NEW APPROACHES IN ARCHITECTURE, PLANNING, AND DESIGN:

THEORY, METHOD, AND PRACTICE

Editor
Prof. Dr. Can KARAGÜLLE

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Chapter 1

Repurposing Historical Buildings: The Case of Akdağmadeni Prison

Selahaddin SEZER[1]

1. INTRODUCTION

Prisons have historically been among the places people have avoided. At the same time, they are places that arouse great curiosity due to the events they witnessed or the significant figures they housed. It is noteworthy that the literature on these places uses different concepts such as "dark legacy, unwanted legacy, legacy of cruelty, disturbing legacy, legacy of shame and conscience." These structures, where traumatic events occurred and which evoke negative connotations in public opinion, should not be rejected simply because of their past functions. However, it should not be forgotten that these structures, like other structures that constitute cultural heritage, are important heritage buildings that connect the past and the present. Changes in the understanding of punishment over time have led to the loss of function of historical prisons and, consequently, their abandonment. As a result, many of these structures have not only been abandoned but also demolished. Despite all these prejudices, the continued existence of these structures, which are part of cultural heritage, is undoubtedly possible through their re-functionalization, taking into account their true identities. This approach ensures the continued existence of structures, their integration into daily life, and their preservation (Ahubay, 2019; Bilge & Güler, 2016; Gürleyen, 2019; Saner, 2020).

These areas, known by various names such as disturbing legacies or places where unwanted events occurred, were divided by Logan and Reeves into four main groups:

- Areas where genocides and massacres took place,
- Areas where wars took place,
- Prisons where political prisoners or civilians were held,
- Camps where people were imprisoned for treatment (Akay, 2016).

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Note: DeepL Translate was used for the translation of this text.

Historical prisons are among the structures considered a source of shame by societies. Initially, imprisonment was not a punishment in itself, but a measure to prevent the offender from escaping until their sentence was performed. The application of imprisonment in its modern sense originated in Europe and America from ancient times. The situation in the Ottoman Empire was not much different; criminals were held in places called "dungeons" until their sentences were determined and performed (Sezer, 2020).

In the Ottoman Empire, the reform movements that began with the Tanzimat process in the 19th century led to changes and transformations first in the understanding of punishment and later in penal institutions. It is known that various prisons built during different periods from the Ottoman Empire to the Republican era, have become inadequate over time due to changes in punishment and needs, security issues, and technical and capacity deficiencies. Except for a few examples that have entered the public consciousness, most of these substandard structures have been demolished, while others have been abandoned and are no longer in use (Halaç & Turan, 2019).

2. EXAMPLES FROM AROUND THE WORLD

2.1.Historic Prisons Restored and Repurposed

The identity of cities is sometimes defined by an object, a monument, or characteristic features. Artificial elements that shape urban identity can be listed as roads, squares, urban facilities, and structures (Sağlık & Kelkit, 2019). Various cities are known for their symbolic structures that allow us to easily identify them. When we talk about a city's symbolic structures, the first things that come to mind are castles, civil structures, religious structures, public structures, water structures, etc. Undoubtedly, these structures are quite effective in creating a general impression of the city as well as establishing a connection with it. In this context, historic prisons, although they carry negative connotations in the cities where they are located, are important symbolic structures in terms of social memory and spatial identity.

The reuse of historic prisons has recently become a frequently used method. In this context, repurposed historic prisons are being reused as hotels, museums, educational facilities, and for many other functions. The table shows examples from around the world of prisons that have been repurposed after being used as prisons.

Table 1. Repurposed prisons: Some examples from around the world

No	Prison Name	Country	City	Year of Construction	Function
1.	Arresthuis Prison	Holland	Roermond	1850	Hotel
2.	Buckingham Old Prison	England	Buckingha	1748	Museum
3.	Bridewell Prison	England	Liverpool	1867	Hotel
4.	The Old Mount Gambier Prison	Australia	Mount Gambier	1866	Hotel
5.	Charles Street Prison	U.S.A	Boston	1851	Hotel
6.	Majesty's Prison Oxford	England	Oxford	1888	Hotel
7.	Langholmen Prison	Swedish	Stockholm	1724	Hotel
8.	Lucerna Center Prison	Switzerland	Lucerne	1862	Hotel
9.	Ljubljana Prison	Slovenia	Ljubljana	1883	Hotel
10.	Ottawa Prison	Canada	Ottawa	1862	Hotel
11.	Helsinki City Prison	Finland	Katajanokka	1837	Hotel
12.	Kaiserslautern Prison	Germany	Kaiserslautern	1867	Hotel
13.	Wyoming Regional Prison	U.S.A	Wyoming	1872	Museum
14.	Alcatraz Island Prison	U.S.A	California	1861	Museum
15.	Abashiri Prison	Japan	Hokkaido	1890	Museum
16.	Eastern State Prison	U.S.A	Pennsylvania	1829	Museum
17.	Sing Sing Prison	U.S.A	New York	1828	Museum
18.	West Virginia State Prison	U.S.A	Virginia	1876	Museum
19.	Horsens State Prison	Denmark	Midtjylland Region	1853	Museum
20.	Fremantle Prison	Australia	Fremantle	1855	Museum

3. EXAMPLES FROM TURKEY

3.1. The Historic Sinop Castle Prison

Sinop, located in northern Turkey, sits on the Black Sea coast at the point where Boztepe Cape meets the mainland. With this unique location, Sinop is a well-preserved and secure city that has been home to many civilizations. One of the city's important structures is the historic prison building located in a natural harbor. Although it is not known exactly who built the historic prison inside the castle or when, it is extremely important for the city. The historic prison was built on a sloping area overlooking the sea, south of the inner castle, which was previously used as a shipyard. The two-story prison building has a tiled roof and a “U” plan. Built of cut stone and brick, the structure has numerous windows (Çakmakoğlu Kuru, 2004; Yılmaz, 2009).

When viewed from the northeast facade, the northern part of the structure is called the “first section,” the middle part is called the “second section,” and the eastern part is called the “third section.” The courtyards belonging to the cells on the ground floor form the “fourth section.” Each section has its own separate entrance and courtyards, separated by high walls. Although the first and second sections of the prison are two-story, the third section has a basement due to the building's slope towards the sea. There are 28 cells in the basement of the third section. In the main prison building, there are cells and courtyards opening onto the corridor on the ground floor. On the first floor, there are dormitories opening onto the corridor, as on the ground floor. There are approximately 28 dormitories opening onto the courtyard in the main prison building. In addition to the dormitories, the main prison building also has service areas such as kitchens and toilets on the ground and first floors (Meral, 2015).

The historic building witnessed many horrific events during its period of use as a prison. In addition to the harsh conditions of the prison, inmates were exposed to undesirable situations, making prison life extremely difficult for them. The prison's proximity to the sea caused high humidity levels inside the building, which had a negative impact on the inmates. Furthermore, the fact that the structure was surrounded by walls created a deterrent effect to prevent prisoners from escaping (Doğancili & Oruç, 2016).

Due to its poor physical condition and inadequacy, the building was completely vacated in 1997 and transferred to the Ministry of Culture in 1999. The historic Sinop Prison is a famous structure due to its unique location, which made it impossible for prisoners to escape, and its hosting of many important figures. As a result of all these experiences, the historic prison has gained significant value. Although it has partially lost its originality due to repairs and additions made over time, the building has been restored in accordance with its original plan as a result of restoration work. After the restoration was completed in 2000, it was planned to use the first and second sections of the prison as a cultural center and the third section as a museum of justice. In addition, the historic prison has been turned into a complete cultural complex with social events, a cafeteria, and accommodation areas. Restoration work continues on the building today, and after being transferred to the Ministry of Culture, the number of visitors continues to increase exponentially. The historic prison, which bore many negative traces of the past, has been restored and repurposed, becoming one of the city's important tourist attractions (Çavuş, 2013; Doğancili & Oruç, 2016; Kalan, 2008).

3.2.Sultanahmet Prison

This historic prison is located in Sultanahmet, on the historic peninsula, one of Istanbul's oldest settlements, which has been home to many civilizations. The area where the building is located is home to important cultural assets such as Topkapı Palace, Haseki Hamam, İshak Paşa Mosque, Hagia Sophia Mosque, and Sultanahmet Mosque. The building was first used as the Meclis-i Mebusan (Parliament) in 1877, and later served as the Ministry of Justice and the Palace of Justice (Korkut & Erarslan, 2020).

Although construction of the building began before World War I, the inscription "Dersaadet Prison 1337" above the entrance indicates that it was completed in 1918-1919 (Çavuş, 2013). Built with a masonry system consisting of interconnected blocks, and whose architect is not definitively known, the building is one of the first examples of contemporary architecture in the Turkish neoclassical style in Istanbul. The prison, with a capacity of 1000 inmates, operated until 1982. The historic prison also included separate sections for women and children (E. Korkut, 2019; Özgen & Özgen, 1997).

The structure, consisting of interconnected blocks, generally comprises two main masses surrounding an inner courtyard oriented east-west. The building is designed as a single-story or partially two-story structure above the basement level. Inside the prison, there are administrative units, dormitories, cells, an infirmary, wet areas, and a courtyard. The main entrance to the structure is on the west side of the detention center street; the administrative units are located in the southwest block, while the dormitories are located in the northwest block (Çavuş, 2013; Korkut & Erarslan, 2020).

The facade layout of the historic building is quite striking. Although there is a significant amount of tile work on the facade of the prison, only the mosque is tiled inside the building. Similarly, the eaves and cornice details add dynamism to the structure. The building has undergone additions and alterations over time due to capacity and different uses. In this sense, the best-preserved part of the building is the southwestern section (Özgen & Özgen, 1997).

Located in one of Istanbul's major tourist areas, the historic prison now serves as a 65-room hotel. Its location and fascinating history made its conversion into a hotel a fitting choice. The building retains its original structure and traces of its use as a prison while undergoing a transformation. The style, materials, and construction techniques of the period in which it was built have been preserved, while inappropriate additions have been removed and reinforced. While the facade remains the same, some interior changes have been made within permitted limits to suit the hotel concept. For example, prison cells have been converted into hotel rooms. As a result, wet areas have been added to the rooms, adding extra weight to the structure. To remedy this, the original vaulted floor system has been replaced with a reinforced concrete slab. Although the conversion from prison to hotel shows functional overlap in terms of circulation, cells/rooms, corridors, service areas, and gathering areas, some significant changes have been made due to functional differences. However, the adjustments made to the original floor levels in accordance with the hotel plan and the tunnel passages implemented for transitions between blocks are noteworthy changes. Similarly, it has also led to some problems with the sanitary and mechanical installations that should be present in a hotel. While whether the implemented practice is right or wrong is entirely a subjective matter, using the historical prison as a hotel, although initially seeming appropriate in terms of functional similarity, has undoubtedly brought about certain restrictions and changes (Apaydın & Eren, 2013).

3.3.Ulucanlar Prison

Ankara was designed as a model city representing the ideals of the Republic and forming the foundations of the nation-state. In this context, the city's old dirt roads were replaced with regular, wide roads, and modern structures representing the Republic were built to serve as examples for other cities. One of these structures was Ulucanlar Prison, built at the foot of Ankara Castle. The historic prison is located in the historic city center, home to many important buildings constructed during the Republic era (Özal, 2017). The idea of building a prison in this area was based on the Ankara Old City Plan prepared by German urban planner Carl Christoph Lörcher in 1924. Following Lörcher's proposal, the General Prison was built in 1925 (Yücesoy, 2018).

Although some structures within the historic prison share similar architectural features and construction techniques, later additions have altered the original layout so significantly that it is now unrecognizable. As seen in the sections that preserve the prison's originality, these striking features of the structure bear traces of Early Republican-era architecture. The structure reflects the architectural features of the period with its pilastered pointed arched openings, symmetrical layout, facade movements, vaulted ceilings, and brick-rough hewn stone alternative wall techniques. Some of the additions made to the prison buildings later, as necessary, have brick walls and wooden roof systems, while others consist of reinforced concrete and steel structures. The administration building is located on the south side of the prison area. To the west of this building are the prisoner and visitor entrances and meeting areas. To the north of the area are the inmates' quarters, consisting of cells and courtyards. The service areas serving the prison are located between the cells and the administrative building. As can be seen, the prison consists of three main sections. These sections consist of areas for visitors, guards, and inmates. The area designated for inmates includes isolation rooms and cells, as well as other sections with restricted access (Çavuş, 2013).

After the prison, which had housed many important figures, was emptied, restoration work began, and today it continues to function as a museum and cultural center. Although some parts of the structure were preserved during the restoration of the prison, an important part of the cultural heritage, this was not the case for many other parts. The women's ward and some of the visitor rooms in the prison have been demolished. In addition, some of the marks left by prisoners on the prison walls have been erased. Such practices in converting such an important building into a museum have weakened the building's connection to its past and led to the erasure of traces in memory (Özal, 2017).

Table-2. Repurposed prisons: Some examples from Turkey

No	Prison Name	Country	City	Year of Construction	Function
1.	Sinop Castle Prison	Türkiye	Sinop	-	Museum
2.	Sultanahmet Prison	Türkiye	İstanbul	-	Hotel
3.	Ulucanlar Prison	Türkiye	Ankara	-	Museum
4.	French Prison	Türkiye	İstanbul	1850	Cultural Center
5.	Ayancık Old Prison	Türkiye		1885	Cultural Center
6.	Şile Closed Prison	Türkiye	Şile	1950	Library
7.	Old Prison (Deveci)	Türkiye	Edirne	1846	Cultural Center
8.	Datça Prison	Türkiye	Muğla	1885	Library
9.	Söke Prison	Türkiye	Aydın	1969	Educational Institution
10.	Ardanuç Prison	Türkiye	Artvin	-	Sports Hall
11.	Yeşilyurt Prison	Türkiye	Malatya	-	Cultural Center
12.	Yedi Kule Prison	Türkiye	İstanbul	1920	Open-Air Museum
13.	Kadirli Prison	Türkiye	Osmaniye	-	Museum
14.	Pertek Prison	Türkiye	Tunceli	-	Film Studio
15.	Buldan Prison	Türkiye	Denizli	1870	Handicrafts Center

16.	Tavas Prison	Türkiye	Denizli	1955	Art House

4. The Repurposed Historic Prison in Akdağmadeni

Located in the Ahishavi neighborhood of Akdağ district, between Büyük Çarşı Street and Sakarya Street. Originally built as a caravanserai, this historic structure was later used as a prison. Known locally as the “Old Prison Building,” it is unknown who constructed this historic structure. However, the date H.1316 (1898-1899) is inscribed on a relief above a room on the first floor of the building. Although it is unknown whether this relief indicates the year of construction, the characteristics of the building and similar structures in the region reinforce this possibility. Originally built as a caravanserai and later used as a prison, the building lost its function when prisoners were transferred and the prison was emptied, and it remained unused for a long time. After being restored, the building, located in the city center, was repurposed. The former prison is now used as a public library.

Figure 1. Location of the historical prison (maps.google.com)

Repurposing is seen as a tool for the preservation and sustainability of historical buildings. Article 5 of the Venice Charter regarding repurposing states: “The preservation of monuments by using them for any beneficial social purpose is encouraged. Therefore, such use is desirable, but the original plan of the building should not be altered. However, within these limits, it is possible to allow and design the changes brought about by the new function.” In this sense, the Venice Charter offers an important framework for repurposing (Turanlı & Satıcı, 2021).

Undoubtedly, repurposing historical buildings according to changing living spaces and emerging needs extends their lifespan and increases the time users can benefit from the existing structures. Historical buildings may lose their functional usability over time, but their physical lifespan is longer than their functional lifespan. Therefore, adapting the building to changing living spaces and different functions and making it available for users' use is extremely important for the continued existence of buildings that have lost their original function, as long as the physical lifespan of the building allows (Emine & Hamiyet, 2017; Giresun & Tonuk, 2018).

The building, formerly a prison and now a public library, is a two-story structure with arched passageways and a central courtyard. It has a rectangular plan extending along an east-west axis and is a typical example of an Ottoman city caravanserai. The central courtyard features ten columns with polygonal shafts standing on square marble pedestals. The arched passageways have pointed and rounded arches with tension beams in the arch openings. The front facade is constructed of finely crafted cut marble and quarry stone, while the other facades are built of rubble and roughly hewn stone. The building has molded eaves and a tiled roof.

The south facade of the building is particularly rich in figures and ornamentation. The decorations generally consist of various figures, geometric and floral motifs. Lion and dragon figures are particularly noteworthy. Geometric ornamentation includes rosettes, circles, squares, and stars in various shapes. Floral motifs include flowers, curved branches, grape clusters, and various leaf patterns. The entrance on the north facade is half a floor higher than the south entrance due to the difference in height. The entrance door on the south facade has a round arch surrounded by moldings and a triangular pediment above it. The keystone of the arch features a relief of a lion, and next to this relief are the expressions "Maşallah" and "Sufanallah" written in Old Turkic, along with various floral reliefs. The lion on the keystone is depicted sitting upright on its front paws. The building features arched doors and windows, and the keystone used is remarkably crafted. On the keystone above the window on the south facade of the building, there are two dragon figures standing upside down, back to back, with their tails curled (Acun, 2005; Anonymous-1; Anonymous-2; Boy, 2017).

Figure 2. South facade of the historical prison (Sezer,2024)

Figure 3. South facade of the historical prison (Sezer,2024)

Figure 4. Figures and decorations on the south facade of the historical prison (Sezer, 2024)

Figure 5. Northern facade of the historical prison (Sezer, 2024)

Access to the ground floor is provided either by descending the stone staircases located to the right and left of the entrance door on the north façade or through the corridor (Z01) connected to the door on the south façade. Around the courtyard on the ground floor, there are ten rooms. The rooms are covered with barrel vaults. Among these spaces, rooms Z02, Z04, Z06, Z09, and Z11 have square plans, while the remaining rooms are rectangular in plan.

Room Z02, located on the ground floor to the right of the entrance door, functions as a staff room. Rooms Z03, Z05, Z07, and Z10 are used as storage areas. Room Z04 serves as the boiler room, Z06 as the kitchen, Z08 as a toilet, Z09 as a computer room, and Z11 as a prayer room (mescit). On the south façade of the ground floor, rooms Z02, Z03, Z10, and Z11 each have a door and a window opening both to the courtyard and to the street. In contrast, rooms Z05, Z06, and Z07 on the north façade are located below the road level. This condition has caused deterioration in the walls of rooms Z05 and Z07, which are used as storage areas and are equipped with two small windows each. It has been determined that rooms Z04, Z06, and Z08, which are used respectively as the boiler room, kitchen, and toilet, were later modified with floor and wall coverings, and that additional plumbing installations were introduced. Furthermore, the vault of room Z08, currently used as a toilet, has been covered with wooden cladding.

Access to the first floor is provided by a metal staircase located opposite the entrance on the north façade. This staircase was added to the building at a later period. On this floor, twelve rooms are arranged around an arcade corridor. All rooms are covered with barrel vaults. Rooms 107, 108, 110, 112, 101, 102, 104, and 106 have square plans, while the remaining rooms are rectangular. Room 107, located to the right of the staircase, is used as a children's book section. Room 108 functions as a lounge, room 109 as a toilet, rooms 110, 103, 104, 105, and 106 as reading rooms, room 111 as the library director's office, room

102 as a staff room, and rooms 112 and 101 as study rooms. The door of room number 101, which was used as a study, bears the inscription H. 1316 in Ottoman Turkish.

