while speaking.
14. ***Disengagement (Off Gaze):*** It refers to the moments when experts break from speaking.
15. ***On Gaze*** refers to the moments when experts are involved in the conversation after they are off-gaze.

Examining the Collective Communication Competence of Meeting Participants

The subsequent strategy outlines the approach taken to formulate meeting timelines. Each expert, along with their respective expertise, is allocated specific color codes, as illustrated in Table 3.

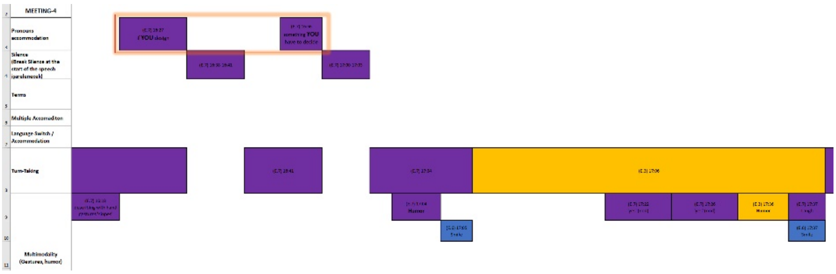
Table 3. Experts

	E.1: Coordinator: architect and academician
	E.2: Material Engineer: Materials Science and Nanotechnology Engineer and academician
	E.3: BIM Expert: architect and academician
	E.4: Machine Learning expert who is an electrical electronics engineer
	E.5: Meteorology Expert
	E.6: Biomimicry Expert: architect and academician
	E.7: Molecular Dynamics Expert

Pronouns serve as linguistic tools for referencing previously mentioned entities in the ongoing conversation. They play a crucial role in establishing reference points and ensuring coherence by linking ongoing utterances to earlier ones. Strategic use of pronouns can align or affiliate a speaker with specific participants or groups, and they also indicate where experts position themselves and others. Different pronoun choices, such as "I," "you," or "they," convey varying degrees of subjectivity, responsibility, or evaluation.

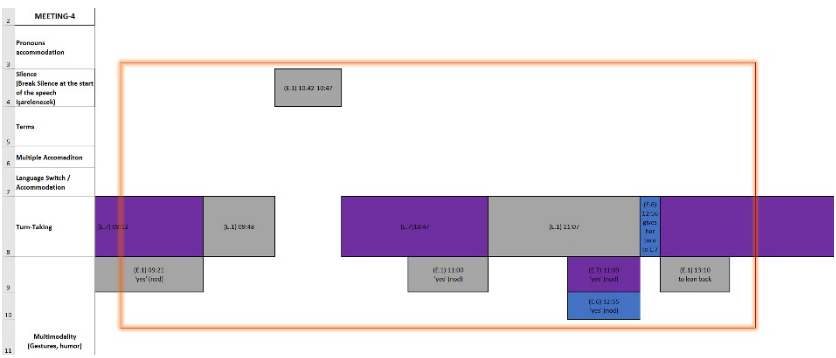
For instance, in the fourth meeting, E.7, a participant new to the meeting, employs the phrase '...if you design...' at 16:27 (Table 4). To delve deeper into this aspect, the study will proceed by subjecting the transcribed meeting data to further scrutiny using the corpus analysis method. This approach will examine the pronoun usage in relation to the words preceding and following them.

Table 4. Example of pronoun used at 4th Meeting



Silence holds paramount importance within the realm of communication, and its significance stems from various factors. Notably, silence plays a pivotal role in regulating the rhythm of conversation, such as turn-taking (Table 5) and floor ownership in conversation. It serves as a marker during the transition between speakers, indicating the shift from one speaker to another.

Table 5. Example of silence and the consequences of turn-taking on the 4th Meeting

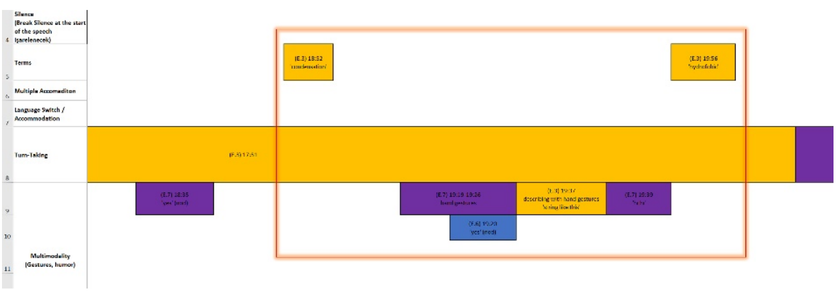


Silence also acts as an indicator of potential issues or disruptions in the ongoing discourse, signifying the need for clarification or temporary lapses in mutual understanding. Participants might leverage silence to prompt additional information from others, seek rephrasing of statements, or address potential misunderstandings. Moreover, silence can convey hesitance, uncertainty, contemplation, or thoughtful reflection.

In an interdisciplinary setting, terms can play a crucial role in facilitating effective communication and understanding between participants from different disciplines. In interdisciplinary collaborations, experts contribute their disciplinary perspectives and frameworks to the discussion. Through exploration and negotiation of term meaning and usage, participants can bridge gaps between diverse disciplinary perspectives and establish a unified understanding of the subject matter.

The terminology assumes a pivotal role in fostering efficient communication and comprehension among participants from diverse disciplines. As seen in Table 6, when the words 'condensation' and 'hydrophobic', which can be associated with E.6, are used by E.3, a confirmation expression indicating that E.6 is in active listening appears (Table 6). Terms can serve as bridges between disciplines, allowing participants to connect and integrate knowledge from diverse fields. Terms are not fixed or static; they are actively negotiated and constructed in interdisciplinary conversations. Through collaborative discussions, participants can refine and adapt terms to reflect the interdisciplinary context better. But at the same time, the use of complex terms can hinder communication between disciplines. However, this can increase participation to make incomprehensible terms understandable. Within the scope of this thesis, being familiar with the terms of different disciplines is considered as an important aspect of collective communication among team members.

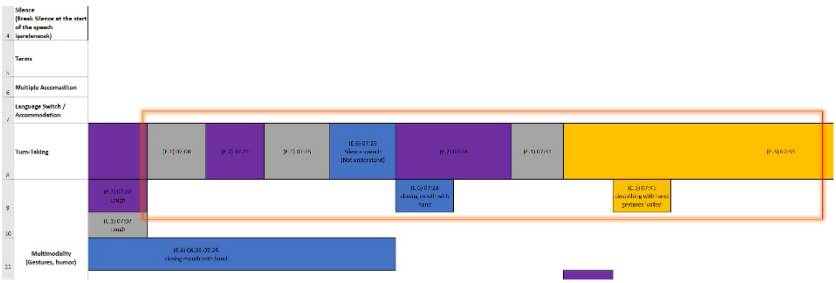
Table 6. Example of term-using at the 4th Meeting



Interdisciplinary collaborations frequently involve participants from diverse cultural backgrounds. Language switching can serve as a bridge, facilitating comprehension and fostering cultural integration.

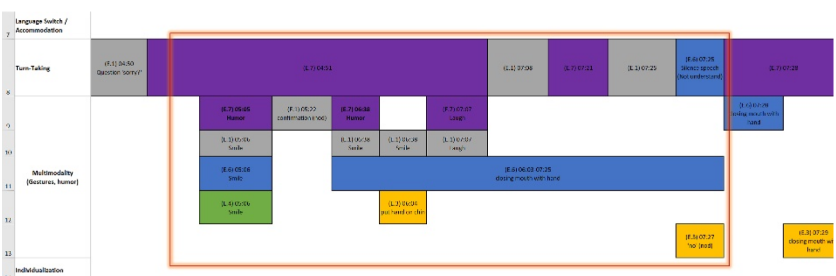
Turn-taking within conversations may encourage active listening and reflection among participants. The norms governing turn-taking promote courteous and well-organized communication (Table 7). Participants indicate their readiness to speak through cues, both verbal and non-verbal, including pauses, hand raises, or other conversational signals. Moreover, turn-taking supports the incorporation of varied viewpoints within interdisciplinary conversations.

Table 7. Example of turn-taking at the 4th Meeting



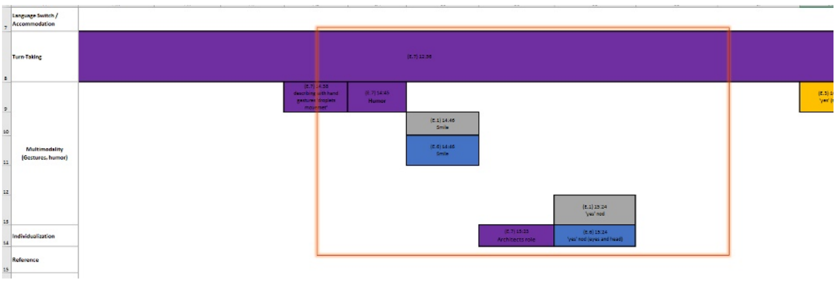
Multimodality pertains to the social interaction of participants, encompassing gestures, gaze, body postures, and movements (Mondada, 2019). Multimodality can enable communication that goes beyond the limitations of verbal language, allowing for more nuanced and comprehensive expression. This multimodal approach can enhance communication effectiveness by adding layers of meaning and context, facilitating a deeper exchange of ideas and mutual comprehension. Additionally, multimodality serves as an indicator of whether experts are engaged in active listening or not (Table 8). The CA analysis determined that humour provides active participation. On the contrary, covering the face with the hand or raising the hand to the hair decreased active listening (Table 8).

Table 8. Example of multimodality at the 4th Meeting



Individualization, within the context of conversation analysis, may encompass multiple dimensions. First, it can refer to the expert taking personal ownership and engaging directly with the subject matter, potentially leading to heightened participation in communication. As can be seen in Table 9, after E.7's statement about the architect's role, the biomimicry expert, who is E.6 architect, gives her approval. Secondly, it can facilitate the exploration of how individuals navigate and respond to specific communicative contexts. However, individualization can also signify the expert's detachment from collaborative group work.

Table 9. Example of individualization at the 4th Meeting



By referring to one another, experts foster engagement and active participation in the conversation. E.3's reference to E.7 during his discourse elicits active listening from E.7 (Table 10). Additionally, this referencing behaviour can be regarded as a positive indicator, demonstrating attentive listening and mutual respect among participants. Furthermore, this referencing behaviour can be interpreted as a favourable sign, showcasing attentive listening and mutual respect among participants.

Questions posed for approval serve as a strategic tool to promote consensus and secure agreement among participants. They also play a pivotal role in elucidating and confirming queries (Table 11), information, or statements that require validation. Participants can foster and maintain a constructive social interaction within the conversational framework by utilizing such questions. Furthermore, these questions stimulate engagement and active participation from all individuals involved in the conversation (Table 11).

Approval/confirmation statements can play a crucial role in cultivating mutual understanding and consensus among participants. By acknowledging and validating the perspectives and contributions of interlocutors, approval can foster the establishment of rapport and the cultivation of trust within the conversations. This, consequently, stimulates active engagement from experts and promotes the development of collaborative relationships among participants (Table 11).

Table 10. Example of reference at the 4th Meeting

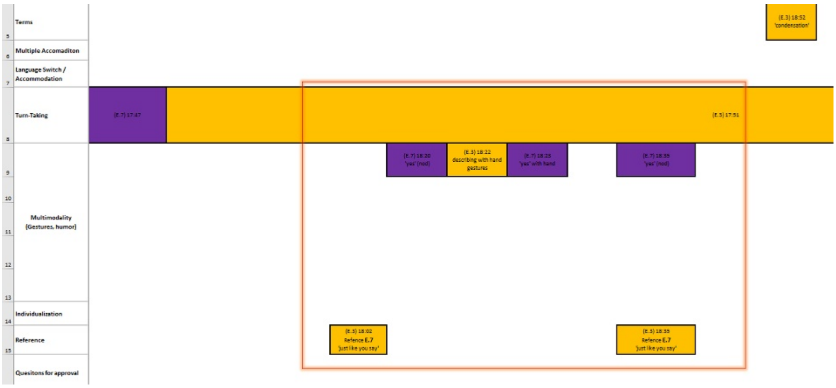
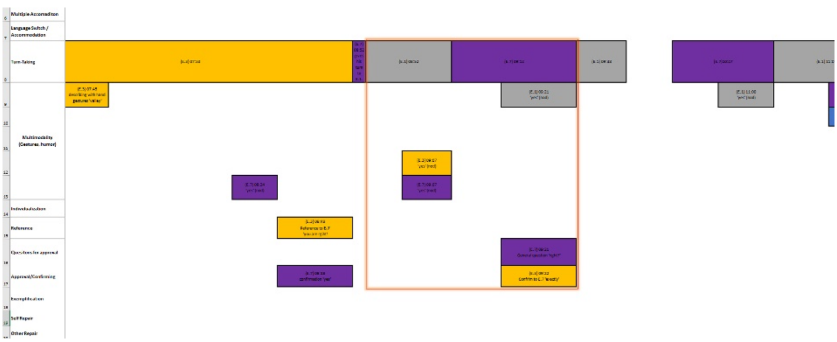


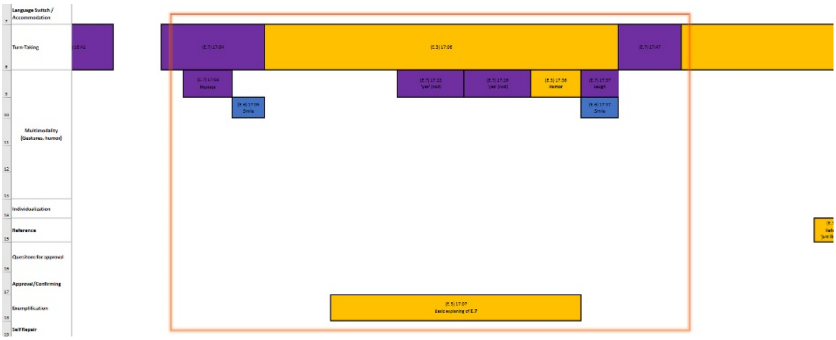
Table 11. Example of questions for approval and approval at the 4th Meeting



Incorporating exemplary or narrative strategies can effectively bolster transdisciplinary collaboration. Recognizing the potential unfamiliarity with discipline-specific terminology among participants from diverse backgrounds, offering straightforward and illustrative examples assumes significance in facilitating effective collaborative work. Understanding the subject can be regarded as a process that strengthens communication (Table 12).

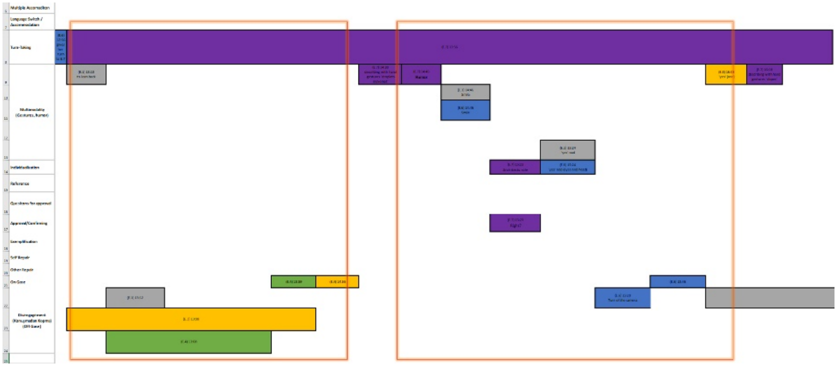
Self-repair in conversations exerts a positive impact on communication by ensuring speech coherence. It functions as a mechanism to rectify interactional issues that might arise during conversations, leading to a more fluid discourse.

Table 12. Example of basic explanation at the 4th Meeting



Conversely, other-repair pertains to the process wherein one expert initiates the correction or clarification of another expert's speech. This is pivotal for accurate comprehension of speech. Nonetheless, it's essential to acknowledge that other-repair can potentially have adverse effects on communication. If the expert, whose speech is interrupted, perceives the situation as disrespectful or condescending, it could lead to detrimental consequences for the ongoing interaction.

Table 13. Example of Off-Gaze at the 4th Meeting

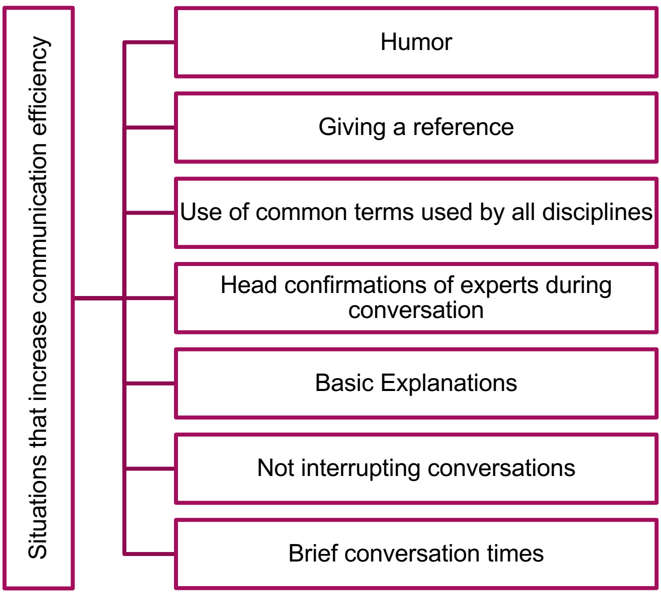


The state of off-gaze among speakers can impede effective communication. Notably, experts often display off-gaze, especially when delivering extensive speeches or intricate expressions (Table 13). Yet, the study acknowledge that this phenomenon is commonly encountered in online meetings and can be seen as one of the inherent challenges linked to such communication platforms.

DISCUSSION AND CONCLUSION

This paper argues that the architectural design process is fundamentally collaborative, necessitating team members to navigate through a range of knowledge levels and scales from different disciplines during the design phase. Effective communication plays a crucial role in facilitating this intricate process. Thus, the paper delves into the study of transdisciplinary project meetings using Conversation Analysis (CA) to unveil the mechanisms that impact communication participation, both positively and negatively. This analysis seeks to provide insights into the overall communication competency of the team members as a collective entity.

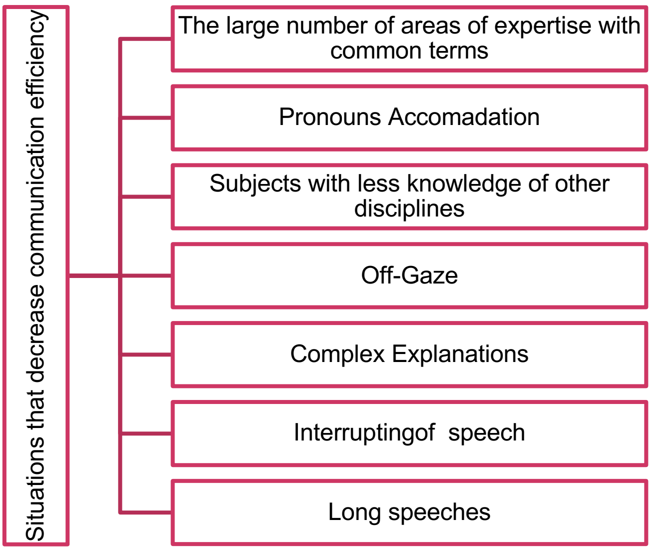
Table 14 Situations that increase communication efficiency



The CA revealed several key findings. Processes such as employing humour, providing references, utilizing common terms understood across disciplines, receiving head confirmations from experts during conversations, offering basic explanations, maintaining uninterrupted discussions, and keeping conversations brief were identified as factors that enhance communication efficiency (Table 14). Conversely, it was observed that a multitude of areas of expertise accompanied by shared terms, challenges in accommodating pronouns, individuals less familiar with other disciplines, instances of off-gaze, intricate explanations, interruptions during speech, and prolonged speeches diminish communication efficiency (Table 15).

These preliminary results analyses of an ongoing study cannot be generalized due to the incomplete nature of the process, limited number of meetings, and their varying durations. These findings contribute to ongoing research which will propose an architectural design studio involving students from multiple disciplines.

Table 15. Situations that decrease communication efficiency



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REFERENCES

Bauer, H. H. (1990). Barriers Against Interdisciplinarity: Implications for Studies of Science, Technology, and Society (STS. *Science, Technology, & Human Values*, *15*(1), 105–119. https://doi.org/10.1177/016224399001500110

Davis, K., Drey, N., & Gould, D. (2009). What are scoping studies? A review of the nursing literature. *International Journal of Nursing Studies*, *46*(10), 1386–1400. https://doi.org/10.1016/j.ijnurstu.2009.02.010

Juvancic, M., Hocevar, M. & Zupancic, T. (2014). Improving Communication and Changing Attitudes in Architectural Practices: Digital Architectural Education

Tools for Non-Experts. *Open House International*, *39*(4), 91–100. https://doi.org/10.1108/OHI-04-2014-B0009

Levac, D., Colquhoun, H. & O'Brien, K. K. (2010). Scoping studies: Advancing the methodology. *Implementation Science*, *5*(1), 69. https://doi.org/10.1186/1748-5908-5-69

Mondada, L. (2019). Contemporary issues in conversation analysis: Embodiment and materiality, multimodality and multisensoriality in social interaction. *Journal of Pragmatics*, *145*, 47–62. https://doi.org/10.1016/j.pragma.2019.01.016

Omar, N. (2014). Communication Competence during the Preparation Phase of the Direct Selling Communication Activities. *Procedia - Social and Behavioral Sciences*, *155*, 228–235. https://doi.org/10.1016/j.sbspro.2014.10.284

Sidnell, J. (2013) Basic Conversation Analytic Methods. (pp. 77-99). In Stivers, T and Jack Sidnell (Eds.) *The Handbook of Conversation Analysis.* Wiley Blackwell.

Sipahioğlu, I. R. & Çağlar, T. N. (2020). *Zoom-in/Zoom-out*. Materiart. Retrieved November 28, 2022, from https://www.materiart.org/glossary-z/zoom-in%2Fzoom-out

Thompson, J. L. (2009). Building Collective Communication Competence in Interdisciplinary Research Teams. *Journal of Applied Communication Research*, *37*(3), 278–297. https://doi.org/10.1080/00909880903025911Trebilcock, M. (2011). A Model for Integrating Environmental Sustainability into Architectural Education. *Journal of Green Building*, *6*(1), 73–82. https://doi.org/10.3992/jgb.6.1.73

Wooffitt, R. (2005). Conversation Analysis & Discourse Analysis: A Comparative and Critical Introduction. Sage.

READING BALIKESİR ÇAMLIK HILL RECREATION AREA WITH DERRİDA'S CONCEPT OF HAUNTOLOGY

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ABSTRACT

Today, cities face many challenges to keep pace with rapidly changing dynamics. While honoring their past, cities must also be open to the innovations of the future. Local regeneration projects play an important role in helping cities achieve this balance. These projects undertake the mission of strengthening or rebuilding the spirit and identity of the city.

The aim of this study is to analyze the architectural and urban arrangements in Çamlık Hill Recreation Area in the context of Derrida's concept of "Hauntologie". Hantologie", a play on words coined by the French philosopher Derrida, refers to the ontology of ghosts, hauntings, and thus the non-existent. The ghost is the central figure of hauntology. The return of a ghost requires it to find a body that will allow it to incarnate. Appearing at different times, through different bodies, the ghost can also seep from the past into the present and the future by becoming embodied through a space or an object. Throughout history, architecture has witnessed the return of ghosts and this situation has been addressed in different ways in the literature.

In this study, how ghosts haunt the space through the historiographical language, references and symbols used in the Çamlık area The process of instrumentalization of a signifier such as "crescent", which has been adopted for generations and contains multiple layers of meaning, in the recovery and regeneration of the lost urban identity is revealed.

Keywords: Hauntology; Architectural Ghosts; Crescent; Çamlık Hill Recreation Area; Jacques Derrida

INTRODUCTION

Today's world is witnessing rapid changes and transformations. The generations, who are new to these transformations and whose expectations are shaped according to the new world conditions, are trying to create suitable environments to catch the dynamics brought by these transformations and to maintain their existence. In a line extending from the past to the future, people's world of thought and identities have been shaped according to the spirit of the time and the conditions of the period.

In the words of Karl Marx, people make their own history, but they do it not only according to their own will, but in connection with the conditions and legacies from the past. Therefore, in the field of architecture, conditions from the past infiltrate into today's structures. In this context, in this study, the efforts to evaluate the heritage from the past and shape future architectural actions are discussed with Jacques Derrida's concept of Hauntology.

The word “Hantologie”, which was created by the French philosopher and founder of the Deconstructive critical thinking method Derrida with a wordplay, was formed by combining the words “hanter” and “logie”. The compound word hantologie, means the ontology of ghosts, the hauntings, and thus of things that exist without existing. The ghost is the central figure of hauntology. What a ghost is has been explained by Derrida in many parts of his work "Spectres de Marx". In Derrida's philosophy, this concept contains many sub-definitions and metaphors. Aiming to get to the roots of the logic of ghost and haunting, Derrida also questioned concepts such as life, death, ghost, spirit, mourning, inheritance, dept, timelessness.

Çamlık is a hill 181-275 meters above sea level in Balıkesir city center, surrounded by residential areas to the north, east and south. Due to its location and height, it is a natural symbolic urban value and an important reference point perceived from many parts of Balıkesir. The panoramic potential of the hill has been evaluated several times since the 1980s. The Atatürk monument and flag, which was built in 1981, and the Balıkesir Çamlık Urban and Architectural Design National Project Competition, which was organized in 2006, are among these interventions. Introduced by Balıkesir Municipality in 2015, it was aimed to leave a better future for future generations, to make Balıkesir different from other cities and to add a new image and brand value to the city. Started in 2016 and completed and put into use in 2021, the area includes units such as “Çamlık Tepesi Şehitler Mosque”, Hilal Minaret and observation terrace, promenade areas, children's playgrounds, walking trails, vocational courses, National Library, Digital Youth Center, shopping streets, and restaurants.

Reaching 33 meters in height, Hilal Minaret and Çamlık Tepesi Şehitler Mosque is the most assertive part of Çamlık Hill Recreation Area. Especially Hilal Minaret, due to its location, size and connotations, has changed the appearance of the hill. It has become the new reference point of the city and the object of Balıkesir city image. As in other urban icons, the crescent rising as a sculptural, spectacular object on the Çamlık hill is a conceptual sign that can be opened to different interpretations due to the values symbolized by the associations that create a unity of language and understanding among generations when considered from a historical perspective. Besides, the Hilal Minaret of 15 Temmuz Şehitler Mosque can be defined as a tool of regeneration of damaged/ missing/lost identity of modernized Balikesir.

The aim of this study is to analyze the architectural and urban spaces in Çamlık Hill Recreation Area in the context of Derrida's concept of "Hauntology". The way in which the historicist language is used in the design of the site and the way in which singular historical references "haunt" the site is discussed. The instrumentalization process of a sign like the "crescent", which is adopted through the generations and contains multiple layers of meaning, in restoring and regenerating the loss of urban identity is examined.

Hauntology in Derrida’s Philosophy

In French, “hanté” means “haunted” or “ghosted.” The English equivalent of the French word “hanté” is “haunt” meaning that a place or a person is frequently visited or influenced. It can also include meanings such as “being haunted” or “haunted.” The word “haunt” usually refers to the state of constantly going somewhere or visiting a place for a particular reason, while the word “haunted” refers to the state in which a place or person is affected by ghosts or creepy beings.

Hauntology, unlike the philosophy of being in the traditional sense, refers to how traces of the past are present in present-day cultural, political, and aesthetic contexts. It means the ontology of ghosts, of those who haunt, and therefore of those who exist without existing. According to Davis; “*Hauntology supplants its near-homonym ontology, replacing the priority of being and presence with the figure of the ghost as that which is neither present nor absent, neither dead nor alive*” (1).

In his study titled "Hauntology, Spectres and Phantoms", Colin Davis states that there are two different related and partially incompatible sources of hauntology in recent critical and psychoanalytic research.

Although the term was coined in French by Jack Derrida in the form of "hauntologie", the chronologically preceding and lesser known second source of hauntology is the work of Nicolas Abraham and Maria Torok in some of their reviews, for example 'L 'Ecorce et le Noyau', with a particular focus on their psychoanalytic work, and their subsequent work (1).

According to Abraham and Torok, the term “ghost”, when used in a psychoanalytic context, represents the presence of a dead relative, communicating the impact of past traumatic experiences and hidden secrets to future generations. This concept refers to the psychic effects of previous generations carrying undisclosed emotional burdens, called the “psychically untreated dead.” The ghost emphasizes the idea that traumatic experiences can affect the lives of grandchildren or subsequent generations on an unconscious level (1). Abraham and Torok developed this concept specifically within a theoretical framework called "phantoms", which describes the burdens carried by dead ancestors. Derrida's ghosts and these ghosts must be carefully distinguished. Derrida's ghost is a deconstructive figure that wanders between life and death, between being and non-being, and that disrupts established certainties. It does not belong to the order of knowledge;

> *“One does not know: not out of ignorance, but because this non-object, this non-present present, this being-there of an absent or departed one no longer belongs to knowledge. At least no longer to that which one thinks one knows by the name of knowledge. One does not know if it is living or if it is dead.” (2)*

Also the ghost is that which is expected to come back. The coming back happens when spirit becomes flesh and blood, embodied as a ghost. According to Derrida, the ghost is the frequency of a certain visibility. But it is the visibility of the invisible. In addition to these, the ghost is also imagined.

> *“All phantasms are projected onto the screen of this ghost (that is, on something absent, for the screen itself is phantomatic, as in the television of the future which will have no “screenic” support and will project its images—sometimes synthetic images—directly on the eye, like the sound of the telephone deep in the ear) (2) .*

The return of a ghost requires it to find a body that allows it to materialize. The ghost, visible through different bodies at different times, is not limited to the human body. Ghosts can be incarnated through an object, a monument, a building, or an urban space, infiltrating from past to present and into the future. A place can have more than one ghost. Sometimes a place can be haunted by a returning ghost, sometimes the place itself can appear as a ghost.

Architecture and Hauntology

According to Derrida, architecture is a form of expression that is structured like texts and loaded with meanings. Architecture constructs meaning by using elements such as space, form, material and experience. Derrida, however, argues that architecture, like language, contains contradictory and paradoxical elements.

The relationship between architecture and "hauntology" can offer a broad intellectual grounding in how space and time are perceived, interpreted, and designed. Architecture not only encompasses the physical design and arrangement of spaces, but also assumes the role of a carrier of memory, history, and cultural meaning. At this point, a parallelism can be seen between the memory of the space and the hauntology.

Derrida states that memory is constantly shaped and changed, that memory can be misleading and incomplete, that memories can change over time, and that they can be reconstructed under the influence of interpretations. Factors such as reuse, restructuring, and reinterpretation of a space can also change the history and memory of the space. With hauntology, the past and the future can be associated with the present moment by revealing the traces underlying the transformation and change of the space.

> *"The memory we are considering here is not essentially oriented towards the past, towards a past present deemed to have really and previously existed. Memory stays with traces, in order to "preserve" them, but traces of a past that has never been present, traces which ... always remain, as it were, to come*/come from the future, from the to come. Resurrection ... does not resuscitate a past which had been present; it engages the future" (3).*

Places carry events, memories, and stories that have happened in them. These factors can form the ghosts of the space. While shaping the physical characteristics of the space, architecture also creates the symbolism and meaning of the space. Hauntology, while addressing the symbolism and meaning of space in a broader context, is also influential in the creation of the ghosts of space.

The Location of Çamlık Hill Recreation Area in the City and Its Importance

The region, which is located to the west of the city center and known as Çamlık Hill today, was known with names such as Hıdırlık Ridge and Hıdırlık Hill until the 1930s. While there were non-Muslim cemeteries in the region at that time, afforestation works were carried out by the rulers of the period since the 1930s, and the cemeteries in the area were moved to another place over time (4). As a result of the afforestation works carried out in the region in the 1950s-60s, it has turned into a green area covered with pine trees that will make it known as Çamlık.

Figure 1. Çamlık Hill Recreation Area (Google Earth, 2023)

The studies to evaluate the potential of this hill, which has a panoramic dominance, have come to the fore from time to time. Organizing the Balıkesir Çamlık Urban and Architectural Design National Project Competition in 1981 to mark the 100th anniversary of Atatürk's birth, placing the Atatürk monument and flag, and in 2006, organizing the Balıkesir Çamlık Urban and Architectural Design National Project Competition (5) in order to contribute to the participation of the hill in urban life and to increase the quality of urban life includes different efforts towards this hill.

The Atatürk Monument built on Çamlık Hill, the accompanying national flag and the stairs directed to the monument are designed to be easily observed from many points throughout the city. In particular, the stairs of the monument extend along the artery that forms the most vibrant trade flow of the city, such as Milli Kuvvetler Street. Through these arrangements, an uninterrupted visual connection has been established between Balıkesir Railway Station and the structure in question. This symbolic area has gained an important place in the memory of almost all city residents.

Figure 2.Stairs and Atatürk monument (taken by Esra Şat)

Çamlık Hill Recreation Area, Hilal Minaret and Şehitler Mosque Project

It has been on the agenda since 2015, when a vision project will be implemented on Çamlık Hill. This place is an important landmark for the city, and the project was promoted by Balıkesir Metropolitan Municipality in 2016. It has been stated that Çamlık Hill Recreation Area and Hilal Minaret and Şehitler Mosque Project aims to leave a better future to future generations, as well as to make Balıkesir different from other cities and to add brand value to the city with a new image.

In the area, which was started to be built in 2016 and completed and opened for use in 2021, there are units such as Çamlık Hill Şehitler Mosque, Hilal Minaret, which has become the symbol of the city, and viewing terrace, relaxation areas, children's playgrounds, hiking trails, vocational courses, National Library, Digital Youth Center, shopping streets, restaurants. In this area, it is aimed that all these units come together in harmony with each other and offer children, young people and people of all age groups the opportunity to use them for cultural, sportive, touristic, scientific, religious, commercial and entertainment purposes (6).

While Mayor Ahmet Edip Uğur stated that the mosque in the project was an unprecedented mosque not only in Turkey but all over the world, he said that the 33 m high crescent minaret on the hill would be a natural image observed from many parts of Balıkesir. Saying that its height will be the rosary to Allah and its form will be the messages of our values, the mayor emphasized that each measure in the mosque is equivalent and there is nothing done by heart.

Ghosts in the Çamlık Hill

Davis (1) says that Derrida invites us to make an effort to talk and listen to the ghost, despite the reluctance inherited from our intellectual traditions. In this part of the study, as proposed by Derrida, it will be tried to talk to the ghosts in the Çamlık hill recreation area, who sometimes embody the tradition of the past generations and sometimes as a projection of the future in different ways.

There are more than one ghost that we can encounter when we consider the Çamlık hill. One of the noteworthy issues in this regard is that some examples of the star motif, which we know was frequently used in the Seljuk period, are used in many ways in the Şehitler Mosque and Hilal minaret.

Figure 3. Some places where the star motif is used in the project (Esra Şat)

As Marx put it, "*a certain phenomenal and corporeal form of the ghost soul, its body-form, is a paradoxical incarnation*". In this context, the star motif, which we see in the minaret of the Şehitler mosque, in its glass domes and windows, in its carpets, column and suspended ceiling coverings, in the panels designed to hide and protect the air conditioners, on the covers of the shoe and clothing cabinets and in many other places in the interior, appears as a ghost that allows the Seljuk spirit to be embodied in a way, and the mosque is haunted by the Seljuk. Beyond the present, tomorrow is haunted.

The Seljuk Period is a period in which the Turks experienced Islam in depth and under the influence of Sufism. Sufi meanings were attributed to the star motif, especially in the Seljuk Period (7). The star motifs used in the Seljuk period were generally intended to reflect Sufi thoughts and carry deep meanings. The stars symbolized reaching God in a mystical understanding. These motifs represented the creation, unity and order of the universe and pointed to the existence of man with God and his place in the universe. In this period, star motifs were frequently used in many areas from architectural works to ceramics, from weaving to handicrafts to flags and items used in daily life. In general, the use of star motifs began to decline towards the middle of the 13th century, when the Seljuk Empire ended, and geometric star motifs were mostly replaced by vegetative motifs. However, as in many examples of today's Turkish architecture, it can be said that the fact that the star motif, which was abandoned centuries ago, was used so much in the Çamlık project, contains messages to remind us of the Seljuk period and the values of this period, to raise awareness, to adopt and to pass on that spirit to the next generations.

It can also be said with a Derridaian look that there is someone who has lost his appearance as the reappearance of the lost. That what we see in this reappearance is that the original meaning of the star motif in its first use, rather than its deep philosophy, architectural design and application quality, has turned into a reference tool to the Seljuk period.

According to Derrida, the ghost is the visible that is not sensible, and the invisible that is audible. It is a contradictory concept in itself. It is both flesh and spirit. It's here and there; that's why it's nowhere and everywhere, even before we see it, it looks at us. Even before any kind of appearance, we get the feeling that he watches us. There is such a ghost on the Çamlık hill, the ghost of Atatürk embodied in the monumental statue. The statue of Atatürk, which was placed on Çamlık Hill in 1981, is located at a point that can be seen from almost anywhere in the city, facing the city and is positioned as if watching its people. The ghost, who is embodied in this statue that looks after us and takes care of us, also speaks to us. He conveys his message through the inscription "This Country Was Turkish in History, Is Turkish Today and Will Remain Turkish

Forever". He leaves us a legacy. We can say that the second of this monument, which was replaced with the larger one on the grounds that it was worn 40 years after it was built, was actually there as the ghost of the Atatürk statue that was there before it; as the ghost of the ghost.

Monuments are works that attract attention and gain symbolism in the place they are located due to their purpose. If the artistic aspect is also strong, the meanings and emotions of the monument are easily transferred to the viewer (8). The statue of Atatürk, which is the vehicle of this transfer on the hill of Çamlık, lives with us as the carrier of Atatürk's ideas and thoughts and the means of transferring them to future generations.

Similarly, another ghost we will talk about is the ghost of former Mayor Ahmet Edip Uğur. With a decision taken by the Balıkesir Metropolitan Municipality Council in 2022, the name of the "Çamlık Tepesi Rekreasyon Alanı ve Hilal Minareli Şehitler Camii" project was changed and it was named as "Ahmet Edip Uğur Gençlik, Kültür ve Aktivite Merkezi" (Ahmet Edip Uğur Youth, Culture and Activity Center) as an expression of loyalty to the late Ahmet Edip, who was the mayor at the time of the decision to carry out the project. Usually, naming a place after a person, such as a street, boulevard, or alley, is done to honor or honor the memory of that person. This person can be a local hero, a famous historical figure, an artist, a scientist or an important name for the society who contributed to that region. His influence or contribution in the place where his name is given is the main reason for keeping his name alive. The ghost of the former president, who was honored by being named, is with his people who went to this area where he pioneered. Where he has no existence of his own, his ghost is with us as his name is mentioned.

Hilal Minaret and Its Ghosts

The crescent, which means "to shout loudly; to appear, to shine; to rejoice" in the dictionary, is the name of the shape of the moon, which looks like a thin bow with its tips from the earth before and after the reunion (9). The symbol of the crescent is a symbol that has had different meanings in historically different cultures and periods. The crescent was often used in ancient times to represent different phases of the moon. The crescent-shaped image of the moon has been adopted as a time measure used to indicate the beginning of the new moon and the end of the full moon. At the same time, the cycle of the moon has been associated with concepts such as fertility and rebirth.

The symbol of the crescent has an important place in Islamic culture. The beginning of the months of the Islamic calendar is determined by the birth of the moon (crescent). The first appearance of the crescent is observed to determine the beginning of the month of Ramadan. The crescent is also considered one of the symbols of Islam and is often used in the flags of Islamic countries. The symbol of the crescent was also included in the flag of the Ottoman Empire. Although there are different theories about the origin of this use (10), it is accepted that the symbol originates from Islamic culture and reflects that the Ottoman Empire was accepted as a representative of Islam. Since the establishment of the Republic of Turkey, the symbol of the crescent has been an important symbol representing the values of independence, unity, national identity and modernization of the Turkish nation. Although it had historically different meanings, this symbol was used as an expression of Turkey's national identity and values during the republican period.

In different periods and cultures, the crescent symbolized many things. In one place it represents hope and rebirth, while in another it symbolizes change and transformation. In Islamic culture, it is used to determine the beginning of the month of Ramadan, while in other cultures it describes fertility and growth. These symbols are intertwined with the physical presence of the crescent and cultural meanings.

This dynamic relationship of the crescent between existence and symbolism has been shaped under the influence of time and cultures. On the one hand, the crescent appears in the sky as a physical reality and represents the different phases of the moon. People attribute different meanings to this image. This complexity creates a state of comeback that can be called the “ghosts” of the crescent itself.

This is where Derrida's concept of “ghosts” comes in. The ghosts of the crescent represent meanings and symbols from the past. In each period, the traces and reflections of the previous ones continue through the symbols that the crescent has carried for centuries. Thus, the crescent is seen not only as a physically observable lunar phase, but also as a symbol reflecting the complexity of history, culture, and meaning.

Figure 4: Hilal Minaret (11), (12)

The fact that the minaret on Çamlık Hill today is in the form of a crescent appears as a situation where the crescent comes back as a ghost.

The expression of Islamic references in the design of the 15 Temmuz Şehitler Mosque and the Hilal Minaret in a historicist language draws attention to Derrida's concept of "ghosts". Each symbol or reference carries the ghosts of previous meanings, and these meanings persist, even as they change over time. Although the historicist design approach here is a controversial issue in the architectural literature, it can be said that it is an ideological choice. The selection of a mosque and minaret as a new icon of the city's brand image is also expected in this context. The determination that the design of a crescent-shaped minaret is a conscious ideological choice is not a new situation, at least not in Balıkesir. Already, the Çamlık region is seen as an ideologically occupied area by symbols such as the Atatürk Monument and the flag seen from all over the city (13).

Figure 5:Hilal Minaret, flag, Atatürk monument (Esra Şat)

As a result, reflection on the crescent allows us to see how a phenomenon can become both entity and symbol. Parallel to Derrida's concept of "ghosts," this reflects our effort to explore the deep meanings and contexts underlying the events and objects we observe.

CONCLUSION

Karl Marx says, "*Men make their own history, but they do not make it just as they please; they do not make it under circumstances chosen by themselves, but under circumstances directly encountered, given, and transmitted from the past*" (14).

Çamlık Hill Recreation Area project is a regeneration effort that carries the traces of the past to the present and tries to reconstruct the identity of the city through these traces. Although the use of Seljuk period motifs and Islamic references may seem like an effort to revive the ghosts of the past, it is not only a reference to the past, but also an expression of an ideological purpose.

Derrida says that the phantom logic he resorts to is "deconstructive", not metaphysical. This logic: abstraction, idealization, ideologization and fetishization, so to speak, are necessary to take into account the processes of metaphysiciation and their effects (15). In this context, when we consider the applications on Çamlık Hill, which is the subject of our study, it is seen that the design and location of the Hilal Minaret, which is presented as a new symbol of the city, not only reconstructs the identity of the city, but is also accepted as a symbol of a certain ideology just like placing a large flagpole and a statue of Atatürk in this area before. the Çamlık Hill Recreation Area project presents an example of local regeneration projects that transform or rebuild the city's identity, in an effort to honor the legacy of the past and be open to future innovations. In addition, it should not be overlooked that the objectives of the project overlap with broader economic and political objectives such as increasing the touristic attractiveness of the city and increasing its brand value.

REFERENCES

1. Davis, Colin. E´tat Pre´sent Hauntology, Spectres And Phantoms. *French Studies.* Vol. LIX, 2005, 3.

2. Derrida, Jacques. Specters of Marx: The state of the debt, the work of mourning and the new international. New York and London : Routledge, 2007.

3. Derrida, Jacquas. *Memoirs for Paul de Man.* New York : Columbia University Press, 1986.

4. -, Yüzbaşı İshak Hakkı Bey. *1920'de Balıkesir.* Balıkesir : Balıkesir Valiliği Kültür Yayınları, 1997.

5. Balıkesir Çamlık Kentsel ve Mimari Tasarım Ulusal Proje Yarışma Şartnamesi.

6. "Büyükşehir'in Çamlık Projesi Hızla İlerliyor". */www.balikesir.bel.tr.* [Online] 2017.

7. Ünver, Günay and Güngör, Harun. *TÜRK DİN TARİHİ.* İstanbul : Laçin, 1998.

8. Şat, Esra. Balıkesir ve İlçelerindeki Atatürk Anıtları ve Tören Alanlarının Kentsel Mekan Organizasyonundaki Rolü. Balıkesir : Balıkesir Üniversitesi Fen Bilimleri Enstitüsü, 2017.

9. Yücel, İrfan. *Hilal.* 1998.

10. Gök, Nejdet and Kutlu, Mehmet. Hilal ve Ay-Yıldız Motifi, Sembol ve İdeolojik Kullanım. *Doğu Batı.* 2005, Şubat.

11. https://www.gercekbandirma.com/balikesir-camlik-projesinde-yildiz-sorunu-tepede-yildizsiz-hilal. 2019.

12. https://www.balikesir.bel.tr/haber-detay?id=2111. [Online] [Cited: 07 10, 2023.]

13. Akgün, Berrin. Markalaşan Balıkesir'in Yeni Kent İkonu Adayı: Çamlık Tepesi Rekreasyon Projesi. *arkitera.com.* [Online] Aralık 2017. [Cited: Ağustos 10, 2023.] https://www.arkitera.com/gorus/markalasan-balikesirin-yeni-kent-ikonu-adayi-camlik-tepesi-rekreasyon-projesi/.