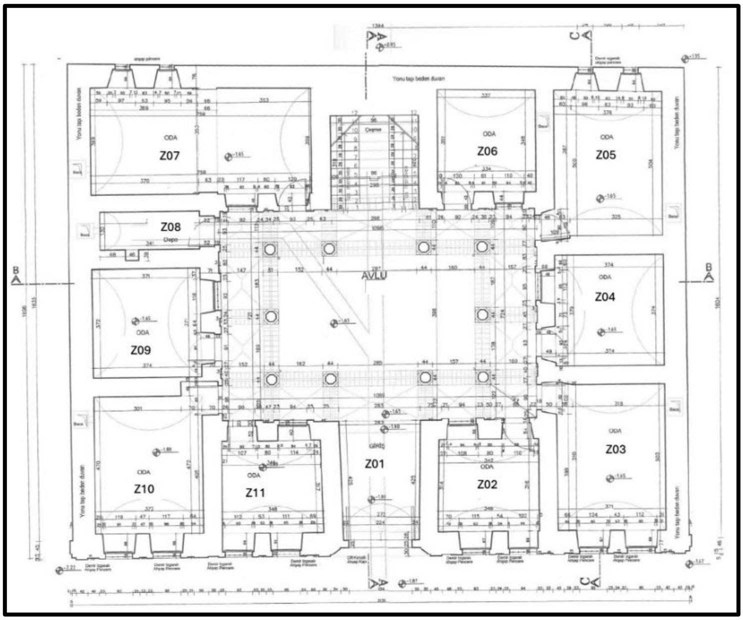

Figure 6. Historic Prison - Ground Floor Plan (Boy, 2017)

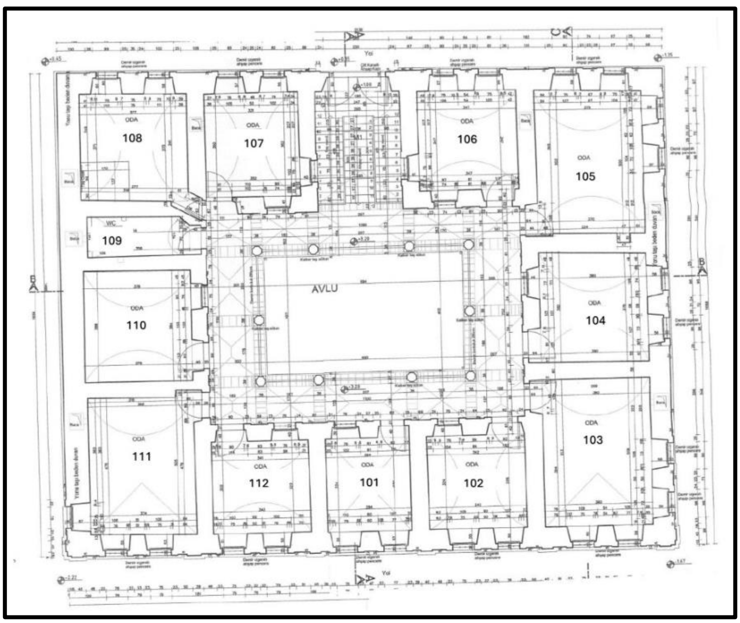

Figure 7. Historical Prison - First Floor Plan (Boy, 2017)

Figure 8. Inter-floor circulation layout in the historic prison (Sezer, 2024)

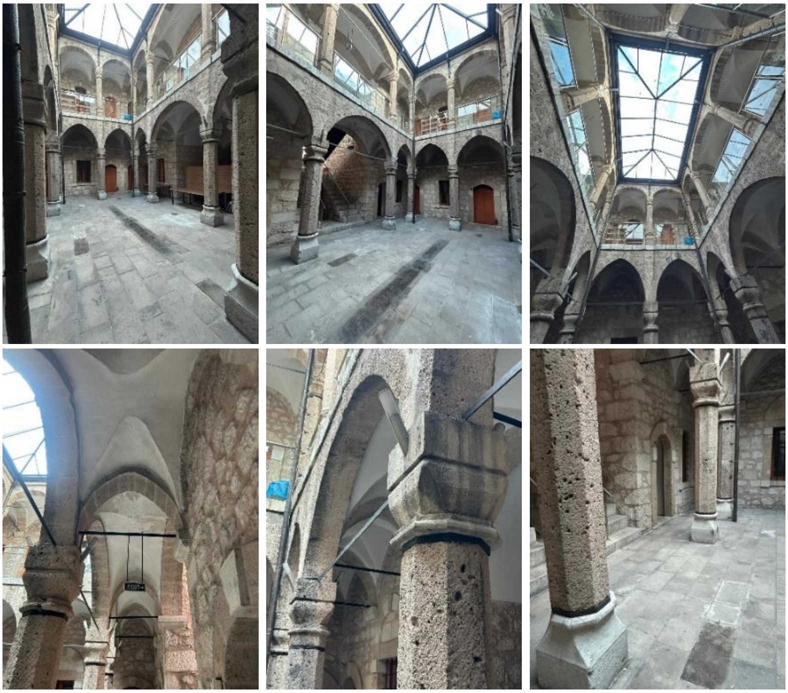

Figure 9. Historic prison ground floor courtyard (Sezer, 2024)

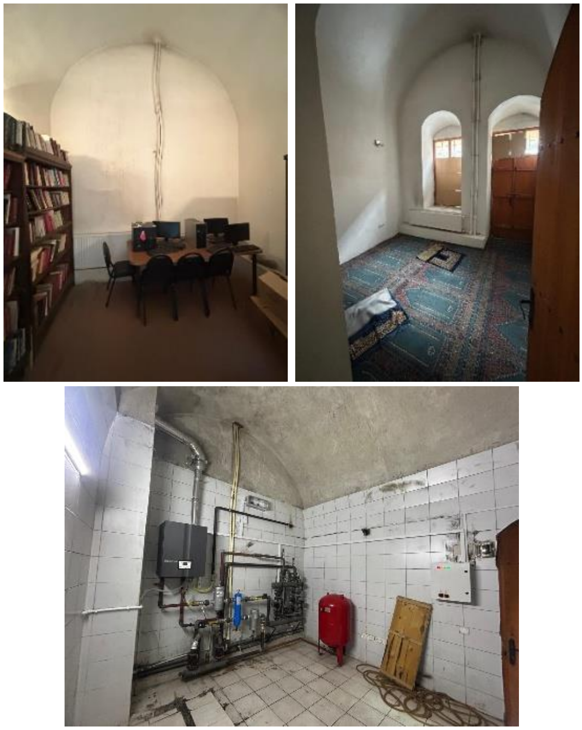

Figure 10. Ground floor computer room, prayer room, and boiler room (Sezer,2024)

Figure 11. The first floor of the historic prison (Sezer, 2024)

Figure 12. Office spaces on the first floor of the historic prison (Sezer, 2024)

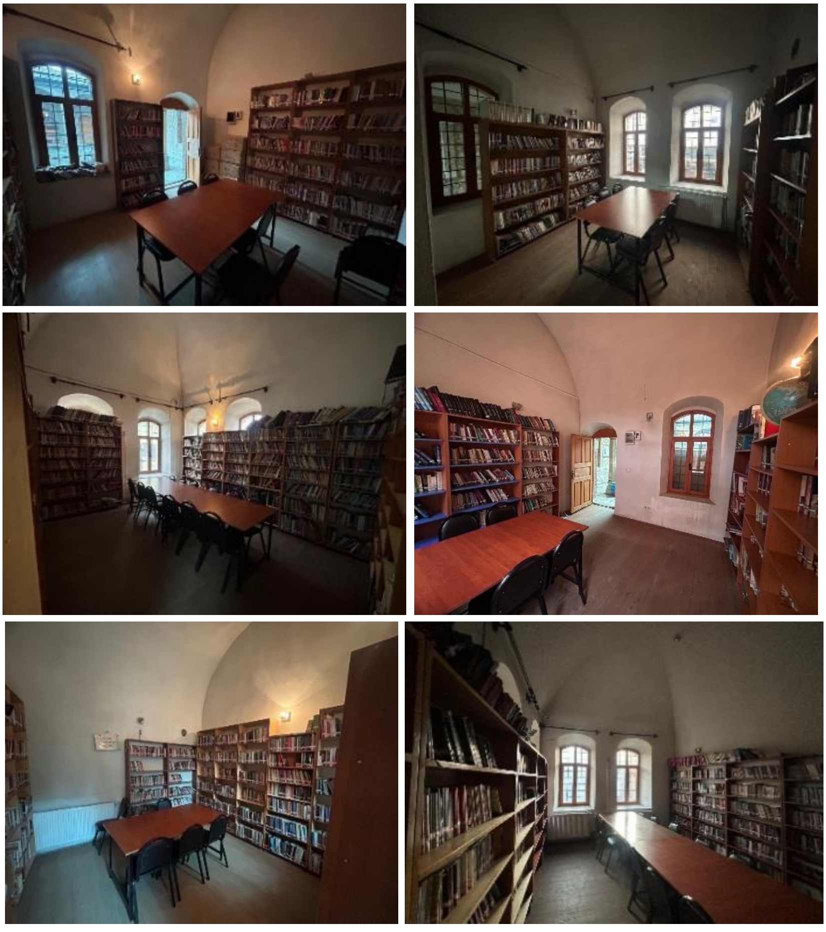

Figure 13. Reading areas on the first floor of the historic prison (Sezer, 2024)

It has been determined that certain principles were not followed during the restoration of the historical prison. Chief among these are the practices implemented to ensure user comfort. A major factor affecting user comfort is the building's heating and cooling systems. A central heating system has been installed in one of the ground floor rooms (Z04). During the installation of this system, ceramic tiles, not present in the building's original design, were applied to the floor and walls of the area chosen as the boiler room. This application was not limited to this area but was also applied to other wet areas such as toilets and the kitchen. Furthermore, the cabinets, countertops, and plumbing installations in these wet areas seriously damage the building's original character. Another issue related to user comfort is lighting. It can be said that the building is not in good condition in terms of natural lighting, which is necessary for its new function. The primary reason for this is undoubtedly related to its original function. The artificial lighting systems used to solve this problem have also been found to be insufficient in many areas, particularly in the reading room. Especially in historical buildings, it is extremely important that heating, cooling, lighting, and security systems meet current needs while being compatible with the building and not damaging its original character. This can only be achieved through special and delicate applications. However, a different approach and technique, far removed from this and similar approaches, has been adopted for the current structure.

Similarly, the floor coverings, ceiling coverings, doors, and windows of the study rooms, reading rooms, staff rooms, and storage areas utilize structural elements that are not part of the original design. In this way, it can be said that the applications are quite far from the building's original form. Access to the existing building is through a door on the north facade. The entrance door on the south facade is no longer in use. Upon entering through the gate on the north side, there are two stone steps leading down to the courtyard, one on the right and one on the left. These staircases have been identified as structural elements belonging to the original building. In the middle of the stone staircases is another single-flight metal staircase leading to the first floor. This staircase was added later. Although archival documents mention a fountain located under this metal staircase on the courtyard level, this fountain is no longer present. The open courtyard in the center of the building is covered with a glass roof. During the building's restoration, faulty plaster applications were observed in places on the octagonal columns located on marble pedestals in the courtyard. The corridors providing circulation on the first floor have glass railings on their surfaces facing the courtyard. Physical damage was later detected at the points where these added railings joined the columns.

Following restoration, moisture problems were identified in many areas of the building, particularly in the units on the north facade. This problem is more frequently encountered in the courtyard units located on the north entrance facade. The main reason for this is that the rooms on this facade are partially below the road level. As a result, deterioration has been observed in the walls, ceilings, or floors of many rooms. While these problems could have been solved with the correct techniques during restoration, they have turned into a serious issue due to faulty or incomplete applications. It is known that the negative effects of this problem damage not only the building materials but also the load-bearing system. In order to fully preserve the original state of the building, it is extremely important to resolve these problems as soon as possible with the correct techniques and methods (Ahubay, 1996; Ahubay, 2019).

In repurposing, the most important aspect is undoubtedly whether the proposed function is compatible with the existing structure. Therefore, it is necessary to carefully evaluate the scale of the building, the relationship between spaces, the circulation scheme, and whether structural elements such as stairs, doors, and windows are suitable for the new function. In particular, it is crucial to analyze whether the changes required by the new function will negatively impact the existing structure (Köse, 2022; Tanrısever, Saraç, and Aydoğdu, 2016). It has been determined that the historical building, which was used as a prison for a long time and is currently a public library, receives insufficient natural light, and artificial lighting is inadequate. All these problems lead to questioning the new function chosen for the historical building. Undoubtedly, lighting is one of the most important issues for libraries. In this sense, the success of repurposing old buildings is undoubtedly parallel to the physical, functional, and qualitative compatibility of the building with its new function. Sustainable success in repurposing can only be achieved when these conditions are met. Considering the issues mentioned above, the renovation and repurposing carried out in the historical building will continue to be controversial in its current state.

Figure 14. Deteriorations observed in the building after the restoration process (Sezer,2024)

Figure 15. Deteriorations observed in the building after the restoration process (Sezer,2024)

5. CONCLUSION

Buildings that have lost their function and are no longer in use are destined to decay over time. The most effective way to save these structures is to ensure they are reused with appropriate functions. The key to success in repurposing buildings lies not only in renovation but also in assigning the most suitable function, taking into account the building's historical and spatial characteristics. This is essential for sustainable preservation. The success of this entire process depends on the building being accepted by people, becoming a part of daily life, and then being preserved as a result of continuous use.

Prisons, which are considered among the worst and most undesirable places in the human mind, are among the most disadvantaged building groups in this sense. Therefore, many prisons are known to have been left to decay or even disappeared. However, it should not be forgotten that these structures are an important cultural heritage linking the past and the present. Overcoming prejudices against these buildings and making them a part of daily life is possible through repurposing them. In this way, these structures cease to be "undesirable heritage" and become accepted by societies, transforming into a part of daily life. This approach is extremely important for sustainable preservation. Today, many former prisons continue to exist thanks to this and similar approaches.

This study comprehensively evaluates the repurposing process of the former prison in Akdağmadeni. The restored building now serves as a public library. However, due to infrastructure deficiencies, the existing building cannot fully meet contemporary requirements. Furthermore, some practices implemented during the restoration to address these deficiencies have been found to have damaged the building. Improving the infrastructure of historical buildings and implementing new technologies requires specialized solutions. It has been determined that such an approach was not taken in the current structure, and in some areas, the original texture has been damaged.

Lighting is one of the most important issues for libraries. However, in this historic prison, which has been converted into a library, the lighting is inadequate and problematic in many areas. The fundamental reason for this is related to the building's identity. It is no coincidence that such a problem is encountered in a building that was used as a prison for a long time and is now used as a library. During the restoration and repurposing process of the historic building, instead of considering its old identity, an approach of renovating the building and repurposing it was adopted. This has led to serious problems between the existing structure and its new function. In such applications, it is extremely important to choose a function by considering the physical, spatial, and historical identity of the building. However, it can be said that in the Akdağmadeni example, these approaches were not followed in determining the new function of the building. Thus, the extent to which the repurposed building has been successful is open to debate.

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Chapter 2

The Elegance And Versality Of Glass Furniture

Burcin SALTIK[1]

ABSTRACT

Glass furniture has emerged as a defining element of contemporary interior design. Its combination of transparency, strength, and elegance allows it to harmonize with almost any décor style. From sparkling coffee tables and dining sets to office desks and shelves, glass furniture symbolizes modern sophistication and timeless beauty. It not only enhances the aesthetic appeal of a space but also creates a sense of openness and lightness that few other materials can achieve. Glass furniture represents an essential element of modern interior and architectural design, blending transparency, functionality, and elegance. This paper explores the evolution, material composition, and aesthetic applications of glass furniture across domestic and commercial environments. From the early innovations of modernist designers to the current use of tempered and laminated glass, glass furniture embodies the principles of minimalism, light transmission, and spatial harmony. The study also discusses the benefits of glass as a sustainable material and its role in enhancing environmental perception through visual openness. Furthermore, it highlights the integration of advanced manufacturing techniques, such as smart glass technology, which enables dynamic transparency and energy efficiency. The research emphasizes that glass furniture not only serves as a functional component but also as an artistic medium reflecting the aesthetic and technological progress of contemporary design. Overall, the paper argues that the continued innovation in glass furniture production will influence future trends in sustainable and adaptive interior environments.

Keywords: Glass Furniture, Furniture Design, Contemporary Design.

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INTRODUCTION

Glass objects have been found dating back to ancient Egypt 3000 BC but nobody knows exactly when glass was first made. Glassblowing was invented in about 100 BC in Syria and windows were first used about 100 AD. A glass industry flourished under the Roman Empire. Glass has been a valuable resource for people throughout the centuries. Modern glass-making has developed the art and technology of glass-making and it can now be made extremely strong and in a variety of types such as plate glass, fibre glass, toughened glass and stained glass. The history of glass production dates back to about 5000 BC.

Glass beads discovered in ancient Egypt and early Roman sites bear witness to a long tradition of drawing and molding techniques used in glass production. For centuries, however, individual craftsmanship dominated manufacturing processes that ranged from using blowpipes and cylinder blow molding techniques to the crown glass method. These manual production methods resulted in small quantities and small window panes which were almost exclusively used in stained glass windows in churches. Demand for glass during the seventeenth century rose because in addition to master church builders using glass in church windows, builders of castles and stately townhouses were now discovering how to use glass to enclose spaces as well.

Glass has been used in architecture and decorative arts for centuries, but its adoption in furniture design became prominent during the 20th century. The rise of modernism and minimalist movements encouraged designers to explore materials that could emphasize simplicity and space. Early pioneers such as Le Corbusier and Ludwig Mies van der Rohe experimented with glass and metal, producing sleek furniture that blended functionality with elegance. Today, glass remains a central element in both residential and commercial interiors, celebrated for its versatility.

TYPES OF GLASS USED IN FURNITURE

Not all glass is created equal. Furniture designers employ various types of glass to achieve a balance of beauty, durability, and safety. The most common varieties include;

- **Tempered glass:** Strong and safe, it shatters into small, blunt pieces rather than sharp shards.
- **Laminated glass:** Multiple layers fused with a plastic interlayer for added strength.
- **Frosted or tinted glass:** Provides privacy and reduces glare while maintaining elegance.

- **Patterned or colored glass:** Ideal for decorative or artistic furniture designs.

CLASSIFICATION OF GLASS FURNITURE

There are mainly four classification of glass furniture. These are;

- **Black glass furniture:** Black glass was invented around 1960's. The glass is addressed as black glass because it appears without lighting. However, it is generally in darker shades of amber or green. Black glass is a strong material due to its main ingredient which is iron oxide. Black glass furniture is known to blend with all types of décor as it is functional and also appears professional. It is popularly used for manufacturing glass tv stands.

Figure 1. Black glass furniture – OAK Furniture Store

- **Antique glass furniture:** When glass was invented thousand years ago, it was tinted in different shades and used for decoration. It basically resembled stained glass. Today, manufacturers are trying to mimic the ancient designs and are producing antique glass furniture. Antique glass furniture is characterized by intricate designs and unique sculpting and is closely linked to stained glass. Some popular options of antique glass furniture are exterior facings and table tops.

Figure 2. Antique glass furniture – ARK Vintage Home Store

- **Frosted glass furniture:** Frosted glass furniture is made out of frosted glass, which is nothing but translucent glass. The cloudy surface of the glass makes the furniture manufactured beautiful and elegant. Some popular frosted glass furniture options are tables, doors, table tops, and lamps.

Figure 3. Frosted glass furniture – Legant Glass Furniture

- **Fiberglass furniture:** Fiber glass furniture is the latest type of glass furniture and is rapidly gaining popularity all across the globe. Fiber glass consists of tiny but solid rods of glass fibers packed together. Fiber glass is sturdy and also resistant to breakage. Therefore, it is widely being used to manufacture varied types of furniture. Staring from chairs to table tops, different types of furniture's are now being made from fiber glass.

Figure 4. Fiberglass furniture – Fiberglass Sidney

BENEFITS OF GLASS FURNITURE

Glass furniture offers numerous advantages that make it an attractive choice for modern homes and offices like;

- **Enhances light and space:** Glass reflects and transmits light, giving rooms a brighter and more spacious feel.
- **Timeless appeal**: Its transparent quality allows it to complement any color palette or style.
- **Easy maintenance:** Glass does not absorb stains or odors and can be cleaned effortlessly.
- **Eco-friendly material:** Many manufacturers now use recycled glass, promoting sustainable design.

CONSIDERATION AND CARE

While glass furniture is durable, it still requires proper care. Avoid placing sharp or heavy objects directly on the surface. Use coasters or mats to prevent scratches, and clean regularly with non-abrasive glass cleaners. Ensure all glass items are supported on stable, level surfaces to prevent cracking or tipping. With consistent maintenance, glass furniture can retain its pristine look for decades.

POPULAR GLASS FURNITURE PIECES

Glass furniture can be incorporated into almost any room. Some of the most popular pieces include:

Figure 5. Overall glass furniture

- **Coffee tables:** Perfect centerpieces for living rooms, often framed in metal or wood.

Figure 6. Glass coffee table – Fenghua Glass Home Store

- **Dining - office tables:** Offer an elegant and spacious dining experience.

Figure 7. Glass dining table – VIG Furniture

Figure 8. Glass office table – Klarity Furniture

- **Shelves and cabinets:** Display items beautifully while maintaining an airy, minimalist look.

 

Figure 9-10. Glass shelves and cabinets

MODERN TRENDS IN GLASS FURNITURE DESIGN

Today’s glass furniture often combines materials such as wood, metal, and acrylic to create balanced and innovative designs. Curved glass edges, smoked finishes, and modular configurations are increasingly popular. Designers are also integrating smart glass technology, which can switch from transparent to opaque at the touch of a button—perfect for privacy or ambiance control.

CONCLUSION

Glass furniture is far more than a fleeting trend; it represents the perfect harmony of form and function. Its clarity and elegance breathe life into any interior, making spaces feel open, modern, and refined. Whether you prefer a minimalist look or a luxurious ambiance, glass furniture adapts effortlessly, offering a timeless statement of beauty and sophistication.

<u>The main advantages of using glass furniture or interiors are;</u>

1. Glass furniture/interiors is easier to maintain. In wooden furniture, we may encounter some difficulty when it comes in contact with termites. But glass furniture does not have that difficulty.
2. The newness of the glass interiors remains intact even after many years. But, wooden furniture gives a dull look after few years of usage.

3. Glass interiors are extremely durable and needs no extra maintenance effort. Another important advantage of using glass interiors is its transparency. Because of its transparency, the glass interiors make a room look more spacious.
4. Glasses can be recycled. It can be reused for the production of new and different products.
5. Glass is fireproof and waterproof. This makes it a perfect material in combination with wood and other metals.
6. Glass can reflect and refract natural light. This nature of glass helps create an illusion of more space in a smaller area.
7. Glass gives rich and expensive look to the home.

Disadvantages are;

1. Heavier than plastic.
2. Not as robust as plastic.
3. Glass furniture has low insulation quality.
4. A procedure to make broken glass safer sometimes causes glass products, including glass-topped furniture, to break without warning.
5. All glass furniture will likely soon be required to be made of tempered glass. However, the procedure that makes tempered glass safer can also make it suddenly shatter.

Glass enables feature pieces to be designed and produced that portray style and individuality; It can complement and enhance themes, statements and ideals. Glass has the ability to attract, reflect and inspire - it can be tactile or intriguingly distant. It can be delicate and fragile through to shatterproof and even explosion proof.

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Chapter 3

Life Cycle Assessment in Historic Buildings: Content Analysis of Existing Applications and A Framework Proposal

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[2] **Semra ARSLAN SELÇUK**

1. Introduction

Extreme weather phenomena, such as heatwaves, floods, wildfires, severe rainfall, and droughts, are closely linked to record levels of global energy consumption and CO_2 emissions into the Earth's atmosphere (IPCC, 2021). The expected warming in the future is predicted to be much more severe unless steady steps are taken to reduce emissions and consumption. Buildings account for nearly 36% of all greenhouse gas emissions and consume around 40% of the world's energy during construction and operation (Medved et al., 2019). Approximately half of all energy usage in developed nations originates from the existing stock of buildings, including historic structures. Thus, it is crucial to improve these buildings in accordance with sustainability and energy efficiency standards (Pisello et al., 2016). Historic buildings are physical examples that bear witness to human history and serve as bearers of social memory and identity, in addition to offering high aesthetic value through their distinctive architectural elements (Historic England, 2015). However, strategies and action plans targeted at improving energy efficiency must primarily address historic buildings because they frequently have inferior energy performance than new buildings (Marincioni et al., 2021).

In light of the climate problem and the effective use of scarce resources, the quantitative evaluation of historic buildings' environmental performance has become essential. To reduce energy consumption and greenhouse gas emissions caused by buildings throughout their life cycle, current techniques for computation and assessment are limited when it comes to historical buildings and primarily focus on new construction. However, when viewed through the

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lens of life cycle assessment (LCA), the environmental impacts of choices such as maintaining, restoring, or dismantling a historic structure and replacing it with a new one differ significantly (Redden & Crawford, 2021). More than a quarter of Europe's existing building stock has historic building status, which will play a critical role in achieving future carbon neutrality targets (Hao et al., 2020). This group of structures undergoes various changes throughout their life cycles, with improvements made as a result of wear and tear, or reuse for a different function (Akın et al., 2018). For this reason, it is necessary to examine the environmental impact, carbon emissions, energy consumption, and resource usage throughout all stages of the construction process, while ensuring that the building's originality is not compromised (Öztürk & Sayın, 2024). However, in practice, conservation and improvement decisions are primarily based on operational energy consumption, visual/aesthetic concerns, or minimum regulatory requirements, and there is limited systematic consideration of factors such as embedded carbon, material choices, maintenance and repair cycles, and life cycle analyses (IEA, 2021). At this point, LCA studies in historic buildings must be integrated into all stages of the building in a practical and controlled manner, taking environmental impact into account.

This study aims to map LCA applications in historical buildings within the framework of the gaps from a bibliometric perspective and to conduct a systematic content analysis based on selected studies. The development dynamics and areas of focus within the discipline are first revealed by analysing publications retrieved from the Web of Science and Scopus databases by year, country, source, and keywords. The research aims, structural typologies, functional units, life cycle approaches, and instruments employed in case-based LCA studies are also thoroughly examined utilising content analysis techniques. The historical building-focused LCA framework aims to integrate conservation principles and life cycle environmental performance into a unified decision-making process, utilising data gathered from these assessments. As a result, it provides a framework that can methodically assist practitioners and scholars in making informed decisions about the preservation, enhancement, and adaptive reuse of historic buildings. The results of this study are expected to aid in the creation of sustainable conservation policies, especially in nations where cultural heritage conservation practices and pertinent laws have not yet fully included LCA.

2. LCA and Historical Building: Conceptual Framework

The theoretical foundations and conceptual elements of LCA will be covered in this phase of the study, along with how key ideas are modified to fit historical patterns. Based on the various approaches and methodological preferences frequently found in LCA applications in buildings, a conceptual framework will also be developed regarding the difficulties LCA faces in historical buildings and its relationship with other tools (energy simulations, life cycle costing, BIM/HBIM, etc.).

2.1. LCA concept and standards

The roots of the LCA methodology can be traced back to the 1960s, when environmental concerns began to take centre stage on public and governmental agendas. Environmental issues such as acid rain and air pollution have worsened due to the world's growing population and accelerating industrialisation. This has been the primary motivator for developing this strategy (Kralisch, 2008). For assessing a product or service's resource consumption, environmental effects, and emissions throughout its entire life cycle, life cycle assessment (LCA) is a standardised and globally accepted technique (Di Giuseppe et al., 2020). At the building scale, LCA encompasses not only energy consumption during the use/operation period but also processes such as raw material extraction, material transportation, construction, maintenance, and repairs during the use period, as well as waste management and demolition at the end of the building's life cycle. LCA provides a more comprehensive and accurate evaluation of a building's environmental performance through this method (Berg & Fuglseth, 2018). In the construction industry, this technique is frequently employed to optimise a building's design by evaluating its capacity to lower resource consumption and environmental pollution (Cavalliere et al., 2018). However, several obstacles must be overcome when applying life cycle assessment (LCA) to buildings, including time constraints, difficulties in gathering life cycle inventory data, complexity in conducting impact assessments, and challenges in interpreting the results (Basbagill et al., 2013).

For LCA applications, several internationally recognised frameworks are available. The ISO 14040 family of standards was first published by the International Organisation for Standardisation (ISO) in 1997. This series provides a comprehensive conceptual framework that harmonises LCA implementation techniques and procedures. In 1990, the Society of Environmental Toxicology and Chemistry (SETAC) launched a comprehensive program to define LCA and develop a general methodology for conducting such studies. Following this, the International Organisation for Standardisation (ISO) also undertook similar initiatives to establish principles and guidelines for the LCA methodology (ISO/DIS, 2007). Although SETAC and ISO have officially conducted independent processes, a largely overlapping understanding and consensus have emerged between the two organisations over time regarding the methodological framework of LCA (Figure 1). This standard series was revised and published in 2006 to provide principles and a framework to support the implementation of LCA. In addition to the ISO 14040 standards, there are also standards specifically targeting the building sector, such as ISO 21930, EN 15978, and EN 15942, among others. However, these standards have been developed based on data obtained from Environmental Product Declarations (EPDs) for construction products and do not directly provide an LCA application framework (Tam et al., 2022). The methodological framework for conducting an LCA, as defined by both SETAC (Fava et al., 1991) and ISO, consists of four main stages. According to SETAC, the LCA stages comprise Target Definition and Scope Determination, Inventory Analysis, Impact Assessment, and Improvement Assessment processes. In contrast, according to ISO, these stages are Target and Scope Definition, Inventory Analysis, Impact Assessment, and Interpretation. During the purpose and scope phase, the study's purpose, target audience, decision context, system boundaries, and functional units are defined, enabling the comparison of different systems through a standard “service output.” Inventory analysis involves compiling and quantifying all inputs and outputs (including energy, materials, water usage, emissions, and waste) within defined system boundaries. During the impact assessment phase, these inventory data are converted into selected impact categories such as global warming potential, acidification, eutrophication, resource depletion, and human health impacts; during the interpretation phase, the findings are evaluated according to the study objective and uncertainties and converted into meaningful results (Fava et al., 1991).

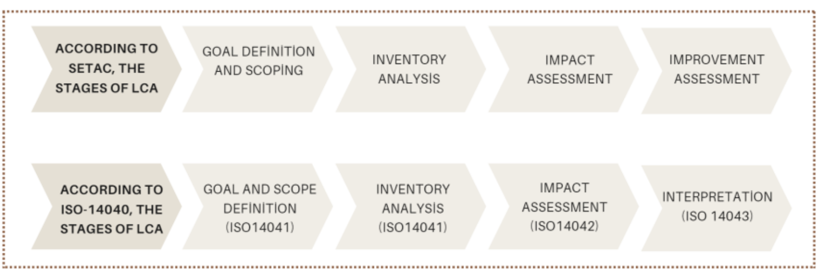

Figure 1. SETAC and ISO define the four main stages of the methodological framework.

2.2. LCA in historic buildings and challenges

LCA is a powerful decision-making tool for assessing the environmental benefits of restoring a historic building or replacing it with an energy-efficient new building. LCA has become increasingly used to assess and mitigate the environmental impacts of historic buildings, contributing significantly to environmental performance in processes such as sustainable restoration, adaptive reuse, and maintenance strategies (Bonoli & Franzoni, 2019). For example, it helps identify intervention strategies with the least environmental impact by enabling the comparison of operational and embedded environmental consequences among various restoration solutions (Endo & Takamura, 2021). The majority of the time, adaptive reuse projects have a significantly smaller environmental impact than demolition and new construction scenarios, which amply illustrates the importance of reuse strategies in heritage preservation (Hu & Świerzawski, 2024). However, LCA is a fundamental technique for assessing embodied carbon, especially in maintenance and repair operations where end-of-life scenarios and the durability of interventions are significant aspects (Franzoni et al., 2020). Compared to modern construction, applying life cycle assessment (LCA) to ancient buildings presents more theoretical and practical difficulties. These structures typically have service lives that are far longer than typical default durations; reference periods, such as 50 years, which are commonly employed in LCA, cannot accurately reflect their centuries-long lifespans. Nevertheless, there are restrictions on the quantity of data accessible for historical materials, as well as the overall consistency of the data (Redden & Crawford, 2020). The LCA principle of "maximum energy/carbon performance" does not always align with the norms of historical building protection, presenting another significant obstacle. High-density insulation, window replacement, and facade cladding are examples of interventions that can be suggested to improve energy efficiency. However, they may harm the building envelope's original materials and details or violate preservation laws.

Legacy systems also pose specific challenges in terms of databases and software infrastructure. Commonly used LCA databases provide detailed data for contemporary building materials and standard details; however, region-specific and detailed inventories for heritage materials, such as traditional stone, wood, adobe, and lime mortar, are often lacking. For this reason, researchers are forced to use proxy data with similar materials or combine limited information compiled from the literature; this situation also increases the uncertainty of the results (Bonoli & Franzoni, 2019; Akşar et al., 2025). Furthermore, the HBIM–LCA integration process remains an evolving field, involving numerous technical and methodological challenges. Firstly, HBIM models prepared for historical structures often have high geometric complexity, and assigning the material and layer information required for LCA to all elements in a consistent and standardised manner is a very labour-intensive process. On the other hand, data format incompatibility between different software (HBIM, energy simulation tools, LCA software) and limitations in data transfer make it challenging to establish a fully automated HBIM-LCA workflow (Zimmermann et al., 2021).

Although extensive studies have been conducted on the energy efficiency and energy improvements of historic buildings, studies on LCA and embodied carbon in historic buildings are still limited in the literature. Öztürk et al. (2025) show in their study that the integration of LCA into processes is limited in the literature review on the energy resilience of historical structures against climate change. Berg and Fuglseth (2018) used LCA to compare the environmental impacts of preserving a historic building as-is, renovating the same building to meet Norway's current energy standards while respecting its originality as much as possible, and constructing a completely new residential building of similar size using similar materials. The study's findings reveal that if a new, energy-efficient building is constructed in place of the historic structure, the environmental payback period exceeds 50 years, resulting in approximately 10 times more greenhouse gas emissions than renovating the existing historic building. Rauf and Crawford (2015) conducted a LCA on a sample residential building they selected in Melbourne, Australia. They found that the annual life cycle energy requirement of a building decreases as its service life increases. Their findings are also consistent with the work of Fay et al. (2000), showing that the annual life cycle energy requirement of a residential building with a 75-year service life is approximately 15% lower than that of a similar building with a 50-year service life; when the service life reaches 100 years, this reduction reaches 25%. Case studies based on LCA for evaluating the environmental performance of historic buildings are still limited in number; however, the findings of existing studies clearly support the view that historic buildings demonstrate strong environmental performance. LCA is a critical tool, particularly for the quantitative comparison of greenhouse gas emissions, but it also enables the assessment of other types of environmental impacts, such as resource depletion, material waste, and pollution (Crawford, 2011; Dahlström et al., 2012; Redden & Crawford, 2021).

2.3. Integration of LCA with other tools (BIM/HBIM-based LCA)

LCA is becoming an integral component of multi-tool workflows, integrated with digital modelling, energy simulation, cost analysis, and monitoring systems, rather than a standalone calculation tool. In particular, Building Information Modeling (BIM)-based LCA applications have gained significant prominence in both research and practice because they enable the automatic extraction of material and element inventories directly from the digital model, the rapid recalculation of the environmental impacts of design changes, and the provision of feedback to decision-makers in the early stages of the design process (Zimmermann et al., 2021). Thus, the BIM model is not merely a geometric representation, but also provides an environment where data such as material, thickness, usage scenario, and maintenance information for each building element is processed, and the inventory required for LCA is semi-automatically generated. BIM applications provide valuable information about a building's life cycle inventory throughout its lifespan, including material properties, quantity calculations, and other details about building components and materials (Lee et al., 2015). Time and labour can be saved by automatically retrieving and entering pertinent data when BIM models are integrated with LCA technologies (Crippa et al., 2018). Furthermore, the combination of BIM and LCA tools enables the rapid evaluation of all possible design solutions, thereby supporting decision-making during the design phases (Kamari et al., 2022). Additionally, Wastiels et al. (2019) categorise BIM-LCA integration into five approaches (Figure 2). These approaches also include the approach where LCA information is added to the model. The advantage of this "enriched BIM" approach is that less LCA information needs to be manually assigned later; this will significantly reduce human error by supporting an automated or semi-automated workflow (Santos, 2019).

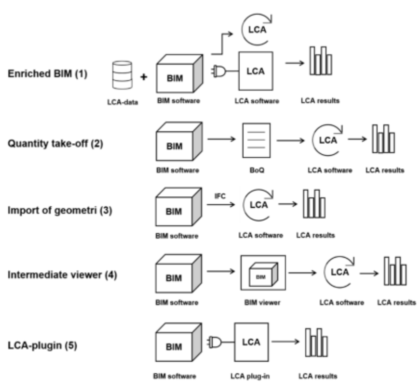

Figure 2. Five approaches to integration of BIM–LCA (Wastiels et al., 2019; Zimmermann et al., 2021).

Considering these benefits, an increasing number of studies related to BIM and LCA have been conducted over the past decade to promote the application of BIM in the environmental impact assessment of buildings. Although this development has enriched knowledge in this discipline, publications on BIM and LCA integration have only increased significantly since 2013 (Crippa et al., 2018). As a result, it is becoming increasingly complex for researchers to gain a comprehensive understanding of the research progress and achievements in BIM-LCA integration within a short timeframe. Due to this, the substantial potential and benefits of combining BIM and LCA technologies have not yet been fully realised (Santos et al., 2019).

The Heritage Building Information Modelling (HBIM) framework is the analogous procedure for historic buildings. Through extensively annotated 3D models created from data collected using techniques such as laser scanning, photogrammetry, and on-site documentation—which can also incorporate complex geometries and deteriorating conditions—HBIM seeks to manage all lifespan data of heritage structures (Dore & Murphy, 2012). By connecting the material and layer information of each structural element in the HBIM model with relevant environmental databases, the primary goal of HBIM-based LCA techniques is to thoroughly calculate the embedded and operational environmental consequences of heritage buildings. This enables the comparison of various restoration, reinforcement, or adaptive reuse scenarios based on specified performance levels, intervention intensity, and material choice. Both energy simulation and LCA results can be generated through the same HBIM-based workflow. For instance, the HBIM model, indoor environmental quality (IEQ) monitoring data, and life cycle assessment (LCA) were used in a study on a cultural heritage building in Kaunas to evaluate how well various renovation options could be optimised in terms of both their compatibility with historical value and their environmental impacts (Svytytė et al., 2025). Similarly, an ArchiCAD-based digital model integrated with One Click LCA was used to assess the environmental performance of a registered heritage building in Bursa, Turkey. This showed that the data flow between digital modelling and LCA is also applicable to heritage buildings (Akşar et al., 2025).

3. Method

The overall structure and development dynamics of the literature on the use of LCA in historical structures were revealed in this study through the use of bibliometric analysis. The bibliometric approach reveals patterns, shifts in focus, and geographical and thematic concentrations across the entire field, rather than relying on a limited number of qualitative case studies; thus, it provides the contextual framework within which the subsequent detailed content analysis will be conducted. Bibliometric analysis, which uses quantitative indicators to examine the structure, transformation over time, and trends of knowledge accumulated in academic literature, is a practical approach that reveals not only publication volume but also the interaction networks between researchers, institutions, and countries (Ninkov et al., 2022). Especially in research areas that have reached a certain level of maturity, bibliometric methods enable the revelation of how scientific collaboration networks are formed, developed, and how their focus shifts. Today, these methods extend beyond simply measuring publication and citation performance to also widely evaluate the position of academic institutions and countries within the global scientific system (Cenk & Arslan Selçuk, 2025). In this way, the study not only discusses the methodological characteristics of individual cases but also contributes to the justification of the proposed heritage-focused LCA framework by systematically and quantitatively revealing the axes on which LCA studies in heritage structures are concentrated and identifying areas where significant gaps exist.

The software tool chosen for conducting bibliometric analyses in this study was one that offers comprehensive and visually rich analyses. In this context, the open-source Bibliometrix package and its web-based interface, Biblioshiny, were utilised. Within the scope of the study, publications obtained from the Web of Science and Scopus databases were analysed by year, country, journal, and keywords using the R-based Bibliometrix package. Bibliometrix is a tool that can provide multi-layered outputs, such as examining publication trends by year, identifying the most productive countries and institutions, analysing the co-occurrence relationships between keywords through network structures, generating thematic maps and multidimensional relational diagrams, and revealing the structural characteristics of the literature through citation analysis (Aria & Cuccurullo, 2017). In addition to bibliometric analyses, systematic content analysis was applied to examine the methodological and content-related characteristics of the selected publications in depth. Within this scope, an analysis was conducted for each study serving the research objective from among 105 publications, covering dimensions such as building type, context, research objective, life cycle stages addressed, software and databases used, and integration with other tools (energy simulation, LCC, BIM/HBIM, etc.). Another objective of content analysis is not only to describe the current situation, but also to identify the conceptual components necessary for developing a historical structure-focused LCA framework. In this regard, the coded data were grouped thematically, with patterns clustering around intervention types, protection–performance strategies, and indicator sets, which were used as building blocks for the framework proposal presented in the subsequent sections of the study. Thus, the method maps the field through bibliometric analysis, fills in the details of this map through content analysis, and ultimately provides a comprehensive and applicable decision framework that can guide LCA applications in heritage structures.

3.1. Database and Research Query

The literature review conducted for this study's bibliometric analysis was carried out using two major bibliographic databases: Web of Science Core Collection and Scopus. The search query was performed by creating two keyword groups to reach the targeted publications. Within this scope, research was conducted in databases using the word groups “historic* building” OR “heritage building*” OR “architectural heritage” AND “life cycle assessment” OR “life cycle analysis” OR “LCA”. Searches were conducted in both databases on December 2, 2025, using the same keywords within the scope of “title, abstract, keyword plus, and author keywords.” A bibliometric analysis was performed using the R-based Bibliometrix package to reveal the numerical and structural characteristics of the selected publications. Using Bibliometrix's data merging and cleaning technologies, the records retrieved from WoS and Scopus were first arranged in a standard format before being combined into a single analysis dataset.

Based on the collected data, 95 publications were identified in Scopus, and 62 papers were located in WoS. Following the data-gathering procedure, duplicate records were removed, and the records from both databases were combined. The complete data gathering procedure includes 105 articles in all. This approach is necessary to ensure that the data set used in the analysis is comprehensive, reliable, and field-specific. A screening procedure based on abstract and full-text readings was carried out following the determination of the results from the two databases. Ten studies that directly address LCA implementation in historic structures and satisfy the inclusion criteria were chosen for in-depth content examination at the conclusion of this process. Network diagrams and timeline graphs were utilised to depict the results, allowing for a thorough evaluation of the times when LCA literature gained traction in historical structures, the regions in which it concentrated, and the issues it addressed. The stages of the study related to this process are shown in Figure 3.

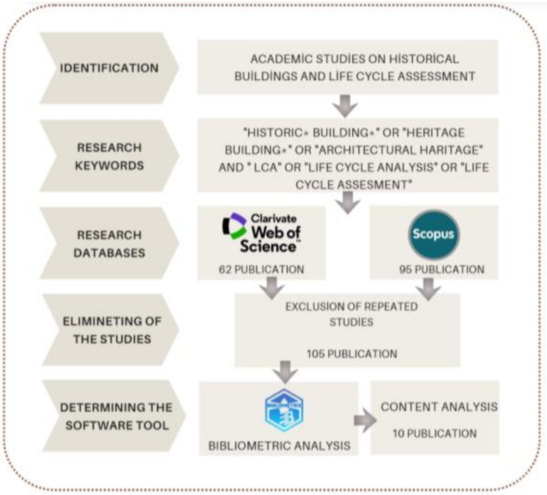

Figure 3. Flowchart of the study's bibliometric analysis.

3.2. Bibliometric Analysis and Findings

This section presents the quantitative and structural characteristics of publications obtained from the Web of Science and Scopus databases and analysed using Bibliometrix/Biblioshiny tools. The findings reveal the field's development trends over time, primarily by showing the change in the number of publications over the years. They then highlight the distribution of studies by country and institution, the journals in which they were published, and their subject areas, as well as the thematic focuses and research clusters that emerge through co-occurrence networks of keywords. The results of various data, including titles, authors, institutions, keywords, and sources, obtained from 105 publications loaded into RStudio's Biblioshiny tool, are presented in Figure 4. Publications were distributed across 56 different sources, with 321 authors producing 105 publications. At the same time, the international co-authorship rate of only 16.19% indicates that studies on historical structures and LCA were primarily conducted at the national level.

Figure 4. Main information obtained from the Biblioshiny tool

When examining the change in scientific production on historical buildings and LCA over the years, a significant increase is seen after 2016 (Figure 5). Studies on LCA peaked particularly in 2021 and 2024. Although there has been an increase in literature on this subject in recent years, it is observed that publications were very limited between 2002 and 2016. The environmental performance of historic buildings, maintenance cycles, and carbon-related studies are important topics in the literature that should be increasingly researched in the years to come. Furthermore, when examining the proportion of studies produced in this field by country, Italy (47) stands out significantly. Spain (20), Portugal (17), Malaysia (14), and Norway (12) follow Italy in scientific output (Figure 6).

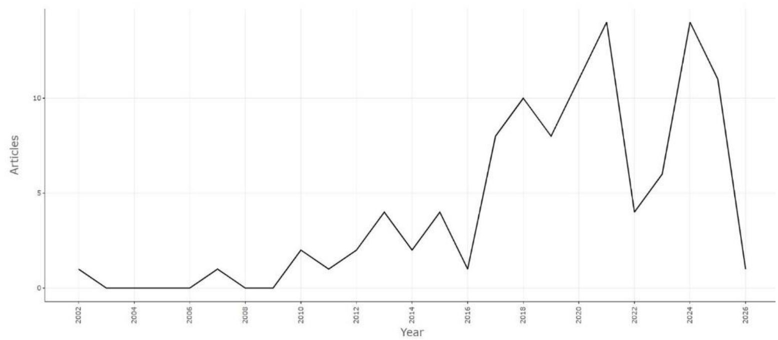

Figure 5. Changes in publications on LCA-historical buildings over the years.

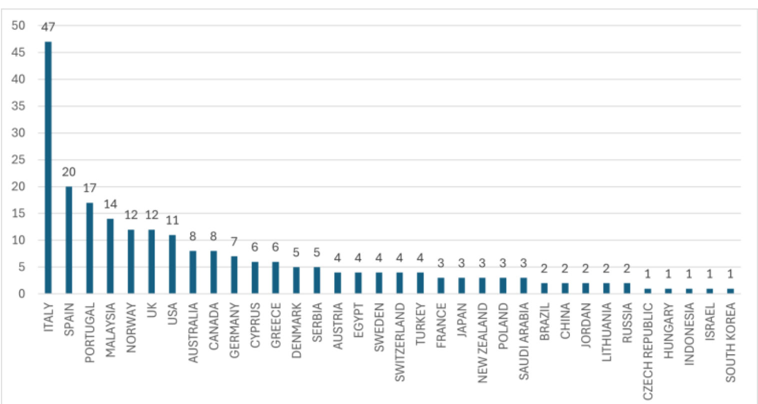

Figure 6. Scientific production on historical structures and LCA by country

Furthermore, when examining the change in countries' scientific output over the years, it is evident that research in Italy has steadily increased since 2012. In

Spain, production has increased rapidly since 2018, while in Portugal, studies on historical buildings and LCA have increased since 2014 (Figure 7).