14. Marx, Karl. *The Eighteenth Brumaire of Louis Bonaparte.* Moscow : Progress Pubishers, 1972.

15. Derrida, Jacques. *Marx & Sons.* 2002.

16. Abraham, Nicolas and MariaTorok. *The Shell and the Kernel: Renewals of Psychoanalysis.* s.l. : University of Chicago Press, 1994.

ARCHITECTURE AND PLACE RELATIONSHIP: A READ ON THE POTENTIALS OF REGENERATIONS BETWEEN SPACES TO PLACES AND PLACES TO SPACES

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ABSTRACT

Human beings continue their existence and actions in space. These actions change with experiences, so space also changes simultaneously. Even though the change continues, space is around all life events and an environment where people maintain relationships. From room to house, house to street, district to city, country to continent, earth to space, every point and situation in which a person lives is a space. In addition, people try to make sense of their environment beyond physical space, in other words, to "make a place" with the experiences that emerge due to the relationship they establish with their environment. In this respect, space and place are phenomena that continue to each other in human life. From the past to the present, many views on architecture and design have discussed the meanings of place and space and their relations with each other: Does space turn into place? Is every place a space? Although various approaches do not accept the phenomenon of place, it can be mentioned that there is a relationship between place and space, which is the subject of many academic studies in architecture and other disciplines. The study aims to examine this relationship and its main elements in detail. It seeks to reveal the concepts of space and place in architecture and the essential factors determining the potential of spaces to become places. While defining the concepts of space and place from different angles, the research, which questions the dialectical relationship with each other, seeks an answer to whether a place regenerates from a space or a space becomes a place. While the research focuses on this transformation, it questions the potentials that prepare the ground for it in a theoretical framework and interprets it through various architectural space examples at different scales. In the conclusion part of the study, the main qualities that can determine the potential of a space to a place are discussed.

Keywords: Place, space, regeneration, potential, human.

INTRODUCTION

Humanity is questioning the environment it has been living in since ancient times. The perception of the universe formed in different parts of the world in every period of history includes the search for answers to man's questions in the nature-human-universe cycle. To find answers to these questions and continue his vital activities, human has tried to arrange the environment in which he lives according to his conditions and needs. First, he wanted to embrace his environment, leave a trace, and connect with his surroundings with the wall paintings he made while trying to live in the cave. (Eren, 2006) Norberg Schulz discussed this sense of belonging and ownership with the concept of a “sense of place.” The idea of the “spirit of the place (genius loci)” is an idea that dates back to Ancient Rome. In ancient Rome, people and the earth were believed to have a spirit given by God, and this spirit kept them alive. (Schulz, 1979) For the sense of place and place, there are different views and meanings associated with these concepts since it was first put forward. Among these meanings, some definitions can be related to the word space.

According to Norberg Schulz (2013), the phenomenon of place requires that the structure of the site be defined in terms of "landscape" and "settlement" and analyzed through "space" and "character." While "space" expresses the three-dimensional organization of the elements that make up a place, "character" refers to the overall "atmosphere" that is the most comprehensive feature of any place. Instead of distinguishing between space and character, a broad concept such as "living space" can be used. Similar spatial organizations can have many different characters according to the concrete functioning of the elements that define the space, namely the boundaries. New characterizing interpretations have been continually added to the history of primary spatial forms. On the other hand, it should be considered that spatial organization imposes certain limits on characterization and that the two concepts are interdependent.

On the contrary, some ideas do not accept the concept of place. The rivalry between the concepts of place and space, sometimes praising or criticizing the place, sometimes glorifying the value of the space or losing its reputation, is a subject of debate dating back to the pre-modern period and continuing today. (Gürkaş,2010)

The purpose of the study, which aims to comprehensively discuss the existence and essential components of this interaction between place and space, is to reveal the concept of place in architecture and the vital elements that determine the potential of spaces to be places. While defining the concepts of space and place from different perspectives, the literature review, in which the dialectical relationship with each other is emphasized, does a space turn into a place, or does a place become a space? Is every space a place? Does the place exist? Tries to find answers to questions. While the research focuses on this dual relationship, it questions the potentials that pave the way for transformation and aims to reveal the indispensable elements of change. In this context, the method of the study is to examine the space-place relationship through various examples in terms of architecture and design discipline. While reading about the interdependence of place and space through multiple examples of transformation from small scale to large scale, from the smallest architectural space to the large urban space, the human and human behavior on them and directly affecting this commitment will also be discussed. In this context, it is thought that the study gains importance in terms of questioning human-environment-behavior relations and will contribute to future studies by taking place in the literature.

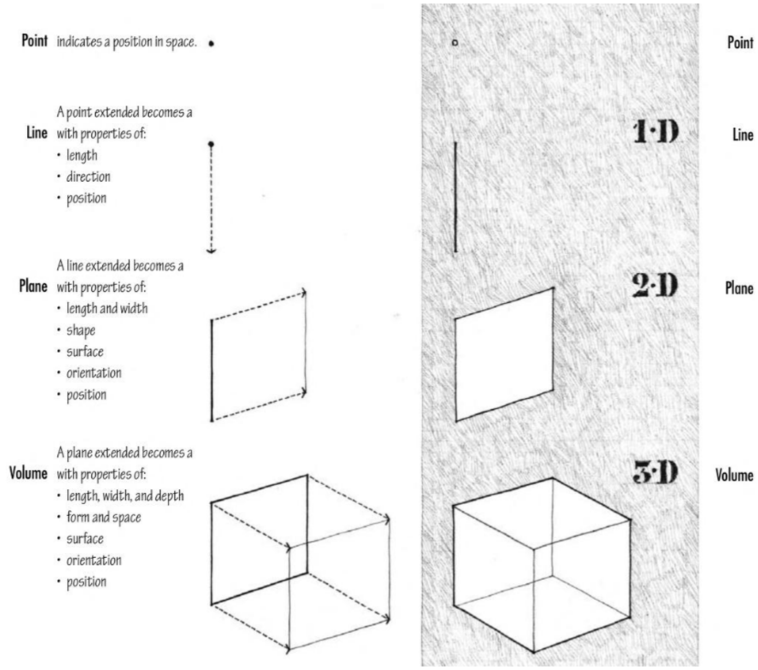


Figure 1. Primer generators of form (Ching,2007)

1. Concepts of Space and Place

The word "mekan" (space) originally comes from the Arabic root "kevn," meaning existence, incarnation, etc. (Eren,2006). In a broad definition, space is anything whose dimensions we can determine. In the narrower context, it has dimensions to human beings. Space can be a place, a landmark, or an address, a point that we can express geometrically with a system of coordinates; on the other hand, it can be accepted as a quantity, a usable surface, or a volume. In different definitions, space can be evaluated in two ways: as an area outside of human activity in which there is something, and the other as the objective and tangible environment in which people interact. (Durmaz Irmak,2008). According to Ching (2007), the formation of three-dimensional physical space starts from the point. Two points combine to form a line, lines combine to form a plane, and planes combine to form three-dimensional volumes. (Fig.1)

> *"Space constantly encompasses our being. Through the volume of space, we move, see forms, hear sounds, feel breezes, and smell the fragrances of a flower garden in bloom. It is a material substance like wood or stone. However, it is an inherently formless vapor. Its visual form, its dimensions, and scale, the quality of its light — all of these qualities depend on our perception of the spatial boundaries defined by elements of form. Architecture comes into being as space begins to be captured, enclosed, molded, and organized by mass elements." (Ching,2007)*

According to Ching (2007), any three-dimensional form expresses the volume of the surrounding space and creates a domain or region that it claims to belong to. The form has horizontal and vertical elements. (Fig.2) Horizontal components defining the space are the base plane, elevated base plane, depressed base plane, and overhead plane; vertical components can be exemplified as vertical linear elements, single vertical plane, L-shaped configuration of planes, parallel planes, U-shaped planes, and closures formed by the combination of four vertical planes. These formal components come together in various ways to form different spaces.

On the other hand, according to Schulz (2013), space corresponds to different meanings. In the current literature, two types of space are defended: space as three-dimensional geometry and space as a perceptual field. However, none of these are satisfactory abstractions from the intuitive three-dimensional unity of everyday experience, which we might call 'concrete space.' Concrete human actions occur not in an ordered and independent space but in a space distinguished by qualitative differences such as "up" and "down." In architectural theory, several attempts have been made to describe space in concrete, qualitative terms.

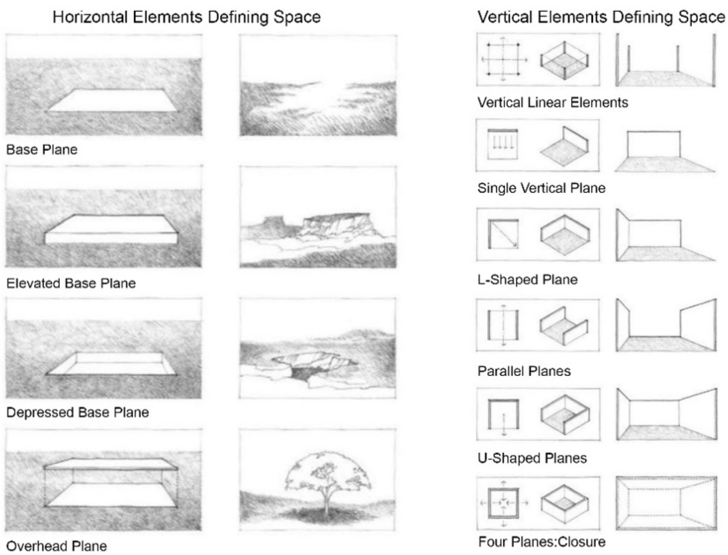


Figure 2. Horizontal and vertical elements define space (Ching,2007)

For example, Kevin Lynch (1964) argued that everyone perceives the world they live in in different ways and uses various clues and methods to differentiate the world he perceives. In his analysis, he limited himself to the effects of physically perceptible objects. He considered the physical qualities of the city as imagined by people. It tries to understand the inner face of the structure of concrete space by introducing the concepts of "node," "path," "edge," "landmark," and "district" at the urban scale to indicate the basic principles that affect the orientation of people in space. Expressing that these concepts create an "environmental image"/"urban image" for people living in the city, Lynch accepts that these elements, which are decisive in determining the direction of the person, are a combination of the perceptual relations in their minds. A good city image creates a sense of belonging to a particular place where people differ depending on cultural developments and the physical structure of the urban space.

Over time, with the effect of modernism, the concept of space was seen as insufficient on its own, and it was also criticized in terms of uniformity and the lack of the human factor in design. In line with the criticisms, the concept of place has emerged in response to the concept of space and to redefine the space. The concept of place is a system that prioritizes the human-environment relationship, human experience, human-specific features, context, meaning, and the concrete and physical qualities of the space. Although it emerged with the redefinition of the concept of space, it differs from space as it has a unique identity in this respect. It carries a sense of belonging as well as physical quality. (Uzunkaya, 2014). However, it would not be correct to distinguish between place and space. Space and place are interconnected or used interchangeably in different situations. Space, by definition, also includes the meaning of "the place where it is located." A place is existential and inclusive (Ergun Bilgili, 2022).

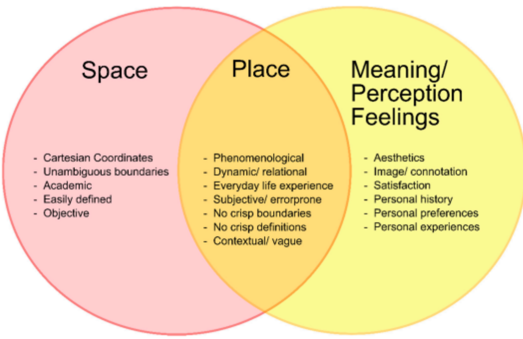


Figure 3. The notion of place to space and perception (Merschdorf & Blaschke,2018)

1.1. Space-Place Relation

Considering the different definitions of space and place, it turns out that the definition of place is always based on an underlying spatial framework. In experience, the meaning of space is often combined with the meaning of place. 'Space' is more abstract than 'place.' What begins as an undifferentiated space becomes a place as we get to know and value it better. The concepts of "space" and "place" require each other in terms of definition. One should be aware of the security and stability of the space, the openness, freedom, and threat of the space and vice versa (Koçyiğit, 2007). For this reason, even if the place is accepted as the fundamental entity of all human perceptions and experiences, regardless of the cartesian coordinate system, it has always needed a spatial definition, making it a derivative of space by its nature. However, a fundamentally human phenomenon, a place not only includes spatial aspects but is also surrounded by semantic features, as shown in Figure 3.

When space is thought of as something that allows movement, place is a pause. Space can be thought of as movement and place as a stop.

The place has security and continuity. Space transforms as value and meaning are attributed to it. Every pause in the movement allows the space to turn into a place. (Tuan, 2001) However, a place has more content than a location or stop word. It is a unique entity, a private community. It has a history and meaning. The place embodies the experiences and aspirations of a society. Place is not only a phenomenon that needs to be explained within an ample space but also a reality that needs to be illuminated and understood by using the perspectives of those who give it meaning. From a humanist perspective, this is the study of people's spatial feelings and ideas in the stream of experience. Experience is the sum of how the world is known. The man knows the world through sensation (emotion), perception, and comprehension and tries to make sense of it. (Tuan, 1979)

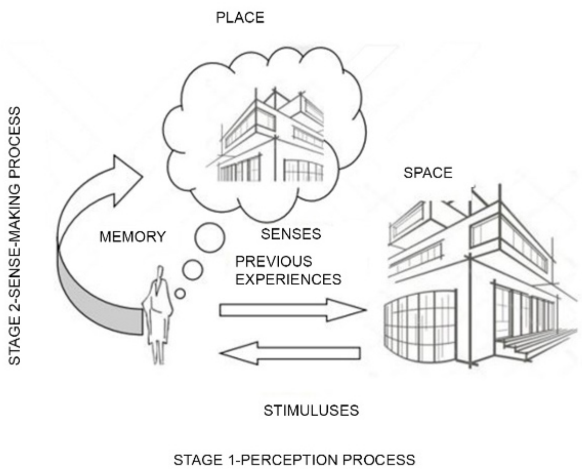


Figure 4. Processes of perception and sense-making (Ertürk, 2019)

The process of transforming a space into a place consists of 2 steps. (Figure 4). The first step is the human perception phase. The individual establishes a relationship with the space through past experiences, senses, and stimuli. The second step is interpretation. In this step, the space turns into an image in the individual's memory and is coded in his memory. Thanks to the memory formed, it establishes a connection with the environment. The place is no longer as it was first perceived. As the individual begins to live in the space he has made sense of, he creates a sense of belonging. The changed space is now differentiated and transformed into a meaningful field. It also brings with it the creation of one's place and the establishment and definition of one's own living space. Thus, the space has become a place with meaning and physical bodies. (Erturk, 2019)

2. Transformation from Micro-Scale to Macro-Scale, from Space to Place, and from Place to Space

As explained in the previous sections, although there is no definite distinction between place and space, it can be said that there are main differences, and there is a relationship between them. It is not easy to see these differences and relationships because places exist primarily within spaces in our daily experience. A place is usually a space to which something has been added - social meaning, tradition, role, function, cultural understanding of nature, etc. An individual's sense of place transforms space. Because the world is spatial and three-dimensional, descriptions of space are associated with everyday experiences. Since everything in our world occurs in space, the "place" also depends on it. Spatiality continues throughout experience and thoughts. Places, then, derive much of their meaning from their spatiality. (Harrison & Dourish, 1980) The sense of place also relates to spatial organization and objects' three-dimensional arrangement. The extent of this environmental and spatial organization can be very small or very large. In architecture, the transformation relations between space and place, which are realized by human perception and experience, can occur at different scales, from a minor architectural interior to a large urban space. (Figure 5) In this part of the study, the space-place relationship will be examined through examples of various architectural scales. Depending on the scale, the examples are handled in three sub-headings: micro-scale (small architectural space), architectural scale (the space of architectural structure or building), and macro-scale (urban space). The examples were first categorized according to Ching's (2007) horizontal and vertical elements that define the space and create the form. These spaces' physical and characteristic features were evaluated, and their potential as places was questioned.

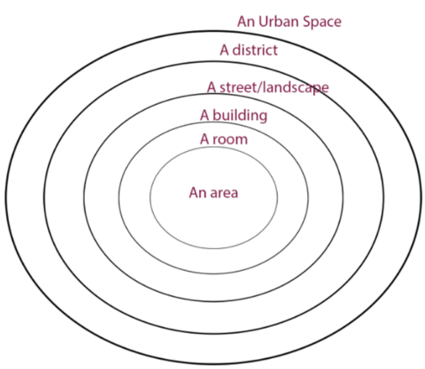


Figure 5. Types of spaces of different scales (Prepared by authors)

2.1. Micro-Scale (Small Architectural Space)

Such spaces are simple singular or small spaces consisting of several planes. They can be located in a small landscape area or interiors.

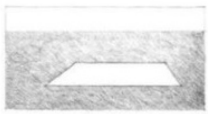
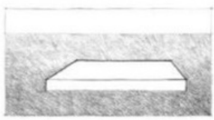
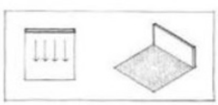
Form Type	Example
Base Plane 	 2.1.a
Elevated Base Plane 	 2.1.b
Single Vertical Plane 	 2.1.c

Figure 6. Examples for the Micro-Scale (Prepared by authors)

Figure 6 (2.1.a.) creates an example for the base plane, one of the most straightforward space definitions according to Ching. The existing area typically appears as a natural landscape surrounded by trees and grass. However, the cover on the grass was defined as a surface that would contrast this landscape area, thus forming the space as the base plane. Objects placed on the cover point to some activities that people do here, such as eating and drinking. From this point of view, it can be said that the small base plane formed by the cover has the potential to transform into a place.

In Figure 6 (2.1.b.), the new horizontal plane raised over a base plane has formed an elevated base plane with vertical surfaces along its edges that reinforce the visual separation between its area and the surrounding ground. Low and high planes create different spaces and environments for human needs, such as eating, drinking, resting, and sheltering. It can reveal the sense of place by people spending time here, using the stairs that connect the spaces, and transforming them according to their needs.

On the other hand, in Figure 6 (2.1.c), a single vertical plane creates a space by rising on the base plane, the ground forming a facade. In order to define the space and express recognition, the color element is used differently with the objects placed. From the various objects used and the color elements used to create a sense of belonging and perception, it can be said that people use the space and have the potential to transform it into a place.

2.2. Architectural Scale (Architectural Space at Structure/Building Scale)

Architectural spaces are associated with architectural structures. This can be a structural element or the building itself. For example, in Figure 7 (2.2.a.), horizontal planes separated from the ground plane and moved to different heights define different spaces by creating specific volumes between them and the ground plane. The spaces formed at different levels have created various living spaces that lean on and extend from the existing buildings and support the streets at unusual angles. Also, it has formed a bond by adapting to its environment. In addition to its function, it is possible to be a place that is in harmony with the environment and recognizable structure.

In Figure 7 (2.2.b.), a horizontal plane pressed from the ground plane defines a new volume with its vertical side surfaces, and thus, a depressed base plane is formed. Surfaces pressed at different heights create spaces at different levels. At the same time, harmony with the environment has been achieved by using the natural slope in this way. These spaces can serve different functions and create various circulation and landscape areas where people can be used. The usage status and density of different spaces and the activities of people here will be decisive for the transformation into place.

As seen in Figure 7 (2.2.c.), vertical linear elements can define a space and planes created differently. The spiral staircase that provides circulation in the vertical direction creates a space. At the same time, it has been the transition space between the base plane and elevated base plane spaces located above and below, which it connects. It can be said that it has the potential to become a place depending on whether people will prefer it for access, the occurrence of actions such as sitting on it, waiting, and their density, etc.

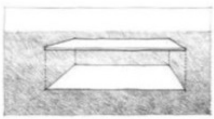
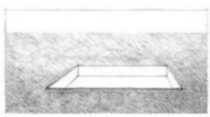
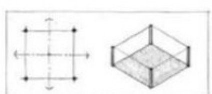
Form Type	Example
Overhead Plane 	 3 Box Housing Project *2.2.a*
Depressed Base Plane 	 Aimé Césaire Primary School *2.2.b*
Vertical Linear Elements 	 Apple Store Fifth Avenue Stairs *2.2.c*

Figure 7. Examples of the Architectural Space (Prepared by authors)

2.3. Macro-Scale (Urban Space)

The space that has the potential to transform into a place can also be a large-scale urban space. Such spaces are denser in terms of human population and are areas where public and social functions coexist in terms of their urban character. Considering the possibilities of such places to be placed, when it is thought the size of these spaces, and their formation in a specific process, the influence of the historical and cultural context can also be a determining factor. These spaces usually emerge as an iconic or symbolic element in the city with the effect of their scale, apart from their status as places. In this respect, there are also different transformation processes that we can interpret as before and after.

In Figure 8 (2.3.a), the L-shaped configuration space formed by the combination of vertical and horizontal planes forming the bottom of the overpass defines the space. In 2.3.b, the facades formed by juxtaposing different surrounding buildings form the boundaries of an inward-looking space they surround by forming four vertical planes. In 2.3.c, a geometric primary plane is defined by the intersection of the transportation axes coming from different angles linearly.

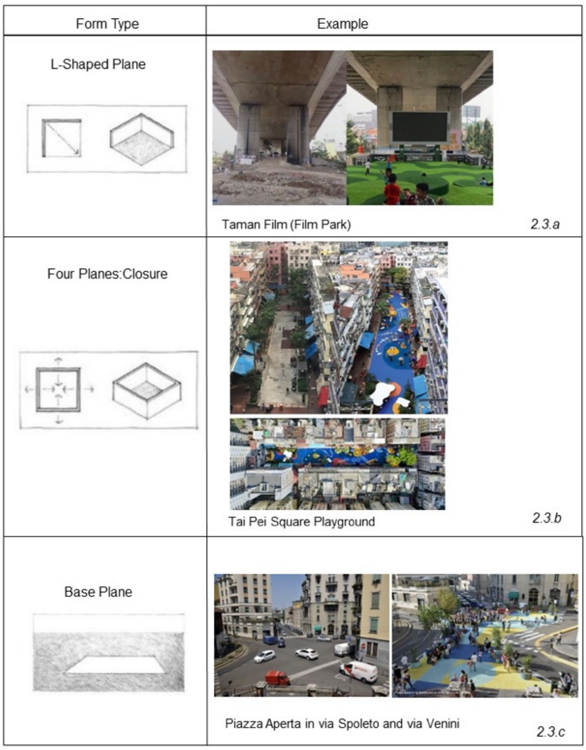


Figure 8. Examples for the Urban Space (Prepared by authors)

Considering the qualities of being a place, all three examples have many common points. First, they have different public functions. Respectively, in Figure 8 (2.3.a), movie screening, seating, and activity area; in Figure 8 (2.3.b), children's playground, sports, and walking areas, facilities for different age groups; and in 2.3.c, pedestrian paths, bicycle paths and seating units like spaces are available as functions. In addition, they are characterized by different color and shape elements to create a visual perception and to be recognized by the citizens. In the case of being a place, when these places enable the participation of the society in various activities to be held in these places individually or jointly, when they make people feel safe and peaceful when they are connected with their environment, accessible, physically and socially compatible, and maintain the cultural and historical values of the environment, in short, it can be said that when they have a specific character that will create a sense of place, they have the potential to become a place.

CONCLUSION

Since his existence, humans have tried to perceive and make sense of his environment. Various spaces have been formed in this environment with natural or artificial effects. At this point, the human being, the determining person, shows various activities in the spaces as he perceives and imposes various meanings in his memory. In this way, with the formation of the sense of place, the physically existing space is transformed into a place. The terms space and place are often used interchangeably, but they can mean different things depending on the context in which they are used. The process of transforming the space into a place, in other words, regeneration of a place from space, includes elements such as the connection between people and spaces and the sense of place, sociability, uses, activities, access, connections, comfort, and image. Making a place is a process that focuses heavily on people and their needs, wants, desires, and visions and is primarily based on community participation. (Moreira, 2021) From the perspective of architecture and design discipline, space formation and transformation processes can take place at various scales, from the smallest architectural space to the macro-scale urban space. At the end of the study, it can be said that for any space to have the potential to transform into a place, it should have some essential qualities, such as:

- • Certain boundaries that physically constitute the space
- • Qualifications such as color, form, etc.
- • Function/activity/role
- • Accessibility
- • Participation
- • A sense of belonging and trust
- • Meaning
- • Preferability
- • Compatibility with the environment
- • Harmony with cultural/historical values

With these qualities, the potential of a space to become a place increases. Similarly, a place already transformed or regenerated can return to its first physical space when it loses these qualities. The sense of place rather than the structure of space shapes behavior in experience and interaction in human life. The potential of a space to be a place is a process that must be accepted culturally or socially in parallel with human perception, behavior, and interaction styles that can be organized around spatial characteristics but are still entirely separate from them.

REFERENCES

Ching, F. D. (2007). Architecture: Form, Space, And Order. John Wiley & Sons.

Durmaz Irmak, Ö. (2008). Antik Dönemden Günümüze Mimari Mekân Anlayışı; Behruz Çinici Ve Şevki Vanlı Eserlerinin Mekânın Algılanmasını Sağlayan Öğeler Açısından Irdelenmesi,Yüksek Lisans Tezi,Akdeniz Üniversitesi,Sosyal Bilimler Enstitüsü,Antalya.

Eren, İ. Ö. (2006). Mimarlıkta Tasarım-Yer Ilişkisi Bağlamında "Yer" E Özgü Mimari Dilin Dönüşüm Sürecinde Yeniden Üretilmesi,Doktora Tezi,Mimar Sinan Güzel Sanatlar Üniversitesi,Fen Bilimleri Enstitüsü,İstanbul.

Ergün Bilgili, G. (2022). Mimarlık Ve Sinema Ara Kesitinde 'Yer', 'Yersizlik' Ve 'Ruhun Yitimi': Ahlat Ağacı Filmi Üzerinden Fenomenolojik Bir Okuma, Yüksek Lisans Tezi, Gazi Üniversitesi, Fen Bilimleri Enstitüsü,Ankara.

Ertürk, F. (2019). Sokak Pratiği Aracılığıyla Yer Ve Yerin Ruhunu Anlamaya Yönelik Bir Sentez Önerisi: Hermeneutik-Fenomenolojik-Semiyolojik (HFS) Çerçeve Yaklaşım,Doktora Tezi,Kocaeli Üniversitesi,Fen Bilimleri Enstitüsü,Kocaeli.

Gürkaş, E. T. (2010). Yer Üzerine Bir Okuma Denemesi: Samatya'da Yer Kurma Pratikleri,Doktora Tezi, Yıldız Teknik Üniversitesi Fen Bilimleri Enstitüsü, İstanbul.

Harrison, S., & Dourish, P. (1980). Re-P1ace-Ing Space: The Roles Of Place Collaborative Systems. Cambridge: Rank Xerox Research Centre.

Koçyiğit, R. G. (2007). Mimarlıkta Yersizleşme Ve Yerin -Yeniden- Üretimi. Doktora Tezi. Mimar Sinan Güzel Sanatlar Üniversitesi Fen Bilimleri Enstitüsü, İstanbul.

Lynch, K. (1964). The Image Of The City. MIT Press.

Merschdorf, H., & Blaschke, T. (2018). Revisiting The Role Of Place In Geographic Information Science. ISPRS International Journal Of Geo-Information, 7(9), 364.

Moreira,S. (2021) What Is Placemaking? Retrieved From: Https://Www.Archdaily.Com/961333/What-Is-Placemaking

Norberg-Schulz, C. (1979). Genius Loci: Towards A Phenomenology Of Architecture, Rizzoli International Publications, (P.414-419).New York

Norberg-Schulz, C. (2013). "The Phenomenon Of Place": From Architectural Association Quarterly (1976). In The Urban Design Reader Second Edition (P. 418). Routledge.

Tuan ,Y.F.(2001). Space And Place-The Perspective Of Experience, Eighth Printing, University Of Minnesota Press, Minneapolis-London

Uzunkaya, A. (2014). Yer” Ve “Yersizlik” Kavramları Üzerine Bir İrdeleme,Yüksek Lisans Tezi,Yıldız Teknik Üniversitesi Fen Bilimleri Enstitüsü, İstanbul.

SIGN IDEA GENERATION IN THE ARCHITECTURAL DESIGN PROCESS

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ABSTRACT

Degeneration and regeneration are in a cycle that creates each other. Each moment this cycle occurs, a layer is added to the thing that made the cycle. Every new layer transforms that thing by altering it. For this reason, the duality of degeneration-regeneration reveals the relations of form-deform-transform. The related relationship will be discussed within the scope of this study through the architectural design process. In this process, the acts of making and remaking that constitute the design idea generation can be read through architectural drawing/narrative, which iteratively gains forms and deforms at each action, creating a new layer where the drawing is transformed each time. Thanks to these layers, the design idea generation in the architectural design process occurs by differentiating specifically for each designer through various tactics/approaches. Since the reading on the design idea generation within the scope of the study is handled in the context of architectural education, it focuses on the architectural design studio. The study aims to discuss the design idea generation in the architectural design process through the relationship between conceptual thinking and spatial productions. For this, the deconstruction method and the hermeneutic reading technique were used. Consequently, the language of thought and its development is the most critical tool that helps to realize the design idea generation in the architectural design process and gains visibility through architectural drawing/narrative. The linguistification of thought makes the architectural design process unique to each designer(architect), and the first steps of it are taken during the architectural design education process, especially in the studio environment.

Keywords: Architectural design process, architectural design studio, architectural drawing/narrative, form-deform-transform.

INTRODUCTION

Architectural design is a generating-oriented field in terms of both design and application processes (in a theoretical or practical context). Application stages, on the other hand, usually proceed in a cyclical process. "Design is conventionally viewed as a process of repetitive cycles of generation/evaluation/modification until convergence is reached by satisfying the design objectives." (Oxman et al., 2007, p.228) The concept of generation, which is included in this process, is today mostly referred to concerning computer-aided design tools and technologies and is discussed within the scope of "generative design" (Gullichsen & Chang, 1985; Emdanat et al., 1999; Krish, 2011) in the literature. However, within the scope of this study, the concept is discussed in terms of production/making in relation to the architectural design process. For this reason, degeneration and regeneration concepts/ duality are considered notions that reveal the form-deform-transform relations due to the synonym of production/making. The form-deform-transform relationship will be discussed through the architectural design process and focused on architectural design studios where the process is visible.

As it is known, there are many studies on architectural design studios. For example, Schön (1984) discussed the design studios as a unique environment that encompasses creative processes; Uluoğlu (2000) discussed the transfer the knowledge of design to students in the context the critiques in the studio; Oxman (2004) discussed a pedagogical framework named as Think-Maps; Kvan & Jia (2005) discussed the "learning styles of architectural students in China and correlates their learning styles with design studio performance" (p.19); Kuhn (2001) discussed the what can be learned from the architecture studio; Paker Kahvecioğlu (2007) discussed the relation between architecture design studio and creativity; Çil & Demirel Özer (2021) discussed the first year architecture design studios. The versatile studies focusing on architectural design studios like these point to the richness of the research field. The difference between this study and the studies mentioned earlier is that it focuses on the concepts of make and form, which are the basic actions that reveal the design cycle. It examines three selected examples through the conceptual approach derived from the relevant literature. Sample analysis is carried out with the help of the deconstruction method and the hermeneutic reading technique.

Firstly, these methods and techniques can be briefly mentioned. "Deconstruction (...) refers to a series of techniques for reading texts developed by Jacques Derrida, Paul de Man, and others; these techniques, in turn, are connected to a set of philosophical claims about language and meaning." (Balkin, 2010, p. 361) Since it is shaped through language and meaning, "deconstruction is a skeptical way of reading. It argues that language moves in uncertainties and therefore cannot produce precise meanings. (…) There is no fixed meaning for deconstruction. The aim is not to break the structure of a text into pieces, but to show that the text already has a fragmented structure." (Eser, 2015, p.184) Deconstruction, which can be thought of through the ambiguity of meaning and the fragmentation of the text, can also be thought of in the context of *architectural representation as a kind of language* (Gürer & Yücel, 2005). However, before the relationship between deconstruction and architectural representation/drawing, the relationship between deconstruction and architecture can be utilized. As Söhmen Tunay and Uz (2021) expressed through Wigley's manifesto for deconstructive architecture, "(…) the concepts of essence and authenticity in architecture have come first among the main elements targeted by deconstructive architecture" (Söhmen Tunay & Uz, 2021). Therefore, deconstruction can be used as a method to conduct the discussion of authenticity and personalization of language in both architecture and architectural representation. For this reason, when we return to the relationship established with the text, we encounter the "author/reader duality" (Eser, 2015). This duality is the meeting of the text, which is fictionalized with the author's intention, with the reader, and the meaning that emerges after this meeting becomes a reader-oriented interpretation and gains importance (Eser, 2015). In the context of architectural representation, the relevant inference can be discussed as the "designer/reader" duality. The related discussion has been conducted with the hermeneutic reading technique. "Hermeneutics, the art of *hermeneuien*, is the art of reporting, informing, translating, explaining and paraphrasing" (Gadamer, 2003, p.13). For this reason, hermeneutic has been discussed in different fields. For example, "(…) philosophical hermeneutics is based on the fact that understanding is possible only if the understander puts his/her specific designs into action" (Gadamer, 2003, p.27). Therefore, the focus of hermeneutics on understanding stems from its relationship with the text (in its most primitive version, its association with sacred texts (Altıntaş, 2022) can be considered in this context). The relationship between deconstruction and hermeneutics with text and language should not be accidental. As a matter of fact, "language mediates all human knowledge about the world. The first orientation to the world takes place by learning a language.(…)" (Gadamer, 2003, p.29-30). All this relational situation between language-meaning-experience can also be discussed through the formation processes of architectural representation and the processes of understanding/signifying it. The trio of "saying, explaining, and translating" (Palmer, 1969, p. 32) expressed for the meaning aspect of hermeneutics can be evaluated as *drawing/making, discussing, and* *transforming* in architectural representation. For this reason, this study, which focuses on the architectural design process and, therefore, the architectural design studio in the context of the design idea generation approach, discusses the relationship between conceptual thinking and spatial productions using the deconstruction method and hermeneutic reading technique. In this context, the study sample consists of a small group of second-year architecture students.

Handling the design idea generation in the architectural design process within the scope of architectural design studios and education is essential, as the studio provides data on preliminary examples of how these ideas came to be and makes the process directly observable. On the other hand, the design idea generation takes place with the actions (such as reading, drawing, making models.) in the process. Therefore, the “iterative” (Hoadley & Cox, 2009, p.20) nature of the architectural design process ensures that it occurs in a design cycle related to the make-form relation. The relationship in question is also subject to a cycle within itself. Actions in the design process activate the make-remake cycle to produce something. Making something in the architectural design process is related to the fact that something comes into existence and becomes visible in the context of the creation, development, and design idea generation. Especially in the design process, the realization of the making is not a one-time situation. For this reason, it repeats itself, and while it repeats, it is transformed with the thing produced. This exposes the make-remake loop. Therefore, every remake is essentially a make. The make phase is also related to the concept of form. Because making something is basically about the thought-gaining form. While something (idea, drawing, space, etcetera) gains form is a result of the act of making (it can be writing or drawing), simultaneously, the act of making gives form to that thing. This relationship reveals the design cycle in the architectural design process, and the design idea is produced. Thus, the make-form cycle, both in itself and together, mediates the formation of the design cycle (and its stages). In this context, the study aims to discuss the design idea generation in the architectural design process through the relationship between conceptual thinking and spatial productions. For this, the path of the study is designed *‘idea generation, actions, design cycle, make-form relationship, and linguistification of thought’* in the context of the degeneration and regeneration cycle. This study discusses this path through drawings/sketches by creating a new layer in which architectural representation is transformed each time.

DESIGN CYCLE FOR THE LINGUISTIFICATION OF THOUGHT

Generating a new idea/ perspective is one of the most critical issues in design. For this reason, many studies focus on ideas and methods/ tactics of designers in the relevant literature. The issue of design idea generation, on the other hand, is related to the "new" and "creative" due to the nature of design. Thus, studies focusing on (design) idea generation have made various evaluations from different perspectives. For example, according to a study focusing on the relationship between idea generation and memory: "(...) Idea generation performance is based on one's ability to access and retrieve diverse ingredients efficiently from long-term memory for producing new ideas" (Liikkanen & Perttula, 2010). The emphasis here is on the memory-ability relationship. Another study is about exposure to examples during the idea generation stage. The researchers came to the following conclusion in their studies on this subject: "(...) exposure to common examples may deteriorate inventiveness, as a result of problem framing, even if the problem definition is presented at a high abstraction level (...)" and "design fixation may occur (…)" (Perttula & Sipilä, 2007). Since design fields such as architectural design are "ill-defined" (Lawson, 2005, p.84), this obsessive situation prevents creativity and the possibility of creating a personal language during the idea generation stage. However, the design idea is structured in the context of the designer's internalized knowledge, experiences, and cognitive processes.

Idea generation is a concept encountered at almost every stage of the architectural design process. It is necessary to be in action for the design idea generation that emerges with the cognitive connections in the process. These actions in the architectural design process, reading, drawing, and modeling, can occur in many different ways. Being in action requires being in production (as intellectual or practical) and performing. This situation can be discussed over the actions of "make" and "form", which turn into a "(…) pattern of behavior during design" (Gregory, 1966, p.8).

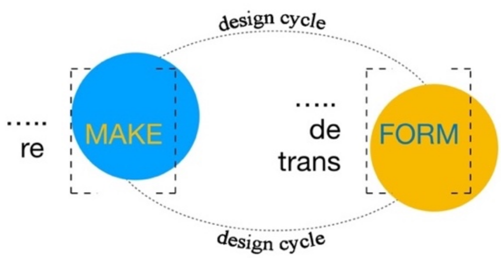

Figure 1: Conceptual approach diagram.

In moments of action, make-remake and form-deform-transform are in a loop (Figure 1) within themselves and affect each other's formation. For example, when a drawing is made and then remade, this process affects the form of the drawing, which either gains new forms or transforms. Therefore, the make-form relationship (it can also be intellectual) interacting in moments of action actually mediates the emergence of the concept of the design cycle. For the design cycle, this study utilized Takeda et al.'s (1990) work and reinterpreted it by privatization in the field of architectural design. According to Takeda et al. (1990), the design cycle, a cognitive model of the design process, has five steps: awareness of the problem, suggestion, development, evaluation, and conclusion. According to them, "**awareness of the problem** is to pick up a problem by observing the object and the specifications and to determine the problem to be solved next; **the suggestion** is to suggest key concepts needed to solve the problem; **development** is to construct candidates for the problem from the key concepts using various types of design knowledge; **evaluation** is to evaluate the candidates in a various way, such as structural computation, simulation of behavior, etc.; **conclusion** is to decide which candidate to adopt so as to modify the descriptions of the object" (Takeda et al., 1990, p.156). These stages also cyclically take place by influencing each other. In the architectural design process context, these stages are still valid. What differentiates here is the tools and thoughts used in the design process.

How design tools are used in the design process is one of the primary indicators that the process varies personally. Thus, the designer can have the opportunity to create his/her own language during the design process. In this context, the "language of thought (language for visualizing the thought)" (Aydınlı & Kürtüncü, 2014, p.17) and its development is the most critical tool that helps to realize the design idea generation in the architectural design process and gains visibility through architectural drawing/ narrative. The linguistification of thought, which is a personal phenomenon, makes the architectural design process unique to each designer(architect). The first steps to be unique are taken during the architectural design education process, especially in the studio environment.

FROM CONCEPTUAL THINKING TO SPATIAL PRODUCTION

The reading on the design idea generation within the scope of the study is handled in the context of architectural education and is focused on the architectural design studio. It is dealt with through the "transforming conceptual thinking into spatial production (…)" (Aydınlı & Kürtüncü, 2014, p.17) approach used in the studio. In this context, the study aims to discuss the design idea generation in the architectural design process through the relationship between conceptual thinking and spatial productions.

It is essential to benefit from the difference between novice and expert knowledge to evaluate the designer profile encountered in studies, including designer behaviors in the architectural design studio. In this context, various studies have been conducted to observe the cognitive activities of novice and expert designers. For example, according to Kavaklı & Gero's study: "The novice deals with three times as many concurrent actions as the expert, whereas the expert seems to have control of his cognitive activity and governs his performance in a more efficient way than the novice, because his cognitive actions are well organized and clearly structured" (Kavaklı & Gero, 2002, p. 39). Since it focuses on novice knowledge, research on novice behavior can be used within the scope of this study. "Novice behavior is usually associated with a 'depth-first' approach to problem solving, i.e. sequentially identifying and exploring sub-solutions in depth, whereas the strategies of experts are usually regarded as being predominantly top-down and breadth-first approaches. (...) designers characteristically deal with ill-defined problems." (Cross, 2004). Therefore, the problem-solving phase is important in the (architectural) design process. Thus, "(...) in the procedure of problem-solving, novices tend to solve the problem by depth-first search. This kind of search depends heavily on declarative knowledge and requires many calculations before the solution is found." (Ho, 2001). When we consider novice behavior in the context of the architectural design process in architectural education, we can evaluate mainly first and second-year students in this category. Since the conceptual thinking process of students with novice knowledge is based on *depth-first search,* the sample group of this study consists of a group of second-year students. The study's sample group consists of the studies of some of the 2nd-year students who took the 2022-2023 Spring term project course at the Faculty of Architecture of Ondokuz Mayıs University. Such studies are valuable to be able to observe and discuss the behaviors and actions of students who encounter architectural knowledge/ education for the first time. As a matter of fact, architecture students generally perceive the architectural education environment in their first years and acquire basic architectural knowledge. However, when it comes to the second year, it is expected that the knowledge that has been laid will begin to be applied gradually (in the context of the project lessons). In this context, first and second-year students gradually have novice knowledge in architectural education. Therefore, 2nd-year students have been considered the sample group in the study, as it focused on how the actions of make and re-make (partially) took place consciously.

Another reason is that since I am the group coordinator of the students who are the subject of the study, I was able to observe all the project processes one-on-one. Therefore, the texts, drawings, and sketches produced by the mentioned students during the project process were evaluated in the context of conceptual thinking and spatial production in this study.

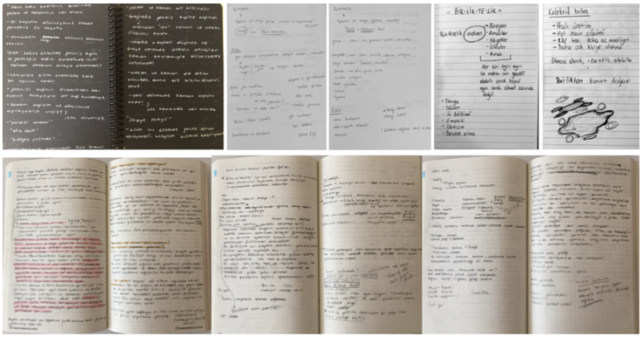

Figure 2: Examples from readings and conceptual approach studies.

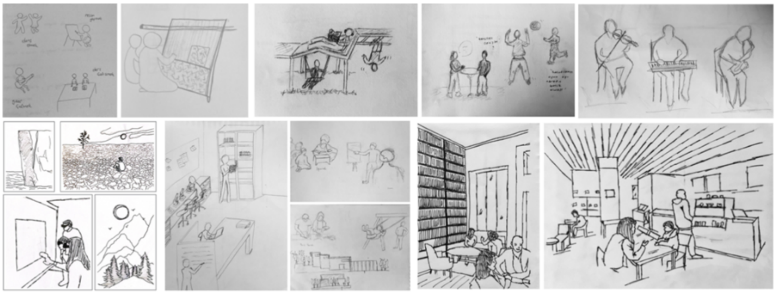

Figure 3: Action drawings and examples of the action-space relationship.

The project topic and theme the students worked on was "togetherness space/ solidarity." Within the project scope, only the project subject/ theme and land information were shared with the students. The students determined their programs in the context of their approach to the subject. During the project process, primarily readings and conceptual studies were carried out. The approach to the subject was discussed with each student, and the students formed their concepts and programs through the concepts they adopted. During the process, conceptual thoughts (Figure 2) were accompanied by action drawings (Figure 3), collages, and analysis-synthesis. The process was continued through discussions of the search for form, form-program relationship, land-form-program relationship, and sketches, drawings, and models accompanied the process. However, it was carried out through sketches of the land-form-program relationship over three selected studies for the in-depth analysis section in this study. While making the relevant sketches, the all students tended to ‘place the emerging mass on the land,’ ‘place the program on the land,’ and ‘zone the land with the analysis (concepts).’ One example was selected from each of these three approaches exhibited by the project group, and these sketches were evaluated as the study's sample group (with hermeneutic reading/ deconstruction method). The three students who own the selected samples are referred to as A, B, and C in the study.

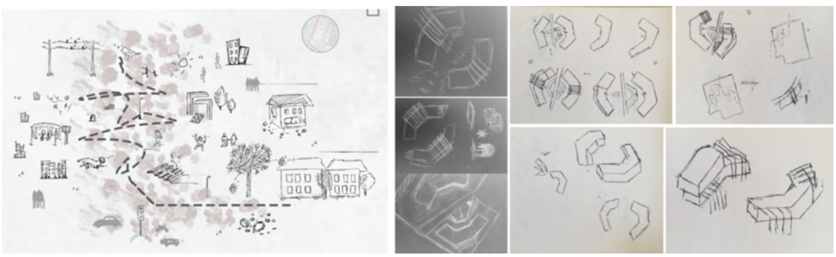

Figure 4: Examples of Student A’s approach to the project.