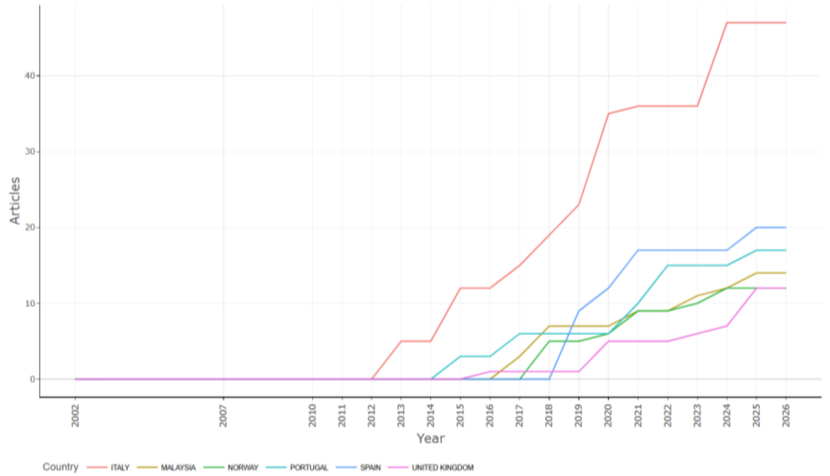

Figure 7. Changes in countries' scientific output over the years

When examining the authors of studies on historical buildings and LCA in the literature and the changes in their scientific output over the years, it is seen that the author of "Kayan, B" has the highest output (10) and has made regular contributions to this subject (Figures 8-9). Furthermore, when examining the sources of these authors' publications, it is seen that the highest proportion is found in the journal "Sustainability" (9). This is followed by the journals "Building and Environment," "Energy and Buildings," and "Heritage" (Figure 10)

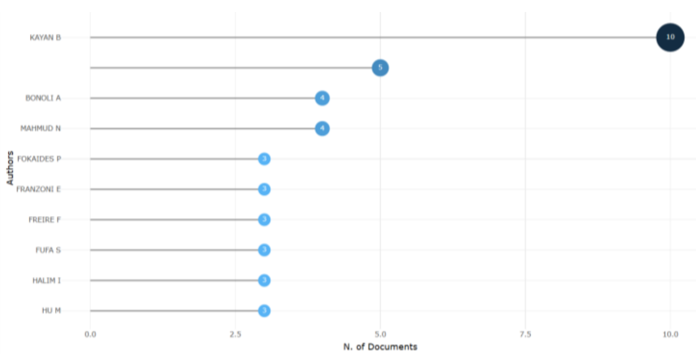

Figure 8. Authors producing scientific work on historical structures and LCA.

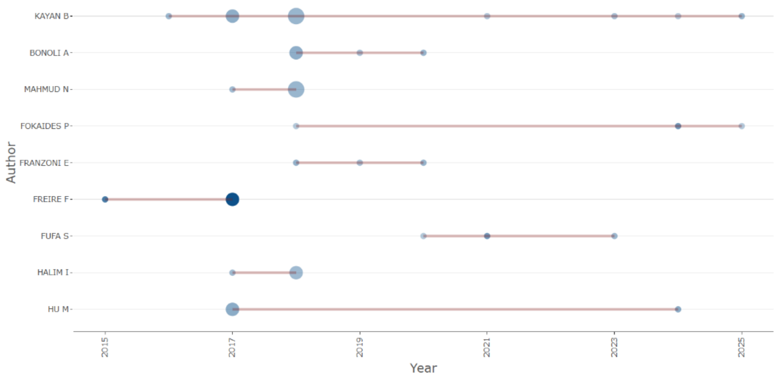

Figure 9. Changes in scientific output by authors on historical buildings and LCA over the years

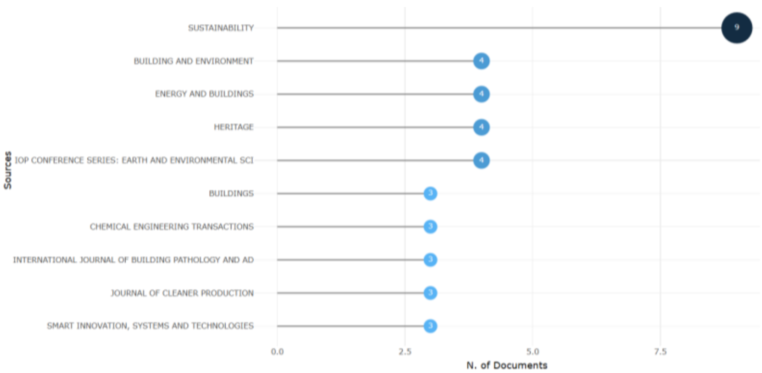

Figure 10. Distribution of sources for studies on historical buildings and LCA

According to the findings, the words with the highest frequency are concentrated around the term "energy" and terms referring to LCA ("life-cycle assessment," "life cycle," "LCA," "life cycle analysis"). These are followed by keywords such as "heritage buildings," "buildings," "sustainable development," "environmental impact," "sustainability," "construction," and "refurbishment," which encompass both general building-related and sustainability-focused terms. Terms such as "historic buildings," "historic preservation," "retrofit," "maintenance," "decision making," "cultural heritage," "embodied energy," "energy efficiency," and "environmental assessment," which are directly related to heritage, conservation, and intervention strategies, also appear at lower frequencies. This distribution indicates that the core axis of the LCA literature on heritage buildings remains centred around the "energy, LCA, sustainability" triangle. In contrast, concepts specific to historic buildings ("historic preservation," "cultural heritage," "embodied energy," "retrofit," "maintenance") appear at lower frequencies, forming secondary clusters (Figure 11). As a result, while a significant portion of the studies adapt the general building LCA discourse to historical building examples, themes such as the unique values of cultural heritage, maintenance-repair cycles, and embodied energy are becoming increasingly prominent, albeit relatively less frequently repeated. This situation represents both a basis (the strong presence of the energy and environmental impact axis) and a research gap (the relatively limited representation of heritage-specific concepts) for the heritage-focused LCA framework to be proposed in this study.

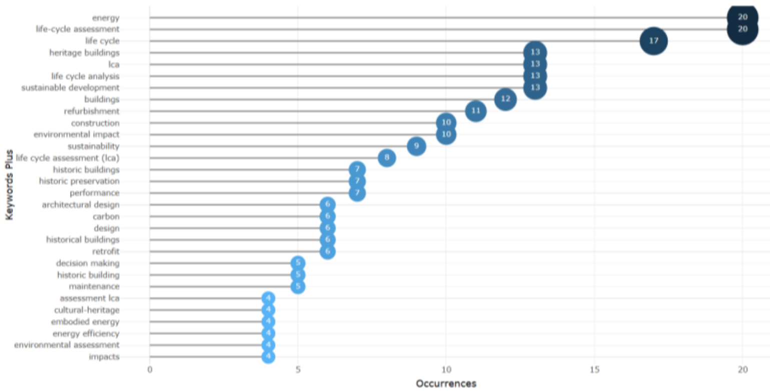

Figure 11. Analysis of the most frequently used words on historical buildings and LCA.

The trend graph in Figure 12 illustrates the evolution of the LCA literature on historical buildings. The terms that stood out between 2008 and 2013 were general concepts focused on architecture and energy use, such as "building design," "energy use," "building construction," "architecture," "architectural design," and "climate change." Therefore, the LCA debate is not yet being conducted directly in relation to heritage structures, but rather in the context of building design, energy use, and the construction sector. During the 2014–2018 period, the introduction of terms such as "life cycle," "life cycle analysis," "sustainable development," "building energy simulations," "maintenance," and "historical buildings" indicates that the discussion has shifted toward a life cycle perspective and the performance of existing buildings. At this stage, LCA is increasingly associated with energy simulations and sustainability discourse, and the concept of historical buildings begins to emerge for the first time. After 2018, there was a concentration of terms such as "energy," "retrofitting," "renovation," "heritage buildings," "life-cycle assessment," "reuse," "retrofit," “heritage conservation,” “cultural heritage,” and “multicriteria analysis” indicate that the field has become focused explicitly on heritage buildings, energy improvement, reuse, and multicriteria decision-making. In recent years (2021–2025), terms such as “building information modelling,” “heritage building information modelling,” and “environmental management” have emerged, indicating that LCA research on heritage buildings is increasingly converging with HBIM/BIM integration and environmental management perspectives. For this reason, the field of work is shifting from general energy and design discussions towards heritage-focused, retrofit and reuse-oriented, HBIM-based, and multi-criteria decision support frameworks (Figure 12).

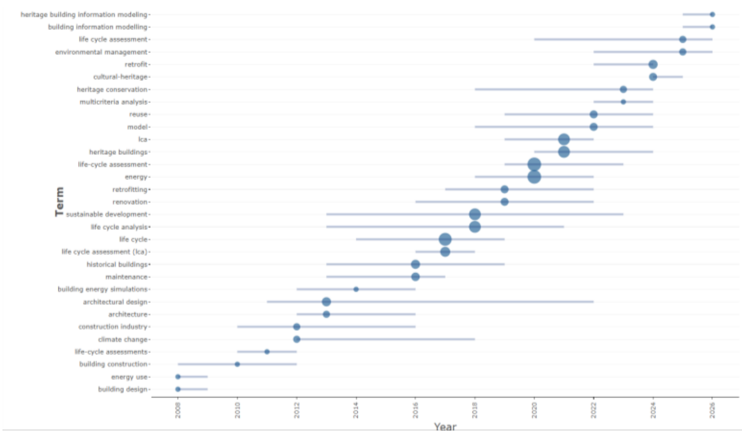

Figure 12. Trend graph of studies on historical structures and LCA by year

The three-field diagram in Figure 13 illustrates the relationship between keywords, countries, and keywords plus, enabling the simultaneous reading of both the thematic and geographical focuses of the LCA literature on historical buildings. Among the countries listed in the middle column, Italy has the highest percentage by far. A significant portion of the key terms on the left, such as “energy,” “life-cycle assessment,” “heritage buildings,” “refurbishment,” and “sustainability,” are linked to Italy. In contrast, on the right, concepts such as “heritage buildings,” “embodied carbon,” “energy efficiency,” “cultural heritage,” and “energy retrofit” are linked back to Italy. Portugal and Spain follow closely behind, with these two countries standing out strongly in terms of intervention and reuse-focused concepts such as “retrofit/renovation,” “embodied carbon/embodied energy,” “adaptive reuse,” and “circular economy.” Countries such as Norway, the United Kingdom, Australia, Canada, the United States, and Denmark are represented by thinner but still distinct connections; research in these countries generally synthesises historic buildings with broader sustainability and building performance themes such as “building energy simulations,” “maintenance,” “environmental impact,” and “sustainable development.” In general, the diagram indicates that LCA studies in historic buildings are concentrated in the Mediterranean and Northern Europe, focusing on energy, LCA, and retrofitting, and increasingly incorporating intervention/reuse issues (Figure 13).

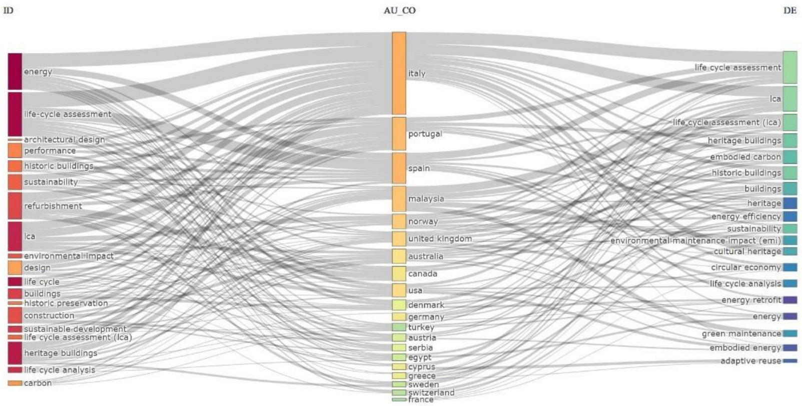

Figure 13. Three Field chart (keywords- country- keywordsplus)

In conclusion, bibliometric findings indicate that the LCA field in historical buildings is primarily focused on energy, retrofitting, and embodied carbon, while geographically, a limited number of countries, notably Italy, Portugal, and Spain, have significantly influenced the literature. Turkey and similar countries, however, are still represented by weak links; this situation indicates a clear gap and opportunity for new research, particularly at the intersection of heritage, LCA, and adaptive reuse. Consequently, these bibliometric findings will provide a contextual background for the subsequent content analysis, thereby helping to clarify the position of the proposed historical structure-focused LCA framework within the field.

3.3. Content Analysis and Findings

Within the scope of the study, 10 publications were identified from the Web of Science and Scopus databases that address the content of “historical structure” and “LCA” in a related manner and will contribute to the target study for evaluation. When making this selection, after reviewing the full texts, the studies should (i) be based on case studies at the scale of historic structures, (ii) use LCA not only at a conceptual level but as a fundamental assessment tool that produces numerical results, (iii) clearly defining the types of interventions (maintenance–repair, cleaning, retrofitting, adaptive reuse, comparison with new construction, etc.), and (iv) representing different methodological approaches such as material selection, scenario analysis, or BIM/HBIM integration. Thus, the 10 selected scientific studies represent a target group that reflects characteristic examples of LCA applications in historical buildings in terms of both geographical distribution and structural typology, as well as methodological diversity. It also comprises studies suitable for detailed content analysis, which will inform the development of a historical structure-focused LCA framework proposed within the scope of the study. The identified studies were examined in detail in terms of country, building function, study purpose, type of intervention, integration with LCA software and other tools (BIM/HBIM, simulation, etc.), and the methodological original contribution of the study. The findings from the 10 studies included in the content analysis are presented in detail according to the parameters specified in Table 2.

Table 2. Findings of studies examined within the scope of content analysis

Source	**Country / Function**	**Aim of the study**	**Type of Intervention**	**LCA stages**	**LCA software**	**Methodologic contribution**
Kayan & Ashraf, (2021)	Malaysia (Work on Singgora roof tiles)	Assessing the environmental impact of repairing Singgora roof tiles.	Maintenance/ repair, repair of Singgora tile roofs (installation and replacement)	Cradle-to-site boundary	Equation and coefficient-based custom calculation	Understanding the LCA relationships with Singgora roofing materials
Berg & Fuglseth, (2018)	Norway / Residential building (Villa Dammen)	Comparing the energy retrofit scenarios of the new building and the historic residence.	Energy retrofit versus energy-efficient rebuild comparison	Production, use, and end of life	SimaPro + Ecoinvent; scenario-based comparison	Determining the payback period analysis for retrofitting in historic buildings.
Hu & Świerzawski, (2024)	Poland, Zabrze / Historic school building	Assessing the LCA impacts of the adaptive reuse of the historic building	Adaptive reuse (based on a 50-year building lifespan) / scenario comparison	Cradle-to-grave LCA approach	Tally® /Autodesk Revit with BIM	Measurability and scenario comparison based on LCA in the adaptive reuse.
Mazzetto, (2025)	Saudi Arabia (Ushaiger village, heritage village)	Comparing traditional and modern material solutions in the	Restoration / material selection (material-level impact assessment) /	Production, supply, transportation, use, and end-of-life of	Calculations according to ISO 14040 and 14044 standards	Provide empirical evidence for evaluating material selection

		restoration of historic buildings	over a period of 100 years	materials		from an LCA perspective
Fokaides, (2025)	Cyprus, Strovolos city/eight historical buildings	Developing the Heritage-LCA framework with sustainability indicators	General decision framework for evaluating general restoration and retrofit scenarios	Cradle-to-grave LCA approach	A general framework is presented	Developing a multidimensional framework for sustainability metrics and heritage preservation
Franzoni, Volpi & Bonoli, (2020)	Italy, Bologna / Historic building	Evaluating the environmental impacts of different exterior facade cleaning/conservation methods	Conservation / cleaning comparison of 6 different methods	Production, transportation, application, waste management	Ecoinvent 3.4 database, SimaPro 8.5.2.2 software / IMPACT 2002+	Assessment of the environmental impacts of cleaning technologies in conservation work
González-Prieto et al., (2021)	Spain / office building (20th century)	Evaluating LCA Impacts under Different Electricity Grid Decarbonization Scenarios in Buildings.	Energy retrofit, efficiency improvement strategies, and scenario analysis	Cradle-to-grave LCA approach, retrofit-centred	CED Method and SimaPro 8.3.0 software	Developing approaches to different electricity decarbonization and reducing emissions.
Pachta & Giourou (2022)	Greece, Naoussa / historical/ new school buildings	Comparing the environmental performance of the life cycle of historical and modern schools	Analysis of global warming potential, fossil fuel consumption, primary energy, etc., values	Product, construction, use, beyond end of life, beyond building life.	“Athena Impact Estimator for Buildings” software	Demonstrate the advantage of the historical building in terms of its embedded impact.
Sugiyama et al. (2024)	Portekiz / historic building	Comparing the environmental impacts of different rehabilitation solutions for a historical building.	Rehabilitation and recovery scenarios (material-focused)	Material production and application processes	HBIM-based BIM model + LCA	To analyse and validate the use of LCA plugins integrated with BIM and to support this approach.
Al-Zrigat, (2025)	Jordan, Amman/ Darat al	Developing a BIM-based assessment to	Restoration/improvement, material/syste	Embodied energy-focused,	Autodesk Revit (BIM),	A BIM-integrated decision

	Funun and Chief British Representative's Building	minimise embedded energy.	m selection	material LCA stages.	FME (ETL), Google Maps API, Power Pivot	framework that includes embedded energy reduction.

This section presents the findings of the content analysis of 10 studies selected as a sample due to their fieldwork nature and methodological diversity, as determined by bibliometric screening. The selected studies represent various types of interventions, including maintenance and conservation, cleaning, adaptive reuse, comparisons of traditional and modern materials in restoration, energy retrofit scenarios, comparisons of historical and modern structures, and BIM-based LCA frameworks. The studies are relatively balanced in terms of function and geography, but they exhibit a structure that is primarily focused on the Europe–Mediterranean and Middle East axis. The examples in Norway and Greece (historic residential buildings, historic and modern schools), the 20th-century heritage office building in Spain, and the conservation/cleaning works in Italy represent LCA applications developed for cold–temperate and Mediterranean climates in the European context. However, examples such as the village of Ushaiger in Saudi Arabia, the historic centre of Amman in Jordan, and vernacular housing in Portugal illustrate the decision-making processes involved in the restoration and improvement of heritage buildings in hot-dry and Mediterranean sub-types. In terms of building functions, heritage buildings at the residential scale (traditional housing, vernacular housing, historic housing), educational buildings (historic and modern schools), office/public buildings, museum/cultural buildings, and mixed-use/cultural buildings are included. This distribution indicates LCA can be applied to various heritage building functions as well as non-residential typologies. Nevertheless, the core sample's sparse representation of typologies such as healthcare, industrial heritage, or large-scale public buildings suggests an area that warrants further research in the future. Furthermore, considering the various interventions, it is evident that LCA can be applied to historic structures not only for "energy retrofitting," but also for decision-making processes such as cleaning, adaptive reuse, maintenance and repair, and material selection. The LCA tools and integration approaches used in the 10 studies examined also show significant diversity. A group of studies conducts case-based LCA using combinations of commercial software and databases, such as SimaPro/Ecoinvent or similar, which transfers energy consumption calculations from external energy simulations or simplified calculations into the LCA model. On the other hand, the examples from Portugal and Amman, which focus on BIM integration, reveal workflows where material and element inventories are extracted from the BIM/HBIM model in historic buildings, followed by the calculation of embedded energy or environmental impacts. When examining the studies in terms of methodological contributions, three studies stand out in particular: the study that formalises the concept of maintenance-related environmental impact for maintenance and repair, articles that develop a framework specific to historic buildings, and studies that propose BIM-based embedded energy minimisation.

4. Framework for LCA applications in historic buildings

While life cycle-based methods are becoming increasingly common in material assessment and selection for new structures, they are still rarely applied in the field of conservation and restoration of historic buildings, which represent a high percentage of the building stock, particularly in Europe (Franzoni et al., 2020). In this study, based on literature review and content analysis findings, a Life Cycle Analysis framework specific to historical structures is proposed. The proposed framework aims to integrate the three components, which are currently addressed separately in existing studies, within a unified decision structure. Within this scope, three components: the historical building-decision layer that defines the conservation context and decision problem (options such as the cultural value of the building, conservation principles, level of intervention, adaptable reuse), the LCA modeling layer, and the digital data and decision support layer, which integrates HBIM/BIM, energy simulation, and multi-criteria decision-making (MCDM) tools. These three layers help ensure that crucial choices about the upkeep, retrofitting, and adaptive reuse of historic buildings are made in a way that is both life-cycle-based and consistent with conservation principles, allowing for a comparable approach. They are implemented through a methodical workflow that includes scenario definition, data modelling, environmental impact calculations, and multi-criteria evaluation.

The study's suggested historical building-focused LCA framework structure is shown in Figure 14. The framework consists of three layers and a five-step procedure. Definitions of the building's cultural value, protection status, stakeholder expectations, and decision type are included in the historical building–decision layer at each stage. The LCA modelling layer encompasses fundamental selections, including functional units, system boundaries, life cycle stages, and impact categories, as well as inventory creation and environmental performance calculations for various scenarios. The digital data and integration layer represents the data flow between HBIM/BIM, energy simulation, LCA software, life cycle costing, and multi-criteria decision-making methods. The steps are as follows: defining the historical building values and the decision problem, determining the functional unit and system boundaries with intervention scenarios, establishing the HBIM/LCA data model, evaluating the LCA outputs within a multi-criteria decision matrix for the historical building, and providing feedback on the selected scenario at both the single building and portfolio scales. Thus, this five-stage framework enables the comparison of maintenance, cleaning, retrofitting, and adaptive reuse decisions for historic buildings in a manner consistent with life-cycle-based and conservation principles. Furthermore, the aim is to promote the integration of this framework with conservation policies, enabling decision-makers to utilise this process to carry out activities.

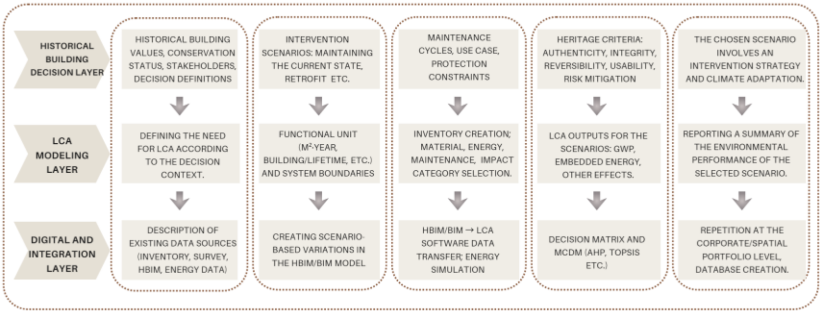

Figure 14. The layered structure of the LCA framework for historic buildings.