Student A focused on “change and adaptation” as a result of his/her readings in the context of the togetherness space/ solidarity theme. Through this set of concepts, he/she deciphered the actions of the land and its immediate surroundings to analyze the land (Figure 4- left). As a result of the synthesis he/she obtained from conceptual inferences and land analysis, he/she created a program (multifunctional hall, exhibition, study areas, recycling workshops, temporary use areas, etcetera) on recycling. While trying to establish the relationship between the spaces that make up the program, Student A turned to a design that can complement each other but consists of two parts. Looking at the first sketches of the student (Figure 4- right) on the formation of the design, one can say that he/she experienced a process in the make-remake cycle. While doing this, it can be mentioned that there is an effort regarding the three dimensions of the form. The fact that the primary form decision remained the same in the make-remake cycle of the student affected the form-deform-transform cycle. The deformation of the angles forming the broken edges has altered the form. However, it will not be meaningful to talk about a radical transformation as a result of these trials.

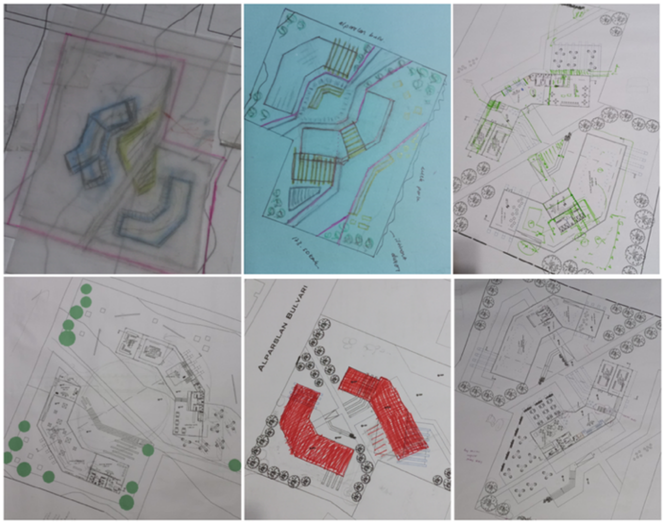

Figure 5: Examples from Student A's working process.

Some of the sketches of the working process of Student A, who made the fundamental decisions in the context of his/her project, can be seen in Figure 5. When these sketches are examined in the context of the design cycle approach, the awareness of problem phase of the cycle can be evaluated primarily through the form-land relationship. Problems such as where the two-part form will be located on the land, how to design the space between the two parts, the stage of deciding on the angles forming the arms of the form, and the actions taken towards this problem can be read. For example, the geometric order in the first form-land relationship trials, seen in Figure 5 upper left, remained almost the same until the lower-middle and lower-right images. However, in the lower-middle and lower-right images, it can be read that the arms of the form have been rearranged. Another critical factor that causes changes in form is questioning the form-space relationship. The student has decided how to bring the spaces in the program together, the suggestions he/she brought to the problem, and how to develop these suggestions. The proposal above, development, and evaluation stages were realized through the (re)make/trans(form) relationship. This situation can be read through the sketches made by the student. The drawings made on the drawings during the project critique (like the green lines in the upper-right image) and their re-evaluation by the student, and then the student coming up with a new proposal at the next stage can be considered an example. The conclusion stage in the design cycle can be evaluated both as a result of the decisions made by the student while drawing each line and through the alternative suggestions that the student produces for each new problem.

Figure 6: Examples of Student B's approach to the project.

Student B focused on the coexistence of different cultures as a result of his/her readings in the context of the project theme. The student designed the program (multi-purpose hall, exhibition, music-dining spaces, workshops, reading/study areas, cafe, etcetera) for his/her project, which he/she called the "cultural interaction platform," by making use of the data he/she obtained as a result of the field analysis (Figure 6- left). At the beginning of the project process – when reading is done on the first sketches (Figure 6- right) - it can be said that the student first tried to place the program in the field through bubble diagrams and staining. It can be seen that Student B, who was on the way to producing a form from the relationship between the spaces that make up the program and from the field data, eventually turned to a holistic form design that holds all the pieces together (Figure 6- right/ right-bottom). The student's use of color each time while creating the diagrams gives visibility to his/her make-remake cycle. Since this cycle is shaped in different ways each time (first the bubble diagram, then the land settlement, then the overlapping of the two, and finally the use of the zoning method), the generation of the building form has led to the form-deform-transform cycle. However, it is interesting that every space was fragmented in the first stages. Then, these fragmented spaces were presented as a single piece without creating almost any semi-open space or separation.

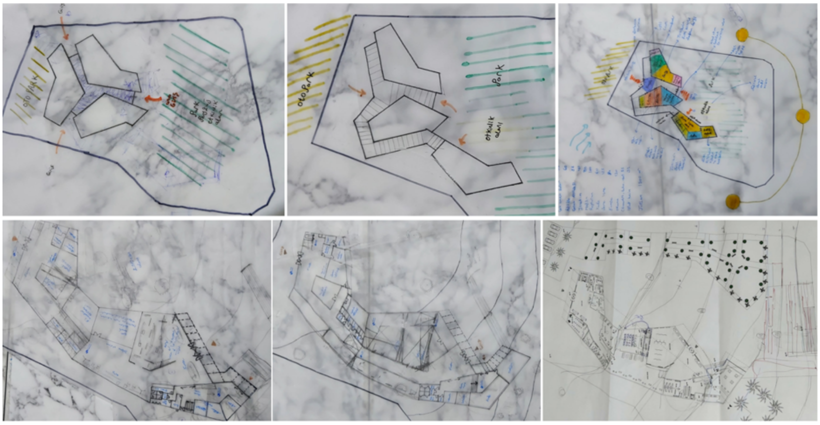

Figure 7: Examples from Student B's working process.

Some of the studies carried out by Student B in the context of form experiment and form-space-land relation can be seen in Figure 7. When one looks at the student's first sketches (Figure 7- top-all), one can think that he/she showed an approach that the form would consist of three independent parts. However, the strip connecting these three parts is also included in the indoor fiction of the student. Thus, the holistic form decision made by the student toward the final diagrams can also be found here. The implementation of this decision can be seen in Figure 7-sub/all drawings. When these sketches are examined in the context of the design cycle approach, the awareness of problem stage of the cycle lies in the question of how form generation and the relationship between spaces should be handled together with the land. Relevant awareness was realized when the student developed his/her project and evaluated alternative scenarios with the suggestions he/she brought in the process and the criticisms he/she received from these suggestions. Suggestion, development, and evaluation stages can be evaluated in the context of form location and space-form relationship. Each suggestion brought by the student developed in each stage/sketch, and the decisions made were realized in the (re)make and de/trans(form) interaction. When we look at the stages from the first form proposal to the last proposal, it can be said that the relationship between deform and transform cycle is visible. This also applies to spatial solutions. The conclusion phase of the design cycle can be evaluated in the context of drawing language and alternative suggestions, as in Student A.

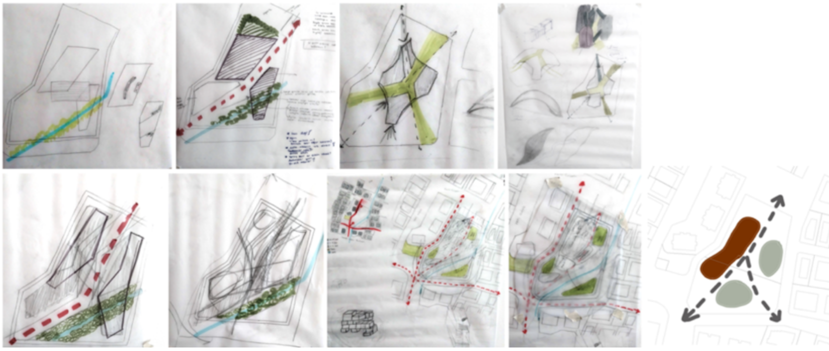

Figure 8: Examples of Student C's approach to the project.

Finally, Student C discussed the project theme through the concepts of the future and hope. He/she made the spatial discussion of these concepts with a space design that focuses on science and technology. He/she proposed a program consisting of student research laboratories, exhibitions, workshops, cafes, etcetera, focusing on soilless agriculture in the program design. To discuss the concept-space relationship on the land, he/she turned to the method of zoning the land. His/her productions (diagrams, sketches) can be seen in Figure 8. When one looks at these sketches, one can say that the student first did various experiments on how to use the land (Figure 8- left). Attempting to divide the land in different sizes and shapes each time, Student C's idea of dividing the land in two (indicated by the red dashed line in the sketches), which was visible almost from the beginning of the process, remained constant. This idea is a synthesis proposal that the student obtained from the field analysis. It can be observed that a similar attitude also applies to the use of green space in the field. The student, who makes the fundamental land zoning decisions, experiences the make-remake and form-deform-transform cycles mostly in building form design. The fact that the spaces in the program are not visible in most of the first design sketches indicates that Student C cannot make the form decision independently of this program. The building form appeared gradually when the relationship between the program and the spaces was included.

Some of the studies carried out by Student C in the context of form experiment and form-space relationship can be seen in Figure 9. When one looks at the first sketches of the student, one can say that he/she applied the final decisions he/she made in the staining study. This decision remained valid in the suggestion, development, and evaluation stages, in which he/she discussed the form-space relationship, and only minor changes (such as playing with the size) were applied. In this situation, the building form decision made in the analysis-synthesis phase did not change, limiting the form-space relation in discussing it. It can be said that the student tries to establish spatial relations within the border of form determined by himself/herself. The stages of the design cycle in suggestion, development, and evaluation gained visibility at the stage where the student questioned which spaces in the program would relate to each other. For example, while the location of the stairs in the form has mostly stayed the same, the spaces shaped around the stairs on the ground floor (such as the foyer, exhibition, and cafe) have gone through the stages of suggestion, development, and evaluation. As another example, the proposal brought by placing the exhibition space on the left wing of the form negatively affected the relationship established with the land, so it was taken to the right wing as a suggestion in the next stage. Changes in which spatial relations are questioned like this have occurred with the (re)make and de/trans(form) interaction of the relevant stages. However, Student C mostly stays in the make-remake loop due to the tendency to keep the form of the structure constant. While the conclusion phase of the design cycle was determined almost at the beginning of the process, it can be evaluated through the drawing language and alternative suggestions in the context of spatial solutions.

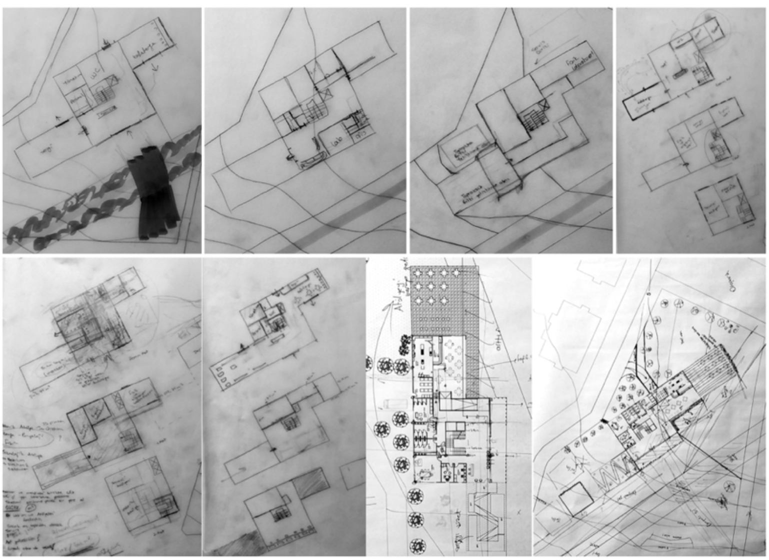

Figure 9: Examples from Student C’s working process.

When an evaluation is made through the conclusion phase of the design cycle in the context of the students’ final drawings, it can be said that the reflection of all students' conceptual approaches (respectively, change and adaptation; the coexistence of cultures; future and hope) to spatial production remains in the field analysis and program design. Relevant approaches have been tried to be captured in the process (in the stage of evolving into spatial production) in the spaces that make up the program and in the relations of those spaces with each other. It may be because the second-year students in the sample group have novice knowledge. However, the conceptual approaches of each student help them find their design language.

IN LIEU OF CONCLUSION

At the end of the study, built on the theme of 'design idea generation, actions, design cycle, make-form relationship and linguistics of thought,' some inferences can be mentioned in the context of students' production. For example, while there was a search and experimentation about three dimensions in the first sketches of Student A, this approach was not observed in other students. However, on the contrary, all students produced sketches through the plan in most of the project process. To make an inference about the development of the students' design cycle stages and the make-form relationship, when the relationships between their first decisions and their final decisions are evaluated, the following can be said: Student A hardly changed the initial form decision, Student B made partial changes, and finally, Student C tried many possibilities in the process. This situation may be due to how students approach the given design problem. It was stated that during the relevant process, students tended to place the building form on the land, place the program on the land, and zone the land, respectively, with the analyses (concepts).

On the other hand, the students exhibit similar behavior patterns in the design cycle process, even if they take different routes conceptually and tactically. This situation may be related to peer interaction and/or the setting of the project process. Another situation is about the reflection of conceptual thinking on spatial production. During the formation of conceptual thinking in all students, the design cycle was influential in the context of personalizing the linguistification of thought. The students differed from each other both in the way they used the tool in their hands and their approach to the given problem in the process. The concept thinking phase of the project process takes a long time but is specialized for each student, which may also be because the students have novice knowledge. In light of all these evaluations, design idea generation develops with the linguistification of thought. However, the linguistification of thought makes the architectural design process unique to each designer(architect), and the first steps of it are taken during the architectural design education process, especially in the studio environment.

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REFERENCES

Altıntaş, S. (2022). Sosyal bilimlerin araştırma yönteminden yaşam felsefesine: Hermeneutik yöntemin zaman içindeki dönüşümü. Pamukkale Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 51(1), 459-479.

Aydınlı, S. & Kürtüncü, B. (2014). Paralaks oda. İstanbul: Yapı Endüstri Merkezi Yayınları.

Balkin, J. M. (2010). Deconstruction. In D. Patterson (Ed.). A companion to philosophy of law and legal theory. (2nd ed., pp. 361-367). UK: Wiley-Blackwell.

Cross, N. (2004). Expertise in design: An overview. Design Studies, 25(5), 427–441.

Çil, E. & Demirel Özer, S. (2021). Mimari habitusun eşiği olarak ilk yıl mimari tasarım stüdyoları. METU Journal of the Faculty of Architecture, 38(1), 139-160.

Emdanat, S., Stiny, G., & Vakaló, E. (1999). Generative systems in design. AI EDAM, 13(4), 239-240. doi:10.1017/S0890060499134000

Eser, O. (2015). Kıta felsefesinde yapısöküm yaklaşımının çeviri olgusuna etkisi. Journal of International Social Research, 8(38), 183-187.

Gadamer, H. G. (2003). Hermeneutik. In D. Özlem (Çev.). Hermeneutik üzerine yazılar. (pp. 13-32). İstanbul: İnkilap kitabevi.

Gregory, S. A. (1966). Design and the design method. In S.A. Gregory (Ed.). The design method. New York: Springer Science+Business Media.

Gullichsen, E. & Chang, E. (1985). Generative design in architecture using an expert system. The Visual Computer (1), 161–168. https://doi.org/10.1007/BF01910018

Gürer, T. K. & Yücel, A. (2005). Bir paradigma olarak mimari temsilin incelenmesi. itüdergisi/a mimarlık, planlama, tasarım, 4(1), 84-96.

Ho, C. H. (2001). Some phenomena of problem decomposition strategy for design thinking: Differences between novices and experts. Design Studies (22), 27–45.

Hoadley, C. & Cox, C. (2009). What is design knowledge and how do we teach it. In C. DiGiano, S. Goldman & M. Chorost (Eds.). Educating learning technology designers: Guiding and inspiring creators of innovative educational tools (pp.19-35). London: Routledge.

Kavaklı, M. & Gero, J. S. (2002). The structure of concurrent cognitive actions: a case study on novice and expert designer. Design Studies (23), 25-40. 10.1016/S0142-694X(01)00021-7

Krish, S. (2011). A practical generative design method. Computer-Aided Design, 43(1), 88-100. https://doi.org/10.1016/j.cad.2010.09.009

Kuhn, S. (2001). Learning from the architecture studio: Implications for project-based pedagogy. International Journal of Engineering Education, 17(4/5), 349-352.

Kvan, T. & Jia, Y. (2005). Students' learning styles and their correlation with performance in architectural design studio. Design Studies, 26(1), 19-34.

Lawson, B. (2005). How designers think? The design process demystified. (4th ed.). Great Britain: Elsevier.

Liikkanen, L. A. & Perttula, M. (2010) Inspiring design idea generation: insights from a memory-search perspective. Journal of Engineering Design, 21(5), 545-560. DOI: 10.1080/09544820802353297

Oxman, R. (2004). Think-maps: Teaching design thinking in design education. Design studies, 25(1), 63-91. doi:10.1016/S0142-694X(03)00033-4

Oxman, R., Hammer, R., & Arı, S. B. (2007). Performative design in architecture: Employment of virtual prototyping as a simulation environment in design generation. eCAADe 25, (Session 05: Simulation), 227-234.

Paker Kahvecioğlu, N. (2007). Architectural design studio organization and creativity. ITU A I Z, 4(2).

Palmer, R. E. (1969). Hermeneutics: Interpretation theory in Schleiermacher, Dilthey, Heidegger, and Gadamer. J. Wild (Ed.). USA: Northwestern University Press.

Perttula, M. & Sipilä, P. (2007) The idea exposure paradigm in design idea generation. Journal of Engineering Design, 18(1), 93-102. DOI: 10.1080/09544820600679679

Schön, D. A. (1984) The Architectural Studio as an Exemplar of Education for Reflection-in-Action, Journal of Architectural Education 38(1) 2-9.

Söhmen Tunay, Z. G. & Uz, F. (2021). "Orijinalkopya" ve mimarlıkta yapısöken manifestolarda köken olgusu üzerine bir okuma. The Turkish Online Journal of Design Art and Communication, 11(3), 1172-1189. DOI NO: 10.7456/11102100/025

Uluoğlu, B. (2000). Design knowledge communicated in studio critiques. Design Studies, 21(1), 33-58.

POLITICS/POLICIES/LAWS/REGULATIONS/ETHICS/ DESIGN

EXAMINATION OF THE CONCEPT OF SUSPENDED CEILING AND EARTHQUAKE IN THE ARCHITECTURAL DEPARTMENTS IN TURKEY IN TERMS OF CURRICULUM CONTENT

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ABSTRACT

One of the most reported types of non-structural damage in past earthquakes is the failure of architectural component suspended ceiling systems (SCS). However, while suspended ceiling system standards in Turkey mostly contain regulations on the dimensions of the system elements, fire resistance, acoustic properties, they do not contain information on installation and assembly instructions that can directly affect the dynamic performance. Therefore in this study, it has been tried to emphasize the importance of getting information about correct application methods by raising awareness about this issue during their architectural education. As a field study, it has been investigated whether the words "earthquake/earthquake behavior" and "suspended ceiling" are present in the course content analysis of universities that have building project / application project courses in architecture departments in Turkey. The concepts of "suspended ceiling" and "earthquake/earthquake behavior" are rarely included in the application/construction projects that contain the application details in the curriculum reviews. However, it is imperative that architects learn from earthquakes, know the types and components of SCS, understand how SCS will behave in the face of earthquakes, and offer appropriate construction solutions, especially in application projects. In conclusion; It has been understood that the material, installation and assembly preferences of SCS can reduce the risk of damage during earthquakes. In this respect, the architectural design decisions made are important and in order to make the right decisions, architects should be provided with adequate training on this subject, as the relationship between SCS and earthquakes is included in application/building projects in architectural education.

Keywords: Earthquake, Suspended Ceiling Systems, Suspended Ceiling Construction, Architectural Education.

INTRODUCTION

Not all buildings that survive an earthquake can be defined as earthquake resistant buildings. Because during an earthquake, the safety of the non-structural elements in the building is as important as the safety of the structural elements and the load-bearing system [1]. Damage to non-structural components can occur at much lower seismic intensities than is required for damage to structural components [2]. In other words, no matter how resistant the structures are to earthquakes, there are always risks that may occur due to non-structural elements. For example, while only 5% of the buildings were completely destroyed in the 1999 Marmara Earthquake, non-structural elements caused serious injuries and material losses in most of the buildings with moderate and major damage [3]. For this reason, non-structural elements must also maintain their integrity in the face of earthquake effects. Damage to non-structural elements during an earthquake significantly affects the functionality of the building and causes the use of the building to be restricted and in some cases impossible. This situation becomes very important for certain types of buildings (hospitals, transportation buildings, etc.) that should primarily maintain their functionality after the earthquake. For example, after the Van Earthquake that took place in Turkey in 2016, the reason why the operations were performed in the field hospitals built in the hospital garden while the hospital building (structure) was standing is because the non-structural systems in the hospital became unusable [5]. The seismic behavior and poor performance of non-structural components as well as functionality in past earthquakes, have become a safety hazard, leading to obstruction of evacuation of buildings, rescue operations, economic losses and, in extreme cases, deaths [6,7,8]. Only in the 1999 Kocaeli earthquake, 50% of all injuries and 3% of casualties were caused by non-structural elements [9].

Damages in non-structural elements cause many preventable injuries and loss of life, as well as economic losses. Nonstructural components make up a large portion of the building inventory. While non-structural elements constitute approximately 90% of the total cost during the construction of the building, structural elements constitute approximately 10% (Figure 1). Therefore, it is important to protect non-structural elements against damage caused by earthquakes in terms of post-earthquake damage costs and economic losses. According to the report of Boğaziçi University Kandilli Observatory and Earthquake Research Institute; 30% of the material losses in the 1999 Marmara

Earthquake were caused by non-structural elements [10]. Furthermore, in addition to the direct damage of non-structural high-cost elements, significant economic losses occur due to functional interruptions in industrial buildings such as factories, loss of labor and stock, damage to machinery and equipment [3].

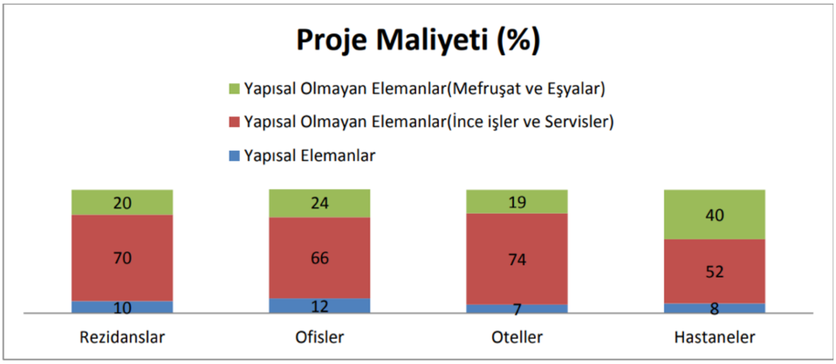

Figure 1. Approximate rates of non-structural systems in the cost of a project in Turkey (Based on Istanbul real estate values, 2015) [11]

Despite the loss of life and property resulting from the behavior of non-structural elements during the earthquake and the damages occurring in these elements, there is currently no national regulation or standard in force regarding non-structural damages. In addition, although many studies have been carried out on the structural damage that may occur as a result of the experiences gained from earthquakes, the number of studies on non-structural elements and risks is very low [3]. One of the most reported types of non-structural damage in past earthquakes is the damage to suspended ceiling systems with architectural components [6, 7, 8]. On the other hand, while suspended ceiling system standards in Turkey mostly talk about the sizes of the system elements, the mechanical resistance of the materials, their fire resistance, and their acoustic properties; it does not contain information on installation and assembly instructions that may directly affect dynamic performance [12].

In this context, general information about suspended ceiling systems and their types is given within the scope of the study. The behavior of suspended ceiling systems during an earthquake is discussed through examples of suspended ceiling systems damaged due to earthquakes in Turkey and other countries. As a field study, it has been investigated whether the words "earthquake/earthquake behavior" and "suspended ceiling" are present in the course content analysis of universities in Turkey that provide architectural education and have building project/application project courses in their curriculum. It has been tried to emphasize the importance of getting information about the correct application methods by raising awareness of architects during their architectural education on suspended ceiling systems, which is an architectural component.

DEFINITION AND TYPES OF SUSPENDED CEILING SYSTEMS

Suspended ceiling systems are a non-structural architectural component that acts as an aesthetic barrier by hiding electrical, mechanical and sanitary installations passing through the ceiling, and can also provide functions such as sound and fire insulation [2, 13, 14]. Today, suspended ceiling systems are frequently used in hospitals, educational buildings, sports halls, industrial buildings, transportation structures, shopping centers and office buildings [14]. The national standard (TS-EN 13964) used in Turkey regarding widely applied suspended ceiling systems addresses the material and dimensional properties of the system, but does not contain regulations regarding installation instructions, which causes substandard applications of suspended ceiling systems in practice. The absence of installation instructions can potentially affect the dynamic performance of these systems [12]. For this reason, it is important to know the suspended ceiling systems well, the components that make up the system, and the correct applications. Suspended ceiling systems are building elements that have various load-bearing system options and many alternatives as coating materials. Suspended ceiling systems typically consist of a grid system, suspension or support wires, perimeter supports, and tiles [2].

Suspended ceiling systems can be divided into two as systems that fit directly on the load-bearing construction and systems that are suspended by hanging rods. In systems that fit directly on the carrier construction, the suspended ceiling is fixed directly under the metal or wooden frame (Figure 2). The sub-construction in the suspended ceiling system is the load-bearing part of the ceiling covering. The superficial and inadequately applied sub-construction prevents the ceiling coverings from being solid and regular. The ceiling may collapse due to components that are not sufficiently strong and not securely attached to the ceiling. For this reason, attention should be paid to the fact that the sub-construction materials are firmly attached to the ceiling and their durability [14].

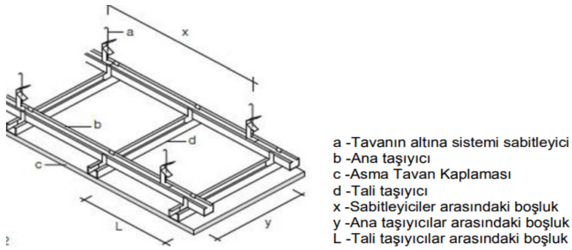

Figure 2. Metal Frame-Ceiling Connection[14].

In suspended ceiling systems suspended with a suspension rod, the ceiling material is hung with hooks under the metal or wooden frame. Systems suspended with a suspension bar consist of fasteners, hooks, hangers, carrier profiles, connectors and ceiling material (Figure 3) [14].

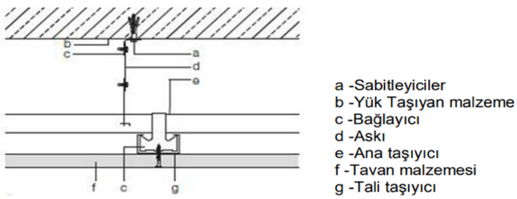

Figure 3. Suspended Ceiling - Ceiling Connection with Suspension Rod[14].

BEHAVIORS OF SUSPENDED CEILING SYSTEMS DURING EARTHQUAKE

The force acting on the structure during an earthquake is related not only to the seismic acceleration but also to the vibration period. Each building has its own natural vibration period and it is shaken more strongly when combined with the earthquake period. In general, the movement of the suspended ceiling during the earthquake is similar to the oscillation. The vibration duration varies depending on the composition of the suspended ceiling systems and the mounting details, for example, it increases with the length of the suspension bolt. Accordingly, the building and the suspended ceiling oscillate differently; the ends of the suspended ceilings collide strongly with the walls and the suspended ceiling collapses by being subjected to a great force acting on the whole [15]. The widespread use of these systems in private/public buildings is also effective in the fact that suspended ceiling systems are among the most reported non-structural damage types in past earthquakes [2].As it can be understood from past earthquakes, no matter how resistant these structures are against earthquakes, there are always risks that may occur due to the earthquake behavior of suspended ceiling systems. For example, suspended ceilings were damaged in buildings with minor or moderate damage after the 2023 Kahramanmaraş earthquakes (Turkey) (Figure 4).

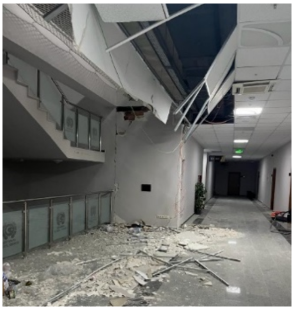

Figure 4. Türkiye 2023 Kahramanmaraş earthquakes; Adiyaman Governor's Office suspended ceiling damage after the first earthquake (Author's archive)

Suspended ceiling system damages can cause search and rescue operations and evacuation from buildings to be hindered. In the second earthquake that occurred in Turkey in February 2023 during working hours, according to the reports of people in the cities hit by the earthquake, the falling and throwing of ceiling elements, especially in public buildings during the earthquake, created a panic atmosphere in the environment, making evacuation processes difficult. For example, the collapse of the suspended ceiling of the emergency call center, which was supposed to continue to function after the earthquake, made the employees panic, and the damage to the equipment disrupted the function of the building (Figure 5).

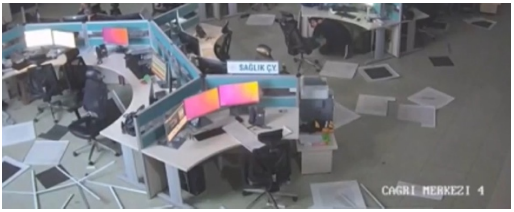

Figure 5. Turkey 2023 Kahramanmaraş earthquakes, suspended ceiling damage in Osmaniye 112 Emergency Call Center after the second earthquake

The earthquake behavior of suspended ceiling systems during an earthquake, the failure to prevent search and rescue efforts, the failure of escape routes, the fact that suspended ceiling systems in structures such as hospitals and industrial buildings do not cause dangerous substance leakage, fire and explosions, prevent loss of life and injuries, especially preserving their function after the earthquake are very important. It is of great importance in terms of ensuring service continuity and preventing financial losses in hospitals, emergency call centers and transportation structures. However, due to the lack of studies at the component level of suspended ceiling systems, the seismic behavior of suspended ceiling systems is not fully understood. For this reason, it is important to examine the damages in suspended ceiling systems during an earthquake and the security threats created by these damages through examples. Examples from Türkiye and the world;

Figure 6. Typical suspended ceiling damages (Url 2).

Figure 7. New Zealand 2016 Kaikōura earthquake suspended ceiling system damages [16].

Figure 8. Suspended ceiling damage in an industrial facility after the Japan Niigata Earthquake 2007 [17].

Figure 9. 2019 Turkey Denizli Earthquake, Damage to the suspended ceiling after the earthquake in Çardak Airport tower (Url 3).

Typical examples of damage are mostly due to the interaction between the suspended ceiling and other components such as the piping passing through it, partition walls or the main structure. A notable feature of observed ceiling damage is greater damage where various service components, such as lightings, are supported by suspended ceilings (Figures 6, 7). It has been found that the ceiling grid system is not strong enough to bear these additional loads, causing the ceiling system to fail in these locations. Although lightweight ceiling tiles weigh only a few kilograms, some gypsum panels can weigh up to 10 kg, as in Figure 7 (on the left). This situation further increases the risk of loss of life during an earthquake [16]. Despite repeated damage to such systems, no systematic study of the seismic behavior has been conducted beyond the competence studies of the manufacturers. As can be seen from the damage examples, there are four variables that affect the seismic performance of suspended ceiling systems. These are the size and weight of the tiles, the use of retaining clips, the use of clamping posts, and the grid components [8].

In this context, in relation to earthquake damage in suspended ceiling systems, the use of flexible and non-displaceable details in the ceiling and wall joints of the carrier profiles used in the assembly of the panels, The connection equipment does not lose its function throughout its service life, In the wall connections of heavy suspended ceilings, between the wall and the ceiling system along two adjacent edges leaving some space is one of the measures that can be taken [9]. As suspended ceiling collapses caused by earthquakes are also caused by the oscillation of suspension bolts acting like a swing, the top of suspended ceilings should be strengthened first. For this, diagonal support elements can be used. In addition, in order to reduce the force acting at the moment of collision between the suspended ceiling and the walls, it is effective to provide sufficient clearance by creating a gap between the suspended ceiling and the walls [15]. Applicants should have taken additional measures to prevent large gypsum boards from falling apart and standardized the quality of workmanship during the manufacture of suspended ceilings [9].

THE RELATIONSHIP BETWEEN SUSPENDED CEILING SYSTEMS AND EARTHQUAKE IN CONSTRUCTION PROJECT/IMPLEMENTATION PROJECT COURSES IN TURKEY

Building project/application project courses are generally third or fourth grade courses taught face-to-face and hands-on with students. In these courses, students are expected to use the knowledge they gained in previous "Architectural Project" courses as well as the knowledge they gained in structural knowledge courses such as "Building Structure". All details related to technical drawing, wet area, carrier system, other system (facade, etc.), material details are the details expected from students to show in the construction project/application project courses. Another expected issue in the projects is that the designs are made by considering very realistic conditions. Within these conditions, there are limitations that they will encounter in their professional lives such as regulations and standards, and problems that need to be solved. In this respect, there are different issues that should be considered as a priority in countries such as Turkey struggling with various disasters. The most important disaster situation for Turkey to be considered is earthquakes as it is one of the countries with high seismicity. It is seen in the destructive results of seismic movements that the damages encountered in earthquakes are generally caused by the decisions taken during the architectural design process [18].

Decisions taken during the architectural design process have an impact on the earthquake behavior of suspended ceiling systems. There are many reasons for the wrong decisions taken at the architectural design stage. The most important of these is the deficiencies in education. .One of the biggest reasons for these deficiencies and wrong decisions is that the concept of “earthquake” is rarely included in the project courses, structure courses and other theoretical courses taken in the architecture department curricula [19, 20].

In this context, in order to examine the place of suspended ceiling systems and earthquake behavior in architectural education as a field study, it was investigated whether the words "earthquake/earthquake behavior" and "suspended ceiling" exist in the course contents of universities that provide architectural education in Turkey and have building project/application project courses in their curriculum.

Table 1. Analysis of the words "earthquake/earthquake behavior" and "suspended ceiling" in the construction/application project course contents

University	Suspended ceiling	Earthquake/ earthquake behavior
Gazi University (Url 4)	-	+
Doğu Akdeniz University (Url 5)	-	-
Yeditepe University (Url 6)	-	+
Gebze Technical University (Url 7)	-	+
Akdeniz University (Url 8)	-	-
Altınbaş University (Url 9)	-	-
Adana Alparslan Türkeş Science and Technology University (Url 10)	-	-
Beykoz University (Url 11)	-	-
Balıkesir University (Url 12)	-	+
Bursa Uludağ Üniversitesi (Url 13)	-	+
Manisa Celal Bayar Üniversitesi(Url 14)	-	+
Demokrasi University (Url 15)	-	-
Dokuz Eylül University (Url 16)	-	+
Eskişehir Technical University (Url 17)	-	-
Fatih Sultan Mehmet University (Url 18)	-	+
Fırat University (Url 19)	-	+
Gaziantep University (Url 20)	-	-
Hatay University (Url 21)	-	-
İstanbul Technical University (Url 22)	-	-
Hasan Kalyoncu Üniversitesi (Url 23)	-	+
Konya Technical University (Url 24)	-	-
Karadeniz Technical University (Url 25)	-	-
Burdur Mehmet Akif Ersoy University (Url 26)	-	-
Mimar Sinan Fine Arts University (Url 27)	-	+
Munzur University (Url 28)	-	-
Niğde Ömer Halisdemir University (Url 29)	-	+
Pamukkale University (Url 30)	-	-
Sivas Cumhuriyet University (Url 31)	-	-
Tekirdağ Namık Kemal University (Url 32)	-	+
Van Yüzüncü Yıl University (Url 33)	-	-
Yozgat Bozok University (Url 34)	-	-
Izmir Ekonomi Üniversitesi (Url 35)	-	-
Istanbul Ticaret Üniversitesi(Url 36)	-	-
Iskenderun Technical University(Url 37)	-	-
Istinye University (Url 38)	-	+

CONCLUSION

It is necessary to protect the integrity of suspended ceiling systems, as they can cause injuries by being damaged by the effect of the earthquake, closure of escape routes, difficulty in search and rescue efforts, financial losses, and in extreme cases loss of life. Legal regulations such as regulations and standards related to suspended ceiling systems, which are non-structural elements that cause a large part of earthquake-related injuries and material losses, should be detailed in a way to guide the earthquake behavior, the components of the system, installation and assembly details should be specified in detail and clearly.

Despite the increase in ceiling covering material options and possibilities, it is necessary to use it correctly and to make the right application in addition to the selection in accordance with the function in the place where it is used. Such an increase in materials and the diversification of carriers bring with it the necessity of considering them as a whole. At the design stage, architects must decide on the most suitable suspended ceiling system and ensure its implementation.

As can be seen in the curriculum reviews, the words "earthquake/earthquake behavior" and "suspended ceiling" are rarely included in the application/construction project course content, which includes application details on technical issues. The lack of national standards and regulations on the seismic behavior of suspended ceiling systems, the fact that studies on non-structural systems are relatively few compared to academic studies on the earthquake behavior of structural systems increase the importance of concentrating on this issue during architectural education.

In addition, in a country like Turkey, where 92% of its geographical land is on active fault lines and struggles with frequent devastating earthquakes, the relationship between architecture and structure and the effect of this relationship on the reliability of structures is of great importance. However, the role of the architect in the seismic behavior of non-structural elements is not taken into consideration much. As can be seen in the curriculum analysis section, earthquakes etc. These subjects cannot find sufficient space in architectural education. Realizing the importance of eliminating this deficiency, suspended ceiling systems and earthquake relations should be included in application/building project courses in architectural education, and studies and projects on the subject should be carried out and architects should be trained on this subject. It should not be forgotten that Turkey is an earthquake country and the precautions that can be taken against this disaster start with architectural design decisions and therefore education.

REFERENCES

1. Özcelik, O., Mısır, I. S., & Sarıdoğan, S. (2016). Performance evaluation of suspended ceiling systems using shake table test, Structural Engineering & Mechanics 58(1):121-142

2. Pianigiani, M., Pourali Bejarbaneh, A., & Dhakal, R. P. (2014). Seismic evaluation of suspended ceilings in a hospital building: A case study. In *New Zealand Society for Earthquake Engineering (NZSEE) Annual Technical Conference*.

3. Büyükkaragoz, A., & Cantürk, R. (2018). Sanayi Yapılarındaki Yapısal Olmayan Elemanların Deprem Etkisi Altındaki Davranışı. *Gazi University Journal of Science Part C: Design and Technology*, *6*(2), 426-435.

4. Taghavi, S., & Miranda, E. (2003) Response Assessment of Non-structural Building Elements. Report No. 2003/2005. Pacific Earthquake Engeneering Research Center, Richmond, CA.

5. Anonim (2020). Teknik Makale: Depreme Dayanıklı Bina Kavramında Yapısal Olmayan Bileşenlerin Rolü, Tesisat Dergisi, Url: https://www.tesisat.com.tr/yayin/322/depreme-dayanikli-bina-kavraminda-yapisal-olmayan-bilesenlerin-rolu_26724.html

6.Sharpe, R., Kost, G. and Lord, J. (1973), Behavior of structural systems under dynamic loads, Building Practices for Disaster Mitigation, Building Science Series 46, National Bureau of Standards, 352–394.

7.Benuska, L. (1990), "Loma Prieta earthquake reconnaissance report", Earthq Spectra, Supplement to 6, 339– 377.

8.Badillo, H. (2003), "Seismic fragility testing of suspended ceiling systems", M.Sc. Thesis, School of Engineering, University of Buffalo (SUNY), Buffalo, NY.

9. Can, Ö., Kopraman, Y., & Büyükkaragöz, A. (2015). Depreme Dayanıklı Bina Kapsamında Yapısal Olmayan Riskler ve Önlemler, 8. *Ulusal Deprem Mühendisliği Konferansı İTÜ, İstanbul*.

10. B.Ü. Kandilli Rasathanesi ve Deprem Araştırma Enstitüsü, (2005). Afete Hazırlık Eğitim Birimi, YOTA, "Yapısal olmayan tehlikelerin azaltılması el kitabı", İstanbul, 2005.

11. İpek, C., Kuzucuoğlu, A. H., & Kıstır, M. R. (2015). Yapısal olmayan sistemlerin deprem etkileri açısından değerlendirilmesi. IBEES2015, Burdur, 7, 197-206.

12. Misir, I. S., & Saridogan, S. (2016). Performance evaluation of suspended ceiling systems using shake table test, STRUCTURAL ENGINEERING AND MECHANICS, 58(1):121-142

13. Echevarria, A., Zaghi, A. E., Soroushian, S., & Maragakis, M. (2012, September). Seismic fragility of suspended ceiling systems. In *15th World Conference on Earthquake Engineering (15WCEE)* (pp. 24-28).

14. GÜLER, M. B., & KASAPOĞLU, E. (2021). İç mekânlarda asma tavan uygulamaları. *Mimarlık ve Yaşam*, *6*(1), 95-121.

15. Beşir, Ş. E., & Dereci, Ş. (2021). Deprem Sırasında Konut İç Mekanlarında Yapısal Olmayan Elemanların Yarattığı Riskler ve Alınabilecek Önlemler. *International Social Mentality and Researcher Thinkers Journal*, *7*(42), 350-360.

16. Baird, A., & Ferner, H. (2018, April). Lessons from Kaikōura earthquake—Where should effort be focussed to reduce the risk from non-structural damage?. In Proceedings of the 2018 NZSEE Conference, Auckland, New Zealand (pp. 13-15).

17. Gilani, A. S., Reinhorn, A. M., Glasgow, B., Lavan, O., & Miyamoto, H. K. (2010). Earthquake simulator testing and seismic evaluation of suspended ceilings. *Journal of architectural engineering*, *16*(2), 63-73.

18. Dallı, M., & Soyluk, A. (2022).türkiye'deki mimarlık bölümlerinde yapı projesi derslerinde giydirme cephe ve deprem kavramının müfredat içerikleri açısından incelenmesi, Tol Kayseri Mimarlar Odası Kayseri Şubesi Mimarlık Kültür Dergisi,14, 38-45.

19.Soyluk, A., & Harmankaya, Z. Y. (2012). Examination of earthquake resistant design in the education of architecture. *Procedia-Social and Behavioral Sciences*, *51*, 1080-1086.

20. İLERİSOY, Z. Y., & SOYLUK, A. (2021). The analysis of architectural design competitions within the scope of earthquake resistant design. *Gazi University Journal of Science Part B: Art Humanities Design and Planning*, *9*(1), 1-17.

Url 1. https://www.dha.com.tr/gundem/7-7-buyuklugundeki-depremde-osmaniye-112-merkezinde-yasananlar-kamerada-video-2208999

Url 2. https://www.aygips.com.tr/img/docs/fc3346c92f53fc76ec99b7d2b063ede5611.pdf

Url 3. https://www.gokyuzuhaberci.com/cardak-havalimani-kulesi-savas-alanina-dondu-51134.html

Url 4. https://obs.gazi.edu.tr/oibs/bologna/index.aspx?lang=tr&curOp=showPac&curUnit=10&curSunit=106060482#

Url 5. https://www.emu.edu.tr/tr/programlar/mimarlik-lisans-programi/880?tab=curriculum

Url 6. https://mimarlik.yeditepe.edu.tr/sites/default/files/curriculum_07-2023_tr.pdf

Url 7. : https://abl.gtu.edu.tr/ects/?duzey=ucuncu&modul=lisans_derskatalogu&bolum=326&tip=lisans

Url 8.Akdeniz: https://webis.akdeniz.edu.tr/file/getfile?guid=711764e7-4229-4394-86f6-72ab46438326

Url 9. https://ects.altinbas.edu.tr/DereceProgramlari/Detay/1/4330/4241/932001

Url 10.https://obs.atu.edu.tr/oibs/bologna/index.aspx?lang=tr&curOp=showPac&curUnit=05&curSunit=1061#

Url 11. https://akts.beykoz.edu.tr/bilgipaketi/eobsakts/ogrenimprogrami/program_kodu/0603001/menu_id/p_27/tip/L/ln/tr/submenuheader/2

Url 12. https://obs.balikesir.edu.tr/oibs/bologna/index.aspx?lang=tr&curOp=showPac&curUnit=36&curSunit=5246#

Url 13. http://bilgipaketi.uludag.edu.tr/Programlar/Detay/252?AyID=25

Url 14. http://katalog.mcbu.edu.tr/Site/CourceStructure.aspx?ProgramID=1391&lang=1

Url 15. https://obs.idu.edu.tr/oibs/bologna/index.aspx?lang=tr&curOp=showPac&curUnit=07&curSunit=7101

Url 16. https://debis.deu.edu.tr/ders-katalog/2014-2015/tr/bolum_1214_tr.html

Url 17. https://akts.eskisehir.edu.tr/tr/program/dersler/246/13

Url 18. https://mtf.fsm.edu.tr/Mimarlik-ve-Tasarim-Fakultesi-OGRENCI--DERS-ICERIKLERI

Url 19. https://mimarlik.firat.edu.tr/contentFiles/165884083347.Mimarl%C4%B1k%20B%C3%B6l%C3%BCm%C3%BC%20Ders%20%C4%B0%C3%A7erikleri.pdf

Url 20. http://mim.gantep.edu.tr/upload/files/Mimarl%C4%B1k%20B%C3%B6l%C3%BCm%C3%BC%20Ders%20Katalo%C4%9Fu%20(2022-2023%20itibari%20ile).pdf

Url 21. https://obs.mku.edu.tr/oibs/bologna/index.aspx?lang=tr&curOp=showPac&curUnit=20&curSunit=2042#

Url 22. https://www.sis.itu.edu.tr/TR/ogrenci/lisans/ders-planlari/plan/MIM/202210.html

Url 23. https://mim.hku.edu.tr/lisans-ders-icerikleri-2/#ucuncu-yil

Url 24. https://ktun.edu.tr/Dosyalar/1031/files/Mimarl%C4%B1k%20Lisans%20Ders%20%C4%B0%C3%A7erikleri.pdf

Url 25. https://www.ktu.edu.tr/dosyalar/mimarlik_a11eb.pdf

Url 26. https://obs.mehmetakif.edu.tr/oibs/bologna/index.aspx?lang=tr&curOp=showPac&curUnit=14&curSunit=40483#

Url 27.
https://www.msgsu.edu.tr/Assets/UserFiles/doc_bolum_icerik_mimfak/mimarlik/2019-2020/mimarlik_somesterlildersplani_tr_2019_09_12.pdf

Url 28.
https://www.munzur.edu.tr/birimler/akademik/fakulteler/gsf/bolumler/mimarlik/Pages/dersicerikleri.aspx

Url 29. https://www.ohu.edu.tr/mimarlikfakultesi/mimarlik/dersplani

Url 30.
https://ebs.pusula.pau.edu.tr/bilgigoster/Program.aspx?lng=1&dzy=3&br=437&bl=7746&pr=548&dm=1&ps=0

Url 31. https://mimarlikgst.cumhuriyet.edu.tr/duyuru/24920-mimarlik-bolumu-2021-2022-guz-yariyili-haftalik-ders-programlari-yuz-yuzeuzaktan

Url 32. https://gsf.nku.edu.tr/gecmiskataloglar.php?bid=519&aid=89

Url 33.
http://bilgipaketi.yyu.edu.tr/DereceProgramlari/Detay/1/61280/9405/932001

Url 34. https://bozok.edu.tr/okul/mmf/bolum/mimarlik/sayfa/lisans-programi-ders-icerikleri/3827

Url 35. https://mmr.ieu.edu.tr/tr/curr

Url 36 https://ticaret.edu.tr/mimarlik/wp-content/uploads/sites/25/2021/11/MIM-Lisans-Ders-Icerikleri-TR.pdf

Url 37.
https://obs.iste.edu.tr/oibs/bologna/index.aspx?lang=tr&curOp=showPac&curUnit=45&curSunit=5707#

Url 38. https://gstm.istinye.edu.tr/tr/departments/mimarlik/ders-icerikleri

REGENERATION OF URBAN SPACE VIA DEGENERATION OF URBAN PLANNING: THE CASE OF POST-EARTHQUAKE URBAN POLICIES IN TURKEY

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ABSTRACT

Turkish Republic has witnessed several major and minor earthquakes. **1939 Erzincan Earthquake** was one of the most destructive disasters of the century, as the first turning point of the young Republic. **1999 Gölcük Earthquake** threatened the most developed city and region of Turkey and appeared as the second critical turning point –a chance to reconsider urban policies on urban resilience. Lastly, a sequence of two consecutive destructive earthquakes (on **6th of February 2023**) hit **Kahramanmaraş** and impacted a whole region of ten cities. This paper aims to examine **how the (Central) State in Turkey reflected such a deep and compelling experience onto urban policy planning to create *more* resilient cities.** The methodology is based on a rough content analysis of legal and institutional documents with respect to a literature review; the post-earthquake urban policies will be analysed through legal and administrative frameworks of planning in relation with the phenomena of 'earthquake' and 'resilient cities' as a form of 'regeneration'.

This research will portrait how planning has been bypassed and degenerated within the process of re-generation of cities. Paper is composed of three sub-sections: first sub-section concentrates on eras and turning points of Turkish urbanization parallel to mentioned three earthquakes; second section examines the critical shifts in urban policy planning in relation with the issues of 'urban transformation', 'regeneration' and 'resilience'; and as a conclusion and further discussion third section investigates the (potential) role of planning within post-earthquake policies and introduces the mitigation planning as an alternative path.

Keywords: Mitigation planning, post-earthquake (urban) policy, resilient city, urban transformation, Turkey.

INTRODUCTION

Human as a species have struggled to survive on earth all the way, which has especially transformed with agricultural and industrial revolution. During this long period human's relationship with nature has been evolved within the capacity, tendency and need for spatial planning –as a way of controlling the nature (from an architectural structure to the scales of city and even regions). Global and rapid changes such as pandemic and wars influence the context of planning and so urban policies usually directly; however (local) disasters (such as earthquakes, floods, landslides, and fires) and accidents (such as vehicle, nuclear, and industrial accidents) may physically influence a limited area but would have a wider impact on mindsets shaping urban policies and planning implementations in differentiated scales and contexts.

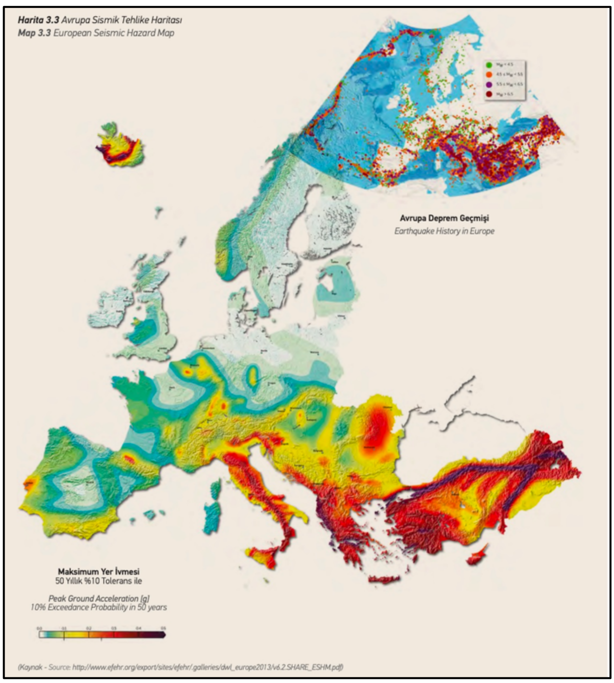

Figure 1. European Seismic Hazard Map and Earthquake History in Europe indicates that Turkey has been in the most hazardous region of seismic movements (AFAD, 2019).

Turkey –actually Anatolia– has been regarded and well known as a land of earthquakes for several centuries (Fig.1.). Beginning with 1939 Erzincan Earthquake (which is assumed to be one of the most destructive disasters of the century), Turkish Republic has witnessed several major and minor earthquakes, one of which occurred recently as a sequence of two consecutive destructive earthquakes on 6th of February, in Kahramanmaraş. For Turkey, another turning point was 1999 Gölcük Earthquake which was also a chance to reconsider the urban policies on constructing 'resilient cities' since this earthquake threatened the most developed city and region of Turkey. Among these turning points, it is a question whether Turkish Republic has learned a lesson from this sequence of disasters and whether implemented this insight to urban policy planning to construct resilient cities. This paper aims to examine how the (Central) State in Turkey benefited from such an in-depth experience of earthquakes, and to analyse the post-earthquake urban policies (focusing on the 6th February, 2023 as a turning point) through questioning the transformation of legal and administrative frameworks of planning in relation with the phenomena of 'earthquake' and 'resilient cities' as a form of 'regeneration'.

The concept of 'urban transformation' has appeared as a pioneer phenomenon during the first half of 2000's in Turkey; moreover, the political and economic shifts have been witnessed with respect to new policies of the party in power, *AKP* (Party of Justice and Development), elected in 2002. Since then, the concept of urban transformation has been developed with new veins as 'rehabilitation', 'enhancement', 'regeneration', etc., and finally in relation with both (to some extent) resilient cities and earthquakes, a comprehensive law (numbered 6306) on urban transformation was legalized in 2012. Parallel to this legislation, *TOKİ* (Housing Development Administration) has appeared as a leading actor day by day in constructing urban fabric, especially after the major destructive earthquakes and other disasters. Moreover, *DPT* (State Planning Organization) was deactivated, and the regional planning was delivered to Development Agencies (*Kalkınma Ajansları*), which led to an incremental planning approach. These three issues may build up the major components of the shift for urban policy planning especially in related with disaster and urban resilience in Turkey after 1999. In 2013 Turkey has also witnessed the Gezi Protests, during which the citizens intended to question and criticize the spatial policies of the party in power.

Examining the veins of these developments, the planning (as a discipline and an institution) can be tracked to lose its legitimacy and value via reproducing urban space. Moreover, recently after Kahramanmaraş Earthquakes, we witnessed the bypass of 'planning' with its institutional tools from the re-generation process of the destructed areas; however almost a whole region was destructed during the disaster, and a wholistic and comprehensive regional and urban planning was needed.

This research will portrait how planning has been bypassed and degenerated within the process of re-generation of cities. Paper is composed of three sub-sections: (defining a context) first part concentrates on the eras and turning points of Turkish urbanization in relation with earthquakes; (giving a frame of changing planning paradigms) second section examines the critical shifts in urban policy planning in relation with the issues of 'urban transformation', 'regeneration' and 'resilience'; and as a conclusion and further discussion third section discusses the role of planning within post-earthquake policies and introduces the mitigation planning as an alternative path. Urban policy planning has sub-components or tools such as legal frameworks, plans-projects, strategy documents, organization of institutions and more generally institutional frameworks. To conduct this study, the main methodology is a rough content analysis through scanning the legal documents which frame 'regeneration' issue especially after major earthquakes parallel to a related literature review on the concepts of 'urban transformation', 'post-earthquake policies' and 'resilient cities' in Turkish case. Exhibiting the legal-institutional turning points in relation with major earthquakes and political shifts, the planning and urban policy within this specific disaster period of Kahramanmaraş Earthquakes will be placed in the planning and urbanization history of Turkey; and the degeneration of planning and the quality of urban policy would be demonstrated.

Eras and Turning Points of Turkish Urbanization within Earthquakes

Turkey has been under the risk of several natural disasters not only earthquakes but also floods, landslides, and forest fires (Şenol Balaban, 2019). Among these disasters earthquakes seem to be most dangerous and influential ones with respect to the social and economic damage. Worldwide, Turkey has been the third country with respect to loss of lives within earthquakes and the eighth country with respect to the number of people impacted on by earthquakes (AFAD, 2023; cited in Çiçek, 2022); approximately at least one earthquake of 5 to 6 magnitude takes place in Turkey each and every year (Çiçek, 2022). 1939 Erzincan Earthquake, 1999 Gölcük Earthquakes and (6th February) 2023 Kahramanmaraş Earthquakes are critical turning points within the history of disasters in Turkey. This first subsection aims to position these major earthquakes and their impacts within the eras of Turkish urbanization.

Turkey has left almost a century behind; within this period urbanization and planning approaches have transformed via changing values of republic and political-economic context. Şengül (2003) introduces three differentiated periods of urbanization till 2000s as (1) 'urbanization of state' (1923–1950); (2) 'urbanization of labour (1950-1980); (3)

'urbanization of capital' (1980 onwards). 2002 Elections added a new layer to this frame as neo-liberal Islamic urbanization of AKP via architecture and implementations of TOKİ. During these decades, several economic, political and social events determined and impacted on forms of urbanization. As Şengül (2003) mentions, central state was the first major determining actor shaping urban and rural space and spatial policies of the republic till 1950s. The first catastrophic disaster takes place in this era; on 27th December, 1939, a destructive earthquake of 7,9 magnitude occurs in Erzincan; 32 968 people are killed during this disaster and 116 720 buildings were damaged and destroyed (BDTİM, 2023). During the first era of urbanization (urbanization of state), four earthquakes occurred with a magnitude more than 7, and loss of thousands of people: beginning with 1939 Erzincan and a loss of almost 33 000 people; 1942-Tokat (3000 loss), 1943-Samsun (4000 loss) and 1944-Gerede / Bolu (3959 loss) (Table 1).

Table 1. The most destructive earthquakes before 2023 Maraş Earthquakes

Time	Place	Magnitude	Number of Death
1903	Malazgirt / Muş	6.7	600
1912	Mürefte / Tekirdağ	7.3	216
1914	Burdur	6.9	300
1939	**Erzincan**	**7.9**	**32 962**
1942	Erbaa / Tokat	7.0	3 000
1943	Ladik / Samsun	7.2	4 000
1944	Gerede-Çerkeş / Bolu	7.2	3 959
1966	Varto / Muş	7.2	2 396
1970	Gediz / Kütahya	7.2	1 086
1975	Lice / Diyarbakır	6.6	2 385
1979	Çaldıran / Van	7.5	3 840
1983	Horasan / Erzurum	6.9	1 155
17.08.1999	**Gölcük / İzmit**	**7.8**	**17 480**
12.11.1999	**Düzce**	**7.5**	**763**
2011	Van	7.2	644

Source: Tabulated on the basis of news on web site: https://www.aa.com.tr/tr/turkiye/turkiye-117-yilda-210-buyuk-deprem-yasadi/1458151 and checked with the table on BDTİM (2023).

The second era of urbanization is ‘Urbanization of Labour’ according to Şengül (2003). After World War II, in early 1950’s, Marshal Aids supported modernization of the agriculture which resulted in a huge amount of migration to the cities and a new actor has been added to the frame as ‘society’, especially the new labour who were farmers before. Within this period between 1950s to ‘80s, parallel to the political conflicts worldwide, societal contradictions and struggles have been witnessed in Turkey, especially in the universities, squatter settlements and factories. The main urbanization problematic of this era was industrialization and later with the appearance of squatters another problem is added to the issues as squatter problem in Turkish context. Before 1960s these authentic spatial units were tolerated since the state had not so much resources to supply housing to the mass immigrated to the cities; but after 1960 a planned era began in Turkey. During the last part of this era urban spaces turned out to be battle grounds and the economy was in a bad situation.

This era witnessed so many transformations on social, political and economic respects not only in Turkey but also all around the world. After Second World War, Welfare State organized and built the urban space especially in the destructed regions and cities. Cold War period and social movements changed the mind sets all through the world. Within this period four more destructive earthquakes were experienced as (see at Table 1): 1966 – Muş/Varto (2396 loss); 1970 –Kütahya / Gediz (1086 loss); 1975 – Dİyarbakır / Lice (2385 loss) and 1976 – Van / Çaldıran Earthquake (3840 loss) which is the most destructive earthquake of this period also can be seen in Figure 2.

1980 is another turning point with a coup d’état and economic-social policies shifted with neo-liberal policies and exchange value of urban space has become prominent rather than use value as Lefebvre (1991) proposes. This process was experienced in 1970s in the western world after the petroleum crisis in capitalism. In Turkey with a new economic-political regime, a period of ‘urbanization of capital’ (Şengül, 2003) has begun with 1980s. This period has also witnessed earthquakes, the most striking ones were 1983 – Erzurum Earthquake (1155 loss) and the period has the peak of Marmara earthquakes in 1999, 17^{th} August, Gölcük Earthquake (17 480 loss) and 12^{th} November, Düzce Earthquake (763 loss). This indicates our second turning point which constitutes also one of the preliminary conditions of the rulership of JDP (Justice and Development Party – *AKP / Adalet ve Kalkınma Partisi*).

Figure 2. The most destructive earthquakes on the map with respect to magnitude and loss before 2023 Maraş Earthquakes (Graph is prepared by Şemya Özkaynak, TRT Haber, Source: trthaber, 2023)

BDTİM
BOĞAZİÇİ ÜNİVERSİTESİ
KANDİLLİ RASATHANESİ VE DEPREM ARAŞTIRMA ENSTİTÜSÜ
BÖLGESEL DEPREM-TSUNAMİ İZLEME VE DEĞERLENDİRME MERKEZİ

Ana Sayfa | Son Depremler | Sismik Ağ | Deprem | Tsunami | EIDA Node | Kurumsal | İletişim | Diğer ... | English

DUYURULAR 29 AĞUSTOS 2023 ML=5.1 TAVŞANCALI-KULU-KONYA DEPREMİ

Sayfada 120 Kayıt Göster Bul:

TARİH	Saat (T.S.)	YER	ŞİDDET	MAG (Ms)	CAN KAYBI	HASARLI BİNA
27.12.1939	01:57	ERZİNCAN	X-XI	7.9	32968	116720
17.8.1999	03:01	Gölcük (KOCAELİ)	X	7.8	17480	73342
24.11.1976	14:22	Muradiye (VAN)	IX	7.5	3840	9232
12.11.1999	18:57	DÜZCE	IX	7.5	763	35519
9.8.1912	03:29	Mürefte (TEKİRDAĞ)	X	7.3	216	5540
7.5.1930	00:34	TÜRK –İRAN SINIRI	X	7.2	2514	-
27.11.1943	00:20	Ladik (SAMSUN)	IX-X	7.2	4000	40000
1.2.1944	05:22	Gerede-Çerkeş (BOLU)	IX-X	7.2	3959	20865
18.3.1953	21:06	Yenice (ÇANAKKALE)	IX	7.2	265	6750
28.3.1970	23:02	Gediz (KÜTAHYA)	IX	7.2	1086	19291
23.10.2011	13:41	Van	VIII	7.2	644	17005
25.4.1957	04:25	FethiyeRodos(MUĞLA)	IX	7.1	67	3200
26.5.1957	08:33	Abant (BOLU)	IX	7.1	52	5200
4.10.1914	00:07	BURDUR	IX	6.9	300	6000

Figure 3. The most destructive earthquakes with respect to magnitude and loss before 2023 Maraş Earthquakes (BDTİM, 2023)

As seen in Fig.3., until 2023 Maraş Earthquakes, the most destructive earthquake seems to be 1939 Erzincan Earthquake and then 17th August, 1999 Gölcük earthquake shines out, which is regarded as a turning point of disaster management in Turkey. After 2000, JDP has resettled the spatial organization of the country and the planning approaches as well with respect to their centralised policies on the basis of Islamic representations.

Critical Shifts in Urban Policy Planning on Disaster in relation with issues of 'Urban Transformation' and 'Regeneration '

Tekeli (1998) mentions five periods of planning from Ottoman Period to 1980s with respect to the idea on Modernization in Turkish Republic: (1) the first steps of urban development and planning in Ottoman Empire (from the half of 19th Century to 1923); (2) Urban development and planning from the establishment of Turkish Republic in 1923 to the end of World War II; (3) the populist character of Modernity Project within the rapid urbanization era between 1950 and 1960; (4) urbanization and planning within the planned period of republic between 1960 and 1980; (5) transformation of urbanization and planning while the modernity project has been eroded after 1980. As the last era, AKP the ruling party and especially Erdoğan (the leader of the party and the president of the country) shapes both the frame of spatial policies and planning paradigms. This sub-section aims to position the policies of disaster management within the shifts of planning paradigms in Turkey and urbanization eras.

Figure 4. 12th November, 1999, Düzce Earthquake (AFAD, 2019: 13)

1999 is the most critical turning point of these policies (Fig.4.). According to Şenol Balaban (2019) after 1999 Earthquakes, certain noteworthy steps were taken to re-organize legal and administrative frameworks. The most critical step was **establishment of the Disaster and Emergency**

Management Authority (*Afet ve Acil Durum Yönetimi Başkanlığı – AFAD*); this institution was planned to focus on pre-disaster actions reducing the risks before the disaster takes place rather than post-disaster actions reducing the damage caused by the disasters. *AFAD* report which is prepared and published in 2019, on the 20th anniversary of 17th August Gölcük Earthquake, also indicates the establishment of *AFAD* as the main vein of the shift (AFAD, 2019: 16).

Pre-*AFAD* Period (1923 – 2009) consists of four sub-periods, three are before 1999 Earthquake, one is after this turning point (AFAD, 2019). Çiçek (2022: 226) gives names to these sub-periods as:

- [1] Sub-period of curing the wounds after the disaster between 1923 – 1944;
- [2] Sub-period of decreasing harm after the disaster between 1944 – 1958;
- [3] Sub-period of curing the wounds after the disaster between 1958 – 1999;
- [4] Sub-period of attempt on mitigation after 1999.

Figure 5. 1939 Erzincan Earthquake (AFAD, 2019: 18)

AFAD report (2019) investigates the transformation of legal and institutional frameworks under these sub-periods; and argues that governments tended to conduct legislative regulations after natural disasters to cure the wounds and damage of the people and to re-construct the living units. During the first sub-period, **Erzincan Earthquake** took place in **1939**. After the earthquake, in 1939, Construction and Development Authority (*Yapı ve İmar İşleri Reisliği*) was established, as an institutional re-arrangement (AFAD, 2019). Moreover, three new laws were enacted: Law no. **3773** – The Law about the Aids of the ones impacted from Erzincan Earthquake (*Erzincan'da ve Erzincan Depreminden Müteessir olan Mıntıklarda Zarar Görenler Hakkında Kanun*), Law No. **3908** and **5243** (Evsile, 2017).

After the first interventions, financial regulations were legalized with the Law no. 3773. After organizing aids, the new location of the city was discussed in August, 1940; and Law No. 3908 – The Law on the Expropriation for the New Location of Erzincan (*Yeniden Kurulacak Erzincan Şehir yerinin istimlakı hakkında kanun*) determined the locational shift for Erzincan. This disaster remained on the agenda of the parliament not only the following year, but the whole decade until 1950s. In 1948, another law was enacted no. 5243 – Law on the Housing which wiheld in Erzincan (*Erzincan'da Yapılacak Konutlar Hakkında Kanun*); however, problems occurred while conducting this legal regulation. The situation of the portable houses to be imported from Austria was questioned during the parliament discussions in February, 1949. The parliamentary question indicates the curiosity on the quantity and quality of the houses brought to Erzincan from Austria (Evsile, 2017). This discussion indicates the inadequacy on interfering the disaster and the legal regulations demonstrate how **the post-earthquake policy focuses on the local issue to cure the post-disaster destructions and loss**, within a **partial point of view** rather than wholistic paradigm and therefore there is no discussion on 'urban transformation' or 'urban resilience'. Özmen and Özden (2013) argues that the disaster policy is grounded on the divine and disasters were seen as a result of 'destiny'; therefore, the state aimed to play a role of healer and post-disaster actions are conducted in this period before 1944. Therefore, as mentioned above, 'an incremental planning paradigm' was adopted during this era (Özmen & Özden, 2013).

Second sub-period begins with an earthquake and legal regulation in 1944; and until the year 1958 covers the era of 'urbanization of labour' (Şengül, 2003) within rapid urbanization through the populist character of modernist project (Tekeli, 1998). With respect to disaster management this era is qualified as a sub-period of decreasing harm after the disaster between by Çiçek (2022). Although the spiritual assumptions continue to some extent with the law no. 4623 – Law about the Precautions Before and After the Earthquakes (*Yer Sarsıntılarında Evvel ve Sonra Alınacak Tedbirler Hakkında Kanun*) is the first legal text concentrating on the 'before' of the disaster. This law was enacted after the earthquake of Gerede in 1944 (magnitude: 7.2; loss: 3959). In addition to this attempt, in 1945, Seismic Regions Map of Turkey (*Türkiye Deprem Bölgeleri Haritası*) was prepared and Regulation on Buildings in Seismic Regions in Turkey (*Türkiye Yer Sarsıntısı Bölgeleri Yapı Yönetmeliği*) was enacted (AFAD, 2019).

This era (between the years 1944 and 1958) seems to be a preparation to the planned era of urbanization and planning in Turkey as Tekeli (1998) mentions. After Karlıova Earthquake in 1949, in 1953, Law no. 6188 was enacted – The Law about Illegal Structures and Incentive on Construction (*Bina Yapımını Teşvik ve İzinsiz Yapılan Binalar Hakkında Kanun*). In the same year, The Earthquake Bureau (*Deprem Bürosu*) is established. Moreover, *DSİ* (*Devlet Su İşleri*) was established as an institution to prevent the possible harm from groundwater and surface water (AFAD, 2019). All of these institutional and legal regulations imply the shift in the mindsets. In 1956, a new wholistic law of urban development (Law no. 6785) was enacted which is also a turning point for planning paradigm and system in Turkey. At the end of this second sub-era, in 1958 a new central institution – Ministry of Development and Housing (*İmar ve İskân Bakanlığı*) was founded, which is the threshold for the next sub-period.

After 1958, disaster policies shifted to a different direction in both Turkey and the world (AFAD, 2019). In 1959, Law on Disasters (no. 7269) was enacted, which is in the third sub-period. This legal text comprised the precautions and the aids at the places which are totally or partially damaged by any disaster such as earthquake, flood, fire, landslide, rock fall, and snowslide (Ökde and Ekinci, 2022). Within this third sub-period, the disaster policy usually focuses on the post-disaster work with a little and partial pre-disaster precautions. In addition to curing state point of view, protecting state paradigm was adopted (Uğur and Işık, 2020). Moreover, in 1965, General Directorate of Disaster Works (*Afet İşleri Genel Müdürlüğü*) was also established (AFAD, 2019). However, in 1966, Varto earthquake hit Turkey (Magnitude: 7,2; Loss: 2396). In addition to such de-regulations on disaster policy, some other legal interventions were observed tackling with the problem of squatter settlement. In 1966, Law (no. 775) of Squatter Settlements was enacted containing the precautions to prevent the construction of squatters in addition to rehabilitation and elimination of the illegal urban areas so that it was aimed to restrain the new formations of squatters (Ökde and Ekinci, 2022). Legal regulations continued in 1970s and '80's especially after earthquakes (AFAD, 2019).

Indeed, the concept of renewal of urban space enters the planning and urbanization practice in 1970s; and this issue was instrumentalized within planning in 1980s (Özdemir Sönmez, 2006, cited in Genç, 2008). However, this concept has become a current issue after 2000s (Genç, 2008). This is also indicating the turning point of the fourth sub-period before *AFAD*. After 1999 Earthquakes in Gölcük and Düzce, which impacted the most developed region of Turkey, Turkish disaster policy has evolved via legal, institutional and financial tools both to decrease the risk before the disaster and to develop post-disaster healing after the event occurs. Therefore, the year 2000 is regarded as one of the most important turning points for disaster risk management. However, the data on loss and damage after disasters since 2000 implies that the resilience performance of Turkish urbanization should be analysed critically (Çiçek, 2022). By 2000, more efficient and sustainable intervention to the disaster was aimed as a part of the post-disaster policy, moreover, pre-disaster policies also have transformed via the issue of 'resilience' to some extent.

Until the establishment of *AFAD* [**The Disaster and Emergency Management Authority** (*Afet ve Acil Durum Yönetimi Başkanlığı*)] 17 statutory decrees (*Kanun Hükmünde Kararname – KHK*) were enacted between 1999 and 2006 – numbered 574, 575, 576, 580, 584, 586, 587 [on Compulsory Earthquake Insurance – *zorunlu deprem sigortası hakkında KHK*], 593, 595 [on Building Supervision – *Yapı denetimi hakkında KHK*], 596, 597, 598, 599, 4708, 4837, 5511, 5491. In addition, a regulation was legalised in 2007 on buildings to be constructed in earthquake areas (AFAD, 2019). This attempt indicates a partial and quicker reaction to the disaster issue; since before detailed laws were discussed and enacted with the parliament however by 2000 statutory decrees become prominent. Çiçek (2022) also mentions this tendency to accelerate the process of intervention; and argues that this tendency resulted in retiring from scientific knowledge and techniques, so that the negative long-term results have been neglected and new settlements have been created which are not resilient to disasters. Allocating forestry and/or pasture area to Ministry of Public Works and Development for new settlements (by statutory decree numbered 581 in 199) was one of the examples (Çiçek, 2022). We witnessed a similar policy after 2023 Kahramanmaraş Earthquakes, post-disaster decisions on new settlements were made even quicker by the Presidential Decrees.

Refocussing three critical regulations after 1999, firstly, Law no. 4708 Building Supervision was a positive attempt to produce more resilient building stock in urban areas, however, the public buildings were precluded and the activities of *TOKİ* – Housing Development Administration (*Toplu Konut İdaresi*) were also excluded from this control. *TOKİ* was established in mid-1980s, and its authority and power have been extended gradually by 2000; and today TOKİ is the main actor producing urban fabric via differentiating ranges and functions. Therefore, this extraction in the new regulation diluted the effect of control issue. Secondly, in 1999 statutory decree no. 587 was regulated on compulsory earthquake insurance so that a financial pool was intended to be formed for earthquake loss; despite this positive idea the regulation still focused on post-disaster period and the urban building stock was still not safe enough. Thirdly, in the planning field, geological and soil investigation report were obligated in 1999. However, investigations in development plans were not comprehensively explained, which has made implementation difficult (Çiçek, 2022).

CONCLUSION: DEGENERATION OF PLANNING WITHIN POST-EARTHQUAKE POLICIES

Evaluating the shifts of agenda and disaster policy in relation with, our first turning point is 1939 Erzincan Earthquake, in which 33 000 people died and this was the most destructive event in 20th century of Anatolia. After 1939 Erzincan Earthquake, the post-earthquake policy focused on the local issue to cure the post-disaster destructions and loss [such as organizing aids and site selections] within a partial point of view rather than wholistic paradigm; although the earthquake was a critical experience to tackle with, unfortunately the lesson was limited to a city. Moreover, there was no need to discuss on 'urban transformation' or no attempt to study 'urban resilience' in 1940s and 50s. Although this era was urbanization of state, we cannot see a central wholistic attempt to create or transform urban fabric which is more resilient to the disasters. Planning has not a specific developed function within this period; the fatalist point of view framed this urban policy (Table 2).

Between 1939 and 1999, the disaster policy developed containing the pre-earthquake issues and phenomena of 'resilience' and 'urban transformation' have entered in the agenda a bit, however the destructive earthquakes and huge amount of loss continued. Rapid urbanization of labour was seen in 1950s, and with 1960s a planned era began. After 1980s, the urbanization of capital has been witnessed and so exchange value has been prominent rather than use value in the urban space. 1999 Gölcük Earthquake hit Turkey on a 17th August, more than 17 000 people died. Precautions were taken but this was not enough; since still the pre-disaster issues are concentrated. On 6th of February, 2023, two huge earthquakes (magnitudes of 7.8 and 7.5) appeared in Kahramanmaraş, more than 50 000 people died and the event influenced a whole region of 10 cities. Since the impact area is so wide and extensive, conducting post-disaster interventions was a bit difficult for the central state; although rapid post-earthquake aids have developed in years, it was challenging to supply all the needs of these damaged cities. The NGOs and public rushed to help as well, to cure the wounds and damages all together.

Figure 6. 2023 Kahramanaraş Earthquake (https://www.birgun.net/haber/kahramanmaras-merkezli-7-7-ve-7-6-lik-iki-buyuk-deprem-10-kentte-en-az-2316-can-kaybi-420300)

Table 2. Main characteristics of most destructive earthquakes and the role of planning and concept of 'resilience' within the disaster policy in Turkey [Prepared by the author as a synthesis of the study]

Earthquake	**Domain and the feature of the disaster**	**Basic Post-Disaster Policy and Action Plan**	**Role of the 'planning' and planner within the policy**	**The role of 'resilience' within the institutional-legal de-regulations**
1939 Erzincan	Impacted the city and rural areas of Erzincan which resulted in the change of the location of the city	Post-disaster curing and healing policy based on the destiny and the divine assumptions	Incremental planning Site selection as a part of post-earthaquake healing policy	None
1999 Gölcük Depremi	Marmara Region The most developed city and	Both more efficient post-disaster intervention s were aimed and	New settlement decisions were made by Ministry of Public Works and	'Resilience' enters the pre-disaster policies however the implementatio n based on

	the region of the country was threatened	pre-disaster mitigation and resilience were mentioned	Development via statutory decrees without long-term scientific techniques	quick results and decisions bring about non-resilient settlements
2023 Maraş Depremi	10 cities of a region and more than 50 000 people died	Rapidly decision on new develop-ment areas via Presidential Decrees	Planning was excluded from the process and decisions are centralized by the President	Regulations focused on 'post-earthquake' rapid renewal as an election campaign rather than resilience

The professional NGOs also offered help after the first shock; *ŞPO* (2023.a) issued a press statement on 9th February, 2023 and declared the intention to present their professional accumulation. Some of the proposals were planning the temporal settlements and contributing the design of cities of tents (*Çadırkents*). Planners and especially academic members of universities (studying on disasters, resilience, urban policy and city planning) joined TV and radio programs and discussed the scientific, technical and sociological dimensions of the disaster. *ŞPO* (2023.b) then warned the authority for the risk of withdrawing scientific point of view and planning principles while reconstructing the destructed cities. Then, on 24th of February, 2023, no. 126 Presidential Decree was published in the Government Gazette, this was regulating the development and settlement issues in the destructed areas via the earthquakes. ŞPO (2023.c) aimed at the public not the public institutions this time and invited the people to stop such "an irrational attempt which will totally destruct our future". However, we saw quick reaction of the government as the implementation of settlement decisions on agricultural areas in Adıyaman.

All this story indicates how the earthquake policies have been mostly focused on post disaster issues and how the planning discipline and implementation have been extracted and degenerated though the developing agenda on 'resilience' and 'urban transformation'. A city cannot be revitalised in one day, we should transform our approach to struggle with the nature, rather we should tend to adopt it and via planning principles and rational-scientific techniques we should aim to construct and regenerate our cities more resilient.

REFERENCES

AFAD. (2019). Türkiye'de Afet Yönetim Sisteminin Dönüşümü. https://www.afad.gov.tr/kurumlar/afad.gov.tr/35429/xfiles/turkiye_de_afetler.pdf [Date of access: 25.08.2023]

AFAD (2023). AFAD ve tarihçesi. https://www.afad.gov.tr/afad-hakkinda [Date of access: 23.08.2023]

BDTİM. (2023). Boğaziçi Üniversitesi Kandilli Rasathanesi ve Deprem Araştırma Enstitüsü Bölgesel Deprem-Tsunami İzleme ve Değerlendirme Merkezi – Büyük Depremler. http://www.koeri.boun.edu.tr/sismo/2/deprem-bilgileri/buyuk-depremler/ [Date to access: 25.08.2023]

Çiçek, H. (2022). Afete meyilli kentleşme ısrarı: 2000-2020 döneminde kentleşme ve kentsel dönüşüm. Konut, afetler ve kentleşme üzerine yazılar (Eds. Ö. Burcu Özdemir Sarı and G. Pelin Sarıoğlu Erdoğdu). İdealkent.

Evsile, M. (2017). 1939 Erzincan Depremi Hakkında Türkiye Büyük Millet Meclisi'nde Yapılan Görüşmeler. Kesit Akademi Dergisi, (8), 1-10. Retrieved from https://dergipark.org.tr/tr/pub/kesitakademi/issue/59838/864683.

Genç, F. N. (2008). Türkiye'de Kentsel Dönüşüm: Mevzuat ve Uygulamaların Genel Görünümü. Yönetim ve Ekonomi. Cilt 15, Sayı 1, pp. 115-130.

Ökde, F. & Ekinci, E. (2022). Depremlerin Kentsel Dönüşüm Uygulamalarına Etkisi: 2020 Elazığ Depremi Örneği. Kent Akademisi Dergisi, 15 (3), 1223 – 1245. https://doi.org/10.35674/kent.1016589.

Özdemir Sönmez, N. (2006). Düzensiz konut alanlarında kentsel dönüşüm modelleri üzerine bir değerlendirme. Planlama, 2, 121-127.

Özmen, B. and Özden, A. T. (2013). Türkiye'nin afet yönetim sistemine ilişkin eleştirel bir değerlendirme. İ. Ü. Sosyal Bilimler Fakültesi Dergisi, (49), 1-28. Retrieved from https://dergipark.org.tr/tr/pub/iusiyasal/issue/631/6426.

Şengül, H. T. (2003). On the trajectory of urbanization in Turkey: an attempt of periodisation. International Development Planning Review. 25, 3, 153-168.

Şenol Balaban, M. (2019). Marmara Depremlerinin 20.yılında kentlerimiz doğal ve çevresel tehlikelere hazır mı? Mimarlık, 409 (Eylül-Ekim), s. 20-24.

ŞPO (Şehir Plancıları Odası). (2023.a). Şehir Plancıları Dayanışmaya ve Mesleki birikimlerini Depremde Zarar Gören Halkımızın Hizmetine sunmaya hazır. Press statement on 09.02.2023. https://www.spo.org.tr/detay.php?sube=0&tip=3&kod=12179 [Access date: 21.08.2023].

ŞPO (Şehir Plancıları Odası). (2023.b. Yıkım Yaşayan Kentlerimizde Yeniden inşa Süreci Bilim, Teknik ve şehircilik ilkelerine uygun biçimde sürdürülmelidir. https://www.spo.org.tr/detay.php?sube=0&tip=3&kod=12188. Press statement on 15.02.2023. [Access date: 21.08.2023].

ŞPO (Şehir Plancıları Odası). (2023.c. İlgili Kurumlara Değil; Halkımıza Sesleniyoruz. Press statement on 24.02.2023.

https://www.spo.org.tr/detay.php?sube=0&tip=3&kod=12211 [Access date: 21.08.2023].

Tekeli, İ. (1998). Türkiye’de Cumhuriyet Döneminde kentsel gelişme ve kent planlaması. 75 Yılda Değişen Kent ve Mimarlık (ed. Yıldız Sey) içinde, (1-24). Türkiye İş Bankası Yayınları.

Trthaber. (2023). Türkiye’de gerçekleşen büyük depremler, Date of the news: 03.03.2021; revised on 11.02.2023] [https://www.trthaber.com/haber/turkiye/turkiyede-gerceklesen-buyuk-depremler-561205.html [Date of access: 30.08.2023]

Uğur, A. & Işık, M. (2020). Türkiye’nin afetlere hazırlık politikalarının toplum algısı üzerinden karşılaştırmalı analizi: Van-Bitlis illeri örneği. Artvin Çoruh Üniversitesi, Doğal Afetler Uygulama ve Araştırma Merkezi, Doğal Afetler ve Çevre Dergisi, 6 (1), 98–118. DOI: 10.21324/dacd.542528.

Law no. 3773, (1940). The Law about the Aids of the ones impacted from Erzincan Earthquake (Erzincan’da ve Erzincan Depreminden Müteessir olan Mıntıklarda Zarar Görenler Hakkında Kanun).

Law No. 3908. (1940). The Law on the Expropriation for the New Location of Erzincan (Yeniden Kurulacak Erzincan Şehir yerinin istimlakı hakkında kanun).

(RE)GENERATIONS OF ARCHITECTURE BY DISASTERS: DESIGNING AN EPHEMERAL SHELTER

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ABSTRACT

Architecture has long been associated with permanence, epitomized by the Vitruvian concept of *firmitas*. However, alongside the solidity of traditional architecture, there exists a realm of temporary structures designed for limited-time events, often linked to pleasure and commercial activities such as pavilion and expo. Yet, the temporary structures possess a more profound potential: economic feasibility, easy transportation, flexible, efficient design and quick construction. This study investigates the concept of temporality, which has often been overlooked in architectural discourse. Instead of viewing temporality and permanence as competing forces, it is proposed navigating temporality at every phase of architecture's narrative, recognizing the value of impermanence as a unique facet of the built environment. Notably, temporary architecture has gained reconsideration after natural catastrophes, epidemics and wars. It is essential to re-evaluate its applicability in the present emergency situations given that the most recent earthquake hit Turkey. In this context, this research highlights the critical role of ephemeral shelters in providing spaces for individuals to continue their lives and eventually transition to permanent living spaces. Despite their ephemeral nature, these structures play an instrumental role in disaster circumstances, significantly enhancing recovery and reconstruction efforts. By shedding light on the significance of temporary architecture beyond its limited-time existence, this study aims to enrich architectural practice and promote the responsible integration of temporary structures into the broader urban fabric. Recognizing temporality as an essential aspect of architectural development can lead us towards a more resilient, sustainable and adaptable built environment, addressing both immediate needs and long-term aspirations.

Keywords: Ephemerality; Temporality; Shelter; Disaster Architecture; Ephemeral Structure; Temporary Architecture.

INTRODUCTION

To a significant extent, the capacity for a structure to endure the effects of time depends on the robustness of the materials and construction techniques used. The conditions and qualities of the architecture that enable it to last across the years, decades, and centuries typically provide permanence in architectural practice. The potential of a structure to last forever depends on the durability of its materials and the soundness of its construction, which can withstand the impacts of both time and environmental factors. Architecture is tended to be associated with permanence from the Vitruvian *firmitas,* but given its broad definitions, it cannot be limited to time-related bounds. In the history of architecture, ephemeral architecture has always existed and will continue to exist. The aim of this articles is twofold: to contextualize and analyze the importance of the ephemeral/temporary architecture in order to comprehend its potential in contrast to permanence and to epitomize the importance of ephemeral construction as a sheltering space, in particularly after the devastating earthquake that hit Kahramanmaraş on February 6, 2023. In addition to contextualizing the ephemerality, the scope of the paper is to highlight the significance of ephemeral structures through case study analysis and solution proposal for their extended application in managing sheltering space for disaster scenarios.

Ephemeral Architecture in the Age of Emergencies

Architectural researches frequently explain their implications and applications in terms of robustness, durability and stability. Permanent structures have always been considered more essential and ultimately more vital to architecture and its history by both architects and architectural historians. Architects are meant to design their buildings to endure forever. Ephemeral works do have a place, but even among architects, they often come across as artificial or shallow due to their transience and lack of substance. Ephemeral architectural products are grounded to the soil like permanent architecture is, but they don't have a fixed position that suggests an existence independent from context. These constructions are to be repeatedly built and dismantled because of their nomadic nature. In recent years, the ephemeral design has been witnessed a rising concern because of epidemics and natural disasters. In particular in the age of disasters, this essay provides a framework for understanding the limitations and benefits of ephemeral architectural applications.

Beside these advancements, the ephemeral structures have been increasingly concerned with sustainability. Ryan and Smith (2017) contend that off-site building followed by on-site integration gives a higher level of convenience and recyclability. Additionally, due to the slow rate of urbanization around the world since the COVID-19 pandemic and also natural disasters, temporary structures have grown in popularity and raised concerns (Ryan and Smith 2017). Thus, the prefabricated approach permits the fulfillment of a variety of building requirements both during times of isolation and after disasters (Hatcher 2021). In this context, I suggest thinking about ephemerality from the perspective of (un)limit(ed)less and temporary timelines rather than from the perspective of short/long-lasting. Ephemerality, along with lightness, adaptability, and other qualities, may be crucial for preserving architectural spaces for as long as desired or necessary. In particular, it is essential to reconsider and reassess the ephemeral architectural uses for shelter during pandemics and natural disasters.

The ephemeral architecture is reconsidered by both architects and decision-makers after the earthquake that struck Kahramanmaraş on February 6, 2023. This reconsideration is related to the term "ephemeral" versus "permanent" in architectural discourse and applications. Here, the term "ephemerality" is related to neither everlasting nor are indestructible. It can be defined as a class of architectural objects that are characterized by transience and the absence of their physical presence from the site. The very beginning of the design idea, these structures are built to last for a certain time period. The main goal is to fulfill their function and then to disappear from the location where were erected. This disappearance is not meant to be infinite absence. Robert Kronenburg (1995) explains being temporary in ephemeral architecture from the standpoint of changing sites, as opposed to the conventional definition of temporary, limited term of existence. They can be disassembled, moved, and reassembled multiple times in various locations as opposed to this disappearing entirely in a short period of time (Klasz and Filz, 2015). The rapid installation and deconstruction of these buildings is essential to aiding victims in surviving, particularly in the post-disaster age.

The post-disaster ephemeral structures vary in terms of their various characteristics, such as their scale, typology, form, and creative technological and financial solutions. They include common features: adaptable use, standardization of each architectural component, easily transportable, quick assembly, and rapid deconstruction. These structures focus on flexibility and the ease of transport and assembly (Cordescu and Kronenburg 2002). After natural disasters occur, it is vital to make the first interventions as soon as possible. Because the victims require a variety of sizes and types of architectural spaces to survive, flexibility is essential to improving and diversifying a number of spaces.

The ease transportation is also fundamental for victims to survive after natural disasters. The structure is usually manufactured in a factory and assembled on site, so that both transportation and application of the material can be carried out quickly and easily. Due to the migratory nature of these designs, when they are gone, nothing is left behind them. They can serve a variety of purposes for brief durations due to their fleeting nature. In the disaster area, these structures range from schools, hospitals and accommodation facilities as either private or public buildings. These structures are superior to permanent ones in terms of their design efficiency, simplicity of use, portability, economy, and flexibility. They are also particularly well suited for adopting new technological advancements.

Ephemeral Sheltering in Disaster Circumstances

Natural disasters have been more frequent, more severe, and more disruptive recently, which has had an influence on the built environment. Buildings have suffered severe damage as a result of these disasters, ranging from full collapse to partial demolition of diverse structures. The damage has significantly increased the number of people who are being homeless, at least temporarily. As a result, it is crucial to execute successful reconstruction projects to restore the damaged life qualities of people and communities. This process is crucial for people to resume their daily-life, which include going to work or school, cooking, cleaning, and also socializing (Johnson, 2007). To meet the needs and promote the wellbeing of the communities, new shelters must be built. Ephemeral sheltering projects can be used until the final settlement is finished because the reconstruction of the spaces takes longer.

Large populations of people frequently lose their houses as a result of natural catastrophes like bushfires, flooding, and earthquakes and need temporary accommodation. Ephemeral shelters usually involve a short stay -3 months to 3 years- in a tent or public shelter, providing a space for people to enable them to return their daily life activities before moving to permanent housing units (Bologna, 2006). These ephemeral shelters are usually consisted of a pre-fabricated house (ready-made spaces to be assembled on site) and they are used for a specific period of time rather than being part of a process (Félix et. al., 2013). Although they can be quickly set up, catastrophe survivors often require housing and facilities for longer-term recovery.