5. Conclusion

This study examines how LCA can be positioned for historic buildings by discussing the construction sector's increasing environmental burden in the context of the climate crisis and the role of the historic building stock within this burden. Bibliometric analysis conducted using the Web of Science and Scopus databases reveals that LCA in historical buildings is a relatively young yet rapidly developing field of research. Publications have increased significantly, particularly in the last decade, and thematically focus on energy performance, retrofitting, and embodied carbon. The geographical distribution reveals that the field is still predominantly shaped by contributions from a few countries (particularly in the Mediterranean and Northern European contexts), with countries rich in heritage structures, such as Turkey, being underrepresented in the literature. Content analysis conducted alongside this has also revealed significant fragmentation in terms of LCA modelling preferences. There is a lack of complete consistency among studies in terms of functional unit definition, system boundaries (cradle-to-gate vs. cradle-to-grave), life cycle modules included, and impact categories; critical parameters for historical structures, such as long service life, recurring maintenance cycles, and end-of-life scenarios, are not always modelled in a sufficiently transparent and comparable manner. Similarly, although conservation principles (such as authenticity, integrity, and reversibility) are emphasised in the discussion section of most studies, they are rarely integrated into the decision model as systematic criteria. In this context, the study proposes a historical structure-focused LCA framework based on findings derived from the literature. Designed as a three-layered framework (historical structure decision layer, LCA modelling, digital data, and decision support system) with a step-by-step workflow, this framework aims to integrate conservation context, life cycle modelling, and tools such as HBIM/BIM, energy simulation, and multi-criteria decision-making into a single decision structure. Thus, for critical intervention types such as maintenance, retrofitting, and adaptive reuse, a repeatable decision support mechanism is proposed that allows for the evaluation of both environmental performance and heritage values within the same matrix. Nevertheless, the study aims to strengthen LCA research in historic buildings in three ways: (i) mapping the development dynamics of the field and its geographical and thematic focuses using bibliometric methods to clarify the framework of the existing knowledge base, (ii) reveals the concrete forms of LCA use in heritage structures and methodological gaps through content analysis of selected case studies, and (iii) proposes a heritage-focused LCA framework that combines heritage values, life cycle modeling, and digital decision support tools to address these gaps. Future works are expected to strengthen the bridge between cultural heritage conservation practices and climate and sustainability goals by testing this framework through pilot applications at different scales and typologies, developing region-specific LCA databases for traditional materials, and integrating social/cultural indicators into multi-criteria decision models in a more systematic manner.

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Chapter 4

Floating Houses In Turkey: A Historical, Legal, And Spatial Assessment

Ayşegül Deniz Yamaçoba[**]

INTRODUCTION

Rise in sea level, which is one of the most serious dangers on the global level due to climate change, directly poses a threat to the settlements along the coast along with socio-ecological systems. Scientific evidence indicates that glacial melting and oceans thermal expansion are rising faster by the higher levels of greenhouse gas emissions which may result in a metric increase in the level of sea levels in this century. In this regard, the coastal nations are facing a rare risk as far as their infrastructure, economy, cultural heritage and population security are concerned. As one of the countries, Turkey is expected to be hit notably by this global threat given that it borders a sea with a long coastline of approximately 8,300 kilometers and 28 major seaside cities, including Istanbul, Izmir, and Antalya (Işildar and Ercoskun, 2022). Erosion along the coasts, heightened risk of floods, salinization of freshwater supply and inundation of residential lands are some of the most critical planning and adaptation issues that face Turkey within the next decades.

To address these physical and ecological demands, architecture, planning and engineering practices have now started to seek other forms of living, alternative models and spatial solutions. Among these here, the so-called floating houses, which are intended to be green, versatile, and have minimal impact on the environment, are gaining more and more scholarly attention and are being used more often by professionals. By merging with the water surface instead of forming permanent landfills, floating structures literally remove the possibility of flooding, help to form a more cordial relationship with the ecosystem, and can be suggested as a resilience tool in the face of such events like climate migration. A large amount of experience and legal regulations have been accrued on these technologies across the world, in the Netherlands, Bangladesh, and the Maldives.

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Nevertheless, the generalizability, historical context, legal and normative framework, and spatial appropriateness of this future and innovative idea in Turkey have not yet been clearly and thoroughly investigated. Nevertheless, rivers, lakes, deltas and coastal areas of Turkey have the prospects of both traditional water-based culture of live (e.g., floating houses and lagoons) and contemporary use. The ambiguous and disjointed legal system is one of the greatest challenges to the introduction of this idea. The Coastal Law, Zoning Legislation, Environmental Law, and building inspection laws have no clear definition and procedure of floating fixed or mobile structures thus creating uncertainty on the investment and safety of the structures, as well as the planning.

The main aim of this section is to develop the floating house phenomenon in Turkey on a multidimensional and holistic approach, both in theory and practice, to the existing field. In these regards, the course of history in Turkey and the world will be analyzed, and the transformation of the connection between water and life will be discussed. After that, the contemporary condition of the subject and its position in the world discourse will be examined. One of the most important steps, the existing legal and administrative system will also be reviewed in Turkey and the gaps and the possible opportunities in this field will be discussed. Lastly, to cement this theoretical and legal background, an implementation analysis will be applied with reference to a particular province of Adana, one of the large delta cities and areas with high water potential. The viability, design principles, environmental impacts and social acceptance of floating homes will be evaluated in the backdrop of the Seyhan River, wetlands, and coastal settlements of Adana. This paper will seek to offer a thorough mapping of the history, current, and future of floating residential areas in Turkey, a concept that is proving to dominate in the list of adaptation measures to climate change, and provide the foundation of policy suggestions regarding sustainable coastal management.

Historical roots and first applications of the floating house concept in Turkey

History and early implementations of the floating house concept in Turkey The concept of the floating house is deeply rooted in the history of the relationship of the Turkish society and water concerning culture and architecture. This connection was not only formed by the practical necessity but also is the mirror of the social life and spatial search of innovations. The concept of water living is dated back to the Ottoman Empire. The classical and the earliest of systematic and written forms can be singled out among the so-called sea baths, which were very common in cities of the seashore, particularly in Istanbul, during the 17th century. These buildings were usually constructed using wooden piles as described in the renowned book of traveller, Evliya Çelebi in his Seyahatname (Travel Book) and surrounded by four sides, and their construction material is wooden floors and grills. These spaces, which addressed the cooling off and socializing demands in the society, also had individual male and female sections to enjoy privacy.

Sea baths, though not as homes, may be regarded as one of the first precedents of methods of creating permanent or semi-permanent buildings on the water and one of the first examples of living in contact with the water in the memories of society (Görüler, 2023; Artun, 2017). The historical background of the concept of water civilization in Turkish culture and understanding water as a habitat of life is based on these practices (Figure 1).

Images of Sea Baths

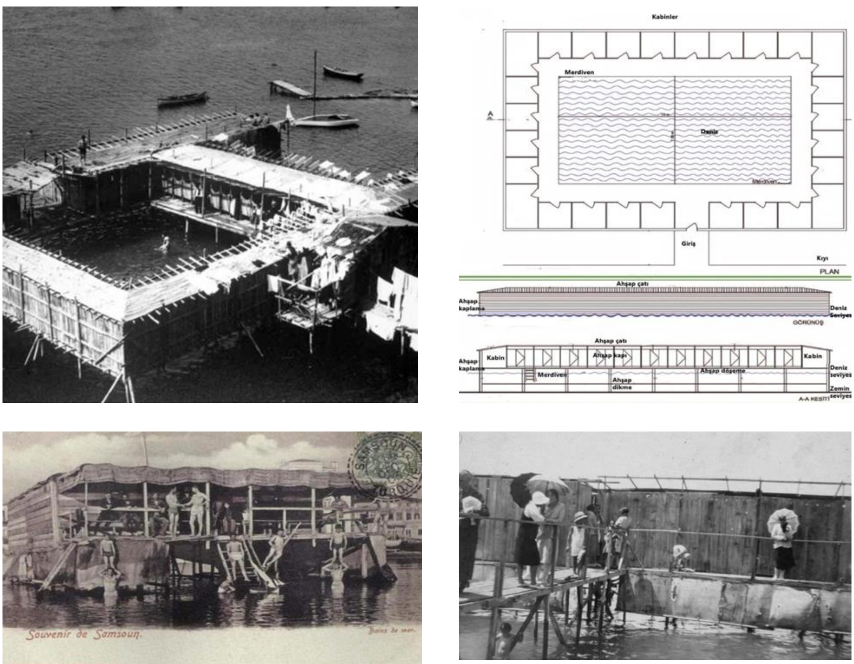

Figure 1. Images of Sea Baths

The earliest case of a floating house, which nowadays is functional in the real sense of the word, is an invention of the work of architects of the Republican period. This building was a radical innovation of its era and was designed by Master Architect Ahsen Yavanar in 1940s and moored on the banks of the sea of Marmara in Istanbul. The house was placed on an established boat platform that measured about 25 meters and had few unit of modern living facilities like a kitchen, bathroom and bedroom. It is regarded as a preliminary test in a mobile lifestyle regardless of permanent coastline and the prototype of modern floating house designs in Turkey (Yapanar, 1952, cited in Tumuer, 2010).

This was more popularized and spread into the general awareness in the 1960s. At this time, a few banks sponsored sweepstakes under the brand Floating Mansion as part of their home acquisition efforts and introduced the floating house to the imaginations and daily longings of common men. These promotions that cover a large number of people with newspaper advertisements and radio proclamations helped the floating house to become a popular cultural phenomenon rather than a luxury or building niche.

The other important technological and design advancement was made in 1970s through a two-story, triangular structure with high design by a renowned architect Melih Koray (Figure 2). It is also significant that it exemplifies more than just functionality, as the object also displays an expression of aesthetics, proving that a discrete architectural language could be applied on the water. The work of Koray was a strong pointer that floating houses could go beyond houseboats.

Figure 2. Floating House Designed by Architect Melih Koray

Since the 1980s however, this interest and practice has started to wane rather rapidly. Macro-level aspects of change, including the rapid urbanization process and turning coasts into large landfills, combined with mooring/mooring problems of floating living, technical and financial factors of maintenance, and the growing environmental pollution concerns (including infrastructure problems such as sewer links), became practical impediments to this life during this period (Kaya, 2018). Moreover, toughness of costal laws and legal loophole governing such forms of innovative buildings acted against the industry and personal projects.

To sum up, the history of floating house concept in Turkey has developed in the wavy manner, starting with Ottoman bathhouses and contemporary prototypes of the Republic, transitioning between the pop culture symbol of the 1960s, up to the provocative designs of the 1970s. In this historical journey, one can clearly identify that the society has always been connected and the relationship with water, how technological, legal, and environmental forces influence or restrict the relationship. In the current context of climate change, the redefinition of this past legacy and its integration with the current engineering, sustainable materials science, and adaptable planning strategies also provide a resource worth utilizing in the future when it comes to future adaptation strategies.

Current Floating Home Applications and Problem Areas in Turkey

Although the world continues to focus on energy-efficient and sustainable floating house projects, Turkey is lagging behind the examples set across the world. Current applications are normally amateur, chaotic and not environmentally friendly. The factors that have contributed to this the most are the lack of a legal mechanism, technical standards, and lack of supervision.

Nevertheless, one can find some instances of floating houses with other applications in the whole country:

Keban Dam Lake Floating Houses: It is a simple house with solar energy of construction, backed by grants of the Agricultural and Rural Development Support Agency and designed to fish (Gulen, 2023; Guner, 2019).

Fold and Float Emergency Shelter: SO? designed. Architecture, this is a foldable prototype, which can be used in the Golden Horn in case of an earthquake and a tsunami (Yamaçoba and Yildiz, 2023) (Figure 3).

Figure 3. ‘Fold And Float’ Emergency Shelter Floating Home Interior (Yamaçoba and Yıldız, 2023)

Riva Stream Floating House: An amateur structure used for vacation purposes, floated on barrels and powered by solar panels (Güler, 2023) (Figure 4).

Figure 4. Floating House in Riva Stream

Seyhan Dam Lake Floating Houses: Floating houses, situated on the lake to relax and enjoy picnics, however, cleared by the Adana Governorship in 2023 because of their irregular constructions and pollution of the environment.

These cases show the opportunities of floating house culture in Turkey, and it is emphasized that there is an immediate necessity of control and oversight measures.

Analysis of the suitability of water areas in Turkey for floating house applications

Turkey has the potential of floating houses, as it has 122 wetlands and 1300 km of coastline that is under the protection of the Ramsar Convention (Ministry of Agriculture and Forestry, 2022). Floating houses cannot however be applied to any body of water. Suitability analysis should be applied in the following criteria (Salihoğlu and Bayram, 2021):

1. Hydrological Conditions: Still water structure or water covered with breakwaters and where the water level never always decreases to a level lower than 1.5 meters.

2. Accessibility and Infrastructure: The close proximity to communal services (health, security, waste collection) and terrestrial transportation (piers).

3. Legal Situation: This is a water area that can be used as a permanent residence.

4. Ecological Sensitivity: Site which will not cause harm to biodiversity and sensitive environments.

By these standards, the most suitable areas to locate floating houses are reservoir lakes and harbors that have breakwaters.

Sea level rise impacts and risk map for Turkey's coastline

Climate change will increase the sea levels, which is a threat to the Turkish coastal cities. Research indicates that the Mediterranean Sea has increased by 6 cm during the past 2 decades, and the pattern is projected to keep growing (Işildar and Ercoskun, 2022). In their study, Kurt and Li (2020) singled out Adana, İzmir, Samsun, and Edirne as the most vulnerable regions whereby land would be lost to rising sea levels. Adana is a high-risk area with its low-lying and vast plains.

In an analysis with the Geographic Information Systems (GIS), Işildar and Ercoskun (2022) identified vulnerability of 28 coastal provinces in terms of physical, economic, and social indicators and found that all the coastlines along the Mediterranean coast belongs to the high-risk category. These findings reveal the need to conduct research on alternative lifestyle models in the coastal regions.

Legal status and deficiencies regarding the use of floating houses in Turkey

Such houses are not yet the concept of a floating house that is defined in the Turkish legislation and the specific regulations of such houses are not defined. It is only land-based caravans and mobile homes that are covered by the "Mobile Home" decree published in 2024. Such a legal loophole poses a compounded issue to the floating house owners:

Issues with Property and Title Deeds: It is not clear whether the structure is regarded as real estate or boat.

Mooring Permit: The permanent mooring on the shore or in a reservoir lake does not have any clear procedure of permits.

Availability of Public Services: It is not clear about the accessibility to the city network (water, electricity, sewage) and address allocation.

Insurance and Financing: It is also hard to insure and mortgage the building.

Floating houses are in practice divided into two types, the catamarans and licensed by a "Type Approval Certificate" issued by Turkish Lloyd. This certificate means that the building meets the safety standards and might offer, but not so many, mooring and network connectivity opportunities. Municipalities can grant operating licenses to commercial corporations like floating restaurants.

International standards for floating house interior design and implications for Turkey

As far as floating homes in Turkey do not have a particular interior design standard, international standards and the current housing regulations may be used to fill the gap. As an illustration, Roover, I. (2012) makes requirements in the areas as follows:

Floating System: Stable and robust construction following the principles of the naval engineering.

Fire Safety: Non-combustible materials, Portable extinguishers, and system of automatic fire hose.

Electrical and Gas Installation: Watertight and secure connections, gas leak alarm systems.

Waste and Sanitary Installation: Connection with the city grid or closed waste processing/discharge system.

Safety and Access: lifeboys, non-slip walkways, sufficiently lit jetties.

In addition, Amsterdam Local Government (2019) has introduced noise, vibration, odor control, and rainwater collection as the sustainability requirements in its environmental planning. The smallest size of the rooms (e.g.

living room of not less than 12 m 2) and bedroom (at least 9 m 2) standards in the Regulation on Principles to be followed in the design and projecting of buildings, which was published in the Official Gazette No. 30113, can also be used to determine the minimum standard of comfort in the floating houses, in Turkey.

Floating house application potential and design parameters in Adana province

Adana, identified as the region of highest risk in climate change vulnerability assessments (Kurt and Li, 2020; Işıldar and Ercoşkun, 2022), presents a compelling case for piloting floating house applications as a climate adaptation strategy.

Suitable Aquatic Sites

The most viable locations for such applications within Adana are its dam reservoirs:

1. Seyhan Dam Lake (currently used irregularly for informal settlements),
2. Yedigöze Dam Lake,
3. Sarıçay Dam Lake (currently under construction),
4. Kozan Dam Lake.

Climatic Context and Renewable Energy Potential

Situated within a hot-temperature climate zone, Adana possesses exceptional potential for solar energy generation due to its prolonged sunshine duration. Empirical calculations indicate an average daily yield of approximately 5.78 kWh per kW of installed capacity. For instance, a standard 3-kW photovoltaic system could therefore generate roughly 17.34 kWh of electricity daily. While wind energy capacity remains more limited, with an average speed of 4,25 m/s, it can be considered a viable complementary renewable source.

Conclusion and Recommendations

Although the concept of floating houses in Turkey is rooted in historical precedent, contemporary applications remain largely amateur and unregulated, hindered by gaps in legal frameworks, technical standards, and environmental planning. As climate change intensifies threats to coastal and riparian settlements, floating houses warrant serious consideration as a sustainable and resilient housing alternative.

To this end, the following recommendations are proposed:

Legal and Administrative Frameworks: A clear legal definition of "Floating Houses" must be established. Subsequently, regulations governing ownership titles, mooring rights, licensing, and integration with municipal utilities and services require formalization.

Development of Technical Standards: National building codes should be developed, referencing international standards, to address the unique requirements of floating structures. These must encompass structural and fire safety, wastewater management, and energy efficiency.

Pilot Projects and Urban Integration: In high-risk regions like Adana, integrated pilot settlements of floating houses should be designed. These projects, developed in collaboration with municipal authorities and academic institutions, must model best practices in environmental sustainability and energy autonomy.

Interdisciplinary Research and Education: Support should be directed toward research programs and professional training modules that synergize expertise from architecture, naval engineering, environmental science, and law.

Public Engagement and Awareness: Proactive public communication campaigns are essential to reposition floating houses from a perception of "luxury" to a recognized and viable climate adaptation strategy.

In conclusion, floating housing holds significant promise for shaping resilient lifestyles in Turkey's vulnerable coastal and lacustrine regions. Realizing this potential, however, is contingent upon a coordinated, inclusive, and forward-looking approach to policy and practice.

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Chapter 5

Technology And Human-Space Interactıon In Resıdentıal Kıtchens: A Thematıc Analysıs

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1. INTRODUCTION

Technological advancements have become primary drivers of transformation in residential interiors, influencing furniture selection, aesthetic preferences, and user behavior. Digitalization, automation, sensor-based systems, artificial intelligence-enabled devices, and Internet of Things (IoT) applications are fundamentally reshaping spatial organization, fixture selection, and human-space interaction, particularly within the kitchen, which is among the most frequently utilized areas of the home (Blasco et al., 2014; Chatterjee et al., 2018; Ganesan & Gobinath, 2024). Consequently, the kitchen serves as a prominent site for technological transformation and direct user interaction, establishing its significance as a research focus.

Since the Industrial Revolution, shifts in lifestyle, changes in residential design, and the integration of technological innovations into kitchen furniture and appliances have continually transformed residential kitchens. The "work triangle" principle, originating from the rationalist approach of the modernist era, exemplifies early efforts to design kitchens for functional efficiency. In contemporary contexts, this principle is reinterpreted through digitalization, flexibility, multifunctionality, and enhanced user experience (Beirão et al., 2021; Ceccacci et al., 2015). Technologies such as digital interfaces, sensor-supported appliances, and artificial intelligence now redefine kitchen spaces according to criteria including productivity, comfort, safety, energy management, and accessibility.

Recent international research characterizes the kitchen as an increasingly interactive, adaptive, autonomous, and user-centered environment. Studies on smart kitchen systems, for instance, emphasize functions such as recording and

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analyzing user behavior and optimizing spatial operations accordingly (Fonseca et al., 2019; Minh & Khanna, 2018). As a result, the kitchen is evolving from a purely functional production and service area into a multifaceted environment that guides and supports users, and in some cases, operates independently. This transformation is reflected spatially in the growing adoption of modular, flexible, and human-centered design concepts.

A comprehensive understanding of kitchen space transformation requires consideration of residential production models, interior design concepts, and evolving housing standards. Urban transformation practices, mass-produced housing, the widespread adoption of modular systems, and the increased use of built-in appliances over the past two decades have significantly reshaped kitchens in terms of spatial and technological integration (Sak, 2014; Uyar, 2014). As a result, analyzing kitchen transformation through both global technological trends and local usage practices has become increasingly important in the literature.

A review of current literature on residential kitchens reveals a strong emphasis on redesign in terms of both design and usage. Technology-focused research investigates the impact of smart appliances, automated cooking systems, sensor-based security applications, and energy-efficient devices on user behavior and kitchen workflows (Blasco et al., 2014; Minh, V. T., & Khanna, 2018; Küçük & Ekren, 2020). Additionally, evolving topics such as open-plan kitchens, integration with multi-purpose living areas, flexible plan designs, and the kitchen's position within the home are frequently addressed (Bech-Danielsen, 2012; Uyar, 2014; Yeşiltepe & Demirkan, 2025). Studies also increasingly focus on the intersection of technology and user needs, including personalized, accessible, and adaptable kitchen designs enabled by digitalization and modular systems (Beirão et al., 2021; Örs, 2020).

This study evaluates post-2000 academic literature on the relationship among users, technology, and spatial transformation in residential kitchens within a comprehensive framework. The analysis demonstrates that technological effects in kitchen spaces represent a multi-layered transformation extending beyond hardware innovations. The study systematically identifies the contexts in which these effects occur.

The research systematically classifies the reorganization of spatial order in response to technological developments, ergonomic preferences, material usage, design approaches, and everyday practices, moving beyond the kitchen's traditional functional role. This study integrates these changes, which are often addressed in a fragmented manner in existing literature, into six main themes. In doing so, it contributes to understanding the kitchen as a dynamic space that both reflects and reconfigures contemporary lifestyles.

The theoretical framework was established through document review and qualitative content analysis. The study is limited to academic research on residential kitchens, excluding commercial kitchen applications, field-based user experience measurements, and quantitative data. This evaluation compiles and interprets the existing body of design research. The central assumption is that technological transformation in kitchen spaces is multidirectional, influencing functionality, design approaches, and lifestyles, and thereby altering the human-space relationship in diverse ways. Accordingly, the study classifies and examines the transformation of residential kitchens through technological integration from both structural and experiential perspectives.

1.1. The Relationship Between Technology and the Kitchen

Throughout its historical development, the kitchen has always played an important role, both economically and technologically, as well as socio-culturally, with its production-based activities and specialized tools and equipment. Defined as the wet area of the home where food is prepared, cooked, eaten, and stored, the kitchen has undergone interesting stages of development from a historical perspective (Ünügür, 1997). Before the Industrial Revolution, economic conditions and cultural influences meant that eating and heating took place in a single space. However, the Industrial Revolution triggered migration from rural to urban areas, thereby driving social change. Changing economic conditions and rapidly growing cities also altered the concept of housing. With the rise of upper-class families, multi-room dwellings began to appear, in which the cooking area was separated from the living area. In the upper classes, the kitchen became a space used only by servants (Sak, 2014).

Scientific and technological developments brought new applications and new building materials to the construction sector. Stoves, which were a mixture of stoves and ovens specific to Balkan culture and previously used solid fuel, were replaced by gas stoves from the end of the 19th century onwards (Sayel, 1993; quoted by Sak, 2014). These and many similar developments have directly influenced spatial design, with kitchens, due to their multiple functions, among the areas where this influence is most clearly visible.