Quarantelli categorizes the shelter and housing needs of victims of disasters from pre-disaster emergency shelters, temporary shelters, temporary housing to permanent rehousing (Quarantelli, 1995; and Nigg et al., 2006). In this study, the use of shipping containers for post-disaster refuge is evaluated as a temporary housing unit. Nevertheless, the relevance of distinct categories for post-disaster shelter is fading. It is now clear that long-term and long-distance displacement, such that seen in the aftermath of Kahramanmaraş Earthquake, can result in an ambiguous space between temporary housing and permanent housing (Levine et al., 2007). In the aftermath of natural disasters, (re)construction projects are often in between the need for immediate action and the ability to respond to long-term needs for sustainable social, architectural and urban development, leading to the emergence of contradictory paradigms that affect all planning policies. These tendencies reflect the increasing demand for adaptability and innovative architectural thinking in the post-disaster housing response.

Shipping Containers as an Ephemeral Sheltering Formation

Shipping containers—modular units with specified dimensions—are employed in conjunction with the growth of industrial exchanges following World War II as a particular aspect of globalization. In terms of the growth of the use of ship containers, notably in architecture and art, the design of a prototype (made of steel and tin panels) became a key factor in the decision to utilize containers to expand across the world. The (re)use of the recycling containers can be considered as a category is the fundamental element of ephemeral architecture.

Containers can be a solution to the issue of ephemeral shelter for a number of important reasons: modularity, flexibility, low structural cost (economy), small footprint, and also easily and short-time constructed. Particularly during times of crisis, modularity is an essential quality since, in addition to the need for accommodation, there is also a requirement for the creation of public spaces like hospitals, schools, and meeting areas to enable victims to carry on their everyday life. Secondly, the containers can be used in different scales. They are flexible to create variety of spaces since the size of the space can be change according to the victim's need. Since they are by nature modular, they can vary over time and adjust to the space requirements of the occupants. Compared to traditional timber, steel, and concrete constructions, the containers are more affordable. They not only offer economic convenience, but also far higher structural strength. Since all structural components are self-supporting, the foundation design is simpler and less expensive. This building method provides a big useable area in a small footprint, making it perfect for multi-story buildings. As ready-made items, they are simple to assemble on the site.

In applications for ephemeral sheltering after a disaster, the utilization of adapted shipping containers is still (un)common. There is a plenty of knowledge about using shipping containers as sheltering space, but most methods fall short in addressing the complex economic, social, and logistical problems that come with it. Additionally, not enough attention is paid to the challenges of providing temporary housing in the wake of disasters (Christensen and Worzala, 2010). One example is the reuse project of the Stadium 974, which was built for the FIFA World Cup 2022 in Qatar. Following the earthquake in Hatay, the containers have been dismantled and transferred there to serve as emergency shelters. Utilizing shipping containers as ephemeral shelters aims to benefit from their inherent advantages such as strength, reusability, and portability (Pena et al., 2012).

Figure 1. Stadium 974, FIFA World Cup 2022, Qatar

Figure 2. The Containers of the Stadium 974, Turkey

Containers are more likely to be used as shelter units after natural disasters, but contemporary applications of containers can also be designed for sustainable architectural products. Material recycling has grown in popularity as a means of producing architecture that is more environmentally friendly. The pioneers of the sustainable revolution in architecture can be interpreted as shipping containers. They are not only environmentally friendly but also have the industrial-yet-creative appearance. Arkitema Architects designs "Beat Box" project that consist of 30 container apartments in Roskilde, Denmark. This architectural intervention transforms the industrial neighborhood into an avant-garde neighborhood.

A steel frame rising from a concrete base holds the containers in place. While there are 90 square meter apartments available, the majority of containers are assembled in pairs to make either one 60 square meter apartment or two 30 square meter flats. Despite some size limitations, shipping containers have a lot to offer. For the size of the required space, they can be merged in various ways. These units can be moved later in their lifecycle due to the rapid and simple style of construction.

Figure 3-4. Beat Box, Roskilde Denmark

Using shipping containers, Mart de Jong and Architectenbureau De Vijf developed the "Spacebox Modular Housing" at Utrecht University in the Netherlands. Mass-produced container boxes put into a modular grid offer an alternative that is undoubtedly less expensive and hence more readily available. They are easy to move and combine in different ways. A growing number of instances of modular and prefabricated buildings are being used in contemporary architecture, such as the "Spacebox" proposal for student housing. They are also constructed in large university towns like Delft and Eindhoven. They are modest homes with a low level of living, but they are adequate for young people who want their own private space to begin living independently.

Figure 5. Spacebox, Utrecht, the Netherlands.

Shigeru Ban designs the Container Temporary Housing by using shipping containers in Onagawa, Miyagi Prefecture, in response to the housing scarcity that followed the earthquake of 2011. This project enhances building density by stacking multi-story containers, which also shortens the construction period, in contrast to conventional emergency units, which require a lot of flat space for development. The placement of the dwelling units in a checkerboard pattern results in open living areas between the containers, which enhances their climatic performance. Depending on how the containers are assembled, there are three different types of apartments: for one or two people (19.8 m^2), for three or four (29.7 m^2), and for more than four (39.6 m^2). By arranging the housing units in three-story rows, the middle space is made available for amenities for the general public: a market, a workshop, and a community center.

Figure 6. Container Temporary Housing, Onagawa, Miyagi Prefecture

Following the earthquake disasters in Southeast Turkey, Shigeru Ban Architects/Voluntary Architects' Network created the temporary dwelling unit in partnership with METU Urgent Design Studio in Ankara. They collaborated on the construction of Paper Log House. The project seeks to quickly and effectively address the critical housing requirements of the regions hit by the earthquakes of 2023. To address the urgent spatial demands resulting from the earthquakes that struck Southeast Turkey in February 2023, the METU Urgent Design Studio was established as a volunteer project within the METU Faculty of Architecture. The effort, which was established a week after the February earthquake, aims to create and build a number of projects to address the immediate spatial needs of the impacted areas, including temporary tents, animal shelters, bathrooms, and interior dividers. One of the projects is the Paper Log House, which was constructed with the assistance of staff and students who volunteered. Shigeru Ban Architects designed the Paper Log Home which was consisted of paper tubes.

The ability of these buildings to be erected, disassembled, and reassembled numerous times in various locations is crucial in the post-disaster environment. These constructions can be continuously transformed and altered in the sense that various features of mobility and architectural space are brought to the forefront after they have completed their life-cycle in the wake of the disaster. Additionally, in the event of damage, some components can be changed without compromising the integrity of the overall structure. All of these factors are considered and utilized throughout implementation. In addition to these options, these structures limit the amount of material used and may allow for upcycling, which represents responsible material use.

Figure 7. Paper Log House, METU Urgent Design Studio and Shigeru Ban Architects/Voluntary Architects Network, METU, Ankara

CONCLUSION

The goal of this article is to attempt to discuss helpful methods for developing and designing better solutions and strategy after natural disasters. As various natural disasters are expected to be steadily on the rise, along with other numerous imminent threats, the aspect of temporary housing for the population will undoubtedly remain a key issue in humanitarian disaster recovery programs. This study draws a number of findings by highlighting the significance of the field of ephemeral sheltering in post-disaster era, as well as its ideas, forms, and scope, in the overall consideration of contemporary architectural phenomena. Ephemeral architectural structures serve certain functions that permanent structures do not, for a variety of reasons, when compared to their permanent counterparts. In disaster areas, ephemeral structures are appropriate for quick installation in different locations and have minimal environmental impact due to their reusability and reliance on easy construction techniques. The excellence of these sheltering structures is built on the concepts of design efficiency, ease of use, and adaptability. It is particularly well-suited for embracing new technological advancements.

After a natural disaster, people need a place to stay, thus it is more crucial than ever to plan settlements on a variety of dimensions swiftly and effectively. Examining the ephemeral sheltering case studies has revealed various potential applications for these structures in the context of natural catastrophes, including: adaptation of space for users' needs and preferences; adjusting for a variety of users; appropriateness for people of all ages; suitability for the needs of elderly and disabled people; changeable function/way of using space (flexible space); individualization of sheltering units; and modular/prefabricated solutions. The flexibility of residential architecture is reflected in the possibility of easy and quick changes in the partition, extension and organization of space. These characteristics make flexible and adaptable sheltering structures compatible with the principles of accessible, universal, and economical design as well as the concept of sustainable architecture.

REFERENCES

Bologna, R. (2006). Strategic Planning of Emergency Areas for Transitional Settlements. Post-Disaster Reconstruction: Meeting Stakeholders Interests Proceedings of a Conference Held at the Scuola di Sanità Militare, Florence, Italy, 17-19 May 2006, July, 1-12.

Christensen, P. & Worzala, E., (2010). Teaching Sustainability: Applying studio pedagogy to develop an alternative post-hurricane housing solution using surplus shipping containers. Journal of Sustainable Real Estate, 2(1), pp. 335-369.

Cordescu, A., and R. Kronenburg, (2002). Mobile: The Art of Portable architecture[M], 186–190. Princeton, NJ: Princeton Architectural Press.

Félix, D., Branco J. M., and Feio, A. (2013). Temporary Housing After Disasters: A State of Art Survey. Habitat International, 40, 136-141.

Hatcher, J., (2021). "Modular Buildings in the Time of Covid-19 [J]." Smart Buildings Magazine 124 (4): 1–10.

Johnson, C., (2007). "Impacts of prefabricated temporary housing after disasters: 1999 earthquakes in Turkey" in Habitat Int., 31, 36–52.

Klasz, W., Filz, G.H., (2015). "A Cloud for Fresh Snow-Research Lab-a hybrid solution of minimal surface prestressed by bending active boundary conditions forming a spherical tetrahedron". Proceedings of IASS Annual Symposia. International Association for Shell and Spatial Structures (IASS).

Kronenburg, R., (1995). Houses in Motion: The Genesis, History and Development of The Portable Building. Academy Editions, London.

Levine, J., Esnard, A. & Sapat, A., (2007). Population Displacement and Housing Dilemmas Due to Catastrophic Disasters. Journal of Planning Literature, 22(1), pp. 3-15.

Nigg, J., Barnshaw, J. & Torres, M., (2006). Hurricane Katrina and the flooding of New Orleans: Emergent Issues in sheltering and temporary housing. The Annals of the American Academy of Political and Social Science, Volume 604, p. 113.

Pena, J. & Schuzer, K., (2012). Design of Reusable Emergency Relief Housing Units Using General Purpose Shipping Containers. International Journal of Engineering Research and Innovation, 4, pp. 55-64.

Quarantelli, E., (1995). Patterns of sheltering and housing in US disasters. Disaster Prevention and Management, 4(3), pp. 43-53.

Ryan, E., and Q. Smith, (2017). Offsite Architecture: Constructing the future[M], 200–205. Abingdon, UK: Taylor & Francis.

DESIGN OF ENERGY EFFICIENT HOUSING SETTLEMENTS IN KAHRAMANMARAS AFTER EARTHQUAKE

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ABSTRACT

After the earthquakes that struck southeastern Turkey on February 6, 2023, the government initiated reconstruction efforts, including plans by the Housing Development Administration (TOKI) to construct housing units in the earthquake zone. However, it is imperative to recognize that the process of rebuilding cities transcends mere construction activities. It demands the formulation of a comprehensive urban plan that considers a myriad of critical elements such as cultural heritage, historical significance, social structure, topography, and climatic conditions. In the context of the 21st century, one of the paramount considerations in urban development lies in the establishment of sustainable built environments. The objective of this study is to elucidate how urban geometry affects building energy performance by harnessing passive system potential through solar gain capabilities. The study was conducted by designing settlement scenarios based on values for design parameters drawn from existing residential building projects. To this end, a range of settlement scenarios was generated with varying H/W ratios, building layouts, and urban forms to compare the impact of urban geometry on the energy performance of residential buildings. It was found that the total energy consumption of a module in the reference building can be changed up to 19.73% by altering the H/W ratio of the settlement and up to 24.73% by changing the urban form. The outcomes of the study may contribute to the regeneration process of Kahramanmaras because urban regeneration extends beyond fulfilling the necessity of shelter; it holds the potential to significantly enhance quality of life and environmental sustainability.

Keywords: Energy Efficient Buildings; Housing Settlement Design; Urban Geometry; Design Parameters; Building Energy Performance.

INTRODUCTION

On February 6, 2023, a series of massive earthquakes, with magnitudes of 7.8 and 7.5, struck southeastern Turkey, resulting in extensive destruction. These earthquakes led to the tragic loss of over 45,000 lives across 11 cities. Post-earthquake damage assessment studies conducted in the aftermath of the disaster revealed that out of the 927,000 buildings within the earthquake-affected region, 118,000 were either demolished, destroyed, or severely damaged, as reported by the Ministry of Environment, Urbanization, and Climate Change (CSB, 2023). Responding promptly to the situation, the government-initiated reconstruction efforts aimed at restoring the cities. The Housing Development Administration (TOKI) announced plans to commence the construction of 244,343 housing units in the earthquake zone (CSB, 2023).

While the intention to swiftly construct earthquake-resistant residential buildings to provide shelter for the thousands affected is commendable, the process of rebuilding cities demands more than just construction activities. A comprehensive urban plan must be developed, considering diverse critical elements such as cultural heritage, historical significance, social structure, topography, and climatic conditions. Creating sustainable living environments, a task requiring time and expertise, necessitates an inclusive planning approach founded on meticulous and collective studies.

In the 21st century, one of the pivotal considerations in urban development is the establishment of sustainable built environments. Evidently, unplanned urbanization has enduring detrimental impacts on both human well-being and the ecosystem. The extensive devastation caused by the earthquakes disrupted not only the built environment but also the natural equilibrium in manifold ways. The estimated 110 million tons of earthquake-related waste are projected to pose a considerable threat to the environment as their hazardous constituents infiltrate the soil and mingle with subterranean water resources (ITU, 2023). Consequently, the post-earthquake reconstruction process underscores the urgency of sustainable design solutions to safeguard the environment. In this context, designing energy-efficient settlements that optimize resource utilization and minimize building-related carbon emissions emerges as a prudent approach.

Housing Development Administration of the Republic of Turkey's (TOKI) undertaking to construct 244,343 housing units as part of the Kahramanmaras housing projects in the epicenter of the earthquake represents a substantial effort (CSB, 2023). Within this framework, the layout and structure of these projects should be carefully conceived, as the urban configuration holds the potential to significantly impact buildings for many years without alteration. The settlement design bears responsibility not solely for shaping communal urban spaces, but also for influencing the energy performance of the buildings that constitute its intricate and dynamic geometry (Page, 1968). Strømann-Andersen and Sattrup's research (2011), which explored the nexus between settlement design and building energy performance, illuminated the significance of effective settlement design. Their work demonstrated that urban geometry could contribute to up to a 19% variance in the overall energy consumption of residential buildings.

Urban geometry, defined by the H/W (Height-to-Width) ratio and urban form, which outlines how neighboring structures relate geometrically, significantly affects building energy consumption by dictating solar access levels and thus shaping passive performance of buildings. Consequently, optimizing solar potential to establish passively operable buildings stands as a crucial aspect of designing for energy efficiency. It's essential to strike a balanced equilibrium between design parameters and energy performance, which requires the careful integration of environmental and climatic data during the preliminary design phase.

The objective of this study is to elucidate how urban geometry can enhance building energy performance by harnessing its passive system potential through optimized solar gain capabilities. The study was conducted through the design of settlement scenarios based on the values for design parameters taken from existing residential building projects. Although, the generic scenario pattern lacks architectural diversity; these scenarios have the fundamental abstract qualities for analyzing overall performance of design parameters by quickly reproducing various alternatives to compare a wide range of possibilities. Moreover, the selected building forms aim to reflect widely used design criteria and construction technologies in Turkey under the impact of existing national regulations. Several mass housing projects realized by TOKI (Housing Development Administration of Turkey) were reviewed in order to produce building typologies of the study. To this end, a range of settlement scenarios were generated with varying H/W ratio, building layout, and urban form to compare the impact of urban geometry on energy performance of residential buildings. The purpose of these evaluations is to furnish valuable data for the preliminary design phase of the housing projects planned for construction in Kahramanmaras, as envisioned by TOKI. The outcomes of the study may contribute to regeneration process of the city after the earthquake because urban regeneration extends beyond fulfilling the necessity of shelter, it holds the potential to significantly enhance the quality of life and environmental sustainability in Kahramanmaras.

METHODOLOGY

Solar access regulated by urban geometry has control over the passive heating, cooling and daylighting performance and consequently energy consumption of buildings. Designing settlement textures as systems to optimize solar access and minimize energy consumption in buildings is crucial for sustainability, necessitating the identification of appropriate design parameter values that define urban geometry. In turn, this enables the optimization of solar access levels for buildings, leading to the attainment of required comfort conditions with minimal active energy consumption. Furthermore, in numerous notable studies that examine urban geometries along with the effects of the existing microclimate, simplifying urban forms into a parametric model consisting of common types and patterns has become a widely adopted method for presenting specific solutions (Vartholomaios, 2017; Natanian, Aleksandrowicz & Auer, 2019; Mangan et al, 2021). In line with this perspective, a parametric methodology was devised to assess the influence of urban design on building energy performance, encompassing the generation of a range of settlement scenarios featuring varying H/W ratios, building layouts, and urban form. Energy simulations were conducted on a reference building within the generated settlement scenarios to be located in Kahramanmaras. The goal was to explore the correlation between urban geometry and building energy consumption (heating, cooling, and lighting) based on varying solar radiation gain capabilities. This was pursued to provide pragmatic design solutions for preliminary design process of new settlements in Kahramanmaras with a focus on enhancing energy efficiency.

Definition of Design Parameters for Settlement Scenarios

The design parameters for generating settlement scenarios, encompassing aspects related to climate, occupants, urban and building forms, and active building sub-systems were elaborated by drawing from both national and international standards, in addition to utilizing statistical data provided by the Turkish Statistical Institute (TURKSTAT).

Design parameters: climate

It is a well-known fact that energy consumption values for reference buildings within settlements exhibit significant variation due to climatic disparities. In the context of this study, meteorological data concerning external climate conditions in the Kahramanmaras district, encompassing outside air temperature, humidity, solar radiation, and wind patterns, were generated using the "Typical Meteorological Year" format through the climate data acquisition program known as Meteonorm 7.0. The findings of a research project conducted by Berkoz et al. (1995) at Istanbul Technical University affirmed that the Kahramanmaras district comprises distinct climate zones, ranging from hot-humid and hot-dry to temperate-dry (Figure 1). Given that this study aimed to propose design solutions for the central region of Kahramanmaras, primarily characterized by a temperate-dry climate, the region experiences heating degree hours of 53,484 for 20°C and cooling degree hours of 7,517 for 26°C (Bulut et al., 2007).

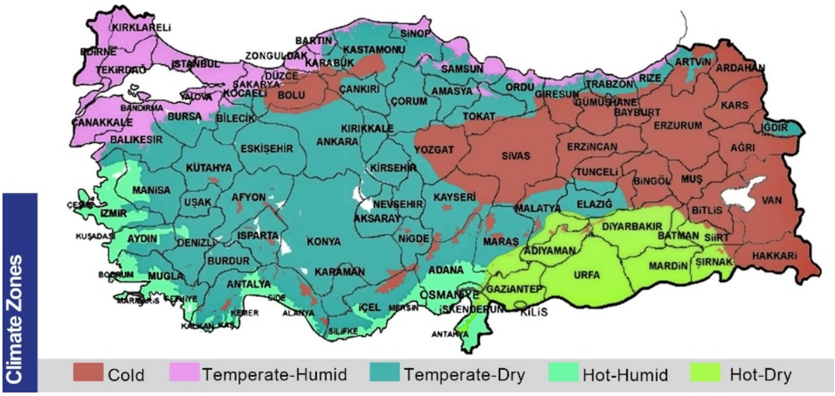

Figure 1. Climate zones in Turkey (E. Berkoz, et al. ,1995).

In relation to indoor climate-related design parameters, an indoor air temperature of 20°C was set during the heating period, with a setback temperature of 13°C. For the cooling period, the indoor air temperature was set at 26°C, with a setback temperature of 32°C. Additionally, natural ventilation was deemed active during the cooling period, ensuring a minimum fresh air supply of 10 l/s per person.

Design parameters: user

User-related design parameters have been defined considering the living space conditions and climatic comfort criteria in calculations. The user density for the reference building is defined as 0.04 m²/person, and the user activity level is set at 110 W/person. The user's clothing insulation level is considered as 1 clo for the heating period and 0.5 clo for the cooling period.

Design parameters: urban and building forms

Within the scope of the study, a flat plot area has been considered in Kahramanmaras province, situated at approximately 37.57° latitude and 36.92° longitude, with an elevation of 568m above sea level.

This study aims to provide reference data for the mass housing projects that the Housing Development Administration of Turkey (TOKI) has undertaken in Kahramanmaras after the earthquake. Therefore, the reference building typology has been developed by examining TOKI's standard projects produced nationwide. Based on this review, a residential module with a floor area of 100 m^2 was defined and two plan layouts were employed: a square plan comprising four modules with a form factor (length/depth ratio in plan) of 1.00, and a rectangular plan comprising two modules with a form factor of 2.00 (Figure 2). The buildings were defined based on these two plan layouts with a height of 15 meters (one ground floor and four upper floors) that TOKI has announced for construction in Kahramanmaras.

Figure 2. Plan layout alternatives: (a) rectangular plan with 2 modules; (b) square plan with 4 modules.

To examine the impacts of different urban forms on building energy performance based on different solar radiation gain capabilities, two distinct archetypal urban typologies were utilized to generate settlement scenarios: pavilion and slab. In pavilion form, the detached buildings receive solar radiation from all directions while in slab form the attached buildings have more limited solar access. These urban forms were devised based on pavilions with a square plan layout and slabs with a rectangular plan layout to ensure that each module could receive solar radiation from two directions. (Figure 3).

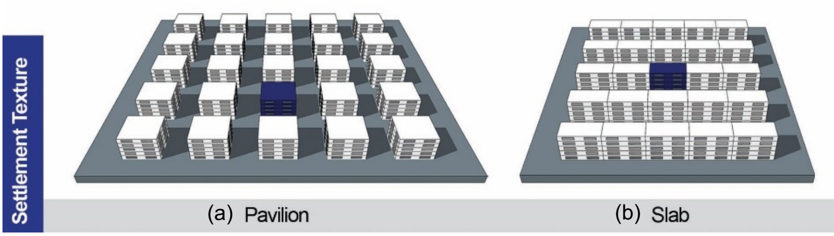

Figure 3. Urban form alternatives: (a) square plan pavilion; (b) rectangular plan slab.

Three commonly accepted H/W ratio values, 0.50 (narrow), 1.00 (uniform), and 2.00 (wide), were taken as reference to assess the impact of urban geometry for generating settlement scenario alternatives (Ahmad et al., 2005). As the primary objective of the study is to analyze the effect of urban geometry, the settlement scenarios were generated using 16 different values within the H/W ratio range of 0.50 to 2.00, defined with an interval of 0.10 (Figure 4).

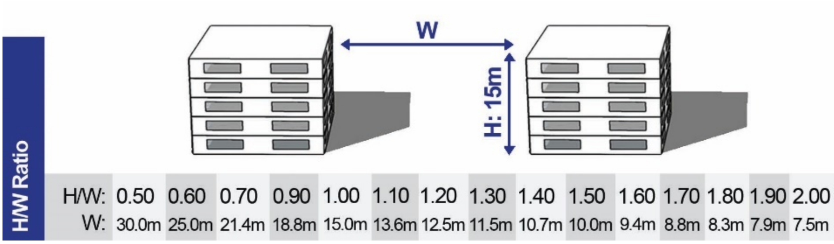

Figure 4. H/W ratios

Layering details of the opaque and transparent components were created in accordance with the limit values for Kahramanmaras, specified in TS 825 Standard (Thermal Insulation Requirements for Buildings) (TSI, 2013). The layering details and calculated U (W/m^2K) values for the opaque and transparent components of the building model are depicted in Table 1. A transparency ratio of 30% was set for all façades of the buildings, and windows of equal size, ensuring this ratio, were incorporated into all sides of the modules.

Design parameters: active building sub-systems

Within the scope of active building subsystems, the heating system for the reference residential building has been determined as a central system with a condensing boiler, utilizing natural gas as the energy source. It is assumed that a cooling system with a performance coefficient (COP value) of 4.50 is available, and electrical energy is employed for cooling purposes. The residential modules are treated as single zones, and these zones are designated as living spaces, with an established illuminance level of 100 lux for the artificial lighting system (CIBSE, 2012). A constructed lighting system, featuring three levels of control and utilizing LED lighting elements, has been defined. This lighting system operates in integration with daylight illumination levels.

Table 1. Characteristics of the building elements.

Construction	Material Layers (from outside to inside)	U Value (W/m^2K)
Exterior wall	0.006m cement plaster + 0.05m rockwool + 0.03m cement rendering + 0.19m brick + 0.02m gypsum plaster	U_{wall} =0.57
Ground floor	1.00 m reinforced concrete + 0.03m concrete + 0.04m extruded polystyrene + 0.03m concrete + 0.05 m screed + 0.01m timber flooring	U_{floor} =0.53
Flat roof	gravel + roofing felt + 0.08m extruded polystyrene + EPDM + 0.04m concrete + 0.14m reinforced concrete + 0.02m gypsum plaster	U_{roof} =0.38
Window	0.06m PVC frame, 0.004m Low-e coated glazing+0.012m argon + 0.004m Low-e coated glazing	U_{window}=1.40

Generation of Settlement Scenarios

Each urban form alternative was based on 25 buildings in a 5x5 matrix in line with the uniform configuration. The total area covered by each settlement scenario varied based on the required distance between adjacent buildings considering the relevant H/W ratio. Settlement scenarios, consisting of 5-story buildings, were developed as square plan pavilion and rectangular plan slab configuration with 16 H/W ratios ranging from 0.50 to 2.00. The generation process produced 32 settlement scenarios, with the building situated at the center of the 5x5 grid defined as the reference building for conducting energy performance evaluations (Figure 5). The scenarios were named after urban typology (P for pavilion form and S for slab form) and H/W ratio (without the decimal point).

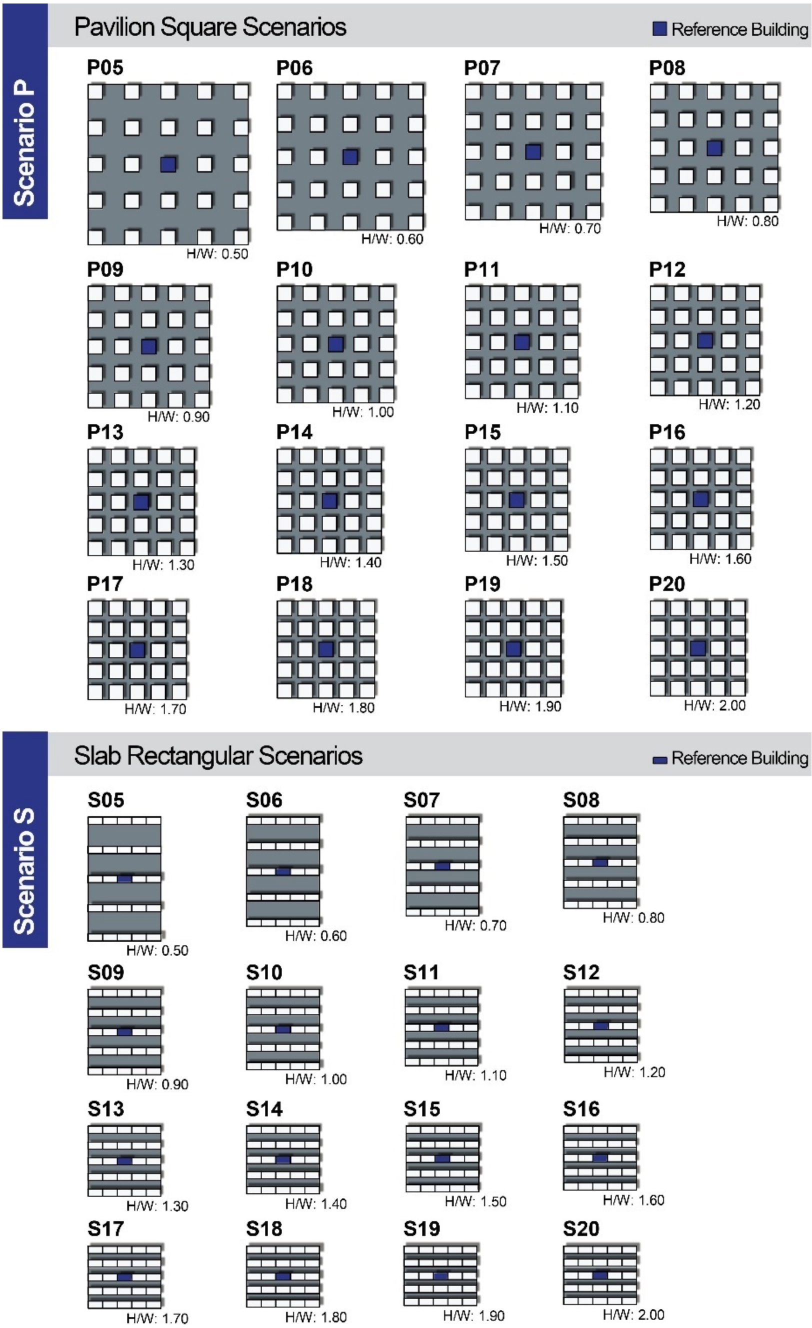

Figure 5. Settlement scenario alternatives.

Evaluation of Settlement Scenarios

To assess the impact of urban geometry on the solar access levels of buildings within settlements, the energy performance of the reference building, as defined in the settlement scenarios, was examined in terms of the annual energy consumption and solar radiation gain. For energy performance assessments, the annual final energy consumption per module and solar radiation gain per module of the reference building were calculated. The annual results per module were calculated by dividing the building's total energy consumption and solar radiation gain by the total number of modules in the reference building: 20 modules in square plan buildings and 10 modules in rectangular plan buildings. These calculations adhered to the detailed dynamic calculation method specified in the Building Energy Performance standard (TSI, 2019). Performance data were generated using the DesignBuilder simulation program, which utilizes the Energy Plus dynamic simulation engine to create virtual building models (DesignBuilder, 2018). In the simulations, it was assumed that the housing units and common hallways of the building model were independent in terms of zoning criteria. The following data were calculated:

- Heating energy consumption (kWh/module/a)
- Cooling energy consumption (kWh/module/a)
- Lighting energy consumption (kWh/module/a)
- Total energy consumption (heating + cooling + lighting) (kWh/module/a)
- Solar radiation gain (kWh/module/a)

Energy analyses were conducted for the reference building in each settlement scenario, and the results were presented in Figure 6. A comparison of the results revealed that modules in pavilions received up to 35.60% more solar radiation than slabs. Furthermore, it was evident that settlement scenarios with higher H/W ratios had limited solar access capabilities because in these settlements the closer proximity of adjacent buildings resulted in overshadowing. The amount of solar radiation gained in the pavilion with an H/W ratio of 0.50 (P05) was 53.57% higher than in the pavilion with an H/W ratio of 2.00 (P20), while in slabs, the difference between S05 and S20 was 49.21%.

The disparities observed in solar radiation gains exerted a substantial influence on the passive heating, cooling, and daylighting potential of buildings, thereby directly impacting the divergences in energy consumption observed among scenarios. In this regard pavilions with same H/W ratios consumed less heating energy ranging from 33.26% to 45.70%, and less lighting energy, ranging from 11.70% to 14.59%, compared to slabs. Similarly, modules in scenarios with an H/W ratio of 0.50 required up to 40.44% less heating and up to 23.82% less lighting energy. On the other hand, higher solar gain led to overheating during summer period which resulted in higher cooling energy consumption. Pavilions consumed more cooling energy, ranging from 15.15% to 34.91% than slabs and scenarios with an H/W ratio of 0.50 consumed up to %36.94 more cooling energy than those with a ratio of 2.00.

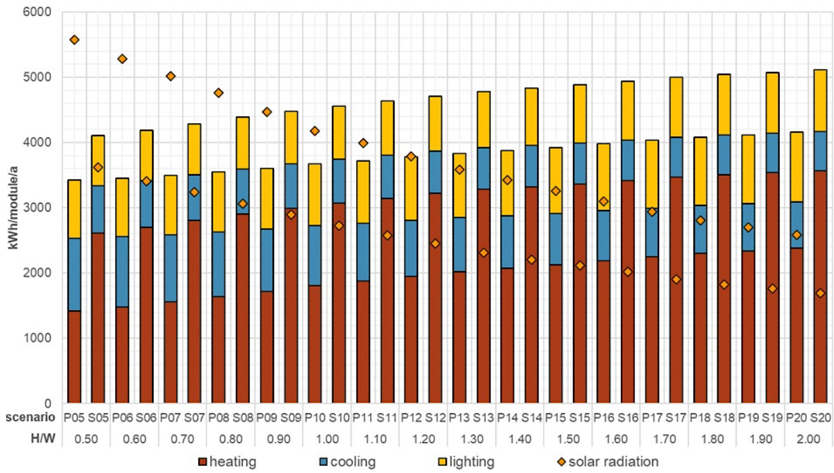

Figure 6. The results of annual energy consumption per module and solar radiation gains obtained from the reference building in settlement scenarios.

Total energy consumption was regarded as the ultimate indicator of the overall energy performance of buildings, which is shaped by the trade-off between heating, cooling, and lighting energy consumption under the influence of the solar access levels. As the total energy consumption performances were compared, it became evident that scenarios with greater solar radiation gains exhibited superior performance. Thus, pavilion scenarios consumed up to 24.73% less total energy than slabs and scenarios with an H/W ratio of 0.50 consumed up to 19.73% less total energy compared to those with an H/W ratio of 2.00. It was clear that design solutions achieving an optimal balance between heating, cooling, and lighting energy consumption based on solar radiation gains resulted in more energy-efficient built environments. Therefore, examining the impact of each energy consumption on overall building energy performance was crucial for designing an energy efficient settlement.

CONCLUSION

In the context of this research, an analysis was conducted to assess the influence of urban geometry on building energy performance. This analysis was carried out through developed settlement scenarios, which were designed to capture the variations in solar access levels defined by urban geometries, with the intent of furnishing essential data to design energy-efficient housing settlements that are to be constructed in Kahramanmaras.

The primary objective of this study was to offer valuable insights into the decision-making process associated with settlement design. This was achieved by highlighting the potential impact of variations in design parameters on building energy performance. It is important to note that within the realm of urban design, the quest for an absolute solution is inherently elusive. Therefore, instead of pursuing an elusive optimal solution, the study opted for a pragmatic approach. It involved an in-depth analysis of the impact levels of each design variable on energy performance. This analysis was conducted through regression analyses, facilitating the comparison of results among different design alternatives. Regression analysis serves as a powerful tool for establishing relationships between design parameters that defined the urban geometry, such as H/W ratio and urban form, and energy consumption outcomes associated with variations in solar radiation gain obtained from developed scenarios. The calculated determination coefficients (R^2) for these design parameters were crucial in assessing their impact on building energy performance, with an R^2 value approaching 1.00 indicating a strong and significant relationship between the variables.

The results of regression analyses regarding the impact of H/W ratio parameter on reference building's energy consumption and solar radiation gains were presented in Figure 7. With a calculated R^2 value of 0.898, it is evident that changes in the H/W ratio have a substantial effect on solar radiation gains (A) of refence building. As expected, a decrease in the H/W ratio, which is associated with narrower distances between buildings, corresponded to an increase in solar radiation gains. When comparing the effect of the H/W ratio on various energy consumption results, the most significant difference was observed in heating energy (B), with an R^2 value of 0.441. Cooling energy (C), with an R^2 value of 0.324, appeared to be less impacted by H/W ratio changes compared to heating energy. Lighting energy (D) decreased as solar access levels increase due to enhanced natural lighting, although an R^2 value of 0.198 suggested that alterations in the H/W ratio have a relatively minor influence on lighting energy consumption in residential buildings compared to heating and cooling. Considering that total energy consumption (E) is shaped by the combined effects of heating, cooling, and lighting energy, it can be inferred that it followed a similar trend to heating and lighting energy consumption. In other words, as street widths decreased, total energy consumption with an R^2 value of 0.268 increased even if cooling energy consumption diminished. These results highlighted the significant impact of the H/W ratio, one of the parameters defining urban geometries, on heating energy consumption, in the case of Kahramanmaras.

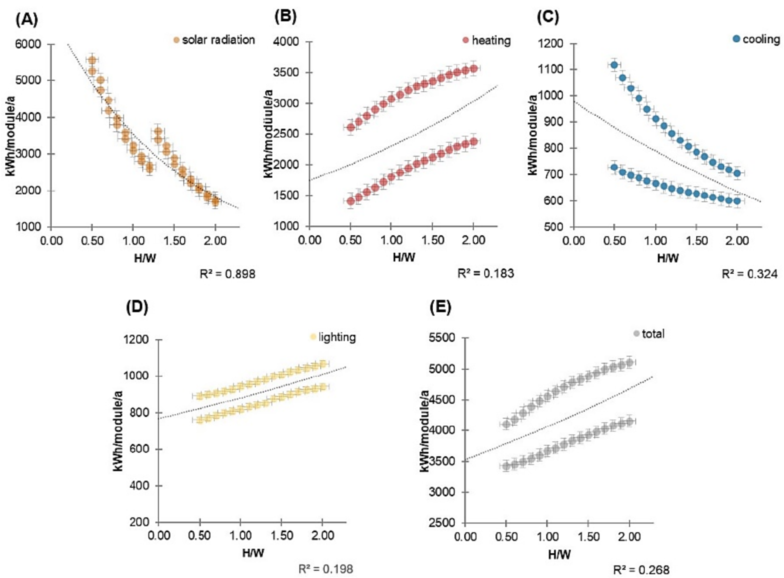

Figure 7. The regression analyses regarding the impact of H/W ratio parameter on the reference building's energy consumption and solar radiation gains.

The results of regression analyses regarding the impact of urban form parameter on reference building's energy consumption and solar radiation gains were presented in Figure 8. The results of regression analyses regarding the impact of urban form parameter on reference building's energy consumption and solar radiation gains were presented in Figure 8. The attained R^2 value of 0.627 showed that the urban form profoundly affected the solar radiation gain (A) capability of the reference building. The dramatic difference between the pavilion form, which was selected to evaluate the performance of detached urban forms, and the slab form, which was selected to evaluate the performance of attached urban forms, proved the importance of the settlement design on building energy performance. Among energy consumption results, heating energy (B) stood out with an R^2 value of

0.809 as the one most significantly impacted by the variations in solar radiation gains generated by different urban forms. Similarly, it was observed that the fluctuation in cooling energy consumption (C) was also notable in relation with urban form selection, although it remained lower in comparison to heating energy with an R^2 value of 0.576. The impact of urban form on lighting energy, however, exhibits a relatively lower correlation compared to other energy consumption with an R^2 value of 0.227. The analysis of total energy consumption (E), an R^2 value of 0.522, demonstrated the substantial influence of the urban form parameter on overall building energy performance. This influence aligned with the heating energy consumption trend and this result highlighted a significant disparity in energy performance between slab and pavilion forms.

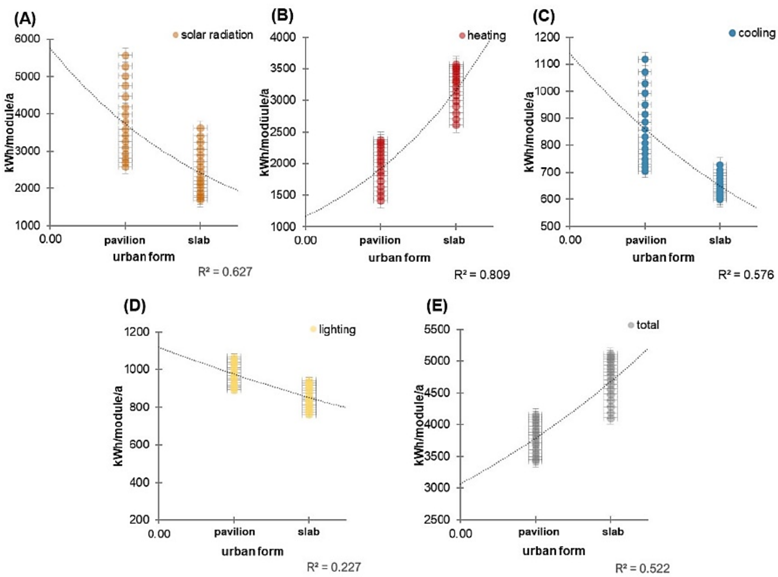

Figure 8. The regression analyses regarding the impact of urban form parameter on the reference building's energy consumption and solar radiation gains.

Considering the limitations of the developed method in this study, the data obtained shed light on how urban geometries, defined by their solar access levels, have a significant impact on passive building performance, resulting in significant changes in energy consumption patterns. Depending on the climatic regions and environmental characteristics of the settlements, the passive performance requirements of buildings vary. In this context, it was determined that in the Kahramanmaras Central region where the study was conducted, the heating period is longer due to the predominance of temperate-dry climate characteristics, leading to a higher heating energy demand compared to cooling. In other words, design solutions that increase passive heating capacities to reduce heating energy consumption take precedence in creating more energy-efficient environments.

When the results from various settlement scenarios with different H/W ratios and urban forms were compared, it was evident that alternatives with higher solar radiation gains exhibited better energy performance. Regarding the H/W ratio, evaluations revealed that a decrease in the H/W ratio, which indicated an increase in the distance between buildings and a subsequent rise in solar radiation gains, led to an increase in cooling energy consumption. However, this increase was compensated for by the reductions in heating and lighting energy consumption which led to a decrease in total energy consumption. When scenarios with H/W ratios of 0.50 and 2.00 were compared, differences of up to 40.44% in heating energy consumption and up to 19.73% in total energy consumption were identified. Similar trends were observed among scenarios with different urban form alternatives. In the analysis of slabs, it was determined that buildings in adjacent layouts, which had lower solar access, exhibited higher energy consumption compared to pavilion alternatives with dispersed layouts. When the results from the evaluated scenarios were compared, it was calculated that in pavilions, the heating energy consumption of the reference building could decrease by up to 45.70%, and total energy consumption could decrease by up to 24.73% compared to the slabs.

Based on these findings, it can be said that designs aimed at increasing solar radiation gains would be suitable for constructing more energy-efficient residential settlements in Kahramanmaras. However, these results were obtained within the framework of the study formed by various assumptions and limitations of the methodology developed. Therefore, it is crucial to analyze each design alternative in this context for any future implementations. For settlement to be built, appropriate design alternatives should be investigated that establish the optimal trade-off between heating, cooling and lighting energy consumption. Hence, using a parametric approach, as employed in this study, to analyze the impact of each design variable on building energy performance during the preliminary design process would be validated as a suitable method.

In conclusion, rebuilding the earthquake-affected city of Kahramanmaras is not only achievable through urban development activities but also requires the reconstruction of the city's identity. In this regard, it is essential to reconstruct the urban identity of the city by considering the components that are crucial for its collective memory, even those that don't exist physically today (Kisakurek, & Bayazit, 2021).To ensure the sustainability of the city, a comprehensive urban plan must be developed, considering diverse critical elements such as cultural heritage, historical significance, social structure, topography, and climatic conditions. However, creating sustainable living environments, a task that demands time and expertise, necessitates an inclusive planning approach based on meticulous and collaborative studies. Therefore, this study aimed to emphasize the importance of energy-efficient urban settlement design in establishing sustainable cities. Thus, urban settlements have a lasting impact on building energy performance along with comfort conditions, making well-thought-out urban geometries crucial for enhancing energy efficiency. Given today's energy crisis and the increasing impact of global warming, adopting a sustainable design approach to establish resource-efficient urban environments is a necessity. Based on the data presented in this study, it is feasible to redesign the earthquake-affected city of Kahramanmaras into a more sustainable urban area through careful planning. Indeed, given the considerable influence of urban geometries on building energy efficiency, strategic planning can integrate a range of urban elements into the urban design process, ultimately creating a more sustainable urban environment.

REFERENCES

Ahmed, K. S., Khare, M. & Chaudhry, K. (2005). Wind tunnel simulation studies on dispersion at urban street canyons and intersections—a review. Journal of Wind Engineering and Industrial Aerodynamics, 93(9), 697–717.

Berkoz, E., et al. (1995). Energy Efficient Housing and Settlement Design, Project No: INTAG 201. The Scientific and Technical Research Council of Turkey, Istanbul Technical University, Istanbul.

Bulut, H., O. Büyükalaca, & T. Yılmaz (2007). Akdeniz Bölgesi için Isıtma ve Soğutma Derece-Saat Değerlerinin Analizi. In Proceedings of the 2007 2nd National HVAC Congress (pp. 111-122). Antalya.

CIBSE. (2012). SLL LL Code for Lighting (SLLCL). The Chartered Institution of Building Services Engineers, London. ISBN: 9781912034413.

DesignBuilder. (2018). DesignBuilder 5.0.3.007 User Manual, (UK).

ITU (2023). Kahramanmaraş Depremleri Ön İnceleme Raporu. Retrieved from https://haberler.itu.edu.tr/.

Kisakurek, Ş. & Bayazit, E. (2021). Collective Memory Urban Memory And Spatial Components In The City Identity: Kahramanmaras City Example. Journal of Environmental and Natural Studies, 3(1), 1-21.

Mangan, S. D., Koclar Oral, G., Erdemir Kocagil, I., & Sozen, I. (2021). The impact of urban form on building energy and cost efficiency in temperate-humid zones.

Journal of Building Engineering, 33, 101626.
https://doi.org/10.1016/j.jobe.2020.101626.

Ministry of Environment, Urbanization and Climate Change. (2023). Retrieved from https://www.csb.gov.tr.

Natanian, J., Aleksandrowicz, O., & Auer, T. (2019). A parametric approach to optimizing urban form, energy balance, and environmental quality: The case of Mediterranean districts. Applied Energy, 254, 113637.
https://doi.org/10.1016/j.apenergy.2019.113637

Page, J. K. (1968). The fundamental problems of building climatology considered from the point of view of decision-making by the architect and urban designer. Paper presented at Symposium on Urban Climates and Building Climatology, Brussels, Belgium.

Strømann-Andersen, J., & Sattrup, P. A. (2011). The urban canyon and building energy use: urban density versus daylight and passive solar gains. Energy and Buildings, 43(7), 2011-2020. doi: 10.1016/j.enbuild.2011.04.007.

TSI. (2013). Thermal Insulation Requirements for Buildings (TS 825). Turkish Standards Institution, Ankara.

TSI. (2019). Energy performance of buildings - Overarching EPB assessment - Part 1: General framework and procedures (ISO 52000-1). Turkish Standards Institution, Ankara.

Vartholomaios, A. (2017). A parametric sensitivity analysis of the influence of urban form on domestic energy consumption for heating and cooling in a Mediterranean city. Sustainable Cities and Society, 28, 135-145.
https://doi.org/10.1016/j.scs.2016.09.006.

EVALUATION OF LIFE CYCLE ENERGY EFFICIENCY OF BUILDINGS

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ABSTRACT

Today, the use of fossil fuel-based resources causes environmental damages. These are climate change, deterioration of ecological balance, and destruction of natural resources. The rapid depletion of fossil fuels is also among the problems. The construction industry is responsible for a large part of the energy used worldwide, especially to provide comfort conditions in buildings. In this context, in the solution of energy and environmental problems, it is necessary to design energy-efficient buildings, to produce targets aiming at energy efficiency and to reduce general consumption on a national scale. Today, due to reasons such as increasing material and resource use and carbon emissions, a building must handle throughout its life cycle, not just in use. In this direction, frameworks and concepts that take into account the life cycle have emerged. In this study, life cycle energy efficient design is handled. A systematic has been developed by us for life cycle energy efficient design framework in the light of literature. First of all, the life cycle stages of a building are explained. Life cycle energy efficient design parameters are analyzed in line with sample studies and an evaluation is made. As a result, in this study, it is aimed to emphasize the concept of energy-efficient design within the scope of a building's life cycle. It is explained that the energy performance and design parameters of a building should be considered throughout its life cycle, and optimization is suggested in this context.

Keywords: Lifecycle; energy efficiency; embodied energy; operational energy.

INTRODUCTION

The construction industry consumes large amounts of energy, also causes a great impact on the environment due to environmental emissions from the production of building materials and the operation of the building system (Xing ve diğ., 2008). Due to increasingly serious global problems such as the energy problem and global warming, buildings have become an important focus of attention in terms of sustainability. In recent years, several Life Cycle Assessment (LCA) based building environmental impact assessment models have been developed to scientifically measure the impacts of key environmental impact factors (Su ve diğ., 2017). LCA is an environmental management tool that holistically and systematically analyzes and evaluates the environmental impacts of a product or process. It can be defined as the calculation and investigation of the environmental impacts of a product or system throughout its life cycle (Zuo et al., 2017). LCA analysis methods are basically handled in four different ways in the literature: input-output analysis, process analysis, input-output hybrid analysis, and process-based hybrid analysis. Life cycle energy analysis (LCEA) is used to estimate the total inputs and outputs, directly and indirectly, of a building's life cycle (Chastas et al., 2017). It is explained as analyzing the energy used by a building at all stages of its life cycle.

The energy consumed by a building during its life cycle is in the form of operational and embodied energy. Life cycle energy consumption is the sum of embodied and operational energy. Research and studies focus more on operational energy. Many studies that include operational and embodied energy simulations, and statistical data show that the operational energy ratio is higher than the embodied energy. This is due to the long service life of buildings (Li et al., 2020). However, with the development of new materials, new technologies and new processes and the proposal of low-energy buildings, the amount of embodied gradually increases. In well-insulated, modern, energy-efficient buildings, embodied energy can account for 40% of total life cycle energy consumption and even be higher than operational energy (Balouktsi & Lützkendorf, 2016). Providing energy efficiency and effectively reducing carbon emissions will be possible with designs that take into account the energy consumed by the building throughout its life cycle. In this context, the total energy load of a building should be analyzed throughout its life cycle of the building, as stated in the international literature.

This paper focuses on the life cycle energy efficiency of buildings and describes principles for the reduction of embodied and operational energy. A systematic has been developed by us for life cycle energy efficient design parameters' framework using reviewing techniques in the literature. First of all, the building's life cycle stages are explained. Embodied and operational energy factors that need to be handled in the building life cycle stages are systematically explained. Life cycle energy efficient design parameters are analyzed in line with sample studies. In this direction, an evaluation is made.

LIFE CYCLE ENERGY EFFICIENCY OF BUILDINGS

Buildings are responsible for a significant amount of energy demand globally. Due to the environmental impact caused by buildings, the construction sector is very important in terms of important energy. In this respect, a comprehensive and systematic life cycle assessment perspective of building energy is important for environmental impact and sustainability. Life cycle energy analysis is an approach that takes into account the amount of energy a building consumes throughout its life cycle (Cabeza et al., 2014).

The energy consumed by a building during its lifespan consists of operational energy and embodied energy. Operational (usage) energy is defined as the energy consumed for heating-cooling, ventilation, lighting, and equipment in order to provide comfort conditions in the interior. Usage energy (operational energy) includes all activities related to the use of buildings during their lifetime. Embodied energy includes the energy required for all activities in the materials production, transportation, construction, maintenance and repair, demolition, and end-of-life management. Operational energy is defined by regulations at the national and international levels. The methodological framework of embodied energy is provided by the LCA method (Chasta et al., 2017). Studies use a life cycle energy analysis (LCEA) approach to analyze total energy consumption and to measure environmental impacts over the building's life cycle (Venkatraj & Dixit, 2021).

The building' embodied energy is basically the energy consumed during the production of building materials and components and during the construction, maintenance/repair, and demolition of the building. It depends on the primary energy sources, the types of materials used, the conversion efficiency of building materials and products, and the demolition and disposal processes. Embodied energy is the sum of the embodied energies of the initial phase, repetition, and demolition. The initial energy is the total energy used to manufacturing and construction processes. Therefore, the initial energy is all the energy consumed before the building is used. Recurrent embodied energy is the energy required to maintain the building during the building use phase. Finally, demolition energy is the energy consumed at the end of its life cycle process (Azari & Abbasabadi, 2018). Embodied energy is in the formation of the building material. It highly depends on the type of material used, primary energy sources, and the efficiency of the building material production processes (Koç et al., 2022). The system framework for the life cycle energy efficiency of buildings is shown in Figure 1. In this study, the building life cycle is handled four stages such as production, construction, use, and end-of-life stages.

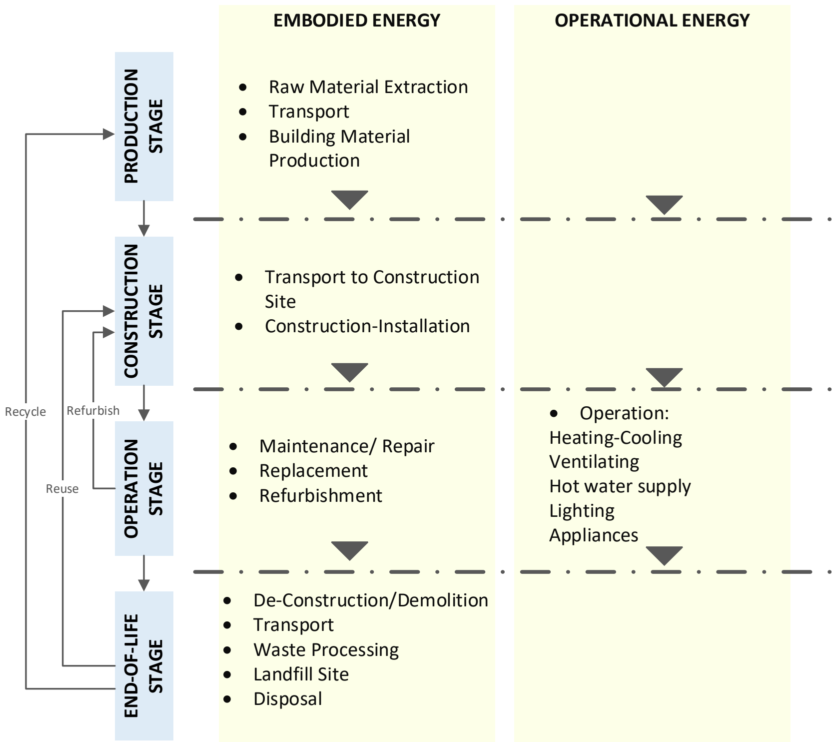

Figure 1. System framework for life cycle energy analysis of buildings.

Production Stage

Production stage activities include raw material extraction, transportation, and building material production. Transportation of materials from raw materials extraction to part fabrication is inventoried as well.

Construction Stage

Construction stages activities include transport to the construction site and construction or installation processes. Construction of the building also includes site earthwork. The construction energy stage consists of mainly electrical energy required off all activities, and transportation to construction site.

Operation Stage

Operation stages activities include embodied and operational energy together. Embodied energy includes maintenance/ repair, replacement, and refurbishment. This type of energy can be called recurrent embodied energy. In order to analyze the embodied energy of a building during its operation stage, the replacement rates of building materials and components are usually obtained assumedly. The initial embodied energy of the building elements or components to be refurbished is the factor that affects the recurrent embodied energy (Bao, 2003). The way the building is used by the users, the maintenance demands of the users, the service life of the building, the lifespan and quality of the materials and components are the factors that affect the recurrent embodied energy. It is the energy required to repair or replace damaged materials and building components.

Operational energy includes heating-cooling, ventilating, hot water supply, lighting, and appliance factors. Operational energy varies greatly depending on the level of comfort required, user factor, operating schedules, and built environment characteristics such as climate conditions. It also contributes an important part to the total energy demand in a building's lifetime. Embodied energy is constant, it does not change with such conditions. The parameters affecting operational energy can be handled passive design parameters and the use of renewable energy systems. These parameters are shown in Figure 2.

Parameters Affecting Operational Energy

Passive Design Parameters	***Use of Energy Generating Systems***
• Building Location and Orientation • Distance Between Buildings • Building Form • Building Envelope Optical and Thermophysical Properties • Solar Control • Natural Ventilation Layout	• PV Systems • Solar Collector • Building Scale Wind Turbine

Figure 2. Parameters affecting operational energy.

Implementations aimed at increasing renewable energy coverage can provide a significant reduction in operational energy requirements. However, the use of renewable energy sources must be analyzed for all life cycle stages. For instance, photovoltaic systems consume energy at all stages of their life cycle, including the manufacture of system components, installation, operation and maintenance of the system, and disposal and recycling of system components. Energy payback period and greenhouse gas emissions are the most important indicators of the life cycle of photovoltaic systems. The relationship between the energy produced and the energy consumed during the lifetime of the photovoltaic system and other active systems should be investigated (Zhang et al., 2018). In addition, the effect of passive design parameters such as building envelope properties on the embodied energy should be analyzed.

End-of-Life Stage

The end-of-life stage includes all activities related to the demolition of the building and transportation to deliver all materials to landfills or recycling facilities. Demolition energy is the embodied energy consumed at the end of its life cycle to destroy the building, recycle and reuse some components, transport to landfills, or transport to incinerators for dispose of other waste. Embodied energy for the end-of-life stage is known to represent a relatively small portion of the total energy used in a building's life (Azari & Abbasabadi, 2018).

Recycling and reuse potential are important factors in the life cycle of a building. Studies show that the recycling potential is about 50% of the embodied energy (Thormark, 2002). That’s why, recycling or reuse of building materials and components should be considered as an important stage that can save energy.

STUDIES WITHIN THE SCOPE OF BUILDINGS’ LIFE CYCLE ENERGY EFFICIENCY

In this section, studies within the scope of the life cycle energy efficiency of buildings are handled in the light of the literature (Table 1). These studies are analyzed in terms of energy efficiency throughout the life cycle.

Table 1. Life cycle studies

References	Year	Analysis	Case Study	Location
Fay et al.	2000	Operational and embodied energy	Residential building	Australia
Ramesh et al.	2012	Operational and embodied energy	Residential building	India

Kovacic et al.	2018	Life cycle energy Global warming potential Acidification potential	Passive Housing	Austria

In Fay et al.’s study (Fay et al., 2000) life cycle energy analysis is handled for the evaluation of alternative design parameters of an energy-efficient residential building. The 'Green House', a two-story brick veneer house located in Melbourne/Australia, is analyzed. A hybrid embodied energy analysis method is used in this study. Material energy densities are calculated using input-output analysis and product quantities are calculated using process analysis. Recurring embodied energy is simulated using displacement factors for many elements in the building. Heating and cooling energy requirements for operational energy are simulated using the NatHERS computer program. A single variation of the building's basic properties, a higher level of insulation, is then modeled. Life cycle energy analyses are carried out over the 0, 25, 50, 75, and 100 years lifetimes. For the life cycle energy analysis method used in the study, it is assumed that the annual operational energy consumption will remain constant throughout the life cycle of the building. According to the results of the research, the added insulation increases the embodied energy of the house compared to the initial base case. There is a 30% reduction in operational energy. Additional insulation to the base case has been shown to reduce the overall life cycle energy. However, this rate is low. In conclusion, the study emphasized the importance of knowing the context of a small improvement. For other strategies, this may indicate greater benefits with lower initial embodied energy and financial costs.

In Rames et al.'s study (Ramesh et al., 2012) a residential building in Hyderabad, India is investigated within the scope of life cycle energy efficiency. The building is evaluated for different climatic conditions and for existing and modified situations. This one-storey, single-family building has a reinforced cement concrete roof, walls filled in with fired clay bricks, and concrete floor. The house is modeled and analyzed for India’s five different climatic zones, warm-humid, hot-dry, composite, cold, and moderate. Instead of the existing exterior wall of the building, blocks made of materials with low thermal conductivity and low embodied energy are studied. These materials are hollow concrete, soil cement, and aerated concrete and fly ash. In addition, the insulation effect (expanded polystyrene, i.e. EPS) on the roof and exterior walls is examined from a life cycle perspective in order to reduce the life cycle energy demand of the building. In the study, it is seen that without insulation alternative wall materials alone, reduce the building life cycle energy demand by 1.5-5%. Aerated concrete has better energy performance as a wall material than other materials. The building’s life cycle energy demand for all wall materials decreases with increasing block thickness. The life cycle energy savings increase significantly when insulation is added to the exterior wall and roof. However, with the increase of insulation thickness, this life cycle energy difference decreases for different alternative wall materials. It is seen that the life cycle energy requirement increases when the wall insulation is over 10 cm. Also, the life cycle energy demand for roof insulation above 10 cm is almost the same for the other 5 cm of insulation and then increases. As a result, it is seen that there is a limit to the insulation thickness that can be applied to the external walls and roof in terms of life cycle. In terms of climate characteristics, the building's life cycle energy demand in the cold climate zone is higher than in other climates. Located in a temperate climate, the building requires the lowest life cycle energy compared to other climates due to its low operational energy demand. With insulation, maximum life cycle energy savings are observed in hot and humid climates, and the least in temperate climates.

In Kovacic et al.'s study (Kovacic et al., 2018) a passive housing block in Austria is analyzed in terms of embodied and operational energy and its related environmental impacts (global warming potential, acidification potential). The use of materials and technology is researched to reduce the energy consumption of a building in terms of environmental impact and benefits. For the analysis, three years of energy data are monitored, and real data based on original documentation of the building's materials and construction are used. Using the LCA method, environmental impacts are evaluated in terms of building materials, operational energy, heating, air conditioning, and ventilation technologies. In the study, global warming potential, acidification potential and primary energy density are compared for 20, 50 and 80 year life-span scenarios. LEGEP software is used to analyze embodied energy and related emissions. Production, maintenance, recycling or disposal stages are handled. Different variants of the construction are modeled and their optimization potentials analyzed. These variants are passive house as built (HVAC sanitary and piping), passive house with HVAC sanitary and piping, timber variant, and variant comparing passive house and low energy house. HVAC sanitary and piping have been found to increase the embedded energy. In this respect, the study highlights the optimization of the sizing of the system and the importance of careful planning to optimize the ecological footprint. For the wooden variant, the concrete construction envelope and balconies of the passive house are analyzed as wooden construction. If facades and balconies were made of wood, global warming potential savings would range between 10% and 17%. However, the life cycle energy load is approximately 5% higher in the wooden model. The fact that the use of wood increases the life cycle energy is related to the processing intensity of the wood. Finally, the existing passive house is compared with a hypothetical low-energy variant of the same building to determine the ecological payback period. Low-energy houses have less insulation than passive houses, so there is less total embodied energy. For low energy-house, it is possible to save 6% on global warming potential and life-cycle energy demand and 7% on acidification potential for construction in the 50-year scenario. However, the increased performance of passive house in total LCA is due to greater operational energy savings.

CONCLUSION

This study clearly shows the factors and potential for reducing life-cycle energy consumption. Life-cycle analysis has been shown to be a useful and important method in guiding energy-efficient building design. This study also showed the importance and necessity of considering the life cycle approach to evaluate the real environmental and energy performances of buildings. Firstly, the life cycle framework and the factors affecting embodied and operational energy are systematically explained. At the same time, studies within the scope of the life cycle energy efficiency of buildings are investigated.

The systematic, life-cycle energy efficiency strategies described in this study provide a framework for decision-making. The energy consumption of buildings starts from their manufacturing stage till the demolition stage. So, it can be said that A building is a set of systems that must be handled throughout its life, including raw material extraction, construction and use, and the demolition phase. When the studies carried out within the scope of life cycle energy analysis are handled, it seems that a design approach that will reduce operational energy demand can increase embodied energy. Material selection, life cycle and actions in the early design stages can be defined as decisive parameters for the reduction of embodied energy. This has a negative effect on total energy efficiency. In this respect, a design approach based on optimum energy performance is important for life cycle energy efficiency. This study will provide information about the importance of maintaining a balance between embodied energy and operational energy throughout the building lifespan, and strategies to reduce energy-related environmental impacts and these impacts at various stages of a building's life cycle.

It is clear that energy-efficient design is an object that needs to be handled throughout the life cycle of a building, and this requirement is emphasized in this study. Energy and environmental emissions are important parameters that needs to be optimized due to its national and global importance. Detailed studies covering the life cycle stages of buildings are needed to determine their impact on energy and the environment. As a result, operational and embodied energy optimization is suggested. To achieve minimum life cycle energy consumption, buildings' embodied and operational energies must reach a certain balance.

REFERENCES

Azari, R., & Abbasabadi, N. (2018). Embodied energy of buildings: A review of data, methods, challenges, and research trends. Energy and Buildings, 168, 225–235. https://doi.org/10.1016/J.ENBUILD.2018.03.003

Balouktsi, M., & Lützkendorf, T. (2016). Energy Efficiency of Buildings: The Aspect of Embodied Energy. Energy Technology, 4(1), 31–43. https://doi.org/10.1002/ENTE.201500265

Bao, Q. (2003). Effective energy management during a building's life cycle. Hong Kong Polytechnic University (Ph.D. Thesis). Hong Kong.

Cabeza, L. F., Rincón, L., Vilariño, V., Pérez, G., & Castell, A. (2014). Life cycle assessment (LCA) and life cycle energy analysis (LCEA) of buildings and the building sector: A review. Renewable and Sustainable Energy Reviews, 29, 394–416. https://doi.org/10.1016/J.RSER.2013.08.037

Chastas, P., Theodosiou, T., Bikas, D., & Kontoleon, K. (2017). Embodied Energy and Nearly Zero Energy Buildings: A Review in Residential Buildings. Procedia Environmental Sciences, 38, 554–561. https://doi.org/10.1016/J.PROENV.2017.03.123

Fay, R., Treloar, G., & Iyer-Raniga, U. (2000). Life-cycle energy analysis of buildings: A case study. Building Research and Information, 28(1), 31–41. https://doi.org/10.1080/096132100369073

Koç, İ., Duru, M. O., & Dinçer, S. G. (2022). Yapılarda Gömülü ve Kullanım Enerjisi Kavramlarının Yaşam Döngüsü Değerlendirmesi (YDD) Metodolojisiyle İrdelenmesi. Bāb Journal of FSMVU Faculty of Architecture and Design, 3(1), 55–69.

Kovacic, I., Reisinger, J., & Honic, M. (2018). Life Cycle Assessment of embodied and operational energy for a passive housing block in Austria. Renewable and Sustainable Energy Reviews, 82, 1774–1786. https://doi.org/10.1016/J.RSER.2017.07.058

Li, C. Z., Lai, X., Xiao, B., Tam, V. W. Y., Guo, S., & Zhao, Y. (2020). A holistic review on life cycle energy of buildings: An analysis from 2009 to 2019. Renewable and Sustainable Energy Reviews, 134, 110372. https://doi.org/10.1016/J.RSER.2020.110372

Ramesh, T., Prakash, R., & Shukla, K. K. (2012). Life cycle energy analysis of a residential building with different envelopes and climates in Indian context. Applied Energy, 89(1), 193–202. https://doi.org/10.1016/J.APENERGY.2011.05.054

Su, S., Li, X., Zhu, Y., & Lin, B. (2017). Dynamic LCA framework for environmental impact assessment of buildings. Energy and Buildings, 149, 310–320. https://doi.org/10.1016/J.ENBUILD.2017.05.042

Thormark, C. (2002). A low energy building in a life cycle—its embodied energy, energy need for operation and recycling potential. Building and Environment, 37(4), 429–435. https://doi.org/10.1016/S0360-1323(01)00033-6

Venkatraj, V., & Dixit, M. K. (2021). Life cycle embodied energy analysis of higher education buildings: A comparison between different LCI methodologies. Renewable and Sustainable Energy Reviews, 144, 110957. https://doi.org/10.1016/j.rser.2021.110957

Xing, S., Xu, Z., & Jun, G. (2008). Inventory analysis of LCA on steel- and concrete-construction office buildings. Energy and Buildings, 40(7), 1188–1193. https://doi.org/10.1016/J.ENBUILD.2007.10.016

Zhang, T., Wang, M., & Yang, H. (2018). A Review of the Energy Performance and Life-Cycle Assessment of Building-Integrated Photovoltaic (BIPV) Systems. Energies 2018, Vol. 11, Page 3157, 11(11), 3157. https://doi.org/10.3390/EN11113157

Zuo, J., Pullen, S., Rameezdeen, R., Bennetts, H., Wang, Y., Mao, G., Zhou, Z., Du, H., & Duan, H. (2017). Green building evaluation from a life-cycle perspective in Australia: A critical review. Renewable and Sustainable Energy Reviews, 70, 358–368. https://doi.org/10.1016/J.RSER.2016.11.251

OPTIMIZING ENERGY USE IN COMPLEX BUILDINGS: A THEMATIC ANALYSIS OF RESEARCH TRENDS

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ABSTRACT

Energy consumption became a critical concern as a result of global population growth, advanced technology, and rising demands, with buildings accounting for a significant portion of global energy use. The present study assesses the factors that influence the energy performance of complex buildings such as healthcare, heritage, and religious buildings, along with the approaches used to optimize energy use. Despite the advances in research, there are still gaps in the literature that need to be addressed. Most studies, for instance, focus on quantitative research, not considering the effects of occupant behavior on energy performance. Furthermore, studies generally tend to focus on specific building types, ignoring the challenges and opportunities that other building types offer. Therefore, optimizing energy use in complex buildings remains a significant challenge.

Given the above scope, the present study conducts a thematic analysis of current energy performance research on complex building types published in the Web of Science database between 2010 and 2022. Thematic analysis categorizes current research efforts by building type, climate and location, study scale, monitoring and data collection, simulation and calibration, evaluation parameters, and decision-making models. The reviewed literature provides a thorough overview of the techniques used to optimize energy use in complex buildings, as well as insights into current research trends and gaps.

Keywords: building energy monitoring; complex buildings; energy performance simulation; calibration, monitoring.

INTRODUCTION

Energy consumption in buildings accounts for more than 30% of the energy consumed in the world (ECE, 2020; Yan et al., 2017), whereas more than 80% of the consumed energy in buildings belongs to the operational phase of the building's life cycle (Akande, Odeleye, Coday & Bescos, 2016; Dong, Li, & McFadden, 2015; Chen et al., 2021). Hence, optimizing energy consumption in buildings became an important research topic (Akande et al., 2016).

Energy performance in buildings represents the measured energy consumption for existing buildings and the predicted consumption for new designs and is composed of parameters such as climate, building envelope, building service systems, indoor environmental conditions, operation and maintenance, and occupant behavior (Yoshino, Hong, & Nord, 2017; Balvedi, Ghisi, & Lamberts, 2018). Field studies, energy monitoring, and simulation models are used to assess the energy performance of existing buildings (Al-Habaibeh et al., 2022). Existing building retrofits can be performed to reduce energy consumption based on the collected data (Martinez-Molina, Williamson, & Dupont, 2022). Whole-building energy audits are frequently used to interpret the energy performance of existing buildings (Capozzoli, Piscitelli, Neri, Grassi, & Serale, 2016) and are accepted as a precursor to improvement and retrofit (Li, Wang, & Zhou, 2020) since performance optimization of existing buildings have a greater potential for energy efficiency compared to new buildings.

The building energy performance (BEP) literature primarily focuses on improving the energy performance of existing buildings. However, most research indicates that office and residential buildings are the most common building types studied for both energy performance monitoring and retrofitting (Niu et al., 2022; Manu, Brager, Rawal, Geronazzo, & Kumar, 2019). Complex buildings are less studied, despite having much higher consumption levels than office and residential buildings. Complex buildings are large-scale structures that serve multiple functions, such as assembly, care, and commerce, and incorporate multiple occupancy profiles to meet more than one spatial requirement (Lu et al., 2022). For example, Jain et al. (2021) stated that hospitals, a significant example of complex buildings, work a full schedule throughout the week and the requirements on Indoor environmental quality (IEQ) are stringent because the related parameters have a direct impact on patient care. Other types of complex buildings include heritage buildings (Martinez-Molina, Williamson, & Dupont, 2022; Coelho, Silva, & Henriques, 2018), religious buildings (Diler, Turhan, Durmuş, Arsan, & Gökçen Akkurt, 2021), etc.

Despite a few studies focusing on complex building energy performance benchmarking (Ahmed, Rajagopalan, & Fuller, 2017; Capozzoli et al., 2016), there is a significant research gap for energy performance studies on complex buildings with geometrical and spatial constraints and diverse occupancy profiles and schedules.

Given the above scope, the current study aims to establish the background knowledge on the quantitative aspects of BEP in terms of benchmarking, monitoring, simulation integration, and occupant behavior, via a systematic literature review, in order to delineate the unique features of complex buildings that necessitate specialized approaches to reduce energy consumption. The systematic review was conducted via the Web of Science (WoS) database between the years 2010 and 2022, covering the scientific work on energy performance of complex buildings. The review was intended to decipher the prevalent complex building types that were subject to energy performance studies, their methodological approach for data-based and model-based evaluation approaches, and the drivers that affected energy performance, such as heating and cooling systems and climatic features. The main aim was to identify challenges and motivations for optimizing energy use in complex buildings. Hence, the Methodology section describes the systematic review approach and the thematic analysis of the selected articles. The Findings section classifies the outcomes of the review, and the Discussion section reports the strengths and weaknesses in the energy performance studies on complex buildings. The Conclusion section presents the challenges and motivations in the optimization of the energy performance of complex buildings.

METHODOLOGY

A preliminary study was conducted as the first step in the systematic review to determine the keywords through an analysis of research trends in the literature. The scarcity of studies focusing on the energy performance assessment and optimization of complex buildings was identified as a gap in the literature. Keyword sets were proposed for use in the WoS database to gain access to scientific research on the subject. Table 1 displays the Boolean operator "and" as well as the search phrases "building energy performance," "monitoring," and the building types included as complex buildings in the current review. Since there is a plethora of research on building types such as hotels, residential, industrial, office, and educational buildings, the complex building types that were less studied in literature were included in the keyword sets. The search in the WoS database was conducted using the combinations of these search phrases (Table 1), and the articles were chosen cumulatively.

Table 1. Search phrases for keyword sets used in the WoS database.

AND	AND	AND
building energy performance	monitoring	hospital / healthcare / clinics
		museum / cultural centers
		church / mosque
		shopping centers

The WoS database is a comprehensive network of research from various domains such as applied sciences, social sciences, arts, and humanities, and it allows researchers to distinguish between different types of publications such as research articles, review articles, conference proceedings, and/or book chapters. The current systematic review study included only research and review articles. In addition, the database defines research categories that can be used during the keyword search process. The selected categories were (1) Architecture, (2) Green Sustainable Science Technology, (3) Engineering Environmental, (4) Construction Building Technology, (5) Energy Fuels, (6) Engineering Civil, (7) Environmental Studies, and (8) Environmental Sciences, to address the interdisciplinary nature of the main research question. Another limitation was the article selection's temporal scale, which was limited to the years 2010 to 2022. As a result of the limitations of (a) specific building types, (b) article types, (c) the temporal scale, and (d) the WoS categories, the database search with the keyword combinations shown in Table 1 yielded 480 review and research articles. The articles that were not relevant to the current study and appeared in more than one search were removed, resulting in a total of 143 articles. The abstracts of these 143 articles were reviewed, and 34 were chosen for systematic review based on their specific focus on the aforementioned building types, as well as the criteria for using an energy performance assessment methodology. Only one of the 34 articles was a review article that focused on thermal comfort studies in hospital buildings (Yuan et al., 2022), while the other 33 were applied energy performance assessment research. The selected articles were processed via Microsoft Excel and coded in NVivo 12 to delineate the following themes: building type, climate and location, study scale, monitoring and data collection, simulation and calibration, evaluation parameters, and decision-making models. The following section presents the main themes that emerged in the classification and coding process of the selected 34 articles.

FINDINGS

Building Type

Of the 34 selected articles 21 focused on healthcare buildings (Ahmed, Rajagopalan, & Fuller, 2017; Bagnasco et al., 2017; Bjørnskov, Jradi, & Veje, 2022; Calama-González, León-Rodríguez, & Suárez, 2018; Calama-González, León-Rodríguez, & Suárez, 2019; Capozzoli et al., 2016; Fifield, Lomas, Giridharan, & Allinson, 2018; Fraile, San-José, & González-Alonso, 2014; Giridharan, Lomas, Short, & Fair, 2013; Gomes, Rodrigues, & Natividade, 2021; González-Gil et al., 2018; Jain et al., 2021; Jiménez Mejía, Barbero-Barrera, & Rodríguez Pérez, 2020; Kim, Jeon, Cho, & Kim, 2018; Lomas, Giridharan, Short, & Fair, 2012; Niu et al., 2022; Short, Lomas, Giridharan, & Fair, 2012; Valdiserri, Cesari, Coccagna, Romio, & Mazzacane, 2020; Yuan et al., 2022; Zaza, Sepetis, & Bagos, 2022; Zorita, Fernández-Temprano, García-Escudero, & Duque-Perez, 2016), while 6 focused on heritage buildings (Al-Habaibeh et al., 2022; De Masi, Gigante, Ruggiero, & Vanoli, 2020; Kramer, Schellen, & Schellen, 2018; Pisello, Castaldo, Pignatta, & Cotana, 2015; Pisello, Castaldo, Piselli, & Cotana, 2018; Sciurpi, Carletti, Cellai, & Pierangioli, 2015). The six heritage building studies had a sublevel distribution of four museum buildings, one dormitory, and one theatre building. Of the remaining 7 articles, 6 focused on religious buildings (Akande et al., 2016; Almodovar-Melendo, Cabeza-Lainez, & Rodriguez-Cunill, 2018; Bay, Martinez-Molina, & Dupont, 2022; Coelho, Silva, & Henriques, 2018; Diler et al., 2021; Martinez-Molina, Williamson, & Dupont, 2022) and one on shopping centers (Kassai, 2019). Figure 1 presents the distribution of the building types in selected articles and the yearly distribution of focus on healthcare buildings, which stood out with 21 instances in the 34 selected articles.

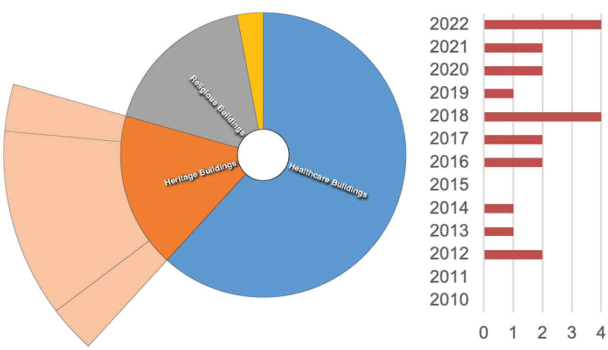

Figure 1. Building types and the distribution of studies on healthcare buildings

Climate and Location

The selected articles were classified based on the climate and location of the case studies. Case studies were conducted in Italy, the UK, and Spain, while other countries were as follows: Australia, China, Denmark, Greece, Hungary, Portugal, Russia, South Korea, Turkey, and the USA.

Table 2. Matrix for location and climate information in reviewed articles

	Humid Continental (Dfb)	Humid Subtropical (Cfa)	Mediterranean (Csa/Csb)	Temperate Oceanic (Cfb)	
Australia				1	1
China	1				1
Denmark				1	1
Greece			1		1
Hungary				1	1
Italy		3	3	1	7
Portugal			2		2
Russia	1				1
S. Korea		1			1
Spain			6		6
Turkey			1		1
UK				7	7
USA		2			2
	2	6	13	11	

Table 2 presents the matrix for the location and climate information for 32 of the selected articles. According to the Köppen-Geiger climate classification, most of the studies were conducted in the Mediterranean (Csa/Csb) and Temperate Oceanic (Cfb) climates (Kottek, Grieser, Rudolf, & Rubel, 2006). Only two studies (Kramer, Schellen, & Schellen, 2018; Niu et al., 2022) were conducted in the Humid Continental Climate (Dfb), which was characterized by four distinct seasons, large seasonal temperature differences, with warm to hot summers and cold winters. Six studies (Bagnasco et al., 2017; Bay, Martinez-Molina, & Dupont, 2022; Capozzoli et al., 2016; Kim et al., 2018; Martinez-Molina, Williamson, & Dupont, 2022; Valdiserri et al., 2020) were conducted in Humid Subtropical (Cfa) climate, which was characterized by hot humid summers and cool to mild winters (Kottek et al., 2006).

Study Scale

Energy performance assessments can be performed at the element, service, room, or whole-building levels. Of the 33 articles reviewed, 17 focused on room-level assessment, 14 on whole-building assessment, and two on service-level interventions. An interesting finding was that studies focusing on healthcare buildings conducted BEP assessments through room-level monitoring and simulation approaches (Ahmed, Rajagopalan & Fuller, 2017; Bagnasco et al., 2017; Calama-González, León-Rodríguez, & Suárez, 2018; Calama-González, León-Rodríguez, & Suárez, 2019; Capozzoli et al., 2016; Fifield et al., 2018; Giridharan et al., 2013; Gomes, Rodrigues, & Natividade, 2021; González-Gil et al., 2018; Jain et al., 2021; Jiménez Mejía, Barbero-Barrera, & Rodríguez Pérez, 2020; Lomas et al., 2012; Niu et al., 2022; Short et al., 2012; Valdisseri et al., 2020).

Monitoring and Data Collection

Monitoring and data collection are regarded as critical components of energy performance studies of existing buildings (Martinez-Molina, Williamson, & Dupont, 2022; Pisello et al., 2015). Aside from providing valuable insight into a building's operational phase, monitoring data also informs energy performance approaches for new designs (Bagnasco et al., 2017). The systematic review of the selected articles revealed three themes that define the monitoring and data collection processes for assessing the energy performance of complex buildings: (1) data collection methods, (2) type of collected data, and (3) monitoring period length. These main themes were also divided into subthemes based on the reviewed articles. The first main theme, **data collection methods** include qualitative (observation and questionnaire) and quantitative (energy bills, sensor-based and web-based data collection) approaches. Six of the 34 reviewed articles collected data using both qualitative and quantitative methods throughout the building performance monitoring process (Capozzoli et al., 2016; Diler et al., 2021; Jain et al., 2021; Kramer, Schellen, & Schellen, 2018; Niu et al., 2022; Martinez-Molina, Williamson, & Dupont, 2022). Akande et al. (2016) relied solely on the questionnaire as the qualitative data collection method, whereas Ahmed, Rajagopalan, and Fuller (2017) relied solely on qualitative data based on observations of the case healthcare building's lighting, equipment, and operation schedules. The remaining studies relied on quantitative data collection methods during the energy performance monitoring process. Table 3 examines the quantitative data collection methods and **types of data collected** in the reviewed articles. Most of the articles concentrate on data collection methods that make use of measurement sensors, particularly to document indoor environmental conditions. The most commonly used indoor environmental conditions to assess the energy performance of complex buildings are temperature and relative humidity (Almodovar-Melendo, Cabeza-Lainez, & Rodriguez-Cunill, 2018; Bay, Martinez-Molina, & Dupont, 2022; Coelho, Silva, & Henriques, 2018; Diler et al., 2021; Fifield et al., 2018; Giridharan et al., 2013; Gomes, Rodrigues, & Natividade, 2021; González-Gil et al., 2018; Jain et al., 2021; Jiménez Mejía, Barbero-Barrera, & Rodríguez Pérez, 2020; Kramer, Schellen, & Schellen, 2018; Lomas et al., 2012; Martinez-Molina, Williamson, & Dupont, 2022; Niu et al., 2022; Pisello et al., 2015; Pisello et al., 2018; Sciurpi et al., 2015; Short et al., 2012; Valdisseri et al., 2020). Furthermore, studies that relied on indoor thermal conditions either collected on-site microclimatic data or obtained meteorological data from the nearest weather station. Other parameters included indoor air quality (IAQ) indicators such as CO2 concentration (Jain et al., 2021; Pisello et al., 2018), indoor air speed (Kramer, Schellen, & Schellen, 2018), particulate matter (Jain et al., 2021; Niu et al., 2022), volatile organic compounds (VOCs) (Jain et al., 2021), ventilation rates (Fifield et al., 2018; González-Gil et al., 2018) and window status (Calama-González, León-Rodríguez, & Suárez, 2019; Fifield et al., 2018; Niu et al., 2022).

Table 3. Matrix for data type, collection methods, and monitoring period length

	Data Collection Methods			Monitoring Period Length	
Type of Collected Data	Energy Bills	Sensor-Based	Web-Based	Long Term	Short Term
Blind Status		1		1	
CO_2 Concentration		2			2
End Use Consumption	5	5	1	7	2
Hot Water		1			1
HVAC Services		5			6
Indoor Air Speed		1			1
Indoor Temperature		19		4	14
Indoor Illuminance		4		2	1
Indoor Radiant Temperature		1			1
Indoor Relative Humidity		17		3	13
Indoor Solar Radiation		1		1	0
Surface Temperatures		5			5
Meteorological Data		7		2	5
Occupant Presence		2		1	1
Outdoor Relative Humidity		5		2	3
Outdoor Solar Radiation		2		1	1
Outdoor Temperature		8		3	5
Particulate Matter (2.5 /10)		2			2
Predicted Mean Vote		1			1
Total VOCs		1			1
Ventilation Rates		2			2
Window Status		3			2

Table 3 also shows the relationship between the monitored parameters and the **monitoring period length**. Most studies concentrated on collecting short-term data and using the monitoring data as a temporal sample to assess a building's annual energy performance. The studies that relied on long-term data conducted a minimum of full-year monitoring for various indoor environmental parameters (Calama-González, León-Rodríguez, & Suárez, 2018; 2019; Bagnasco et al., 2017; Capozzoli et al., 2016; Kim et al., 2018; Zaza, Sepetis, & Bagos, 2022; Zorita et al., 2016; Coelho, Silva, & Henriques, 2018; Diler et al., 2021; Jiménez Mejía, Barbero-Barrera, & Rodríguez Pérez, 2020; Sciurpi et al., 2015; De Masi et al., 2020).

Simulation and Calibration

The most used optimization method to achieve energy performance benchmarks in buildings is building performance simulation (BPS). When calibrated with BEP monitoring data, BPS becomes a highly effective and efficient tool (Ahmed, Rajagopalan & Fuller, 2017). A thorough energy audit, monitoring, and the development of calibrated simulation models are the foundations of a holistic approach to assessing BEP, particularly for existing buildings (De Masi et al., 2020). Therefore, the selected articles were reviewed based on the use of calibrated simulation models and comparison with the monitoring data. Of the 34 articles 17 used BPS software as the means to assess and/or optimize BEP. The most commonly used BPS software were DesignBuilder/EnergyPlus (Ahmed, Rajagopalan & Fuller, 2017; Calama-González, León-Rodríguez, & Suárez, 2019; De Masi et al., 2020; Diler et al., 2021; Jiménez Mejía, Barbero-Barrera, & Rodríguez Pérez, 2020; Sciurpi et al., 2015; Bjørnskov, Jradi, & Veje, 2022; Gomes, Rodrigues, & Natividade, 2021; Pisello et al., 2015), IES VE (Bay, Martinez-Molina, & Dupont, 2022; Giridharan et al., 2013; Lomas et al., 2012; Short et al., 2012) and TRNSYS (González-Gil et al., 2018; Valdisseri et al., 2020). Few studies used daylighting and hygrothermal simulation tools as well (Almodovar-Melendo, Cabeza-Lainez, & Rodriguez-Cunill, 2018; Coelho, Silva, & Henriques, 2018). Ten studies that used simulation optimization also used a calibrated simulation approach based on monitoring data (Bay, Martinez-Molina, & Dupont, 2022; Bjørnskov, Jradi, & Veje, 2022; Coelho, Silva, & Henriques, 2018; De Masi et al., 2020; Diler et al., 2021; Giridharan et al., 2013; Gomes, Rodrigues, & Natividade, 2021; González-Gil et al., 2018; Pisello et al., 2015; Valdisseri et al., 2020) and seven of these studies were conducted in healthcare buildings.

Evaluation Parameters

BEP research in existing buildings typically entails retrofit interventions aimed at lowering consumption and reducing environmental degradation (Al-Habaibeh et al., 2022). The targeted effects can be evaluated across different sets of parameters based on differences in research design. According to the systematic review on BEP evaluation of complex buildings, the most common evaluation parameters were energy consumption (Ahmed, Rajagopalan, & Fuller, 2017; Bagnasco et al., 2017; Bjørnskov, Jradi, & Veje, 2022; Capozzoli et al., 2016; Gomes, Rodrigues, & Natividade, 2021; Jain et al., 2021; Kim et al., 2018; Lomas et al., 2012; Zorita et al., 2016) and indoor temperature profiles Fifield et al., 2018; Giridharan et al., 2013; Gomes, Rodrigues, & Natividade, 2021; Jain et al., 2021; Jiménez Mejía, Barbero-Barrera, & Rodríguez Pérez, 2020; Lomas et al., 2012; Valdiserri et al., 2020), which were mostly found in studies on healthcare buildings (Table 4).

Table 4. Matrix for evaluation parameters, data collection methods, and calibration status

	Building Type				Data Collection		Calibration Status	
Evaluation Parameters	Healthcare	Heritage	Religious	Shopping	Qualitative	Quantitative	Conducted	Not Conducted
Carbon Footprint	3		2		1	4	2	
Daylight Levels	3		1			3		3
Energy Consumption	14	3	3	1	6	16	5	2
Energy Costs	1	2				3		
Energy Demand	3	2				5	3	1
Heat Gains	1					1		1
Indoor Air Flow			1			1	1	
Indoor Air Quality	1				1	1		
Indoor CO_2 Concentration		1				1		
Indoor Illuminance		1				1		
Indoor Relative Humidity	2	1	1		1	4	2	
Indoor Temperature	7	5	3		3	16	7	2
Lighting Consumption	3					2		2
Predicted Mean Vote	1		2		1	3	2	
Supply Temperature	1					1		
Surface Temperature		2				2		
Water Vapor Pressure			1			1	1	
Window Status	1				1	1		

The data collected in these studies was mostly quantitative, and those that used simulation optimization commonly relied on calibrated models. There is a relationship between the monitored parameters and the evaluation parameters, and qualitative data collection was used alongside quantitative data collection methods (Table 4). Other evaluation parameters that received attention were those related to indoor air quality, CO_2 concentration, and thermal comfort and these studies also relied commonly on quantitative data collection (Jain et al., 2021; Pisello et al., 2018; Bay, Martinez-Molina, & Dupont, 2022; Martinez-Molina, Williamson, & Dupont, 2022).

Studies that focused on daylighting levels and lighting consumption (Calama-González, León-Rodríguez, & Suárez, 2018; Calama-González, León-Rodríguez, & Suárez, 2019; Almodovar-Melendo, Cabeza-Lainez, & Rodriguez-Cunill, 2018; Pisello et al., 2018) also focused on quantitative data collection methods, however relied less on calibrated simulation approaches.

Decision-Making Models

Commonly, the use of monitoring data and calibrated simulation approaches for BEP research requires further validation of the approaches (Ahmed, Rajagopalan, & Fuller, 2017), therefore, several studies focus on mathematical and/or statistical models to classify and predict the BEP related data (Niu et al., 2022). Model validation commonly aims to reveal the uncertainties of the simulation's inputs, which are commonly assumed parameters such as air change per hour or solar heat gain coefficients (Coelho, Silva, & Henriques, 2018). Only eleven of the reviewed articles relied on validation of the method for decision-making on BEP levels. The most used approach was sensitivity analysis (Coelho, Silva, & Henriques, 2018; De Masi et al., 2020; Giridharan et al., 2013; Short et al., 2012), followed by descriptive statistics (Calama-González, León-Rodríguez, & Suárez, 2018; Calama-González, León-Rodríguez, & Suárez, 2019). Other approaches included mean absolute and square error (Bjørnskov, Jradi, & Veje, 2022), multi-criteria decision-making (Kim et al., 2018), linear regression, and random effect regression (Zaza, Sepetis, & Bagos, 2022), linear mixed effects model (Capozzoli et al., 2016), and random forest models (Niu et al., 2022).