In fact, all kinds of developments in a society have affected the kitchen. With standardization in building construction, spatial elements, building materials, structural elements, and kitchen equipment also became standardized, and the production of various types and models of kitchens began (Bozbaş, 1990). Today, the modern kitchen has become a living space. The kitchen, which has become a space for cooking, preparing, and eating, as well as for conversations, has formed a visual and functional unity with the living room (Kurt, 2006). The kitchen has become a space that reflects the cultural development of technology (van den Eijnde, 2020). In summary, technological developments that gained momentum after the Industrial Revolution led to a revolutionary transformation, replacing the fire at the center of the kitchen with the gas stove, and this transformation has continued to evolve since then. During this process, the definition of the kitchen and many related phenomena have also changed, and our way of life, our means of communication, and our approach to the kitchen space have become part of this change (Figure 1).

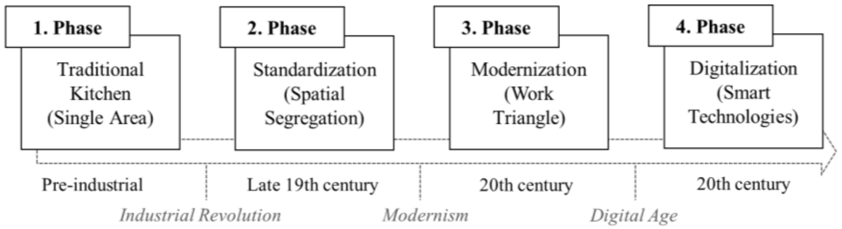

Figure 1. The historical development of residential kitchens under the influence of technology

The transformation of the residential kitchen indicates that this space has evolved beyond being merely a functional production area into a constantly changing living space, alongside social structure, technological developments, and spatial organization. Technological innovations, which gained momentum with the Industrial Revolution, brought about a comprehensive change across kitchen equipment and spatial design; this change redefined the kitchen's position within the home, user profiles, and usage practices. In this context, the transformation undergone by the kitchen can be seen not merely as a physical or technical change, but as a holistic process reflecting the reshaping of human-space relationships, lifestyles, and cultural values. This underscores the importance of the research question regarding the scope and dimensions of this transformation.

2. METHODOLOGY

This study adopted a qualitative research method to determine the effects of technology on the human-space relationship in residential kitchens. Since the study is based on the systematic analysis of sources addressing the subject in both theoretical and historical contexts, a research process combining documentary review, qualitative content analysis, and inductive interpretive analysis was designed.

The research process began with defining the subject and purpose of the study and clearly stating the relevant assumptions in the text. This stage established the theoretical framework for subsequent steps by outlining the basic orientation of the study and the research questions. In the second stage, the research's conceptual framework was designed; key concepts, the theoretical background, and existing approaches in the literature were systematically addressed. In the third stage, data collection and analysis methods were determined, and qualitative research techniques such as content analysis were defined in accordance with the nature of the study. In the fourth stage, data channels and sample selection were established; appropriate literature sources were carefully selected in line with the research's scope and limitations. In the fifth stage, the selected literature sources were examined using content analysis methods, and the data were coded and classified thematically. In the final stage, the findings were evaluated, and a comprehensive interpretation was made in the context of human-space relationships and technology interaction in light of the analysis results, and the contributions of the study to the literature were presented.

2.1. Determination of Data Sources

The research data set consists of academic books, articles, theses, and papers addressing topics such as kitchen spaces, technology, user behaviors, spatial transformation, and human-space relationships. In this context, the study focuses on systematically revealing the effects of technology on kitchen spaces.

When determining the data sources for the research, sources from after 2000 were primarily evaluated. A compendium of studies with a direct focus on the subject was assembled, encompassing data that can be interpreted in terms of the human-space relationship, containing historical or conceptual explanations, and addressing the effect of technology on spatial transformation. Conversely, studies that did not address the impact of technology on the transformation of residential kitchens were excluded from the analysis.

Consequently, a total of 18 literature sources that met the established criteria were incorporated into the study. In this regard, the study was designed not only as a descriptive literature review but also as an analytical and selective document analysis.

2.2. Content Analysis

The identified sources were examined using content analysis methods. Content analysis is a qualitative analysis technique that aims to systematically reveal the relationships, concepts, and themes that appear explicitly or implicitly in texts. In this regard, the process was carried out in four stages:

Comprehensive reading of the data: Each source was examined in terms of information units relevant to the research question, "How does technology affect the human-space relationship in the context of the residential kitchen space?"

Coding: Every statement or concept in the texts that pointed to the technology-kitchen relationship was recorded as a code; the researcher made the definitions of the codes.

Formulation of conceptual categories: Similar codes were grouped to form meaningful thematic categories, and these categories were evaluated in terms of their explanatory power within the context of human-space relations.

Interpretation of themes: In the final stage, the relationships between categories were examined; it was discussed whether the themes offered a comprehensive understanding of how technology reconfigures the kitchen.

The inductive nature of the process followed required an analytical approach that focused on deriving categories directly from the data rather than predetermining themes. Thus, the study developed a unique classification that made the relationships in the literature visible.

2.3. Evaluation and Interpretation of Findings

After completing the thematic classification, the categories were re-examined with respect to the effects of technology on spatial functioning, user behavior, materials, ergonomics, and lifestyle. The aim at this stage was not only to describe the findings in the literature, but also to reveal the structural dimensions of the transformation that technology has brought about in the kitchen space.

The methodological framework followed strengthens both the systematic and conceptual consistency of the research, ensuring that the findings are presented in a scientific classification grounded in the literature.

3. FINDINGS

The study examines the impact of technology on the kitchen space within the context of the human-space relationship. In this regard, literature data were evaluated as materials. Eighteen literature sources providing data on the interaction between the kitchen and technology were examined within the scope of the study (Table 1), and the data were analyzed using content analysis.

Table 1. Literature Sources Used in Content Analysis

Bech-Danielsen (2012)	Beirão et al. (2021)	Bell & Kaye (2002)
Blasco et al. (2014)	Ceccacci, Menghi & Germani (2015)	Chatterjee et al. (2018)
Charytonowicz & Latala (2011)	Fonseca et al. (2019)	Kurt (2006)
Lee, Jung & Kim (2005)	Minh & Khanna (2018)	Özturan (2010)
Sak (2014)	Siio, Hamada & Mima (2007)	Tehrani (2012)
Tekmen (2007)	Uyar (2014)	van den Eijnde (2020)

The literature review revealed that technology affects the human-space relationship in residential kitchens in various dimensions, and these effects have been grouped under six main categories. These categories are “Function,” “Ergonomics,” “Material,” “Method,” “Design Approach,” and “Lifestyle.” Each category represents a specific aspect of the changes technology has brought to the kitchen.

When evaluating the functional transformation of the kitchen in the context of technology, it was found that the possibilities offered by digital technologies enable the kitchen to perform various secondary functions, such as socializing and acquiring information, in addition to its basic function. In terms of ergonomics, while progress has been made in ensuring accessibility and flexibility, technology also has positive effects in terms of personalizing the kitchen. Under the heading of materials, the proliferation of technological surfaces that provide cleanability, durability, and ease of maintenance is noteworthy. In terms of methods, there are technical innovations, particularly in the cooking, preparation, and cleaning processes. Findings related to design approaches show that technology directly affects kitchen layout, fixture design, spatial integrity, and aesthetic decisions. Finally, the lifestyle category indicates that technology has transformed the kitchen from a space focused solely on cooking into an everyday part of life (Table 2).

Table 2. Classification of Data Obtained from the Literature Analysis

Impact of Technology

FUNCTION	ERGONOMICS	MATERIAL
❿Spatial Multifunctionality ❿Changing Habits ❿Remote Control ❿Complexity in Functions	❿Accessibility ❿Flexibility ❿Personalization	❿Material Variety ❿Clean Environment

METHOD	DESIGN APPROACH	LIFESTYLE
❿Production Variety ❿Increased Efficiency ❿Easy Cleaning ❿Appropriate Climate Control	❿Setting Standards ❿Aesthetic Diversity ❿Providing a Communication Environment ❿Providing a Learning Environment ❿Encouraging Sustainability	❿Comfort ❿Practicality ❿Time Savings ❿Safety ❿Reduced Communication ❿Living Space ❿Ease of Use and Maintenance ❿Difficulty Adapting to Innovation

The findings reveal that technology transforms the functional characteristics of the kitchen, adding new meanings to existing functions; new ways of working, new user behaviors, and new spatial arrangements have emerged. However, the automation, modularity, and accessibility elements provided by technology have directly impacted ergonomics, redefining the physical and cognitive relationship the user establishes with the kitchen.

Another important finding revealed in the analysis is that the categories are interrelated. For example, the remote control feature defined in the “function” category is directly linked to practicality and safety in the “lifestyle” category. Similarly, accessibility and flexibility, as defined in the ergonomics category, have been enabled by innovations in both technological materials and design approaches. This shows that technology has brought about a holistic transformation in the kitchen.

Overall, the literature findings reveal that technology has redefined the kitchen from technical, cultural, and spatial perspectives, becoming a decisive factor in user behaviors, spatial configurations, and design decisions. It is evident that the human-space relationship has been reshaped through technology, and the kitchen has transformed into a multifunctional living space.

4. CONCLUSION

The findings of this study, which examines the effects of technology on the human-space relationship in residential kitchens, show that technology transforms the human-space relationship in residential kitchens not only in a single dimension but also simultaneously in different themes. The classification of the findings under six thematic headings reveals that the relationship between the kitchen space and its users is restructured in different contexts. In this regard, the findings indicate that technology has become not only an auxiliary/supportive element in the kitchen, but also one of the components that structures and transforms human-space interaction. Evaluating the results in line with the classification obtained will contribute to revealing the scope of technology's impact on residential kitchens.

The findings obtained under the theme of function show that the actions performed in the kitchen have diversified and that the boundaries between these actions have become more flexible over time. The findings reveal that the kitchen has been redefined as a multifunctional space that accommodates actions such as socializing, acquiring information, and communicating, in addition to its basic functions of food preparation and cooking. This situation has paved the way for the human-space relationship to be reestablished not only through physical usage practices but also through the space's capacity to direct users toward certain behaviors. These findings show that while technology increases functional efficiency in the kitchen, it also expands and redefines the role of the space in everyday life.

Findings obtained in the context of ergonomics reveal that technology has redefined the body-space relationship in the kitchen space. Thanks to automation systems, accessible fixtures, and modular solutions, the kitchen is no longer an area used according to predetermined standards but has become a space that adapts to the user. This finding points to a significant shift in the human-space relationship; space is no longer a structure that expects adaptation from the user, but rather a system that responds to the user and takes shape with them. However, this situation also brings with it debatable consequences, such as the increasingly indirect nature of the spatial experience and its occasional complexity depending on the technology used.

Findings related to the theme of materials show that technology transforms the human-space relationship in the kitchen space at a sensory and perceptual level. The proliferation of easy-to-clean, durable, and hygiene-focused surfaces changes the nature of contact between the user and the space, affecting everyday actions such as maintenance, cleaning, and continuity. In this regard, the findings reveal that material technologies should be considered not only as a significant technical advancement but also as a tool that shapes the user experience and transforms the relationship established with the space.

Findings obtained under the theme of method show that actions performed in the kitchen are reorganized through technology and that this organization also transforms the human-space relationship in terms of time. Smart/digital cooking, cleaning, and climate control systems change the quality and intensity of time spent in the kitchen, directing the user toward shorter but more intense interactions with the space. Although this provides increased comfort and efficiency, it also carries the risk of weakening the kitchen's historical role as a place for gathering and sharing. However, opportunities such as remote communication and online communication, which have also entered our lives through technology, can contribute to mitigating this risk. The findings reveal this dual effect as one of the fundamental tensions of technological transformation in the kitchen space.

Findings obtained in the context of the design approach show that technology brings not only formal transformation to the kitchen space but also behavioral innovations. Kitchen designs developed through digital design tools and mass production systems present a structure that encourages specific usage scenarios and directs user behavior. This situation demonstrates the critical importance of the aforementioned concept and the communication established with the user, requiring the designer to consider the different problems that may arise.

The findings obtained within the scope of the lifestyle theme show that technology has transformed the kitchen into a multifunctional space at the center of everyday life. Open-plan solutions and kitchen designs integrated with living spaces make the kitchen a space where different activities, such as socializing, working, and communicating, can take place together. This increases the continuity of the human-space relationship and leads to the redefinition of the spatial boundaries and meanings of use of the kitchen within the home. In this context, the kitchen ceases to be merely a functional space and acquires the quality of a place where everyday life practices are produced and discussed.

When the findings are evaluated holistically, it is seen that technology simultaneously affects the human-space relationship in residential kitchens in spatial, physical, perceptual, and temporal dimensions. This result supports studies on spatial experience and interaction, which argue that the human-space relationship cannot be explained solely through responses to the physical environment. These studies show that technology is actively involved in this relationship as an interface and that human-space interaction is becoming increasingly layered, dynamic, and flexible (Dourish, 2001; Fatah gen Schieck et al., 2025; Verbeek, 2011). This raises the question of whether technology strengthens the human-space relationship or makes spatial experience more indirect and complex. This effect involves positive transformations as well as risks, so more careful, multifaceted assessments from stakeholders involved in kitchen design are necessary.

When considering both the positive and negative aspects, it is clear that technology has become a decisive factor in the evolution of residential kitchens and shapes the interaction between the user and the space. In this regard, the thematic classification developed highlights the importance of evaluating the kitchen not only as a technical functional area but also as a dynamic interior space where human-space interaction is reproduced. In conclusion, the kitchen has become an interior space constantly reconfigured by technology, where the relationship between the user and the space continues to evolve.

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Chapter 6

Classıfyıng The Temporary: A Termınologıcal Analysıs Of Dısaster Relıef Shelters

Gülşah ŞENOCAK[1]

INTRODUCTION

In the 20th century, the utilization of temporary spaces increased, either out of necessity or preference. Temporary spaces may emerge due to cultural, economic, social, or compulsory reasons. Those arising from cultural, economic, or social needs usually address specific demands. Mobile museums, libraries, and healthcare vehicles—established to enhance accessibility to cultural activities or social services—are examples of temporary spaces shaped by both aesthetic and functional concerns. While migration constitutes an economic necessity for seasonal workers who must relocate within the country for employment, it represents a social lifestyle for nomadic communities such as the Roma (Roman people).

Disasters and emergencies in human history have largely occurred unpredictably. These crises have displaced people and forced them to migrate. Migration and the temporariness associated with it have always existed throughout human history. Forced migration caused by natural disasters such as earthquakes and floods, as well as by human-made disasters like war and conflict, continues to exist. In this context, temporary space design stemming from necessity has become a practice that must be addressed. In the face of disasters and emergencies, the potential need for temporary spaces is a critical issue that should not be ignored.

The focus of this research is on the conditions that force individuals into temporary situations and the temporary spaces formed under such conditions. The fundamental premise of the research is temporariness born out of necessity. Within the scope of this research, the concept of "disaster relief shelter" is addressed as an umbrella term; and the classification of the typologies used in this context is aimed. The study examines how temporary disaster shelters have

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been addressed throughout history and aims to contribute through a classification-based approach.

The study is considered valuable in terms of demonstrating interdisciplinary research areas that the discipline of interior architecture can engage in. In order to ensure livability, interior architecture must work within the field of disaster relief shelters. This terminological study is also structured to provide the necessary information and infrastructure for our discipline.

METHODOLOGY

This study mainly uses literature review as the data collection approach and conceptual classification as its analyzing method. It takes a descriptive approach to explain key concepts related to disaster relief shelters and its system. The work on terminology aims to gather terms from the literature and organize them clearly and systematically. In this way, the study follows a qualitative research method, focusing especially on document analysis and terminology review.

The research question underpinning this study is: “In what ways can the typologies used in the field of disaster relief shelters be classified, and where does the interior architectural perspective stand within this framework?” Accordingly, the study will first explore emergency situations and shelter responses. After examining how this topic has been addressed in the literature, disaster relief shelters and their classification methods will be discussed in detail. This research, conducted as a classification study, brings the issue of terminology to the forefront.

The proposed classification is structured around three main axes to ensure a clearer understanding of the terminological and structural diversity in temporary post-disaster shelters. Within the scope of the study, seven distinct shelter typologies were examined and analyzed based on the following criteria: (1) shelter status and period of use, (2) approach - type, and (3) the classification between housing and shelter. This framework enables a systematic evaluation of disaster relief shelters and contributes to clarifying the conceptual framework.

For each shelter typology, definitions gathered from various sources were examined, and their prominent characteristics were analyzed. This approach enabled the qualitative mapping of the typologies based on their defining features / key focus. The findings of this analysis are presented in the conclusion section, offering insights that contribute to the discourse on disaster relief shelters.

EMERGENCY AND SHELTER RESPONSE

Throughout history, people have been forced to leave their homes for various reasons. These reasons include situations that make life unsustainable, such as natural disasters, political instability, wars, and infectious diseases. These events have made it impossible for individuals to remain in their living environments, pushing them towards other geographic locations. The primary need of individuals facing forced migration is a safe shelter where they can meet their basic needs. Those who are forced to migrate instinctively seek a space where they can be protected. Shelter is among the essential services that humanitarian organizations must provide in the initial phase of emergency interventions. The United Nations High Commissioner for Refugees (UNHCR) defines shelters as safe and healthy enclosed spaces that provide individuals with privacy and living conditions that respect human dignity (UNHCR Emergency Handbook, 2019).

The survival of an individual who has overcome a crisis depends on meeting certain minimum needs. These basic requirements are clearly defined within global frameworks that set international standards. For instance, the Sphere Project categorizes these needs as shelter, access to safe water, hygiene conditions, food supply, and healthcare services (Sphere Association, 2018). Similarly, the UNHCR Emergency Handbook lists the establishment of settlements and provision of shelter, clean water, sanitation, nutrition, health, education, and aid distribution among the priority services to be provided following emergency management in crisis situations (UNHCR, 2007). The International Federation of Red Cross and Red Crescent Societies (IFRC) initiates the process of needs assessment primarily through a comprehensive situation analysis in emergencies. Intervention areas are grouped under seven main headings: relief phase (aid), healthcare services, livelihood support, water and hygiene, food and nutrition, security and protection, and shelter (ICRC and IFRC, 2008, p. 19; UNHCR, 2007, p. 79). Shelter, addressed by leading platforms and NGOs in the field, is considered one of the foremost elements in humanitarian aid.

Shelter should be regarded not only as a space meeting physical needs but also as a living environment contributing to individuals’ emotional, social, and psychological recovery processes (Davis, 2011, p. 207). Beyond being a basic necessity, shelter plays a critical role in reducing the impacts of humanitarian crises and initiating the recovery process. Providing shelter is the first step toward easing trauma caused by emergencies, supporting adaptation to daily life, and promoting long-term resilience.

Tents, which are often the first solution that comes to mind and are typically deployed in the initial phase of a disaster, are highly suitable as emergency shelters due to their ease of setup, portability, and reusability. However, while they effectively meet short-term and immediate needs, they generally fall short in providing sufficient comfort and durability for long-term use. When it becomes necessary to offer basic services such as healthcare and education in emergency zones, more permanent and functional structures are required. At this point, more robust and long-lasting units such as containers are preferred. While tents and containers remain the most commonly used shelter solutions worldwide, various design studios and manufacturing companies continue to develop alternative models to meet temporary housing needs.

Throughout history, people have been displaced from their homes for various reasons, creating a continual need for temporary shelter solutions. However, the issue began to gain international attention and become the subject of systematic research largely after World War II. The unprecedented scale of destruction and human loss caused by the war prompted both governments and researchers to address the problem of temporary shelter more seriously and to develop alternative housing models (Kronenburg, 1995, pp. 95–97). The rise in awareness of refugee issues, along with the involvement of global platforms such as the United Nations and various NGOs, also emerged during this period.

One of the core components of forced migration is the concept of refugeehood. According to the United Nations, a refugee is defined as someone "who have fled their countries to escape conflict, violence, or persecution and have sought safety in another country" (UNHCR, 2018, p. 3). The shelter needs of refugees are met in various ways by host countries, one of which is the establishment of refugee camps with disaster relief shelters.

Today, Turkey is among the countries hosting the highest number of refugees worldwide. Following the outbreak of the Syrian civil war in 2011, a large number of Syrians found temporary protection and shelter in Turkey. Between 2011 and 2017, most refugee housing needs were initially met with tents in tent cities. From 2016 onwards, these were gradually replaced by more durable and long-lasting container settlements. One of the largest refugee camps established in Turkey is the Adana Sarıçam Accommodation Center, consisting of 19 m² containers and accommodating approximately 25,000 to 30,000 people (Figure 1).

Figure 1: Adana Sarıçam Accommodation Center, Temporary Housing (Author's personal archive, 2019)

In the 21st century, shelter design has increasingly attracted the attention of various design disciplines and professionals. Within this context, the significance of disaster relief shelters and their role in forced migration has become clearly evident. However, there remains conceptual confusion regarding the classification of these living spaces. Although most temporary living spaces are generally categorized as disaster relief shelters, containers where people reside for extended periods are often referred to as temporary housing. While all typologies fall under the broader concept of temporariness, permanent housing is also recognized as a distinct category. This study aims to provide a framework to clarify this conceptual confusion in terminology. Accordingly, the typologies used in disaster relief shelter contexts will be examined in detail.

DISASTER RELIEF SHELTERS

There are numerous organizations that develop solutions in the field of emergency and shelter response. Among the most competent institutions in addressing refugee-focused humanitarian crises globally is UNHCR. UNHCR categorizes emergency refugee settlements under three main headings. One of these is temporary settlements, established with shelters in designated camp areas. In these settlements, specific standards meticulously define the structure of the shelters, the arrangement of service areas, transport infrastructure, the provision of basic needs within the shelter, and spatial criteria such as square meter allocations (UNHCR, 2007, pp. 207–225).

The living spaces provided for individuals in need of shelter due to humanitarian crises and emergencies, whether for short- or long-term use, are referred to as disaster relief shelters (DRS). Studies in the field reveal that a wide range of typologies has been developed for these shelters. Research on the terminology used to describe shelters has identified more than 300 terms employed by various countries, organizations, and cultures (Brogden & Kennedy 2020, p.13).