DISCUSSION

The above-mentioned findings were obtained from the systematic review of the literature on assessing the BEP of complex buildings. There are a few emphases that need to be discussed to conduct further research and address performance gap issues within the research domain. First, most research on the energy performance of complex buildings is based on quantitative data collection methods, with hospital buildings receiving more attention than other building types. This is due to the numerous indoor environmental conditions and requirements that healthcare facilities must navigate and fulfill, which make the particular buildings interesting case studies. Maintaining desired indoor environmental conditions necessitates a challenging operation of services and systems; thus, energy performance research becomes extremely important for healthcare buildings. However, the complexity of functions and activities within healthcare buildings makes whole-building energy performance assessments difficult. Therefore, researchers commonly focused on room-level assessment strategies. A second challenge with complex buildings is data collection. While environmental monitoring may be preferred in healthcare facilities, particularly in heritage and religious buildings, the former necessitates preservation and the latter necessitates privacy; thus, energy performance monitoring becomes more difficult, and researchers prefer to focus on short-term data collection. Furthermore, complex buildings have unique features that require specialized approaches to reduce energy consumption. Reviewed studies often relied on simulation optimization, with only a few relying on additional decision-making models that increased the validity of BEP studies. As a result, model calibration and validity remain significant issues in the reviewed literature, with most calibration approaches relying solely on measured data, ignoring the effects of dynamic components in local climatic conditions and occupancy patterns, making energy performance assessment and optimization difficult for complex buildings. Another significant finding revealed that the reviewed research frequently focused on budlings in temperate climates. There is a research gap for BEP of complex buildings in extreme climatic conditions. Benchmarking and evaluation parameters also follow similar trends with the monitored data. Proposed retrofit or improvement interventions are evaluated over the changes in the measured parameters. A holistic, whole-building assessment approach, on the other hand, necessitates evaluating the effects of single interventions on other parameters such as indoor air quality, daylighting levels, the need for artificial lighting, etc. A shading device, for instance, may help to reduce cooling loads in a patient room but significantly increase lighting loads. As a result, sensitivity analyses should be carried out to assess the negative effects of retrofit interventions as well.

CONCLUSION

The present study presented a systematic analysis of energy performance research on complex buildings in the Web of Science database between 2010 and 2022. The thematic analysis categorized current research efforts via building type, climate and location, study scale, monitoring and data collection, simulation and calibration, evaluation parameters, and decision-making models. The reviewed literature provided a thorough overview of the approaches used to optimize energy use in complex buildings, as well as insights into current research trends and gaps. Overall, the systematic review indicated that there are shortcomings in BEP research on complex buildings, especially in addressing whole-building performance assessment, simulation model calibration, and decision-making processes, such as uncertainty and sensitivity analyses. Further studies on the BEP of complex buildings need to incorporate a more thorough methodological approach, which entails (a) whole-building level BEP assessment, (b) through a long-term energy performance monitoring, (c) with the inclusion of occupant behavior and operational schedules (d) as parameters of simulation model calibration and uncertainty and sensitivity analyses.

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REFERENCES

Ahmed, T. M., Rajagopalan, P., & Fuller, R. (2017). Experimental validation of an energy model of a day surgery/procedure centre in Victoria. *Journal of Building Engineering*, 10, 1-12.

Akande, O. K., Odeleye, D., Coday, A., & Bescos, C. J. (2016). Performance evaluation of operational energy use in refurbishment, reuse, and conservation of heritage buildings for optimum sustainability. *Frontiers of Architectural Research*, 5(3).

Al-Habaibeh, A., Hawas, A., Hamadeh, L., Medjdoub, B., Marsh, J., & Sen, A. (2022). Enhancing the sustainability and energy conservation in heritage buildings: The case of Nottingham Playhouse. *Frontiers of Architectural Research*, 11(1), 142-160.

Almodovar-Melendo, J.-M., Cabeza-Lainez, J.-M., & Rodriguez-Cunill, I. (2018). Lighting Features in Historical Buildings: Scientific Analysis of the Church of Saint Louis of the Frenchmen in Sevilla. *Sustainability*, 10(9).

Bagnasco, A., Catanzariti, R., Coppi, L., Fresi, F., Silvestro, F., & Vinci, A. (2017). Multi facility energy monitoring in medical structures: Defining KPIs for energy saving and exporting best practices. *International Journal of Heat and Technology*, 35 (1), 214-220.

Balvedi, B. F., Ghisi, E., & Lamberts, R. (2018). A review of occupant behavior in residential buildings. *Energy and Buildings*, 174, 495-505.

Bay, E., Martinez-Molina, A., & Dupont, W. A. (2022). Assessment of natural ventilation strategies in historical buildings in a hot and humid climate using energy and CFD simulations. *Journal of Building Engineering*, 51, 104287.

Bjørnskov, J., Jradi, M., & Veje, C. (2022). Component-level re-commissioning of a newly retrofitted Danish healthcare building. *Journal of Building Engineering*, 104277(51).

Calama-González, C.M., León-Rodríguez, Á.L., & Suárez, R. (2018). Daylighting and Energy Performance Evaluation of an Egg-Crate Device for Hospital Building Retrofitting in a Mediterranean Climate. Sustainability, 10, 2714.

Calama-González, C.M., León-Rodríguez, Á.L., & Suárez, R. (2019). Daylighting Performance of Solar Control Films for Hospital Buildings in a Mediterranean Climate. Energies, 12, 489.

Capozzoli, A., Piscitelli, M. S., Neri, F., Grassi, D., & Serale, G. (2016). A novel methodology for energy performance benchmarking of buildings by means of Linear Mixed Effect Model: The case of space and DHW heating of out-patient Healthcare Centres. *Applied Energy*, 171, 592-607.

Chen, S., Zhang, G., Xia, X., Chen, Y., Setunge, S., & Shi, L. (2021). The impacts of occupant behavior on building energy consumption: A review, *Sustainable Energy Technologies and Assessments*, 45, 101212.

Coelho, G. B., Silva, H. E., & Henriques, F. M. (2018). Calibrated hygrothermal simulation models for historical buildings. *Building and Environment*, 142, 439-450.

De Masi, R. F., Gigante, A., Ruggiero, S., & Vanoli, G. P. (2020). The impact of weather data sources on building energy retrofit design: case study in heating-dominated climate of Italian backcountry. s. 264-284.

Diler, Y., Turhan, C., Durmuş Arsan, Z., & Gökçen Akkurt, G. (2021). Thermal comfort analysis of historical mosques. Case study: The Ulu mosque, Manisa, Turkey. *Energy and Buildings*, 111441(252).

Dong, B., Li, Z., & McFadden, G. (2015). An investigation on energy-related occupancy behavior for low-income residential buildings, *Science and Technology for the Built Environment*, 21(6), 892-901.

ECE. (2020). Updated Framework Guidelines for Energy Efficiency Standards in Buildings. Economic Commission for Europe, Committee on Sustainable Energy. Available at: https://unece.org/sites/default/files/2020-12/ECE_ENERGY_GE.6_2020_4e.pdf

Fifield, L.J., Lomas, K.J., Giridharan, R., & Allinson, D. (2018). Hospital wards and modular construction: Summertime overheating and energy efficiency. *Building and Environment*, 141, 28-44.

Fraile, J. C., San-José, J., & González-Alonso, A. (2014). A Boiler Room in a 600-Bed Hospital Complex: Study, Analysis, and Implementation of Energy Efficiency Improvements. *Energies*, 7, 3282-3303.

Giridharan, R., Lomas, K. J., Short, C. A., & Fair, A. J. (2013). Performance of hospital spaces in summer: A case study of a 'Nucleus'-type hospital in the UK Midlands. *Energy and Buildings*, 66, 315-328.

Gomes, M. G., Rodrigues, A. M., & Natividade, F. (2021). Thermal and energy performance of medical offices of a heritage hospital building. *Journal of Building Engineering*, 102349(40).

González-Gil, A., López-González, L. J., Fernández, M., Eguía, O., Erkoreka, A., & Granada, E. (2018). Thermal energy demand and potential energy savings in a Spanish surgical suite through calibrated simulations, Energy and Buildings, 174, 513-526.

Jain, N., Burman, E., Stamp, S., Shrubsole, C., Bunn, R., Oberman, T., Barrett, E., Aletta, F., Kang, J., Raynham, P., et al. (2021). Building Performance Evaluation of a New Hospital Building in the UK: Balancing Indoor Environmental Quality and Energy Performance. *Atmosphere*, 12(1), 115.

Jiménez Mejía, K., Barbero-Barrera, M. M., & Rodríguez Pérez, M. (2020). Evaluation of the Impact of the Envelope System on Thermal Energy Demand in Hospital Buildings. Buildings, 10, 250.

Kassai, M. (2019). Energy Performance Investigation of a Direct Expansion Ventilation Cooling System with a Heat Wheel. Energies, 12, 4267.

Kim, J. R., Jeon, E. C., Cho, S., & Kim, H. (2018). The Promotion of Environmental Management in the South Korean Health Sector—Case Study. *Sustainability*, 10, 2081.

Kottek, M., Grieser, C. J., Rudolf, B. B., & Rubel, F. (2006). World Map of the Köppen-Geiger climate classification updated. *Meteorologische Zeitschrift*, 15, 259-263.

Kramer, R., Schellen, L., & Schellen, H. (2018). Adaptive temperature limits for air-conditioned museums in temperate climates. *Building Research & Information*, 46(6), 686-697.

Li, J., Wang, Q., & Zhou, H. (2020). Establishment of Key Performance Indicators for Green Building Operations Monitoring—An Application to China Case Study. *Energies*, 13(4).

Lomas, K., Giridharan, R., Short, C., & Fair, A. (2012). Resilience of 'Nightingale' hospital wards in a changing climate. *Building Services Engineering Research and Technology*, 33(1), 81-103.

Lu, J., Zhang, C., Li, J., Zhao, Y. Qiu, W., Li, T., Zhou, K., & He, J. (2022). Graph convolutional networks-based method for estimating design loads of complex buildings in the preliminary design stage. *Applied Energy*, 322, 119478.

Manu, S., Brager, G., Rawal, R., Geronazzo, A., & Kumar, D. (2019). Performance evaluation of climate responsive buildings in India - Case studies from cooling dominated climate zones. *Building and Environment*, 148, 136-156.

Martinez-Molina, A., Williamson, K., & Dupont, W. (2022). Thermal comfort assessment of stone historic religious buildings in a hot and humid climate during cooling season. A case study. *Energy and Buildings*, 262, 111997.

Niu, B., Li, D., Yu, H., Mahyuddin, N., Liu, Y., Wu, J., Wang, X., & Pan, S. (2022). Investigation of occupant window opening behaviour during the summer period in a Beijing maternity hospital, *Journal of Building Engineering*,45, 103441.

Pisello, A. L., Castaldo, V. L., Pignatta, G., & Cotana, F. (2015). Integrated numerical and experimental methodology for thermal-energy analysis and optimization of heritage museum buildings. *Building Services Engineering Research and Technology*, 37(3), 334-354.

Pisello, A. L., Castaldo, V. L., Piselli, C., & Cotana, F. (2018). Coupling artworks preservation constraints with visitors' environmental satisfaction: Results from an indoor microclimate assessment procedure in a historical museum building in central Italy. *Indoor and Built Environment*, 27(6), 846-869.

Sciurpi, F., Carletti, C., Cellai, G., & Pierangioli, L. (2015). Environmental monitoring and microclimatic control strategies in "La Specola" museum of Florence, *Energy and Buildings*, 95, 190-201.

Short, C. A., Lomas, K.J., Giridharan, R., & Fair, A.J. (2012). Building resilience to overheating into 1960's UK hospital buildings within the constraint of the national carbon reduction target: Adaptive strategies, Building and Environment, 55, 73-95.

Valdiserri, P., Cesari, S., Coccagna, M., Romio, P., & Mazzacane, S. (2020). Experimental Data and Simulations of Performance and Thermal Comfort in a Patient Room Equipped with Radiant Ceiling Panels. Buildings, 10, 235.

Yan, D., Hong, T., Dong, B., Mahdavi, A., D'Oca, S., Gaetani, I., & Feng, X. (2017). IEA EBC Annex 66: Definition and simulation of occupant behavior in buildings. *Energy and Buildings*, 156, 258-270.

Yoshino, H., Hong, T., & Nord, N. (2017). IEA EBC Annex 53: Total Energy Use in Buildings - Analysis and Evaluation Methods, *Energy and Buildings*, 152, 124-136.

Yuan, F., Yao, R., Sadrizadeh, S., Li, B., Cao, G., Zhang, S., Zhou, S., Liu, H., Bogdan, A., Croitoru, C., Melikov, A., Short, C. A., & Li, B. (2022). Thermal comfort in hospital buildings – A literature review, *Journal of Building Engineering*, 45, 103463.

Zaza, P.N., Sepetis, A., & Bagos, P.G. (2022) Prediction and Optimization of the Cost of Energy Resources in Greek Public Hospitals. Energies, 15, 381.

Zorita, A. L., Fernández-Temprano, M. A., García-Escudero, L. A., & Duque-Perez, O. (2016). A statistical modeling approach to detect anomalies in energetic efficiency of buildings, *Energy and Buildings*, 110, 377-386.

A RESEARCH ABOUT FLEXIBLE DESIGN WITHIN THE CONTEXT OF SUSTAINABILITY

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ABSTRACT

In a world facing the challenges of rapid urbanization and environmental degradation, the integration of sustainability principles into design processes has become imperative. This paper presents a comprehensive investigation of the intersection of flexible design and sustainability, with the aim of developing an understanding of how flexible design strategies can contribute to the creation of environmentally conscious and adaptable built environments. Flexible design is defined as the ability of a structure to adapt quickly to change and ensure long-term use by allowing user intervention. It enables buildings to respond to changing needs and accommodate various functions over time. Flexibility in architecture is essential because not all uses can be foreseen at the design stage, and different needs may emerge over time. Flexible architecture offers several advantages, including long-term use, fitness for purpose, user intervention, adaptability to technological innovation, cost-effectiveness, and environmental sustainability. It is also better able to adapt to changing social and cultural trends. Sustainability in architecture means maintaining the ability of a structure to meet the needs of its users throughout its lifetime. Flexibility has been identified as a fundamental element of building sustainability as it allows structures to adapt to changing needs and preferences, thereby promoting long-term use. Therefore, sustainability and flexibility are considered to be parallel concepts. The objective of the study is to discuss the status and importance of flexible design within the context of sustainability. This study explores flexibility approaches and definitions, categorizing them through examples to demonstrate the importance of flexible design in sustainable architecture.

Keywords: Flexibility; Sustainability; Flexible Design; Sustainability in Architecture.

INTRODUCTION

To effectively conduct our daily activities, it's essential to fulfill our fundamental necessities. Obviously these needs are constantly evolving in today's ever-changing environment. In paralleling with this evolution, as demands and expectations for spaces progress, there is a rising desire for more adaptable and flexible environments. Although the concept of flexibility is not a new idea in architecture, it means the potential for change in a phenomenon. Flexible design is the process of creating a structure that can adapt quickly to changes throughout its lifespan. Thus, long-term use is ensured by allowing user intervention in the building. Flexible design makes it possible for a building to fully respond to changing needs, and the spaces within it can adapt to different functions. Therefore, it is clear that flexible design is required in terms of varying the design to meet user needs and building sustainability. By virtue of flexible design, the problem of meeting changing user requirements and emerging new spatial needs for long-term use can be solved.

Against the functionalist idea that the spatial parts of a building are for certain uses, the idea that not all uses may occur during the design can be predicted and that different needs may occur over time with use has made flexibility a necessity in architectural design (Forty, 2000). Flexible architecture is a design approach that makes it simple for a structure to adapt to changes that occur throughout its lifetime. This approach offers long-term use, is fit for purpose, allows user intervention, benefits from technical innovations, and is economical and ecologically suitable (Kronenburg, 2007). In addition, it has a greater chance of adapting to changing social and cultural trends. Flexibility aims at a design that is most suitable for the user and can adapt to the changes that may occur in long-term use instead of trying to produce the most accurate or beautiful design (Özinal & Erman, 2021). In this context, flexible design occurs as a useful a tool for meeting the changing spatial needs. The fact that the proposed flexible solution to the problem considering the potential change is permanent rather than instantaneous and temporary makes the design sustainable.

As a timely and important concept in today's architecture, sustainability or the sustainability of something, refers to the ability to maintain the current situation and be permanent with self-renovation capabilities. This term plays an important role in the conscious design of the built environment, with its economic, social, and environmental aspects. Sustainable design helps to create a sustainable way of life within a community. The expected performance of a building is the continuation of its capacity to meet all user requirements throughout its lifetime. At this point, flexibility can be expressed as the basic element of the sustainability of a building, as the building can respond to changing needs and preferences and bring long-lasting use (Broome, 2005). Sustainability and flexibility are two directly related concepts because their goals overlap with flexible design. The sustainability of an object requires not only that it can exist forever but also that it should be able to change, transform, and respond to its expected needs. In this regard, objects that can be sustained should keep up with time and adapt to change through their capacity for flexibility. Hence, sustainability and flexibility are considered to be parallel concepts.

In this study, the importance of flexible design, which plays an essential role in the context of sustainability in architecture, is tried to be presented. It examines the role of flexibility in meeting changing user needs, optimizing resource use, and reducing waste. The methodology of this study comprises a literature review and an examination of the selected examples. This paper presents a conceptual framework that integrates flexibility and sustainability.

FLEXIBLE DESIGN APPROACHES IN ARCHITECTURE

The concept of flexibility has introduced a new perspective to architecture by incorporating time, the unknown, and the unpredictable into design (Forty, 2000). The aim of responding to different users or different needs in changing times has led architects to search for flexible design methods. Le Corbusier's projects, in which he applied the ideas of free plan and free facade, which are directly related to the flexible design approach, can be considered among the first modernist examples of flexible design. With its understanding of freedom, it aimed to eliminate the dependence of the plan on the structural system and facade. Corbusier developed a method in which the structural system was fixed and all other parts of the building were interchangeable, supported by an open-plan design to ensure flexibility (İslamoğlu & Usta, 2018).

Habraken supported a method similar to that of user participation. Habraken (1972), in his "Open Building" approach, applies the model of user participation in design and suggests that the building should be designed to be flexible in order to adapt to future and as yet unknown changes. Similar to Corbusier's approach, the open building approach also provides flexibility through the construction of a structural system. Within the limits determined by the open space scenario and the load-bearing system, arrangements can be made in diversity owing to the freedom given to the user. The freedom provided to the user by the load-bearing system is the basis of Habraken's understanding of flexibility

(İslamoğlu ve Usta, 2018). Hertzberger (2009), who had a similar view to Habraken, also defended the idea that the building should be designed in an unfinished state that can be filled by the user according to their needs. He emphasized that the structural system should allow users to make arrangements.

Similarly, Forty (2000) associated flexibility with the technical possibilities of a building. In Forty's approach, the construction of the structural system also plays an important role; however, the technical possibilities expressed by the moveable-changeable quality of the non-fixed building elements are higher in the foreground. In a building, components other than fixed elements, such as load-bearing systems, wet areas, and stairs, become mobile and changeable, allowing different uses for the space. Thus, as another indicator of flexibility, diversity in the use of space was achieved.

Schneider and Till (2007) defined flexibility as the design of the remaining areas of the building, excluding the fixed components (structural system and service volumes), such that the architect can freely organize and use them. In this context, flexible design, together with user-participatory design, supports lifelong use (in the context of both the user life cycle and the life of the structure) and is considered a sustainable design (Schneider & Till, 2005).

Robert Kronenburg defined flexible architecture as the design of a building so that it can easily respond to changes throughout its life. Emphasizing that the user has a say in the construction and use phases and that the building should be designed in a way that is open to intervention, Kronenburg explained the four characteristic features of flexible architecture: adaptability (changeability), transformability, mobility, and interaction. He also emphasized that technological possibilities should be evaluated and that the flexibility of the building can be increased by using these possibilities (Kronenburg, 2007).

In the evaluation of the approaches, it can be seen that the concept of flexibility in architectural design is related to concepts such as adaptation, sustainability, mobility, interaction, modularity, and transformation. In this context, it can be concluded that flexibility in architectural design is essentially an interdisciplinary and multifunctional form of design and, as a result, it often relates to innovative and contemporary design issues (Özinal, 2021).

It can be said that the flexible design approach is seen as a solution tool to enable a building to meet and adapt to the requirements arising from changes in space, user, technology, function, and time. The fact that the proposed solution to the problem created by the change is continuous rather than instantaneous and temporary adds to the sustainability of the design. Considering the above definitions and approaches, flexible design can be defined as a sustainable space design that can adapt to the changing life cycle and allows for user-centered use (Özinal, 2021).

Today, flexibility has entered a new phase, and improved technology offers several options for flexibility. While creating creative solutions with functional and dimensional content in the emphasis of space, flexibility in design has also gained importance in terms of facade elements. Beyond user-centered design, flexibility has become a tool for offering an ecologically sensitive design. With the support of kinetic applications and the multifaceted influence of technology, not only user requirements but also environmental management and sustainable design goals have recently been included in the scope of flexibility (Özinal & Erman, 2021).

WHY FLEXIBILITY?

People constantly change the style and design of their homes in response to a variety of unavoidable circumstances such as self-identification, lifestyle, technological development, and family structure (Habraken et al., 1981). As a result, housing adaptability to accommodate changes is an important requirement. Flexibility allows systems and spaces to have a degree of unpredictability in terms of their future demographic, social, and technical requirements. Consequently, it seeks to extend the life of a building while optimizing the use of resources and energy. Although there is no definitive record of a building's lifespan, scientific studies have shown that the acceptable lifespan of a building is approximately 100 years (Kumar Dhar et al., 2013). According to a 2000 survey, the average lifespan of buildings in Japan, the United States, and the United Kingdom is 30, 55, and 77 years, respectively (Eguchi et al., 2011, as cited in Kumar Dhar et al., 2013). Weather, temperature, and the frequency of natural disasters continue to have a significant impact on longevity. In the context of Cyprus, Saifi et al. (2012) observed that these layout changes are the result of environmental, private, cultural, and social factors. However, these may differ depending on individual preferences for layout design and aesthetics (Kumar Dhar et al., 2013).

Over time, there has been an increase in the number of buildings demolished before their expected lifespan. Owing to limited space and a growing population, it is not possible to stop demolitions. Internal plan adjustments may be possible if the structure is designed with a degree of flexibility. Thus, flexibility allows occupants to benefit from on-demand functionality and prevents destruction (Kumar Dhar et al., 2013).

Özinal (2021), in his study of housing users, found that the majority of participants had moved one or more times in the last 10 years. The participants stated that the reason for moving was that the previous residence could not meet their needs and that a small number of rooms was effective in this situation. When asked if they would like to move from their current residence, the participants indicated that they would not move if they could make the changes they wanted. An inadequate number of rooms and space in the dwelling appear to be the main reasons for moving. It is believed that by designing a dwelling in such a way that it can adapt to the changing needs of the user, the quality of the dwelling is enhanced rather than being a commodity that can be constantly changed. Therefore, the lifelong usability of housing is particularly important and valuable in terms of sustainability.

In their study, Thomsen et al. (2010) find that "life cycle extension by renovation and re-use of existing stock is generally more sustainable, more effective and more efficient as replacement by new construction." According to Schneider and Till (2005), flexibility is more cost-effective in the long run because it limits the obsolescence of the housing stock, and housing will last longer and be less expensive in the long run, minimizing the need for major alterations or relocation. Lans and Hofland (2005) noted that flexible design aims for the durability of construction for up to 200 years. Flexible design helps conserve financial and natural resources, so it is a natural part of a sustainable system.

FLEXIBILITY WITHIN THE CONTEXT OF SUSTAINABILITY

The permanence of the natural and built environments in which we live is of great importance to the continuation of life in the universe. Therefore, the concept of sustainability is now at the forefront of every field. Sustainability, or the ability of something to last, means the ability to maintain the current situation, be permanent, and renew itself. This is an important concept in contemporary architecture. The consequences of global warming and climate change affect every aspect of our lives. To minimize these effects, the idea of a sustainable environment has begun to take hold in architecture, as well as in many other fields. As a result, research and design approaches have emerged that are defined by terms such as sustainable architecture and sustainable buildings (Özinal, 2021) (Figure 1).

Sustainable architecture also refers to a design approach that aims to produce solutions that are suitable for long-term use. The point of this approach is that in designs where sustainability is included as a design criterion, the existing design can be adapted to allow reuse. Considering the cost of reconstruction and the ecological impacts it creates, the importance of sustainable architecture's ability to change, transform, and adapt is quite clear in terms of the world and the world's resources (Cesur, 2012).

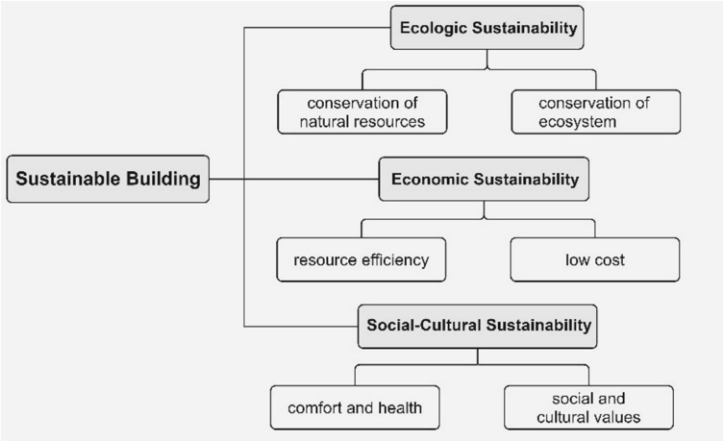

Figure 1. Reflection of sustainable development approach to the building (Özmehmet, 2007)

Sustainable architecture also refers to a design approach that aims to produce solutions that are suitable for long-term use. The point of this approach is that in designs where sustainability is included as a design criterion, the existing design can be adapted to allow reuse. Considering the cost of reconstruction and the ecological impacts it creates, the importance of sustainable architecture's ability to change, transform, and adapt is quite clear in terms of the world and the world's resources (Cesur, 2012).

Although sustainability is more commonly associated with approaches such as "green architecture" and "ecological design," it is derived from the word "duration," which is related to the concept of time. In this direction, sustainable objects should keep up with time and adapt to change. Flexible design, characterized by adaptability, modularity, and responsiveness, offers a promising way to meet these challenges. Consequently, if sustainability aims at efficiency, it does not simply mean energy efficiency. Flexibility, while providing economic efficiency with long-term use, greatly reduces building and industrial waste (Buluklu, 2014). As their aims overlap with flexible design, sustainability and flexibility are two ideas that are inextricably linked.

Involving users in the design process is a requirement for a sustainable design approach. Sustainability is ensured in flexibly designed houses through user participation, which also plays an important role in flexible design approaches (Broome, 2005). Sustainability in housing can be achieved by involving users in the design process and by being able to cope with the economic, social, and environmental changes that may occur during the users' lifetime. Flexibility is therefore directly linked to sustainable social, environmental, and economic factors (Schneider & Till, 2005) (Figure 2).

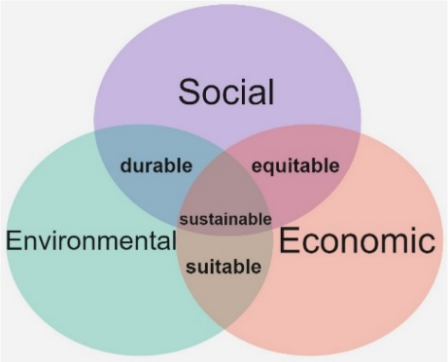

Figure 2. Components of sustainable design (Özinal, 2021)

Social Sustainability: The potential of a building to meet the needs of current and future users determines its capacity for social sustainability. As people age, their physical activities become more limited. Spaces that can easily adapt to the changing needs of users as they age allow them to age in place. This eliminates the need to move, which can be socially and economically disruptive. The social sustainability of a building is made possible through flexible design with user participation.

Environmental Sustainability: The building is designed to minimize waste, conserve energy and water, and reduce greenhouse gas emissions during construction and throughout its lifespan. Additionally, by designing spaces for long-term use, the need for demolition and renovation can be avoided, along with the waste of energy and resources. Environmental sustainability is ensured through design that takes into account the continuity of ecological values.

Economic Sustainability: The building is designed to save money during construction and throughout its lifespan. Economic sustainability is achieved because the organization of space anticipates future changes, reducing the costs of renovation, alterations, and relocations.

These three headings are known components of the sustainability concept. Regarding the relationship between architectural design, flexibility, and sustainability, it is thought that functional sustainability should be added to the main components of sustainability. Besides the former mentioned components, functional sustainability supports buildings' resilience for future uses with unknown users.

Functional Sustainability; can be seen as the prevention of functional obsolescence, which is seen when the building does not respond to needs and does not keep up with life changes. Flexibility increases the lifespan of the building by increasing its potential for regeneration and adaptability. Technological systems and spatial arrangements that allow flexible use of the building support functional sustainability. This ensures the long-term usability of the building and reduces the need to move (Özinal & Erman, 2021).

Through examples linked to sustainable social, environmental, and economic factors, assessing flexibility will be clearer. For instance, the three-storey Ballet Mécanique apartment building in Zurich features dynamic facades that can transform into balconies and sunscreens for five apartments. These movable facade elements can be adapted into balconies, sunshades, or facade cladding according to the users' needs. In this way, by adapting to changing environmental conditions, the relationship between interior and exterior spaces is controlled by the user (Figure 3).

Figure 3. Ballet Mécanique apartment in Zurich (URL-1)

Environmental conditions may force a building to be flexible. The Sharifi-ha House in Iran, an example of such a situation, provides a solution to the formal constraints imposed by the site by offering multiple options for the user's interaction with the environment, despite its location on a very narrow plot. The house consists of units that can be rotated by up to 90 degrees at the user's request to adapt to changing weather conditions. Consequently, the demands of the physical environment in which the house is situated have allowed the design to be enriched by the possibilities of flexible use rather than being limited (Figure 4).

Figure 4. The Sharifi-ha House in Iran (URL-2)

Architect Roberto Rossi's residential project in Italy can rotate 360 degrees and generate its own energy from natural sources. Rossi has found a solution by designing the house to rotate on its own axis in response to the user's desire to change the view's direction. In this way, the user can adjust the view according to their preferences. From a technical perspective, the rotation of the house aids the solar panels on the roof in achieving maximum efficiency by capturing daylight throughout the day. The stored solar energy meets the house's energy needs with the assistance of the technical system employed in the building. This housing project, which enables users to change the house's viewing direction and fulfill its energy requirements through renewable energy sources, serves as an example of flexible design within the context of environmental and economic sustainability (Figure 5).

Figure 5. 360 degree rotating house, Roberto Rossi's residential project in Italy (URL-3)

A House with 3 Walls, a residential project built in Japan, has been designed to be flexible, with an approach that anticipates the future needs of the user. The three curtain walls, which form the primary structural support of the building, incorporate a support system solution that allows the size of the rooms to be modified. This approach achieves an open-plan configuration within the project and enables the addition or removal of a room in the residence based on the user's requirements. Furthermore, the folding and sliding nature of the interior dividing elements, such as doors and internal walls, allows for changes in spatial configuration. The concept of dividing the house into two and transforming it into two separate residences for distinct user groups, in anticipation of a potential reduction in the number of occupants in the future, enables the house to maintain its social and environmental sustainability within its context. This approach also contributes to economic sustainability by eliminating the need for users to relocate as their needs change (Figure 6).

Figure 6. A House with 3 Walls residential project in Japan (URL-4)

Flexibility can be used as a valuable tool to improve the quality of life in housing and to address issues of identity, particularly in mass housing estates with diverse socio-cultural groups. Nemausus (1985-1988) is a social housing project designed by Jean Nouvel in different types of 114 houses (single-storey, two and three-storey) whose core ideas of design are user-centered design and flexibility. Nouvel explains that the flexibility of the design allows the house to be personalized and the user to anticipate how they will live in it in the future. Flexibility in the project provides functional sustainability by meeting the needs of an unidentified and inhomogeneous user profile and by attempting to accommodate other components that cannot be predicted due to the uncertainty of the future (Figure 7).

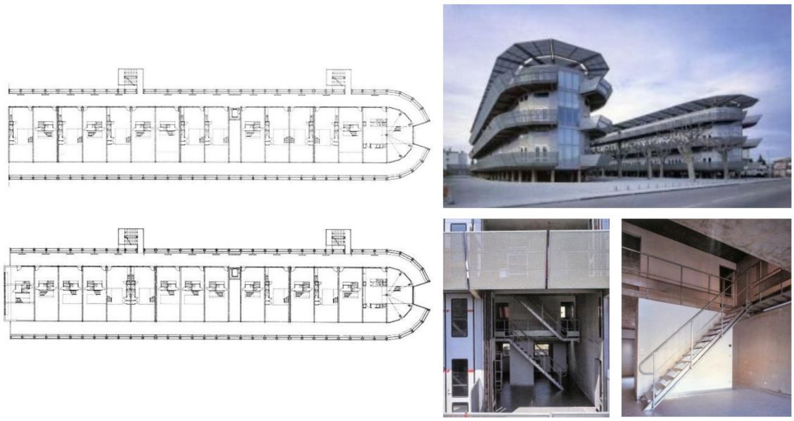

Figure 7. Nemausus social housing project designed by Jean Nouvel (URL-5)

CONCLUSION

The concept of flexibility in architecture is not just a modern trend but a timeless principle deeply rooted in the adaptability of human living environments. As our lives continue to evolve in response to changing circumstances, the built environment must also be able to transform and respond to these changes. This adaptability, often referred to as flexibility in architectural design, plays a vital role in achieving sustainability in various dimensions.

Flexibility in architecture is about creating spaces and structures that can easily adapt to changing user needs, technological advances, and environmental conditions. It ensures that buildings can be used over the long term, reducing waste and optimizing the use of resources. Flexibility is not just a design approach; it is a tool for meeting the ever-changing space needs of buildings and contributing to their sustainability. Sustainability, on the other hand, is about the ability to maintain the status quo while responding to change, and this concept is closely related to flexibility. Buildings designed with flexibility in mind can adapt to demographic changes, technological developments, and evolving user preferences. This adaptability enhances social sustainability by allowing people to age in place and avoid the social disruption caused by frequent moves. It also supports environmental sustainability by reducing the need for demolition and renovation, conserving energy and resources, and minimizing waste. Economic sustainability is achieved through cost-effective designs that anticipate future changes and reduce the costs associated with renovation and relocation. Functional sustainability prevents functional obsolescence by ensuring that a building can adapt to changing needs, thereby extending its life through the increased flexibility provided by technological systems and spatial arrangements, reducing the need for relocation.

In today's world, where change is inevitable and sustainability is paramount, flexibility in architectural design is not just a desirable feature; it's a fundamental requirement. Integrating flexibility and sustainability into architectural concepts is essential to creating built environments that can stand the test of time while minimizing their impact on the planet and enhancing the quality of life for their users. Flexibility is therefore emerging as a key solution to the challenges of our ever-evolving world, helping to create sustainable and adaptable living spaces for generations to come.

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REFERENCES

Broome, J. (2005). Mass housing cannot be sustained. In Architecture and participation (pp. 65-75). New York: Spon Press.

Buluklu, B. (2014). *Konutta kullanıcı katılımı bağlamında esneklik ve iki adımlı ev sunumu sistemi.* [Master's Thesis, Dokuz Eylül University]. YÖK Theses database.

Cesur, F., (2012). *Sürdürülebilir stadyum binalarının üretimi üzerine bir araştırma.* [Master's Thesis, Uludağ University]. YÖK Theses database.

Eguchi, T. , Ill, S.R. , Dainty, A. , Austin, S. and Gibb, A. (2011), "The cultivation of adaptability in Japan", Open House International, Vol. 36 No. 1, pp. 73-85.

Forty, A. (2000). Words and buildings: A vocabulary of modern architecture. London: Thames & Hudson.

Habraken, N. J., (1972). Supports: An Alternative To Mass Housing. Urban International Press, 2nd edition, p124.

Habraken, N.J. , Boekholt, J.T. , Dinjens, P. and Thijssen, A. (1981), Variations: The Systematic Design of Supports, MIT Press, Cambridge, MA.

Hertzberger, H., (2009). Lessons for student in architecture, 010 Publishers, Rotterdam, p272.

İslamoğlu, Ö., Usta, G., (2018). Mimari Tasarımda Esneklik Yaklaşımlarına Kuramsal Bir Bakış. The Turkish Online Journal of Design Art and Communication, 8(4):673-683.

Kronenburg, R. (2007). Flexible: Architecture that Responds to Change. London: Laurence King.

Kumar Dhar, T., Sk. Maruf Hossain, M., & Rubayet Rahaman, K. (2013). How does flexible design promote resource efficiency for housing? A study of Khulna, Bangladesh. Smart and Sustainable Built Environment, 2(2), 140-157.

Lans, W., & Hofland, C. M. (2005). Flexibility, how to accommodate unknown future housing requirements.

Özinal, D. (2021). *Konut Kullanıcısının Esnek Tasarıma Bakışı ve Esnek Kullanım Tercihleri.* [Master's Thesis, Çukurova University]. YÖK Theses database.

Özinal, D., & Erman, O. (2021). Housing flexibility in terms of changes, opportunities, and sustainability of goals and values. Journal of Design for Resilience in Architecture and Planning, 2(2), 187-205.

Özmehmet, E. (2007). Avrupa ve Türkiye'deki Sürdürülebilir Mimarlık Anlayışına Eleştirel Bir Bakış. Yaşar Üniversitesi E-Dergisi, 2(7), 809-826.

Saifi, Y., Yuceer, H. & Bilge, B. (2012), "Flexible social housing as an alternative to mass-produced housing in the walled city of Famagusta", Journal of Applied Sciences, Vol.12 No.17, pp.1869-1881.

Schneider, T., Till, J., (2005). Flexible Housing: Oppourtunities and Limits. Arq: Architectural Research Quarterly, 9(2): 157-166.

Schneider, T., Till, J., (2007). Flexible Housing. Architectural Press, Routledge, United Kingdom, p256.

Thomsen, A., Van der Flier, K. & Ozuekren, A.S. (2010), "Upgrade or replace? The effect of the EPBD on the choice between improvement or replacement", 22nd International Housing Research Conference, Istanbul, July 4-7.

URL-1: https://www.dezeen.com/2018/09/03/ballet-mecanique-moving-walls-manuel-herz-architects-balconies/ date of access 25.05.2023

URL-2: https://www.arkitera.com/proje/sharifi-ha-evi/ date of access 25.05.2023

URL-3: https://worldarchitecture.org/architecture-news/ehcvm/roberto-rossi-completes-a-fully-rotating-house-in-italian-countryside.html date of access 25.05.2023

URL-4: https://www.archdaily.com/106601/kyoto-model-a-house-with-3-walls-shigenori-uoya-miwako-masaoka-takeshi-ikei date of access 25.05.2023

URL-5: https://www.atlasofplaces.com/architecture/nemausus/ date of access 25.05.2023

OCCUPANT SATISFACTION IN THE GREEN AND NON-GREEN BUILDINGS: SYNTHESIZING RESULTS THROUGH META-ANALYSIS

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ABSTRACT

Certified buildings, which are the criterion of the green building system, aim to protect user health, increase user comfort, and reduce water and energy consumption. The satisfaction criteria established as a result of past research have differed in terms of the occupant, and these criteria have significantly affected the occupant's satisfaction. Increasing occupant satisfaction is related to determining satisfaction criteria and the level of impact these criteria have. The criteria affecting the satisfaction of green building users compared to non-green building users and the determination of the effect sizes of these criteria are considered a problem. Hence, in this study, a systematic literature review was conducted to determine satisfaction criteria in green buildings. After that, a meta-analysis was performed based on these criteria' statistical values (population, average, standard deviation). Acoustic comfort, which affects indoor environmental quality and depends on the user's perception, is the criterion by which green building occupants have the lowest level of satisfaction. Visual comfort, indoor air quality, control of the users on the equipment, design of the structure, and efficiency criteria were the ones with the lowest level of satisfaction after acoustic comfort. The criterion with the highest level of satisfaction is the user's perception of health. This criterion is followed, respectively, by thermal comfort, the general condition criterion of the structure, and the criteria of building management. Improvements to the criteria determined to have low satisfaction levels will increase the satisfaction levels of green building occupants and contribute to developing quality-oriented designs.

Keywords: Occupant Satisfaction; Green Building; Meta-Analysis

INTRODUCTION

In light of countries' desires to minimize energy consumption and reduce the utilization of natural resources, the connection between the concepts of sustainability and green building has been established. Sustainability has become a popular area with increased social awareness, increased negative impacts from the built environment, and the development of sustainable building technologies and building materials. Actually, reducing resource use and increasing resource efficiency are the foundations of sustainable design (Webster and Dunn, 2001). Sustainability in the building industry can be attained by making investments that are environmentally and ecologically sound. Utilizing low-energy building materials and meeting energy requirements are crucial for this (Renner et al., 2008). On the other side, there is no single definition of a "green building," according to research on the subject. The U.S. Environmental Protection Agency defines a green building as a structure that is environmentally friendly and efficient in resource utilization throughout its lifecycle (The U.S. Environmental Protection Agency, 2010). The U.S. Green Building Council characterizes green buildings as structures that are constructed and operated with the intent of enhancing environmental, economic, health, and efficiency aspects (The U.S. Green Building Council, 2003). According to Clevenger (2008), while energy and water savings are achieved in green buildings, user health is also taken into consideration by variables like temperature, humidity, indoor air quality, and illumination (Clevenger, 2008). There are various green certification systems, such as Three Star Certified, Green Star, Green Building Label, Casbee, Korean Green Building Certification Criteria, Leed, Breeam, Dgnb, and SBTool. The fundamental aim of all certification systems is to create a sustainable built environment and increase the quality of life for users. Concurrently, these certification systems present measurable performance criteria, thus establishing national benchmarks for green buildings. The construction industry's first step toward contributing to sustainability is the adoption of the green building concept. While green buildings draw attention to the creation of a sustainable built environment (Halicioglu and Gurel., 2023; IEA, 2021b; UNEP, 2021), only design-oriented analyses will not be sufficient to achieve sustainability goals (Halicioglu et al., 2023). The effectiveness of a green building is determined by how much green solutions for its occupants increase the likelihood of desired results and must be consistent with the objectives of energy efficiency and sustainability (Halicioglu et al., 2023). Most of the research focused on green buildings is concentrated on energy, water, and natural resource conservation. However, it should be taken into consideration that criteria for the quality of the indoor environment, such as indoor air quality, visual comfort, acoustic comfort, thermal comfort, user control of devices, building design, and building management, also directly affect user satisfaction.

Maximizing user satisfaction is also closely related to the concept of quality. In this context, the relationship between quality and user satisfaction has gained significance. Quality is the capacity to meet needs and satisfy users (Deming, 1986). On the other hand, satisfaction is the most important step in meeting user needs and ensuring user comfort (Newsham et al., 2009). With the emergence of green certification systems, researchers have focused on examining user satisfaction in certified buildings. Lee (2007) conducted research on 15 LEED-certified structures. In terms of cleaning, upkeep, and office furniture quality, user satisfaction has been seen as positive (Lee, 2007). However, acoustic comfort and thermal comfort criteria gave negative results in terms of user satisfaction. Turner (2006) evaluated the indoor environmental quality of seven LEED-certified buildings, finding negative user satisfaction results in a lack of acoustic comfort (Turner, 2006). Leaman et al. (2007) explored how users assess indoor environmental factors in green buildings. They reported that users' satisfaction with ventilation, temperature, noise, and lighting factors was weak (Leaman et al., 2007). Lee and Kim (2008) compared user satisfaction between 15 LEED-certified and 200 non-certified buildings and pointed out that the quality of office furniture, thermal comfort, cleanliness, and maintenance criteria showed higher levels of user satisfaction, while lighting comfort, acoustic comfort, and office layout criteria exhibited significantly lower levels of satisfaction in certified buildings (Lee and Kim, 2008). Most research on green buildings has primarily focused on energy usage, natural resource consumption (Halicioglu and Gurel, 2023), and cost savings. In a study conducted in Chicago, LEED-certified office, school, and multi-family dwellings were compared with similar conventional buildings. Certified buildings were found to use fewer energy resources (Scofield and Doane, 2018). Another study examined the adoption of green building practices to achieve sustainable development. Due to the high cost of green building development, this study analyzed the economic evaluation of the life cycle of green buildings (Li et al., 2019). At the same time, Clay and his colleagues investigated whether LEED certification really contributes to energy efficiency. It has been concluded that buildings with LEED certificates have high energy efficiency, and the improvements are economically meaningful (Clay et al., 2023). In addition to this, the often overlooked indoor environmental quality has been identified as significantly influencing the quality of sustainable buildings and user satisfaction (Lee and Kim, 2008). For instance, indoor environmental quality is defined as the relationship between building occupants' health and well-being (NIOSH, 2023).

In the green building literature, the number of studies undertaken within the scope of occupant satisfaction is increasing day by day. However, even though these studies examine the same topic, they can yield differing results. This situation necessitates the need to converge these studies towards a single conclusion. In line with this target, this study is aimed at enhancing user satisfaction in green buildings. Within this study, the criteria that influence the satisfaction of users in green buildings compared to users in other types of buildings will be identified, and the magnitudes of the impacts of these criteria will be determined. In light of the results obtained, the aim is to enhance the satisfaction perceptions of green building users to the maximum level by improving the criteria with the lowest satisfaction level in the experimental group of green buildings compared to the control group of non-green buildings.

RESEARCH METHODOLOGY

The study focused on maximizing user satisfaction and determining criteria for achieving a single result. Firstly, the study used systematic literature scanning and then the meta-analysis method.

The Scopus, Web of Science, and Google Scholar databases are used in the systematic literature review study. The "title/abstract/keyword" fields of the Scopus and Web of Science databases were used for searches. The following keywords were used: Construction, Building, Certifi* or Green, occupant or user, satisfaction or comfort, and poe or {post occupancy evaluation}. There were no year restrictions for the study selection. Only peer-reviewed journal publications and studies written in English were included. The search was limited to subjects that directly related to user satisfaction in green buildings. A total of 136 sources were accessed from the Scopus database. Only 100 full-text articles published in peer-reviewed journals were examined, and the full text of four articles could not be reached. In 92 articles, the desired statistical data could not be reached, and therefore these studies were excluded from the scope. The remaining five articles were included in the meta-analysis study. Eight studies were included in the meta-analysis by searching the Google Scholar database with keywords. In the Web of Science database, the full text of only 17 articles published in peer-reviewed journals was examined, and the full text of 10 articles could not be reached, or they were the same as the articles accessed from the Scopus database. The remaining 2 articles were included in the meta-analysis study. Various guidelines are available for systematic literature review and meta-analysis reporting. As seen in Figure 1, the Prisma Protocol was used as a basis for the process of including studies in the meta-analysis.

The meta-analysis method is the combination of research results by the researchers, explaining the diversity in the results obtained, widening the sample size, obtaining more reliable and accurate results, and presenting these results using statistical methods (Dempfle, 2006; Littell et al., 2008). After the systematic literature review was completed in the study, the meta-analysis application steps for the problem and purpose of the study were followed.

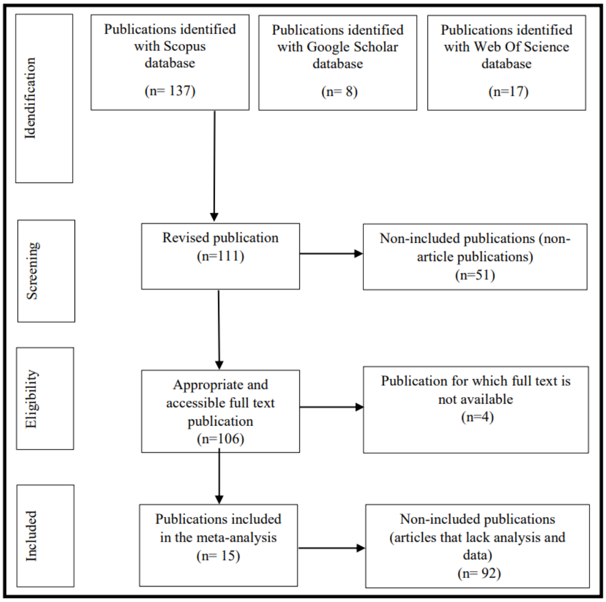


Figure 1. Prisma protocol for systematic literature review and meta-analysis reporting

Definition of Problems

To what extent do the user satisfaction criteria, which are an indicator of quality in green buildings, affect user satisfaction?

Which criteria can be improved to maximize user satisfaction?

Criteria for Inclusion of Studies in the Analysis

Studies included in the scope of the analysis should include: (1) a case study; (2) a sample size consisting of the experimental group (green building users) and control group (non-green building users); (3) statistical data to calculate the effect size of the studies; and (4) examined at least one of the quality factors affecting user satisfaction.

Organization of the Studies for the Analysis

The methods and results of the studies included in the meta-analysis were reviewed. As seen in Table 1, a total of 15 studies are coded with numbers, such as [n]. In cases where the study examined more than one case study, the case studies were represented as (a), (b), and (c). Table 1 also categorizes the criteria examined by the identified 15 studies. Besides, these 15 studies selected for meta-analysis are displayed using the * symbol in the references section.

Table 1. The satisfaction criteria in the reviewed studies

Satisfaction criteria	Sources
USER PERCEPTION	
Thermal Comfort	
General Thermal Comfort	Sant'Anna et al. 2018 [2], Jonsson 2014 [3], Ravindu et al. 2015 [5], Khoshbakht et al. 2018 [7], Sediso and Lee 2016 [9] (a), Sediso and Lee 2016 [9] (b),
The temperature in the studying area during the summer/ winter/ transition season	Bonde and Ramirez 2015 [1], Altomonte and Schiavon 2013 [4], Paul and Taylor 2008 [6], Gou et al. 2013 [8], Menadue et al. 2013 [10], Liu et al. 2018 [11](a), Liu et al. 2018 [11](b), Liu et al. 2018 [11](c), Altomonte et al. 2017 [12], Baird et al. 2012 [13], Xuan 2018[14], Menadue et al. 2014[15],
Temperature Stability	Khoshbakht et al. 2018 [7], Menadue et al. 2013 [10], Baird et al. 2012 [13], Menadue et al. 2014[15],
Temperature Level	Menadue et al. 2013 [10], Menadue et al. 2014[15],
Acoustic Comfort	
Noise level/ General noise/ Acoustic/ Sound in the studying area	Sant'Anna et al. 2018 [2], Jonsson 2014 [3], Altomonte and Schiavon 2013 [4], Ravindu et al. 2015 [5], Paul and Taylor 2008 [6], Khoshbakht et al. 2018 [7], Gou et al. 2013 [8], Sediso and Lee 2016 [9](b), Menadue et al. 2013 [10], Liu et al. 2018 [11](a), Liu et al. 2018 [11](b), Liu et al. 2018 [11](c), Altomonte et al. 2017 [12], Baird et al. 2012 [13], Xuan 2018[14]
Tranquility	Paul and Taylor 2008 [6],
Noise from colleagues	Khoshbakht et al. 2018 [7], Baird et al. 2012 [13],
Noise from other people	Khoshbakht et al. 2018 [7], Baird et al. 2012 [13],
Noise from indoor	Khoshbakht et al. 2018 [7], Baird et al. 2012 [13],
Noise from outside	Khoshbakht et al. 2018 [7], Baird et al. 2012 [13],
Unwanted interrupts	Khoshbakht et al. 2018 [7], Menadue et al. 2013 [10], Baird et al. 2012 [13],
Visual Comfort	
General visual comfort/ Illumination	Sant'Anna et al. 2018 [2], Altomonte and Schiavon 2013 [4], Ravindu et al. 2015 [5], Khoshbakht et al. 2018 [7], Gou et al. 2013 [8], Sediso and Lee 2016 [9](a), Sediso and Lee 2016 [9](b), Menadue et al. 2013 [10], Altomonte et al. 2017 [12], Baird et al. 2012 [13], Xuan 2018[14]
Natural light	Bonde and Ramirez 2015 [1], Jonsson 2014 [3], Paul and Taylor 2008 [6], Khoshbakht et al. 2018 [7], Menadue et al. 2013 [10], Liu et al. 2018 [11](a), Liu et al. 2018 [11](b), Liu et al. 2018 [11](c), Altomonte et al. 2017 [12], Baird et al. 2012 [13],
Artificial light	Bonde and Ramirez 2015 [1], Khoshbakht et al. 2018 [7], Menadue et al. 2013 [10], Liu et al. 2018 [11](a), Liu et al. 2018 [11](b), Liu et al. 2018 [11](c), Baird et al. 2012 [13],
Brightness	Paul and Taylor 2008 [6],

Glare	Paul and Taylor 2008 [6], Khoshbakht et al. 2018 [7], Menadue et al. 2013 [10], Baird et al. 2012 [13],
Air Quality	
General air quality in the studying area	Bonde and Ramirez 2015 [1], Sant'Anna et al. 2018 [2], Jonsson 2014 [3], Altomonte and Schiavon 2013 [4], Ravindu et al. 2015 [5], Khoshbakht et al. 2018 [7], Gou et al. 2013 [8], Sediso and Lee 2016 [9](b), Altomonte et al. 2017 [12], Baird et al. 2012 [13],
Humidty	Paul and Taylor 2008 [6], Liu et al. 2018 [11](a), Liu et al. 2018 [11](b), Liu et al. 2018 [11](c), Menadue et al. 2014[15],
Ventilation/ still - draughty	Ravindu et al. 2015 [5], Paul and Taylor 2008 [6], Baird et al. 2012 [13],
Air movement	Khoshbakht et al. 2018 [7], Menadue et al. 2014[15],
Dry air	Khoshbakht et al. 2018 [7], Baird et al. 2012 [13],
Fresh air	Khoshbakht et al. 2018 [7], Menadue et al. 2013 [10], Liu et al. 2018 [11](a), Liu et al. 2018 [11](b), Liu et al. 2018 [11](c), Baird et al. 2012 [13],
Clean air	Liu et al. 2018 [11](a), Liu et al. 2018 [11](b), Liu et al. 2018 [11](c), Baird et al. 2012 [13],
Air smell	Khoshbakht et al. 2018 [7], Menadue et al. 2013 [10],
BUILDING DESIGN	
Area Layout	
Shared workspace/ open office	Altomonte and Schiavon 2013 [4], Altomonte et al. 2017 [12],
Amount of space available for self-study/storage	Altomonte and Schiavon 2013 [4], Liu et al. 2018 [11](a), Liu et al. 2018 [11](b), Liu et al. 2018 [11](c), Altomonte et al. 2017 [12],/ Khoshbakht et al. 2018 [7],
Availability of meeting rooms	Khoshbakht et al. 2018 [7], Baird et al. 2012 [13],
Desk space	Khoshbakht et al. 2018 [7], Baird et al. 2012 [13],
Layout	Sediso and Lee 2016 [9](b),
Privacy/ Visual and sound privacy	Ravindu et al. 2015 [5]/ Altomonte and Schiavon 2013 [4], Liu et al. 2018 [11](a), Liu et al. 2018 [11](b), Liu et al. 2018 [11](c), Altomonte et al. 2017 [12],/ Altomonte and Schiavon 2013 [4], Altomonte et al. 2017 [12]
Amount of Light	Altomonte and Schiavon 2013 [4], Altomonte et al. 2017 [12]
Ease of interaction with colleagues	Altomonte and Schiavon 2013 [4], Liu et al. 2018 [11](a), Liu et al. 2018 [11](b), Liu et al. 2018 [11](c), Altomonte et al. 2017 [12],
Outside view/ View	Ravindu et al. 2015 [5], Khoshbakht et al. 2018 [7], Menadue et al. 2013 [10],
Space Furniture	
Furniture/ Furniture comfort	Ravindu et al. 2015 [5], Khoshbakht et al. 2018 [7], Sediso and Lee 2016 [9](a), Sediso and Lee 2016 [9](b), Liu et al. 2018 [11](a), Liu et al. 2018 [11](b), Liu et al. 2018 [11](c), Baird et al. 2012 [13]/ Altomonte and Schiavon 2013 [4]
Colors and textures of upholstery, furniture and surface finishes	Altomonte and Schiavon 2013 [4], Paul and Taylor 2008 [6], Liu et al. 2018 [11](a), Liu et al. 2018 [11](b), Liu et al. 2018 [11](c), Altomonte et al. 2017 [12],
Furniture adjustability	Altomonte and Schiavon 2013 [4],
Ergonomics	Sant'Anna et al. 2018 [2],
Building Design/ Beauty/ Image for visitors	Altomonte and Schiavon 2013 [4], Paul and Taylor 2008 [6], Khoshbakht et al. 2018 [7], Gou et al. 2013 [8], Menadue et al. 2013 [10], Altomonte et al. 2017 [12], Baird et al. 2012 [13], Xuan 2018[14]
Needs	Khoshbakht et al. 2018 [7], Gou et al. 2013 [8], Menadue et al. 2013 [10], Baird et al. 2012 [13], Xuan 2018[14]

Space in the building/Indoor public space	Khoshbakht et al. 2018 [7], Sediso and Lee 2016 [9](b), Baird et al. 2012 [13], Xuan 2018[14]
Indoor Traffic	Liu et al. 2018 [11](a), Liu et al. 2018 [11](b), Liu et al. 2018 [11](c),
Accessibility	Sediso and Lee 2016 [9](a),
Requirements/ Opportunities to Meet Needs	Ravindu et al. 2015 [5], Khoshbakht et al. 2018 [7], Menadue et al. 2013 [10], Baird et al. 2012 [13]
USER CONTROL ON TECHNOLOGIES	
Control Over Internal Environment	Ravindu et al. 2015 [5], Liu et al. 2018 [11](a), Liu et al. 2018 [11](b), Liu et al. 2018 [11](c), Baird et al. 2012 [13], Xuan 2018[14]
Ease of use of devices	Bonde and Ramirez 2015 [1],
USER'S PERCEPTION OF HEALTH AND PERFORMANCE	
Health	Khoshbakht et al. 2018 [7], Gou et al. 2013 [8], Menadue et al. 2013 [10], Baird et al. 2012 [13]
Productivity	Khoshbakht et al. 2018 [7], Gou et al. 2013 [8], Menadue et al. 2013 [10], Liu et al. 2018 [11](a), Liu et al. 2018 [11](b), Liu et al. 2018 [11](c), Baird et al. 2012 [13], Xuan 2018[14]
BUILDING MANAGEMENT	
Cleanliness	Sant'Anna et al. 2018 [2], Altomonte and Schiavon 2013 [4], Ravindu et al. 2015 [5], Khoshbakht et al. 2018 [7], Liu et al. 2018 [11](a), Liu et al. 2018 [11](b), Liu et al. 2018 [11](c), Altomonte et al. 2017 [12], Baird et al. 2012 [13], Xuan 2018[14]
Maintenance	Altomonte and Schiavon 2013 [4], Khoshbakht et al. 2018 [7], Liu et al. 2018 [11](a), Liu et al. 2018 [11](b), Liu et al. 2018 [11](c),
Request for changes in the building	Khoshbakht et al. 2018 [7],
Speed of response to problems	Khoshbakht et al. 2018 [7],
Impact of response to problems	Khoshbakht et al. 2018 [7],
User behavior change	Khoshbakht et al. 2018 [7],
Cleaning and Maintenance	Sediso and Lee 2016 [9](a), Sediso and Lee 2016 [9](b),
Security	Khoshbakht et al. 2018 [7], Xuan 2018[14]
GENERAL STRUCTURE OF THE BUILDING	
Overall Satisfaction	Jonsson 2014 [3], Paul and Taylor 2008 [6], Khoshbakht et al. 2018 [7], Gou et al. 2013 [8], Sediso and Lee 2016 [9](a), Sediso and Lee 2016 [9](b), Menadue et al. 2013 [10], Liu et al. 2018 [11](a), Liu et al. 2018 [11](b), Liu et al. 2018 [11](c), Baird et al. 2012 [13], Xuan 2018[14]

Converting the data obtained from the studies to a defined standard format

The data obtained in order to compare whether the studies used within the scope of the analysis comply with the determined criteria are collected in a common format.

Meta-Analysis Application

Effect sizes were calculated using the information obtained from the study. Cohen's d and Hedges' g techniques are employed, with the formulas below (Borenstein et al., 2009).

(1) $$d = \frac{\overline{X1} - \overline{X2}}{Swithin}$$

d (Cohen's d) is effect size and, and is the average of the sample experimental group and control group survey data. represents the difference and heterogeneity between studies.

(2) $$Swithin = \sqrt{\frac{(n1-1)S1^2 + (n2-1)S2^2}{n1+n2-2}}$$

where the Swithin is calculated by including the sample size of the experimental and control groups (n1, n2,..) and the standard deviations of the respective samples (S1, S2…). With the obtained data, Cohen's d (effect size) is calculated in equation (1).

(3) $$Vd = \frac{n1+n2}{n1n2} + \frac{d^2}{2(n1+n2)}$$

Vd represents heterogeneity, taking into account the internal variability of the studies and the magnitude of the impact. is sample size of the experimental and control groups. d represents effect size.

(4) $$SEd = \sqrt{Vd}$$

Vd represents the default error value of the effect size. At this point, Hedges g is used to avoid high effect size values (calculated with Cohen d) due to small sample sizes.

(5) $$J = 1 - \frac{3}{4df-1}$$

The term "J" refers to the corrected Cochran's Q statistics. Cochran's Q statistics are used to evaluate heterogeneity and measure differences between studies. df is the degree of freedom. This is calculated as a deficit of the amount of study used

(6) $$df = n1 + n2 - 2$$

The degree of freedom is a value that reflects the complexity and freedom of the model in statistical analysis. In this case, the degree of freedom is calculated by subtracting two of the sum of the sample sizes n1 and n2.

(7) $$g = J\,x\,d$$

g represents Hedges' g statistics, a statistic representing the size of the effect. J refers to a corrected version of Cochran's Q statistics. d represents Cohen's d statistics, a statistic that representing the size of the effect.

(8) $$Vg = J^2 x\, Vd$$

The term "Vg" refers to the estimated heterogeneity variance. The term "J" represents the corrected Cochran's Q statistics, and the term "Vd" refers to the internal variance of the studies.

(9) $$SEg = \sqrt{Vg}$$

The term "SEg" refers to the standard error value of the effect size. Vg is a statistic representing the estimated heterogeneity variance. According to Cohen and his friends, the size of the effect is classified as follows;

· 0 ≤ effect size value ≤ 0.20 is a poor effect,

· 0.21 ≤ effect size value ≤ 0.50 is modest effect,

· 0.51 ≤ effect size value ≤ 1.00 is moderate effect,

· 1.01 ≤ effect size value is strong effect (Cohen et al., 2007).

The use of the random effects model is preferred because the studies show changes both between themselves and within themselves. Additionally, in this study, non-green building users are designated as the control group, while the experimental group consists of green building users. The positive outcome of the effect size value indicates that the satisfaction of green building users is higher than that of non-green building users; conversely, a negative outcome indicates that the satisfaction of non-green building users is higher than that of green building users. The collected data is processed using the R programming language. In the identified studies, each comparison between green and non-green buildings is treated as an individual case study. If the sub-criteria examined within the scope of each case study have more than one component, the arithmetic average of the relevant data is taken. Within the scope of each criterion, case studies that are satisfied by green building users are defined as positive, and case studies of criteria that are satisfied by non-green building users are defined as negative.

Evaluation of Study Differences

After the analysis is completed, homogeneity and heterogeneity tests are performed. If there is heterogeneity, this situation is investigated and publication bias is tested (Şahin, 2005; Mittlböck, & Heinzl, 2006; Rücker et al., 2008). For the heterogeneity test, the p-value statistics of Chocran Q, I^2 and tau^2 are checked. The I^2 value ranges from 0% to 100%, and a value close to 0 indicates that the variability is due to sampling error or chance. When this value approaches 100, it shows that it is due to real heterogeneity between studies. Heterogeneity levels are categorized as low (0%–40%), moderate (30%–60%), adequate (50%–90%), and high (75%–100%) (Cooper et al., 2009). The number of studies analyzed has an impact on the Chocran Q (P-value) value. As a result, the power of the test is low if there are few studies included in the analysis and high if there are many. Heterogeneity is shown by a P-value of 0.1. It is advised to use 0.1 rather than 0.05 due to the test's low power. According to Borenstain, the Q value should not be used alone as a measure of heterogeneity, other values revealing heterogeneity should also be calculated (Borenstein et al. 2010). Tau^2 is the absolute measure of variation between studies. When the value is 0, the test is homogeneous; and when $tau^2>0$, the test is heterogeneous (Kılıçkap, 2018; Borenstein et al., 2009).

FINDINGS AND DISCUSSION

In this section, the definition and scope of the criteria affecting the comfort of green building users and the findings of the meta-analysis are presented.

Thermal Comfort: Thermal comfort is related to many variables such as climate, season, gender, and age. In addition, average radiant temperature, relative humidity, air velocity, metabolic temperature, and clothing type are also factors that affect thermal comfort (Katafygiotou and Serghides, 2014). As a result of the meta-analysis (Figure 2) conducted with a total of 18 case studies, it is concluded that the thermal comfort in green buildings is negative in 6 of the studies and positive in 12 of them. However, when all the studies are brought together, the effect size of the satisfaction of green building users on thermal comfort compared to other building users is +0.53 (the standard deviation value is 0.28), and the satisfaction level is moderate. The confidence interval is between -0.02 and +1.08. At the same time, as a result of the analysis, it is determined that the studies have a high degree of heterogeneity since P value < 0.1, $tau^2 > 0$ and I^2 value = 99.63%.

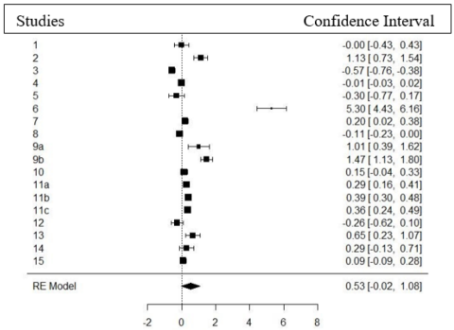


Figure 2: Forest plot of users' thermal comfort satisfaction

Indoor Air Quality: Indoor air quality is defined as "the comfortable range of air inside a building for temperature, humidity, ventilation, and chemical or biological pollutants" (Anderson et al., 2014). Indoor air quality in green buildings is found to be negative in 3 case studies and positive in 13 studies (Figure 3). When all the studies are put together, the effect size of the satisfaction of green building users on indoor air quality compared to non-green building users is +0.30 (the standard deviation value is 0.09), and it has a modest effect. The confidence interval is between +0.10 and +0.49. Since the P value is < 0.1, $tau^2 > 0$, and I^2 value is 96.63%, these studies also have a high degree of heterogeneity.

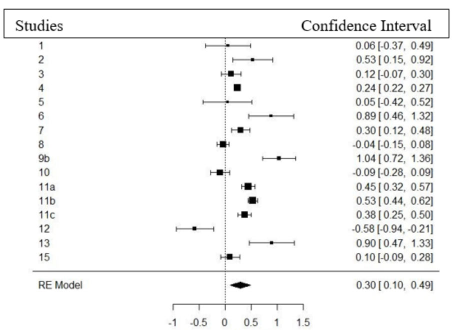


Figure 3: Forest plot of users' indoor air quality satisfaction

Acoustic Comfort: The factors impacting acoustic comfort include ambient sound level, sound transmission between spaces, sound echoes, and noise from office equipment (Preiser et al., 1988). The analysis shows that 7 of the 15 case studies are negative, while 8 are positive (Figure 4). In other words, when the case studies are considered individually, the level of acoustic comfort for green and certified building users is not significantly different from that of other building users. When all of the studies are considered, the effect size of user satisfaction with acoustic comfort in green or certified buildings is +0.10 (the standard deviation value is 0.08) and has a poor effect. The confidence interval is between -0.06 and +0.27. Since P value < 0.1, tau² > 0 and I² value= 95.19%, the studies have a high degree of heterogeneity.

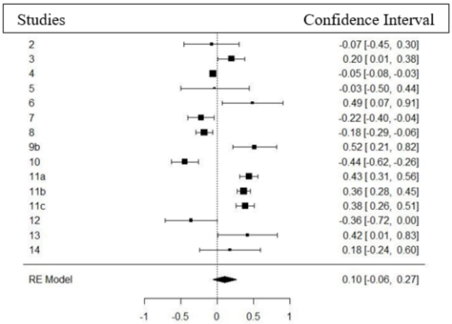


Figure 4: Forest plot of users' acoustic comfort

Visual Comfort: It is another criterion that affects user performance, productivity, and satisfaction (Veitch, 2001). Based on the analysis, the satisfaction effect size of green building users compared to other building users is +0.23 (the standard deviation value is 0.09) and has a modest effect (Figure 5). The confidence interval is between +0.04 and +0.42. Since the p value < 0.1, tau² > 0 and I² value= 96.29%, the studies have a high degree of heterogeneity.

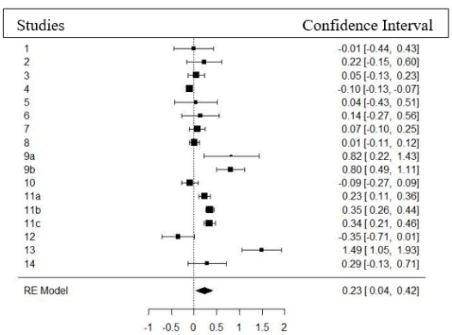


Figure 5: Forest plot of users' visual comfort

Building Design: The layout of the space, accessibility to areas such as furniture and storage, and being happy with the location, size, shape, layout, and details of these areas affect the user's satisfaction with the building's design and behavior (Preiser et al. 1998). Only 2 of the 15 case studies are negative (Figure 6). At the same time, the majority of green or certified building users are more satisfied with the design of the building than non-green building users. As a result of the calculations, the effect size of satisfaction of green building users compared to other building users is +0.36 (the standard deviation value is 0.08) and has a modest effect. The range of the confidence interval is from +0.20 to +0.52. The studies show a significant degree of heterogeneity because the p value < 0.1, tau2 > 0, and I2 value= 93.99%.

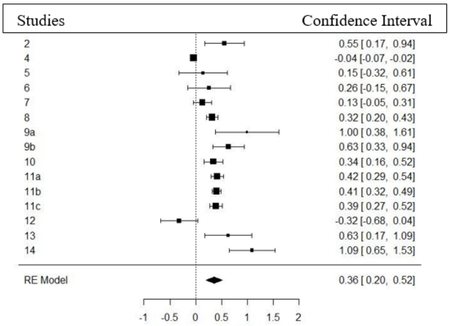


Figure 6: Forest plot of users' satisfaction with building design

User Control Over Technology: It is the capability for users to simply locate and utilize control equipment, as well as to regulate equipment in accordance with their own preferences and level of comfort. The user's productivity and health are also impacted by this. Among the reviewed studies, only 7 case studies examined this criterion. In the result obtained by combining these 7 studies, only 1 study is negative (Figure 7). As a result of the analysis, the satisfaction effect size of green building users' control over equipment compared to non-green building users is +0.30 (the standard deviation value is 0.12) and has a modest effect. The confidence interval is between +0.06 and +0.54. Since the P value < 0.1, tau² > 0, and I² value= 90.80%, the studies have a high degree of heterogeneity.

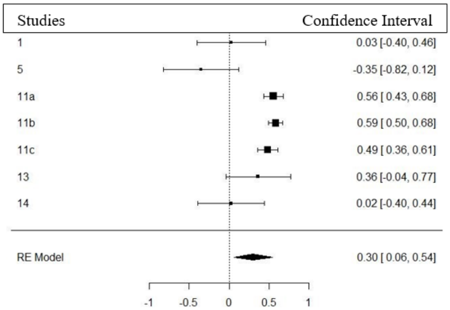
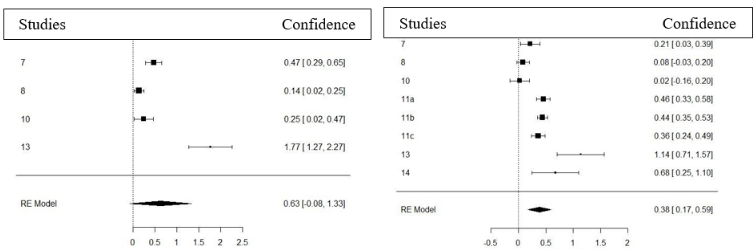


Figure 7: Forest plot of users' satisfaction with control over devices

Perception of Health and Productivity: According to studies, the criteria that affect occupant satisfaction also have an impact on occupant health and productivity. The effect size of the user's perception of health in green buildings compared to non-green buildings is +0.63 (the standard deviation value is 0.35) and has a moderate effect, and the confidence interval is between -0.08 and +1.33 (Figure 8a). For users' health perception, the studies have a high degree of heterogeneity, as the P value < 0.1, tau² > 0, and I² value= 97.97%. Since only a few studies have examined the user's perception of health, the results obtained may differ in studies with larger samples. The effect size of the productivity perception of green building users compared to other building users is +0.38 (the standard deviation value is 0.10) and has a modest effect, and the confidence range is between +0.17 and +0.59 (Figure 8b). Similarly, studies of productivity perception show a high degree of heterogeneity since the P value is < 0.1, tau2 > 0, and I2 = 93.40%.



(a) (b)

Figure 8: Forest plot of users' perception of health(a) and productivity(b)

Building Management: The management of the building is one of the criteria that affects user satisfaction and comfort. Lai and Pang defined maintenance as "activities that can prevent the decay of buildings, reduce breakdowns, and eliminate safety hazards" (Lai and Pang, 2010). Out of 12 case studies, only one study is found to be negative. Considering all the research, the effect size of user satisfaction with building management in green buildings compared to other buildings is +0.40 (the standard deviation value is 0.08) and has a modest effect, and the confidence interval is between +0.23 and +0.57 (Figure 9). The studies have a high degree of heterogeneity, as the p value < 0.1, tau² > 0, and I² value= 93.12%.

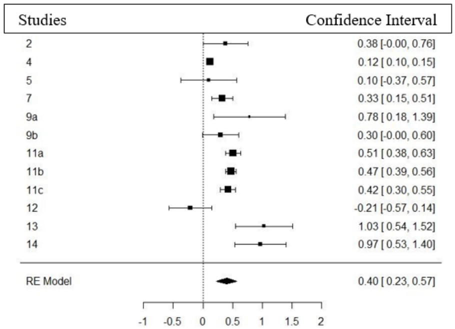


Figure 9: Forest plot of users' building management satisfaction

General Structural of Building: In accordance with this criterion, the overall satisfaction of users is examined. In these studies overall satisfaction includes the user's general comfort and well-being, the user's productivity and performance, as well as the user's perception of health. As a result of the analysis, only 2 of the 12 case studies are negative, as shown in Figure 9. Considering all of the studies, the effect size of the user's overall satisfaction in green buildings compared to non-green buildings is +0.43 (the standard deviation value is 0.10) and has a modest effect, and the confidence interval is between +0.21 and +0.64 (Figure 10).

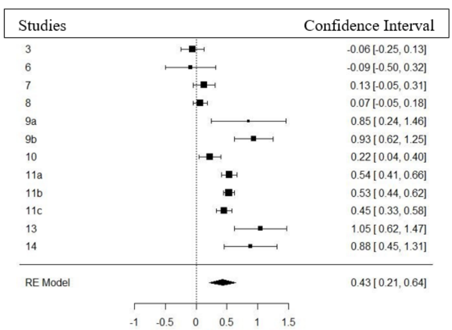


Figure 10: Forest plot of users' overall satisfaction

Since the p value < 0.1, $tau^2 > 0$ and I^2 value= 94.20%, the studies have a high degree of heterogeneity. Table 2 summarizes the results of the meta- analysis.

Based on the size and levels of effect of the criteria examined, it is concluded that green building users are more (moderately) satisfied with thermal comfort and health perception criteria compared to non-green building users. Acoustic comfort, a criterion that falls under the user's perception criterion, has the lowest level of satisfaction.

Table 2. Effect size and level of satisfaction criteria as a result of analysis

Satisfaction Criteria	Effect Size	Effect Level	Number of Negative Case Studies	Number of Positive Case Studies
Thermal Comfort	+0.53	Moderate effect	6	12
Indoor Air Quality	+0.30	Modest effect	3	13
Acoustic Comfort	+0.10	Poor effect	7	8
Visual Comfort	+0.23	Modest effect	4	13
Building Design	+0.36	Modest effect	2	13
User Control Over Technology	+0.30	Modest effect	1	
Perception of Health	+0.63	Moderate effect	0	4
Perception of Productivity	+0.38	Modest effect	0	8
Building Management	+0.40	Modest effect	1	11
General Structural of Building	+0.43	Modest effect	2	10

Visual comfort, indoor air quality and user control over technology come after acoustic comfort. In green buildings, user satisfaction is determined to be poor in terms of indoor air quality, acoustic - visual comfort and user control over technology. Therefore, the reasons for dissatisfaction with the established criteria need to be identified and improved. This will contribute to increased user satisfaction.

The most important factor that determines the validity of the meta-analysis is how well the studies involved represent the population. (Robinson et al., 2008). Funnel graphics and Fail-Safe N calculations are used to verify the bias of the studies included in the analysis. Since 18 case studies are included in the analysis, only the funnel plots of criteria with more than 10 case studies (thermal, acoustic, and visual comfort; indoor air quality; building design, building management, and general structural of buildings) are analyzed. Fail-Safe N is calculated according to the Orwin approach. A very regular symmetry is not achieved when the satisfaction criteria's funnel plots are examined. In spite of this, the number of studies used in the analysis and fail-safe N calculations indicate that this study still has certain power. However, examining the resulting heterogeneity and the inclusion in the meta-analysis of all the work done in this work (article, thesis, book, conference) is important to clearly demonstrate the power of the study.

CONCLUSIONS

In this study, a meta-analysis application is carried out to obtain a single result from the survey results made to measure the satisfaction of green building and non-green building users. User satisfaction is examined under 6 main criteria. These criteria are user perception (thermal - acoustic - visual comfort, and air quality), building design, user control over technology, user perception of health and productivity, building management, and general building structure. As a result of the analysis, users of green buildings are found to be less satisfied with the acoustic comfort, which has an impact on the quality of the indoor environment and is dependent on the user's perception. This criterion is followed by visual comfort, indoor air quality and user control over technology respectively. Increased and improved emphasis on acoustic, visual comfort, indoor air quality and user control over technology criteria in green buildings will be an important step towards increasing user satisfaction.

Data collected from some studies are approximate calculated (Bonde et al., 2015; Sant'Anna et al. 2018; Ravindu et al., 2015; Paul et al., 2008). Only articles published in peer-reviewed journals are included in the analysis. Books, conference proceedings and theses are not included in the analysis. The analysis only contained 15 papers, thus the results should not be generalized because of this. The satisfaction of users of green buildings versus users of non-green buildings can be discussed more generally by including all pertinent studies in the analysis. At the same time, according to the information obtained from the analysis of each criterion, the study has a heterogeneous structure This heterogeneity may be due to the types of certificates the case studies have, their location, season, climate, or even the gender of the users. According to these variables, it is important to investigate the satisfaction of the users and the heterogeneity of the study.

REFERENCES

Anderson, A., Cheung, A., & Lei, M. (2014). Evaluation of Hong Kong's indoor air quality management programme: Certification scheme, objectives, and technology. Bachelor of Science Project Report, *Worcester, MA: Polytechnic Institute*.

* Altomonte, S., & Schiavon, S. (2013). Occupant satisfaction in LEED and non-LEED certified buildings. *Building and Environment, 68*, 66-76.

* Altomonte, S., Saadouni, S., Kent, M. G., & Schiavon, S. (2017). Satisfaction with indoor environmental quality in BREEAM and non-BREEAM certified office buildings. *Architectural Science Review, 60*, 343 - 355.

* Baird, G., Leaman, A., & Thompson, J. (2012). A comparison of the performance of sustainable buildings with conventional buildings from the point of view of the users. *Architectural Science Review, 55,* 135 - 144.

* Bonde, M., & Ramirez, J. (2015). A post-occupancy evaluation of a green rated and conventional on-campus residence hall. *International journal of sustainable built environment, 4*, 400-408.

Borenstein, M., Hedges, L. V., Higgins, J. P. T., & Rothstein, H. R. (2009). *Introduction to Meta-Analysis*. Chichester: Wiley

Borenstein, M., Hedges, L. V., Higgins, J. P., & Rothstein, H. R. (2010). A basic introduction to fixed-effect and random-effects models for meta-analysis. *Research synthesis methods, 1 (2),* 97-111.

The National Institute for Occupational Safety and Health (NIOSH). (2023). *Indoor Environmental Quality, Overview.* available at: https://www.cdc.gov/niosh/topics/indoorenv/overview/ (accessed 5 March 2023).

Clay, K., Severnini E., Sun, X. (2023). Does LEED certification save energy? Evidence from retrofitted federal buildings. *Journal of Environmental Economics and Management, 121:102866.*

Clevenger, C. (2008). Leadership in energy and environmental design. available at: http://seedconsortium.pbworks.com/w/file/fetch/44727508/LEED.pdf *(accessed 20 August 2023).*

Cohen, L., Manion, L., & Morrison, K. (2007). *Research methods in education (6th Edition)*. New York: Routledge.

Cooper, H., Hedges, L. V., & Valentine, J. C. (Eds.). (2009). *The handbook of research synthesis and meta analysis (2nd ed.)*. New York: Russell Sage Publication.

Deming, W. E. (1986). *Out of the crisis*. Cambridge: MA: Center for Advanced Engineering Study, Massachusetts Institute of Technology.

Dempfle, A. (2006). *Evaluation of methods for meta-analysis of genetic linkage studies for complex diseases and application to genome scans for asthma and adult height.* Doctoral Dissertation, Universitat Marburg.

* Gou, Z., Prasad, D., & Lau, S. (2013). Are green buildings more satisfactory and comfortable?. *Habitat International, 39,* 156-161.

Halicioglu, F.H., Demirkapı, H. B., Gurel, K., Kasul, N. (2023). Exploring Key Quality Indicators (KQIS) in Green Office Buildings Through Pareto Analysis. Architecture, Civil Engineering, Environment, vol.16, no.2, pp.15-27. https://doi.org/10.2478/acee-2023-0012

Halicioglu, F.H. & Gurel, K. (2023). The perceived quality of green buildings: from a review of occupant satisfaction towards a conceptual framework. *International Journal of Quality & Reliability Management*, July, Vol. ahead-of-print No. ahead-of-print. https://doi.org/10.1108/IJQRM-10-2022-0307

IEA - International Energy Agency (2021b), “World energy outlook 2021”, available at: https://iea.blob. core.windows.net/assets/4ed140c1-c3f3-4fd9-acae-789a4e14a23c/WorldEnergyOutlook2021.pdf (accessed August 2023).

Katafygiotou, M. C., & Serghides, D. K. (2015). Bioclimatic chart analysis in three climate zones in Cyprus. *Indoor and Built Environment, 24(6),* 746–760.

* Khoshbakht, M., Gou, Z., Xie, X., He, B., & Darko, A. (2018). Green Building Occupant Satisfaction: Evidence from the Australian Higher Education Sector. *Sustainability, 10(8)*, *2890.*

Kılıçkap, M. (2018). Meta-analizleri nasıl yorumlayalım: Türkiye’de kardiyovasküler risk faktörlerine yönelik yapılan meta-analizlerin metodolojik açıdan değerlendirilmesi*. Türk Kardiyoloji Derneği Arşivi, 46(7),* 624-635.

Leaman, A., Thomas, L., & Vandenberg, M. (2007). 'Green' buildings: What Australian users are saying. *Australian Institute of Refrigeration, Air Conditioning and Heating Inc. EcoLibrium®. 6(10),* 22-30.

Lee, Y. S. (2007). The relationship between indoor environmental quality and worker satisfaction and performance in Leadership in Energy and Environmental Design (LEED)-certified buildings. (Unpublished doctoral dissertation). *University of Minnesota, Twin Cities.*

Lai, A. W.Y., & Pang, P. S.M. (2010). Measuring Performance for Building Maintenance Providers. *Journal of Construction Engineering and Management, 136(8),* 864-876.

Lee, Y.S., & Kim, S. (2008). Indoor Environmental Quality in LEED-Certified Buildings in the U.S. *Journal of Asian Architecture and Building Engineering, 7(2)*, 293 - 300.

Li, S., Lu, Y., K, H. W., Chang, R. (2020). The economics of green buildings: A life cycle cost analysis of non-residental buildings in tropic climates. *Journal of Cleaner Production,* 252, 119771.

Littell, H. J., Corcoran, J., & Pillai, V. (2008). Systematic reviews and meta-analysis*. New York: Oxford University Press.*

* Liu, Y., Wang, Z., Lin, B., Hong, J., & Zhu, Y. (2018). Occupant satisfaction in Three-Star-certified office buildings based on comparative study using LEED and BREEAM. *Building and Environment, 132,* 1-10.

* Menadue, V., Soebarto, V., & Williamson, T. (2013). The effect of internal environmental quality on occupant satisfaction in commercial office buildings. *HVAC&R Research, 19(8)*, 1051 - 1062.

* Menadue, V., Soebarto, V., & Williamson, T. (2014). Perceived and actual thermal conditions: case studies of green-rated and conventional office buildings in the City of Adelaide. *Architectural Science Review, 57(4)*, 303 - 319.

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PLoS Medicine, 6(7),*1-6.

Mittlböck, M., & Heinzl, H. (2006). A simulation study comparing properties of heterojenity measures in meta analyses. *Statistics in Medicine, 25(24),* 4321-4333.

Newsham, G.R., Brand, J., Donnelly, C., Veitch, J., Aries, M., & Charles, K., (2009). Linking indoor environment conditions to job satisfaction: a field study. *Building Research and Information 37(2),* 129–147.

* Paul, W., & Taylor, P. (2008). A comparison of occupant comfort and satisfaction between a green building and a conventional building. *Building and Environment, 43*, 1858-1870.

Preiser, W. F., Rabinowitz, H. Z., & White, E. T. (1988). Post-occupancy evaluation. *New York: Van Nostrand Reinhold.*

* Ravindu, S., Rameezdeen, R., Zuo, J., Zhou, Z., & Chandratilake, R. (2015). Indoor environment quality of green buildings: case study of an LEED platinum certified factory in a warm humid tropical climate. *Building and Environment, 84*, 105-113.

Renner, M., Sweeney, S., Kubit, J. (2008). United Nations Environment Programme, Worldwatch Institute, Cornell University Global Labor Institute, International Labour Organization, International Organisation of Employers, International Trade Union Confederation, Green jobs: towards decent work in a sustainable, low-carbon world, UNEP, Nairobi, Kenya.

Robinson, V. M. J., Lloyd, C. A., & Rowe, K. J. (2008). The impact of leadership on student outcomes: An analysis of the differential effects of leadership types. *Educational Administration Quarterly, 44*(5), 635-674.

Rücker, G., Schwarzer, G., Carpenter, J. R., & Schumacher, M. (2008). Undue Reliance on I^2 in Assessing Heterogeneity May Mislead. BMC Medical Research Methodology, 8, 79.

* Sant'Anna, D., Dos Santos, P.H., Vianna, N.S., & Romero, M.A. (2018). Indoor environmental quality perception and users' satisfaction of conventional and green buildings in Brazil. *Sustainable Cities and Society, 43*, 95-110.

* Sediso, B.G., & Lee, M. (2016). Indoor environmental quality in Korean green building certification criteria—certified office buildings—occupant satisfaction and performance. *Science and Technology for the Built Environment, 22*, 606 - 618.

Şahin, M. C. (2005). Internet Tabanlı Uzaktan Egitimin Etkililiği: Bir Meta Analiz. *Yüksek Lisans Tezi, Çukurova Üniversitesi, Sosyal Bilimler Enstitüsü.*

Scofield, J.H., Doane, J. (2018). Energy performance of LEED-certified buildings from 2015 Chicago benchmarking data. *Energy & Buildings, 174,* 402-413.

Turner, C. (2006). LEED building performance in the Cascadia Region: A post occupancy evaluation report. Cascadia Region Green Building Council, Portland, OR.

The U.S. Green Building Council. (2003). Building momentum: National trends and prospects for high-performance green buildings. *Rep. Prepared for the U.S. Senate Committee on Environment and Public Works*, *Washington, D.C.*

The U.S. Environmental Protection Agency. (2010). Green Building. *http://www.epa.gov/greenbuilding/pubs/faqs.htm (accessed January 1, 2021)*.

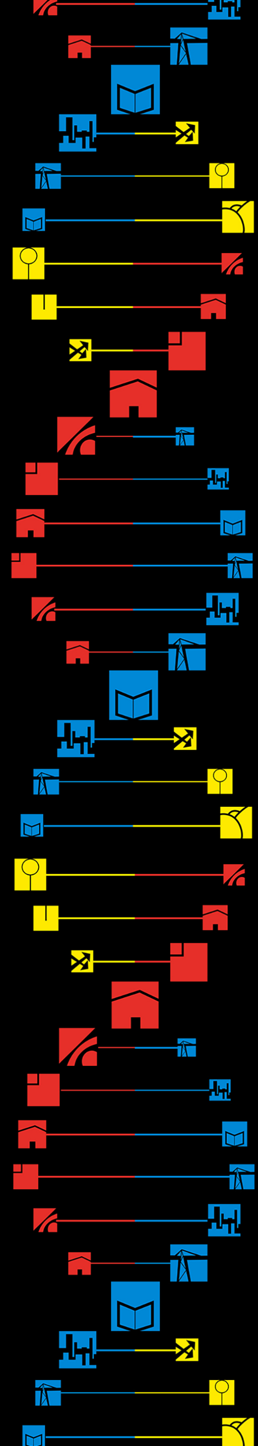
UNEP - United Nations Environment Programme. (2021). Global status report for buildings and construction: towards a Zero-emission, efficient and resilient buildings and construction sector, available at: https://globalabc.org/sites/default/files/2021-10/GABC_Buildings-GSR- 2021_ BOOK.pdf (accessed February 2022).

Veitch, J. (2001). Psychological Processes Influencing Lighting Quality. *Journal of The Illuminating Engineering Society, 30*, 124-140.

Webster, C.B., & Dunn, B.C. (2011). Creating a model of sustainability through the design, construction, and operations of a new high school. *Journal Green Building, 6*, 1-20.

* Xuan, X. (2018). Study of indoor environmental quality and occupant overall comfort and productivity in LEED- and non-LEED–certified healthcare settings. *Indoor and Built Environment, 27*, 544 - 560.

* Zalejska-Jonsson, A. (2014). Parameters contributing to occupants' satisfaction: Green and conventional residential buildings. *Facilities, 32,* 411-437.



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