Disaster relief shelters play a vital role in the recovery phase of communities after large-scale disasters. These shelters provide safe and private living spaces for individuals who have had to leave—or been forced to leave—their homes in the aftermath of a disaster. Displaced populations are required to reside in these shelters until they either find a new place to settle or are able to return to their former homes. As this period can range from several months to several years, shelters becomes essential. These shelters provide essential needs such as coverings, blankets, gas and stoves, and also ensure access to clean water and healthcare services (Bashawri, Garrity, & Moodley, 2014). They should provide protection in diverse weather conditions and offer a defined living space tailored to users' needs. Moreover, they should enable social activities and physical interventions, and ensure basic elements such as identity, privacy, and security. Shelters should also be spatially organized to facilitate access to services and possess the capacity to expand to accommodate new family members. Furthermore, they must offer features that allow for the protection and storage of personal belongings (Kronenburg, 1995, p. 101). Although disaster relief shelters are defined as temporary, their usage often extends over several years. The situation of refugees, especially those displaced due to war or conflict, is largely shaped by the conflict itself. The world's largest refugee camp, Dadaab, was established in 1991 for people fleeing the civil war in Somalia and remains active today (UNHCR, n.d.). In such long-standing temporary settlements, the shelters used undergo certain transformations. These changes, along with additions over time, have contributed to the development of new categories for disaster relief shelters.

Disaster relief shelters evolve and diversify over time based on users' needs. Factors such as the duration of use, the extent to which user-specific solutions are provided, the speed of setup, materials used, and construction systems play a key role in this differentiation.

In 1980–81, Ohio State University conducted a study examining shelter practices following mass disasters. The research analyzed shelter types used in three major disaster cases in the United States. Based on the findings, disaster relief shelters were classified into four main categories. These categories also represent the phases shelters typically go through after a disaster:

- Emergency Shelters
- Temporary Shelters
- Temporary Housing

- Permanent Housing (Quarantelli, 1982, p.1; Quarantelli, 1995, p.45; Wu & Lindell, 2004, p.64).

The four typologies mentioned above were developed within the U.S. context, especially to describe shelter types used after frequent natural disasters in North America. However, IFRC defines three additional types of shelters. According to the IFRC, these are particularly suitable for crises caused by human factors such as war and conflict. These three categories are:

- Transitional Shelters
- Progressive Shelters
- Core / One-Room Shelters (IFRC, 2013, p. 8).

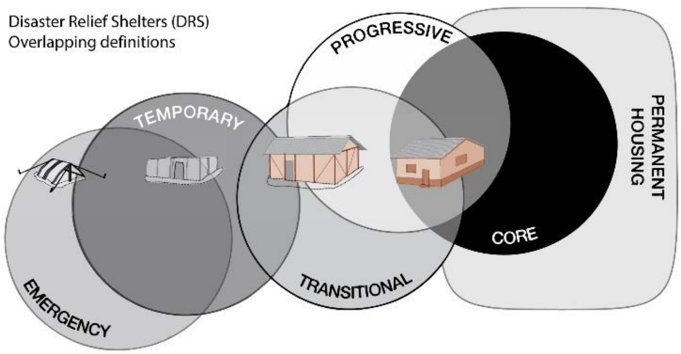

Figure 2: Disaster Relief Shelters (IFRC, 2013, p.9)

The classification of disaster relief shelters is not limited to identifying the physical products themselves; it also reflects the different stages experienced throughout the post-disaster sheltering process. Although shelters may initially be categorized under a specific type, they can transform over time and evolve into another category (Figure 2). Therefore, a designed shelter may not belong exclusively to a single type; it can fit into multiple types during its lifecycle and be described differently by various cultures, organizations, or individuals. This transformative nature of disaster relief shelters has led to the use of diverse terminologies. In this study, seven commonly used terminological classifications will be detailed and discussed.

Emergency Shelters

Emergency shelters are the type within DRS that require the least preparation time and planning. This term refers to temporary structures provided immediately after a disaster to meet people’s shelter needs for a very short period. These spaces are generally intended for use only for a few hours or at most one day and can be set up using existing buildings such as schools, public buildings, warehouses, mosques, or churches (Quarantelli, 1995, p. 45). Emergency shelters can be public buildings or spaces used for a few hours or days, as well as simple single-volume structures like tents covered with plastic sheets. Various examples appear in the literature for this term; however, this study primarily focuses on basic tent-like structural examples used in camps or public areas. It should be noted that the purpose and characteristics of all types of emergency shelters are essentially the same.

In some crises, the length of stay in emergency shelters may extend beyond a few hours or days. If homes are severely damaged or unusable after a disaster, or if people cannot return to their homes due to war or violence, the duration of stay in these shelters is prolonged. In such cases, people must remain in emergency shelters until temporary shelters are provided or the effects of the disaster subside. The shelters provided in these situations include tents, simple portable structures made with plastic covers, or specially designed units for such emergencies.

In such shelters, the allocated living space varies according to climatic conditions. In hot and tropical regions, a maximum of 3.5 m^2 per person is recommended, excluding kitchen and cooking areas. In cold climates and urban settlements, this space ranges between 4.5 and 5.5 m^2 per person, including kitchen and bathroom areas (UNHCR, 2007, pp. 220–221). This standard is widely recognized as the minimum requirement for DRS. Emergency shelters represent the initial shelter response provided to individuals displaced by any disaster or emergency. Producing shelters in line with these standards and ensuring their rapid delivery and installation during crises is crucial for an effective and organized disaster response.

Following the heavy rains and floods in Kenya in 2018, an emergency shelter project was launched for displaced communities. Shelter kits were provided to 2,000 families, and educational sessions on the assembly of emergency shelters using distributed plastic sheeting and materials were conducted (Figure 3) (Global Shelter Cluster, 2019, pp. 12–16).

Figure 3: Kenya, Shelter Kit (Global Shelter Cluster, 2019, pp.12-16)

The primary aim of such shelters is to provide a space where basic survival needs can be met until the crisis subsides. Emergency shelters are among the portable housing solutions that must be delivered as quickly as possible immediately following a disaster. In this context, rapidly deployable tents or temporary structures built from locally available materials are commonly preferred. Due to their simple design, these types of structures facilitate shelter assembly even by individuals without technical expertise, thereby speeding up the overall process.

Temporary Shelters

Temporary shelters are designed for short-term use but provide more advanced solutions than emergency shelters when needed. They can be created by modifying emergency shelters if the crisis persists and existing solutions are insufficient. These shelters accommodate stays ranging from a few days to several weeks (Félix, Branco & Feio, 2013, p. 137; Quarantelli, 1995, p. 45), with reinforced versions lasting up to one year (IFRC, 2013, p. 110).

The boundary between emergency shelters and temporary shelters often appears blurred. Both are typically simple, single-volume structures aimed at ensuring survival. However, a behavioral distinction is made at this point: while the eating needs of individuals in emergency shelters are generally not addressed, in temporary shelters—where individuals are expected to stay for a relatively longer time—the question of where and how meals will be provided becomes a significant issue (Bashawri, Garrity & Moodley, 2014, p. 926; Quarantelli, 1995, p. 45).

Temporary shelters are designed with an emphasis on speed of production and low cost, which consequently limits their lifespan. They are generally planned as portable structures that can be reassembled in different locations. These shelters are not expected to provide full resistance against natural disasters such as strong earthquakes or hurricanes. Therefore, they are constructed to be lightweight and safe, aiming to prevent loss of life in case of possible collapse. It is recommended to use materials that can be recycled or replaced if necessary during the shelter's construction. Temporary shelters differ from emergency shelters by permitting more durable materials (IFRC, 2013, pp. 8–17).

The shelter project for refugees displaced to Chad following the 2019 events in Sudan was implemented in 2020. The camp, developed through a participatory approach, involved the construction of 1,850 temporary shelters. Each shelter, measuring 17.5 m², was constructed with a wooden frame and a sheet metal roof, and covered with plastic tarpaulins (Global Shelter Cluster, 2021, pp. 7–13). In 2022, following a tropical storm that struck the Republic of Malawi, a humanitarian aid project was launched to provide shelter kits and construction training. The shelters, designed to accommodate approximately five people and measuring 20 m², were built using timber frames, tarpaulins, and other construction materials (Figure 4) (Global Shelter Cluster, 2023, pp. 34–39).

Figure 4: Chad Temporary Shelters (left), Malawi Temporary Shelters (right) (Global Shelter Cluster, 2021, pp.7-13; Global Shelter Cluster, 2023, pp.34-39)

As demonstrated by these examples, both projects involve users in the construction process, resulting in a building period that is somewhat longer than emergency shelters. The primary objective is to provide a dignified temporary living space where individuals' basic needs can be adequately met.

Temporary Housing

The primary purpose of temporary housing, as opposed to emergency or temporary shelters, is to provide individuals with a living space where they can resume their daily routines and responsibilities. These units are generally designed for longer-term use, ranging from six months to three years.

Prefabricated buildings and mobile units that offer the necessary comfort for maintaining everyday life fall within this category. Temporary housing differs from permanent housing in that it assumes the displaced person or refugee will eventually return to their original home. However, due to social, economic, or political factors, these dwellings sometimes become permanent. For instance, following the 1968 earthquake in Sicily, despite the construction of new homes, affected individuals continued to reside in their temporary housings (Quarantelli, 1995, p. 45; Bashawri, Garrity, & Moodley, 2014, p. 926). Temporary housing plays a vital role in post-disaster recovery, as it enables individuals to carry out daily activities such as cooking, working, education, and socializing. They can be fully manufactured in factories, or constructed using mobile units transported to the site in one or multiple parts, as well as emergency support kits delivered in packaged form (Félix, Branco, & Feio, 2013, p. 137).

A collaborative research project titled MobARCH, carried out by the Istanbul Metropolitan Municipality in partnership with Istanbul Technical University, focused on designing temporary housing solutions for potential disaster scenarios. The unit designed in the project aimed to be reusable, durable, environmentally compatible, and provide a comfortable living space meeting basic survival needs. During the design process, DRS designs used after the Marmara Earthquake were examined, and the needs of disaster victims were analyzed. Emphasizing ease of production, sustainability, and the use of recycled materials, the design utilized wooden panels measuring 3 meters by 1 meter and weighing under 100 kilograms each. The resulting prototype is intended for use as temporary housing following a possible Istanbul earthquake (Figure 5).

Figure 5: MobARCH Temporary Housing Prototype (Şener & Altun, 2009, p.69)

Temporary housing units represent one of the most widely implemented forms of DRS in camp settings, with prefabricated structures, containers, and trailers being the most commonly utilized examples.

Transitional Shelters

Transitional shelters are defined as post-disaster temporary living spaces that can be rapidly constructed using materials that are either reusable in permanent buildings or easily dismantled and transported. These structures serve as a bridge between emergency shelters and permanent housing. They are typically intended for use over a period ranging from three to five years, until permanent housing solutions can be implemented. According to standards, a minimum of 18 m² of living space should be provided for a family of five, with 3.5 m² allocated per person; however, these standards may vary depending on local conditions and decisions made by the relevant authorities (IFRC, 2011, pp. 8–14). Transitional shelters should be built using durable and long-lasting materials to allow for their integration into permanent housing or their transformation into permanent structures if necessary. In consideration of this potential, they must also be portable (IFRC, 2013, p. 8).

Following the 2017 floods and landslides in Sri Lanka, transitional shelters were provided for displaced communities. These shelters were constructed using a participatory approach that combined cash assistance, safe construction training, and the reuse of materials salvaged from damaged homes in the region (Global Shelter Cluster, 2019, pp. 117–121) (Figure 6).

Figure 6: Sri Lanka Transitional Shelters (above), Democratic Republic of the Congo Transitional Shelters (belove) (Global Shelter Cluster, 2019, pp.117-121; Global Shelter Cluster, 2023, p.12)

The Second Congo War, which began in 1998—also known as the Great War of Africa—continues to affect the Democratic Republic of the Congo. A volcanic eruption in 2021 further influenced population displacement and mobility in the area. For people affected by both conflict and natural disasters, DRS has become a critical necessity. In 2023, a shelter assistance initiative was launched as part of a multi-layered project. The program addressed both temporary and permanent solutions for internally displaced persons (IDPs), returnees, and those residing in urban areas or temporary centers as separate categories (Figure 6) (Global Shelter Cluster, 2023, pp. 11–16). This situation highlights the multi-dimensional and long-term nature of the issue, demonstrating how transitional shelter can evolve through different typologies over time.

In practice, temporary housing and transitional shelters are not always clearly distinguishable from one another. Their organizational structures, intended purposes, and characteristics are often defined in similar ways. Nevertheless, they are treated as distinct concepts in the literature (Quarantelli, 1982; Quarantelli, 1995; Felix, Branco, & Feio, 2013; Bashawri, Garrity, & Moodley, 2014). However, the terms "temporary housing" and "transitional shelters" are sometimes used interchangeably. The Global Facility for Disaster Reduction and Recovery (GFDRR) examined the use of transitional shelters and temporary housing following the 2011 Japan Earthquake, and categorized temporary housing as a type of transitional shelter (Yoshimitsu, Yasuo, Akihiko & Bettencourt, 2013). Similarly, Johnson analyzed the temporary housing used after the 1999 Marmara Earthquake as part of the transition process between emergency shelter and permanent housing programs, and discussed the problems encountered during long-term use (Johnson, 2007, pp. 36–37).

Transitional shelter refers not only to an outcome, but also to a developmental process. These shelters offer a level of comfort sufficient to allow individuals to resume daily life after the emergency phase. The concept also include structures that begin as basic plastic sheeting and are gradually improved through incremental additions. Transitional shelters may evolve into four different types: they can be converted into permanent housing, reused elsewhere, completely dismantled, or recycled (Shelter Centre, 2009, pp. 3–6). Due to these characteristics, transitional shelters are also defined as a shelter program and are referred to as an approach within humanitarian aid platforms.

Progressive Shelters

DRS that are designed and planned with the potential to be converted into permanent housing are referred to as progressive shelters. These shelters are typically placed on land suitable for long-term use and are intended to be integrated with future or ongoing permanent housing developments. In contrast, shelters located on land allocated specifically for temporary use are not classified as progressive shelters. The expected duration of use for these shelters is typically between three and five years, and materials intended for reuse in permanent housing are expected to be more durable (IFRC, 2013, pp. 8–17, 110; Bashawri, Garrity, & Moodley, 2014, p. 926).

Following the flood disaster in Colombia in 2011, a progressive shelter project was initiated. Within the scope of the project, 148 housing units were built. Each shelter was designed with a total area of 49.75 m² and included a kitchen, a bathroom, and two rooms (IFRC, UN-HABITAT & UNHCR, 2014, pp. 6–9). As indicated by the scale of the project, the aim was to establish a shelter system that would allow residents to eventually transform their units into permanent housing (Figure 7).

Figure 7: Colombia – Dona Ana: A New Village Established with Progressive Shelters (IFRC, UN-HABITAT & UNHCR, 2014, p. 9)

In progressive shelters, users have the opportunity to expand their space and convert it into permanent housing using their own resources and locally available materials (IFRC, 2013, p. 111). There are examples where transitional shelters have been upgraded to progressive shelters. Additionally, the term core housing, as used in the literature, is sometimes applied to progressive shelters (IFRC, UN-HABITAT & UNHCR, 2014, p. xii). Although the term shelter is commonly used, it is evident that the issue is approached from a housing perspective.

Core Shelters / One-Room Shelters

A core shelter is a disaster relief shelter (DRS) designed to offer an expandable living space with the necessary infrastructure, aiming for future conversion into permanent housing. These shelters aim to offer a safe and comfortable living environment that meets basic needs and are generally planned as one or two-room units. Core shelters are considered the most advanced model of DRS during the process of moving towards permanent housing and represent a step beyond progressive shelters. Core shelters are built on land allocated for long-term or permanent use by the occupants. Since longevity is a key objective, the quality of materials used and the care taken by users directly affect the lifespan of these shelters. Therefore, the typical lifespan of core shelters ranges from five to ten years (IFRC, 2013, pp. 8–17, 110; Bashawri, Garrity, & Moodley, 2014, p. 926).

Burkina Faso has been experiencing terrorism and internal conflicts since 2015. As a result, many people have been forced to leave their regions. A project initiated in 2021 aims to address the shelter needs of displaced populations due to these conflicts. The project, implemented across four cities, has delivered 312 core shelters with a total area of 30 m² and an allocation of 3.5 m² per person (Global Shelter Cluster, 2023, pp. 2–10) (Figure 8). When discussing core shelters, one of the most important features is the expandable nature of disaster relief shelters. These projects are located on permanent land, allowing users to modify and eventually convert the shelters into permanent housing.

Figure 8: One Hundred Core Shelters in Kaya City, Burkina Faso (Global Shelter Cluster, 2023, p. 5)

The term core shelter is also used interchangeably with core housing in project documents. This usage is logical considering the potential for these shelters to evolve into permanent housing. In recent years, project reports have increasingly used the term core housing to describe projects that involve the development of transitional shelters or those with the potential to evolve into permanent housing.

Core shelters can be gradually developed and converted into permanent housing according to the changing needs of users. Expandability is a key feature of these types of shelters, providing the necessary comfort for disaster-affected individuals to adapt to their daily living practices.

Permanent Housing

The most advanced stage that disaster relief shelters can evolve into is permanent housing. This final category may be reached through the gradual transformation of transitional, progressive, or core shelters over time (Bashawri et al., 2014, p.926; IFRC, 2013, p.8). Permanent housing must offer a level of comfort that enables individuals to reintegrate into their daily routines and responsibilities. As these structures are intended for long-term rather than short-term use, they are built on land suitable for permanent settlement. Therefore, they must be constructed with durable materials and designed to withstand potential risks and hazards.

Mozambique’s Cabo Delgado region has been struggling with both natural disasters and conflict due to civil war. In 2021, a project was initiated in the region to protect IDPs with a particular focus on the safety of women and girls. By involving female users in both the design and construction processes, 50 permanent housing units were built, based on two models measuring 36 m² and 42 m² (Figure 9) (Global Shelter Cluster, 2023, pp. 40–45).

Figure 9: Northern Mozambique – Cabo Delgado, Permanent Housing (Global Shelter Cluster, 2023, pp.40-45)

Permanent housing provided after a disaster is ensured either by repairing existing structures or by constructing new ones (Quarantelli, 1995, p.50). This approach is generally applicable to disaster survivors who remain within their own country. However, in the case of refugees who are forced to cross national borders due to famine, drought, civil war, or conflict, the provision of permanent settlements involves political dimensions and thus these settlements are often not classified as permanent housing. For individuals who remain within their own country, providing permanent housing through state or humanitarian aid agency support is a more straightforward process. In contrast, shelters built in refugee camps are usually categorized as temporary, emergency, or transitional shelters. Nevertheless, in some refugee settlements, these shelters undergo transformations over time through user-driven interventions and evolve into permanent housings suitable for long-term habitation.

CLASSIFICATION OF DISASTER RELIEF SHELTERS

There are seven main typologies commonly used in the field of disaster relief shelters. These typologies are sometimes combined and referred to by different names. Additionally, they represent not only final products but also processes. In the literature, shelters are discussed both as outcomes and as approaches that vary depending on the type of disaster or crisis. The following points are considered important in this context:

- Temporary and transitional shelters are sometimes collectively referred to as "T-Shelters" in some sources; they are designed to be reusable or relocatable (IFRC, 2013, pp. 8–9; Johnson, 2007, p. 39).
- Progressive and core shelters are built on permanent lands with the potential to be converted into permanent housing (IFRC, 2013, p. 9).
- Transitional shelters are relocatable or reusable shelters constructed with the participation of affected people, using local resources or with the support of aid organizations (Bashawri et al., 2014, p. 926; IFRC, 2013, p. 8).
- Transitional shelters is also defined as structures that are continuously improved through incremental construction processes and can evolve into permanent housing (Shelter Centre, 2011, p. 2).
- Shelter typologies are considered both as types of Disaster Relief Shelters (DRS) and as approaches. Reports and guidelines often provide notes on terminology to clarify concepts before presenting examples (Global Shelter Cluster, 2021, p. 7; IFRC, 2013, p. 8).

- The term "shelter" refers to temporary spaces that meet basic needs, whereas "housing" indicates more comprehensive settlements suitable for daily living (Quarantelli, 1995, p. 45).
- Permanent housing is generally provided for disaster-affected populations; for refugees, temporary or transitional shelters are more commonly used, although some long-term examples may spontaneously evolve into permanent housing over time.

The shelter typologies presented in this study have been classified into three categories: status and period of use, approach and type, and the distinction between housing and shelter. According to this classification, status and period of use will be detailed first.

Classification Based on Status | Period of Use

Although different organizations and policies use various terms for temporary disaster shelters, these structures are fundamentally grouped into three main categories. This classification, based on status or period of use, includes shelters used during the emergency phase for short-term use, shelters intended for the transitional phase, and permanent or semi-permanent shelters designed for long-term use.

Emergency shelters typically consist of basic structures such as tents, plastic sheeting, or lightweight frameworks, primarily designed to meet short-term needs. As the crisis prolongs, these structures become inadequate, and the need for temporary housing increases. Transitional shelters or temporary housings—such as containers, prefabricated units, or structures built with local materials—offer spaces where individuals can maintain daily living activities. Although often criticized for their cost and resource use, these shelters support the recovery process and buy time for the construction of permanent housing (Johnson, 2007, p. 36). Temporary housing has been employed following nearly every major disaster (Johnson, 2010, p. 74). Since long-term living in shelters such as tents is not sustainable, disaster-affected individuals are compelled to move into more dignified and suitable living environments (Bakbak, 2018, pp. 251–252). Permanent housings, on the other hand, include core or progressive shelters placed on land suitable for long-term use and designed to eventually evolve into permanent housing (Figure 10).

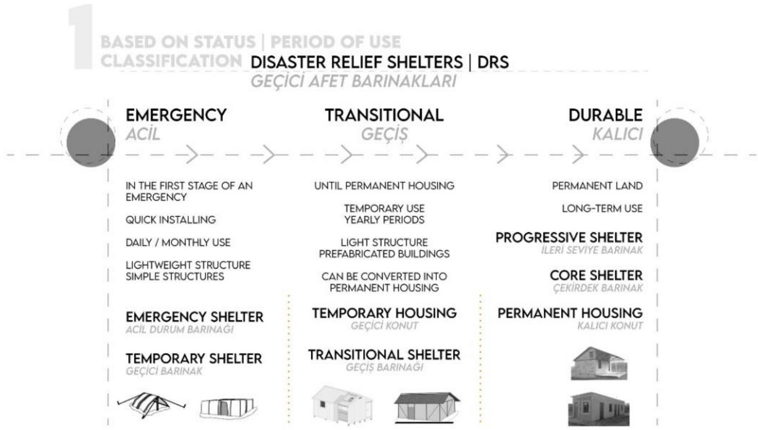

Figure 10: Classification based on status or period of use

Classification Based on Approach | Type

Disaster Relief Shelters can be seen both as a final product and as a process. Accordingly, some shelter typologies are viewed more as project approaches rather than outcomes. Shelter typologies are considered as distinct phases in some sources, while in other platforms they are viewed as a process evolving into permanent housing.

Some disaster relief shelter types refer to the shelters themselves, while others describe the process and approach of design or construction (Global Shelter Cluster, 2023, p.v). Also one design, one shelter can belong to multiple catagories, overlapping between different DRS types (IFRC, 2023, p.9). This makes hard to conclude that shelter refers to the final product or design process. Emergency, transitional, and permanent are the three main phases and process of DRS design. Also, there are some important features as re-used, upgraded, and expanded, to describe transitional, progressive, and core shelters. These features indicate that these shelter types also refer to some approach and process related to DRS (Figure 11).

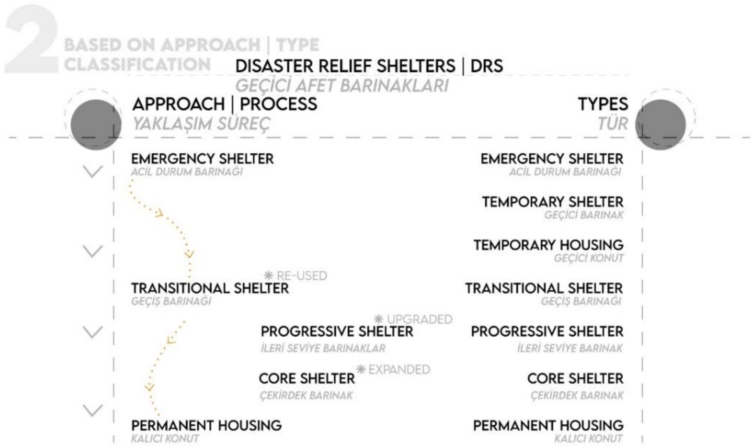

Figure 11: Classification based on approach and type of DRS

Classification Based on Housing | Shelter Differentiation

A significant distinction emerges in the literature reviewed within the field of disaster relief shelters. There is a notable differentiation between the frequently interchanged terms "shelter" and "housing" (Figure 12). Among the disciplines working on post-disaster temporary accommodation—particularly in the field of interior architecture—this distinction stands out as a key classification criterion. The term shelter refers to temporary spaces established immediately after a disaster, where basic needs are met. In contrast, the concept of housing denotes more structured and permanent spaces where individuals return to their regular life practices.

Temporary housing and progressive shelter, core shelter and permanent housing which are used for more durable solutions, are related to housing approach. Main purpose is give to daily rutine and ordinary life practices. At the other hand, emergency shelter and temporary shelter are related to giving basic needs to affected people (Figure 12).

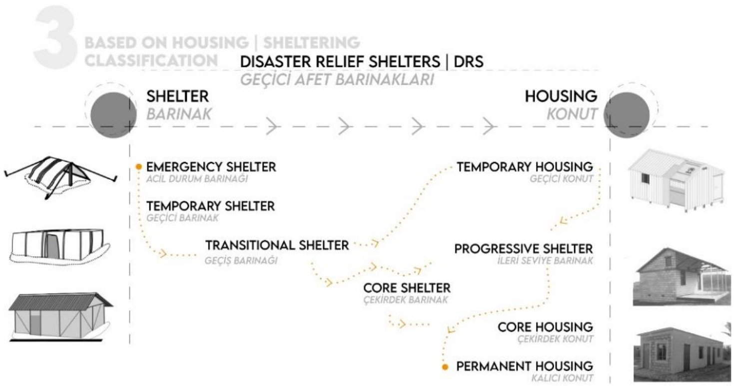

Figure 12: Classification based on housing shelter differentiation

For the field of interior architecture, one of the primary areas of research is DRS developed with a housing-oriented approach that support the reestablishment of individual daily routines. When the housing approach is emphasized in DRS, interior architecture should be included in the research process. However, there is another critical issue that cannot be overlooked at this point. For refugees who are forced to migrate beyond their national borders, using terms such as housing, semi-permanent, or permanent—which emphasize long-term living and daily routines—becomes problematic. Therefore, DRS should always be analyzed with full awareness of the disaster or emergency context from which they emerged.

The use of the terms shelter and housing varies not only according to the physical characteristics of the structure, but also depending on the type of disaster, the socio-political context, and the user's status. This can be clearly seen through the example of core shelters. A core shelter refers to a humanitarian aid unit built to meet essential needs and designed for potential expansion. Core housing, on the other hand, represents the first stage of permanent housing—it is a structure planned along with infrastructure and designed to be expanded over time. For disaster victims who remain within their own country after a natural disaster, the core housing approach offers long-term solutions and is often preferred. In contrast, in cross-border crises or cases of forced migration, the term core shelter is more commonly used. However, in post-disaster projects initiated after refugees return to their homeland, the term housing is sometimes employed. As a result, it has been observed in the literature that both terms appear in parallel, depending on specific contexts and institutional policies.

DISCUSSION AND CONCLUSION

Disaster relief shelters were primarily categorized into four types by Quarantelli (1982), and the IFRC (2013) later added three additional types to this classification. These shelters are not merely physical structures; they also represent the broader process of post-disaster temporary accommodation. Although temporary disaster shelters are often viewed merely as a matter of technical terminology, the concepts chosen are also shaped by socio-political preferences. The classification of shelter types as temporary or permanent may vary depending on both the nature of the disaster and whether the user is a migrant, refugee, or local resident. For instance, even structures with the potential to evolve into permanent housing may continue to be labeled as "temporary" due to political reasons. So, temporariness becomes a concept that encompasses not only a timespan but also administrative and social sensitivities.

To better understand the terminological and structural diversity, the seven types of disaster relief shelters examined in this study were analyzed along three main axes: status and period of use, approach and type, and the distinction between housing and shelter. This classification helps clarify the conceptual framework and ensures a systematic approach to the analysis of DRS.

The seven typologies discussed in this study can be followed in Figure 13. Disaster relief shelters are catagorized in terms of lifespan, period of use, structure type, land use, social background, keywords, and a temporariness scale.

Figure 13: DRS Typologies in Relation to Duration, Use, and Design Attributes

The main aim of this research is to provide an explanation of disaster relief shelter typologies by examining their purposes and naming systems. To provide clarity on this matter, the findings were analyzed and presented along three main axes. This section presents a collective overview of all the assessed attributes and keywords that define each type of temporary disaster shelter (Figure 13). Accordingly, it is important to emphasize that, based on the analysis, certain conclusions have been drawn (Figure 14).

Figure 14: Key Focus Areas in Designing DRS

The main point of emergency shelters is their short-term availability and life-saving support. Temporary shelters rely on a rapid setup process and basic structural systems. As the next step, temporary housing refers to a return to daily life and activities, with a longer lifespan compared to temporary shelters. Transitional shelters are one of the key approaches adopted by major humanitarian organizations. Their main features include being user-driven and based on reusable materials and relocatable structures. Progressive shelters are usually upgraded from transitional shelters toward permanent ones, focusing on transformation and long-term usability. Core shelters—also known as core housing or one-room shelters—are expandable structures. These basic one- or two-room units allow users to maintain daily routines and expand their homes based on evolving needs. Permanent housing must be disaster-resilient and support permanent settlement. It is especially relevant for internally displaced people (IDPs) or returnees. All these key points should be considered in the design of disaster relief shelters (DRS).

This study elaborates on the typologies used in the field of temporary disaster shelters. Various classification proposals related to this topic are presented within the research. Generally, the discipline of interior architecture should be involved in every stage of the sheltering process. It should actively engage in designing DRS that support users' daily activities as they begin to return to their routines. From this perspective, interior architecture should be included in all phases between temporary and permanent housing types. This research is also considered valuable for encouraging the involvement of interior architecture in this field and for demonstrating the contexts in which it can contribute.

In conclusion, this study aims to explain how the terminologies used in the context of temporary housing are shaped through structure, process, and context. Since the classifications presented may manifest differently in various disaster scenarios, it is important to understand temporary housing typologies not as fixed and singular entities but as variable and evolving processes.

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Chapter 7

Insulatıon Propertıes Of Bamboo As A Buıldıng Materıal And Rısk Assessment

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Zuhal ÖZÇETİN[2]

1. INTRODUCTION

Bamboo is a tropical plant generally found in Asia with hardened bark. It is not a tree or a species of wood. It has a hollow, hard trunk known as a bamboo reed. Bamboo is a large, woody plant belonging to the Poaceae family. It is widespread in tropical, subtropical and temperate regions of the world. It is a highly diverse plant capable of adapting to a wide range of climatic and soil conditions. There are around 90 genera and 1,200 species of bamboo worldwide. While most bamboo is found in forests, it is also commonly found outside of them, typically in agricultural lands, along riverbanks, roadsides and in rural areas. Bamboo is a long, stick-like non-timber forest product which is sometimes used as a substitute for firewood. Furthermore, although it can be found anywhere in the world, it plays a significant economic role globally. Its uses include housing, handicrafts, pulp, paper, panels, boards, veneer, flooring, roofing, fabric, and vegetables (bamboo shoots). The growing popularity of bamboo products has led to the development of bamboo industries in Asia, which are spreading rapidly across continents to Africa and America.

Bamboo has numerous beneficial effects in alleviating many social and environmental problems in many countries. It serves as a natural preservative in environmental restoration and in the production of handicrafts, artwork, and furniture. Bamboo products, such as solid and laminated boards, flooring, roofing sheets, supports, and others, have become the primary wood varieties in the construction and fencing industries worldwide. It is used as wood in construction, furniture, utensils, fiber, and paper (Hossain M.F. et al., 2015).

In some Latin American countries, low-rise buildings, known as "Bahareque," have a structural system similar to wood, with bamboo as the

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main components. The main supporting components of this traditional building system, shown in the figure, are horizontal and vertical bamboo elements (Correal, 2016).

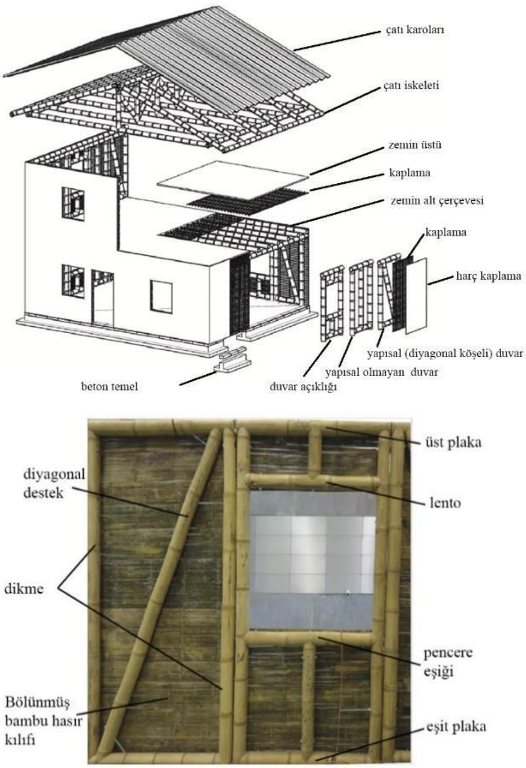

Figure 1. Examples of structural bamboo skeleton systems (Correal, 2016; Karakuş Zambak, 2022)

Due to its high strength properties, bamboo has recently been studied by researchers, and studies have been conducted on its use as a load-bearing element in construction. This is increasing the development of bamboo products and the use of bamboo in the construction industry. However, the transformation of bamboo into an industrial raw material raises concerns about the sustainability of bamboo resources (Karakuş Zambak, 2022).

Table 1. Botanical classification of bamboo (Karakuş Zambak, 2022)

Realm	Branch	Class	Lower class	Team	Family	Subfamily	Genus	Type
Plantae	**Magnoliophyta**	**Liliopsida**	**Commelinidae**	**Cyperales**	**Gramineae (Poaceae)**	**Bambusoideae**	**30-90 farklı çeşit**	**500-1200 farklı çeşit**

There are many different species of bamboo, each with their own distinct characteristics. Different species of bamboo have also been used for the construction of traditional rural dwellings. However, it is important to emphasise that the suitability of a given species of bamboo depends on its physical and mechanical properties. Not all bamboo species are suitable for construction purposes. Those with the size and strength characteristics suitable for construction are known as 'timber bamboo' (Correal, 2016; Karakuş Zambak, 2022).

In tropical regions, the most commonly used species for construction are Bambusa, Chusquea, Dendrocalamus, Gigantochloa and Guadua. Those in the Phyllostachys group are found in temperate regions (Karakuş Zambak, 2022; Minke, 2016).

2. METHOD

This study examines the cultivation of bamboo and its role in the construction sector as a building material, investigating its use and properties in international contexts. The cultivation of bamboo in Türkiye has been examined, as have its advantages and disadvantages, and risk analyses have been created. Recommendations have been made for its cultivation in our country.

3. BAMBOO PLANT, FEATURES AND RISKS

Bamboo species have been introduced to Türkiye from many countries, particularly Georgia, for over 100 years. Some Phyllostachys species, which do not occupy significant areas of Türkiye, are well-known, as are Pleioblastus and Sasa species, which have become established over the last 30–40 years. Notable examples include Phyllostachys heterocycla cv. pubescens and Phyllostachys bambusoides Sieb. & Zucc. Some bamboo species are considered to contribute to rural development in both Japan and Türkiye and are used for erosion control, which is one of Türkiye's most important environmental problems. It is predicted that Phyllostachys species will be used for this purpose, particularly in northern Türkiye, in the near future.

Bamboo is one of the most interesting plants in terms of its cultivation and growth cycle. Bamboo seeds in the soil grow only a few centimetres for five years, and then grow 30 metres within six weeks. Bamboo plants can reach heights of up to 40 metres. A single bamboo plant can produce 15 km of reed in its lifetime (Özdinç, 2021).

Table 2 presents an analysis of the fibre properties of the bamboo plant.

Table 2. Properties of Bamboo Fibers (Özsev Yüksek, 2008)

Strengths	**Weaknesses**
It is naturally antibacterial.	It has low breaking strength.
It is an environmentally friendly fiber and is biodegradable.	Its wet strength is 60% of its dry strength.
She has a soft attitude.	It shows weak cohesion properties in spinning.
It is bright.	

Figure 2. Places where bamboo is grown in Türkiye (Forestry, 2005)

In order to understand the potential of bamboo as a construction material, it is crucial to understand its anatomical structure. This is because the structure directly affects the material's physical and mechanical properties. Circular cross-sections form the physical structure of bamboo. While nearly all species have circular cross-sections, some bamboo species have square (Chimonobambusa quadrangularis) or even triangular forms (Correal, 2016; Karakuş Zambak, 2022).

The above-ground portion of bamboo stems, known as culms, consists of nodes and internodes. The number, spacing and shape of nodes vary from species to species and they provide cross-sectional connection. The cross-sectional structure of a bamboo culm is characterised by numerous vascular bundles embedded in the parenchyma ground tissue. Culture tissue consists of two cell types: parenchyma cells and vascular bundles. At nodes, cells run in parallel, while the walls of the internodes contain longitudinal cells. The internodes that form the bamboo cavities have variable wall thicknesses, and density increases with the height of the conical bamboo. The moisture content affects the long-term performance of bamboo. Bamboo that has been processed and dried has higher strength properties than fresh green bamboo. Although the moisture content varies between species, it is generally in the range of 20% to 30% (Correal, 2016; Karakuş Zambak, 2022).

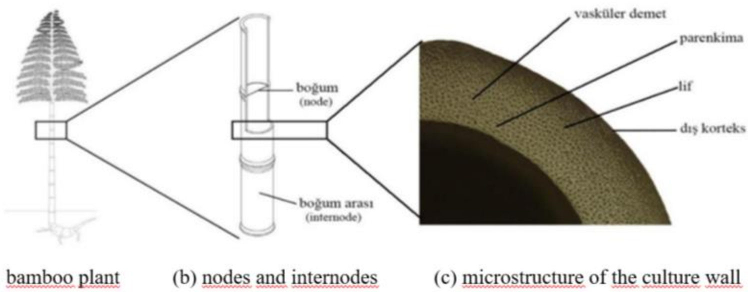

Figure 3. Structure of Bamboo Culture (Correal, 2016; Karakuş Zambak, 2022).

3.1. Features of Bamboo

Since 1940, physical, mechanical and chemical analyses have been conducted on more than 70 bamboo species, determining that they contain 15-18% moisture. The saturation point of the fibres within the trunk is 30–35%. Radial contraction is 4-5%, the burning value is 4,550–4,680 kcal/kg, tensile shrinkage is 3-4%, and tensile strength is double that of wood. Density is 10% greater than that of wood. Fibre content is 40–60%, fibre length is 1,500–2,000 and fibre width is 12–17 (Baykan, 1999).

The physical properties of bamboo are listed below (Zambak et al., 2022; Marangoz & Aydın, 2022; Yu, 2007; Qisheng, 2002).

Examining the properties of the bamboo plant reveals that:

- Bamboo does not corrode like steel reinforcement and is sustainable.
- The energy required to produce bamboo is 50 times less than that required for steel. It is an environmentally friendly alternative to steel. It is more economical than steel. It is a sustainable material.
- It grows quickly in almost every tropical and subtropical region and matures quickly. It is easily accessible and reduces construction costs.
- It has recently been cultivated in the Eastern Black Sea Region of Türkiye.

- Bamboo is a rapidly renewable material. It is reusable and accelerates deforestation.
- ISO 22157 is a global standard for the approval of bamboo as a building material. It describes how to determine compressive, flexural, tensile and shear strength and durability.
- Bamboo's physical properties include a durable, hard-surfaced, hollow, tubular body. This provides excellent acoustic properties.

3.2. Risks

There are some risks associated with the cultivation and use of bamboo. The following risks have been identified (Aykaç and Sofuoğlu, 2021; Marangoz and Aydın, 2022; Zambak et al., 2022; Yu, 2007; Qisheng, 2002):

- Damage caused by physical, mechanical and chemical effects, outdoor conditions and biological pests. Regarding this, it is recommended to use low-cost, environmentally friendly preservatives against biological pests. Trials were conducted by dipping the plant in neem seed oil (NSO). Samples immersed in this oil were more resistant to fungi and biological pests.
- Bamboo contains organic matter that provides nutrients to insects and microbes. When the temperature and humidity are suitable, bamboo is vulnerable to insect and fungal attacks. Bamboo ground should be kept clean at all times to prevent fungal infestation. Precautions should also be taken against herbivores. Before planting, any dry leaves, branches or rubbish in the excavated pit should be burned. The heat generated eliminates fungal pests and mycelium in the soil.
- Structures constructed with bamboo have low resistance to biological deterioration during their lifetime. Therefore, the durability of bamboo structures should be increased using chemical protection methods.
- Comprehensive and reliable data on bamboo-reinforced concrete beams is difficult to find.
- Bamboo has a high water absorption capacity. It is resistant to water and moisture. Unlike wood, it does not warp, bend or become damaged by contact with water.
- Legal uncertainties surrounding international regulations and standards hinder the adoption of bamboo as a building material in many parts of the world.
- Most countries do not have building guidelines for bamboo. This makes it difficult for those who want to use bamboo for construction. It is

especially important to create guidelines in light of the recent rise in bamboo cultivation in Türkiye.

- Regulations and standards need to be established to determine bamboo properties such as fire resistance, strength and durability. Bamboo's fire-resistant properties are due to its density and the high silicate content on its surface. This fire resistance can be increased by filling the bamboo with water, which can withstand temperatures of up to 400°C. The bamboo behind the charred layer remains undamaged. This is because bamboo chars slowly and predictably and conducts heat poorly.
- As bamboo is an invasive plant, it must be controlled. Factors that limit its spread include rainfall, soil type, temperature, altitude and latitude.
- Bamboo is earthquake-resistant. Bamboo has high resistance to forces relative to its weight. Its energy-absorbing capacity and flexibility make it resistant to earthquakes.
- Climate risk: Bamboo requires an annual rainfall of 1500 mm to achieve good quality. It is grown in well-drained, sandy loam soils, clayey loam river silt, or rocky, rocky areas.
- Suitable physical environment risk: It grows in yellow, reddish, yellow, and brownish yellow. Soils with a pH between 5 and 6.5 are suitable. It grows between 8.8°C and 36°C.

4. CONCLUSION AND DISCUSSION

Studies conducted in Japan between 1995 and 1998 identified three economically valuable bamboo species that can grow in Türkiye's Northeastern Black Sea Region. These are Phyllostachys pubescens Nakai and Phyllostachys bambusoides Sieb. et al. Zucc. and Phyllostachys henonis var. nigra. Bamboo rhizomes of Phyllostachys bambusoides Sieb. Et. Zucc. were produced from a mixed stand of Phyllostachys pubescens and Phyllostachys bambusoides in the Pazarköy district of Rize, Türkiye (Baykan, 1999).

Various studies have been conducted on bamboo species found in the Pazardzhik district. In addition to these studies, bamboo's importance in the construction sector and architectural design is growing.

While it is possible to grow bamboo in Türkiye, it is not a naturally occurring plant species. Bamboo thrives in humid, temperate climates. The coastal regions of Türkiye, particularly the humid, mildly temperate areas of the Black Sea and Southern Marmara, may be suitable for bamboo cultivation. However, due to drier and colder climates, it can be more challenging to care for bamboo in some inland areas. Bamboo grows naturally in Asia, particularly in regions such as China, Japan and India, where it is quite common. In

Türkiye, bamboo has been cultivated in Trabzon, Rize, İzmit, Istanbul, Bursa, Izmir, Mersin and Antakya. Bamboo plants are cultivated in gardens and for landscaping in Türkiye. It is a fast-growing, durable and aesthetically appealing plant, making it popular for decorative purposes. However, successful bamboo cultivation requires attention to growing conditions, including the right soil, sunlight, and watering.

Bamboo is a plant that stands out with its fast growth and aesthetic appeal. It can be used as an ornamental plant in garden arrangements, landscaping, and even in pots. Additionally, bamboo can be used for a variety of purposes, including building materials, furniture, craft products, musical instruments, and more. In terms of sustainability, bamboo is considered an environmentally friendly resource due to its rapid growth and renewable nature. Unlike trees, which take years to mature, bamboo can be harvested every few years, making it a sustainable alternative for a variety of products. Some bamboo species also serve as a primary food source for giant pandas in their natural habitat. Bamboo has gained popularity worldwide due to its environmentally friendly nature and diverse applications. It is used in products such as bamboo flooring, bamboo toothbrushes, bamboo textiles, and even in the construction of environmentally friendly buildings.

Besides its disadvantages, bamboo's advantages are anticipated to be particularly important in our country, which is critically affected by earthquakes. Studies conducted so far indicate that its use in the construction sector is highly advantageous. In addition, analyzing the physical and chemical properties required will facilitate ease of use, particularly for bamboo plants grown in Türkiye. These analyses are considered important to guide standards and regulations.

In addition to all these applications, researching the thermal, acoustic, and fire insulation properties of building materials and analyzing bamboo varieties grown in Türkiye is recommended and crucial.

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