



GLASS USE IN RE-USED HISTORICAL BUILDINGS: THE CASE STUDY OF TRABZON KIZLAR MONASTERY

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Abstract

Rapidly developing technological data in the current age affects the field of building materials. Glass is a transparent and fragile building material that is often preferred with traditional materials in restorations. In this study, it is aimed to determine the architectural compatibility of the glass used in the restoration of historical buildings and to reveal the advantages and disadvantages. In this context, Kızlar Monastery, which is located Trabzon in Turkey, has been discussed. The study consists of three stages. In the first stage, the theoretical infrastructure for the subject was created through literature research. The data related to the study area were obtained in the second stage, and the current situation features were examined. In the third stage, glass usage areas were analyzed in the re-using process in Kızlar Monastery. In the findings of the study, it was seen that the interventions made for Kızlar Monastery to connect the past and the future of the building greatly contributed to the original value of the building. As a result, it has been determined that the interventions made by paying attention to the preservation of the original space flow of historical buildings: Reuse; Restoration; Glass Technology; Kızlar Monastery

Introduction

Historical buildings are one of the most important components of cultural heritage. Our social identity is shaped by monuments, structures, urban textures, and social and spiritual values, which are our cultural heritage in historical continuity [1]. Therefore, the preservation of these values directly affects the quality of life and contributes to the development of a sense of belonging between generations. Although historical buildings have generally been replaced by reinforced concrete and steel structures in the last century, they still have an important share of the existing building stock. However, as building materials' durability deteriorates over time, interventions and restoration work become necessary [2, 3]. Contrary to this necessity, many of the historical buildings in the world are being destroyed and cannot be used as a result of neglect, improper planning, vandalism, and unconscious interventions. In addition, natural disasters such as fire, floods, and earthquakes trigger this process [4].

The preservation and restoration of the original architectural features of historical buildings belonging to the cultural heritage is becoming a very sensitive problem in Anatolia, as in many other regions. Many buildings that contain historical cultural values in many of the cities in Anatolia are used for different functions, such as residences, offices, and museum

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centers. Therefore, during the transformation of the building, it is necessary to take adequate precautions against both functional and physical regulations and to carry out interventions as a result of making the necessary analyses [5]. It is of great importance to activate the sustainable planning and preservation strategy for the historical heritage we still own today.

Today, one of the ways to meet the changing user needs as a result of social, cultural, and societal effects and technological developments is to change the functions of historical buildings. Functional change is the replacement of the original function of the buildings under preservation due to their architectural aesthetic features and historical-cultural values [6]. While some of the buildings that could not maintain their original function and that were abandoned continue to live again with a change of function, they also find the opportunity to rejoin urban and social life. However, in some cases, the new functions, which are transformed without considering the integrity of the building, its architectural value, its structural condition, and its contribution to the environment, negatively affect the architectural identity, original elements, and fiction of the building [7-10]. When the structures that have undergone functional changes that have received a largely positive result are examined, it is seen that these structures are usually industrial structures and monumental structures [11-13]. The design and implementation stages are carefully and delicately considered in functional changes that usually have a positive result. The process should be continued with material preferences compatible with the original materials used in the building without making quick decisions. Materials that will not damage the original material during use and that will not prevent it visually should be preferred. Contemporary and innovative materials are also included in restoration applications with the development of technology. Glass, which is one of the contemporary materials, has been used more frequently in restoration applications in recent years [14, 15].

The sociological, economic, political, and religious history of the past forms the basis of the structures and has different typological features according to these values. Monasteries are one of the most important historical building typologies due to the fact that they reflect the social and religious life that countries had in the past through their architecture. They also represent the cultural and social values of their era. The interest in the preservation of monasteries has started to increase in recent years, thanks to the increasing awareness of conservation and preservation the physical documentation of these features. Within the scope of this study, the Kızlar Monastery located on the outskirts of Boztepe in the city of Trabzon is discussed (Fig. 1).



Fig. 1. Kızlar Monastery located on the outskirts of Boztepe (image by Ahmet Kalmuk).

When the literature studies on Kızlar Monastery were examined, it was seen that there was no study on the architectural features and transformations of Kızlar Monastery apart from

the reuse proposals for the Kızlar Monastery, which were carried out within the scope of interior architecture studio classes [16]. The architectural features and recent restoration process of Kızlar Monastery, which have many values in both the history and social life of Trabzon and are of great importance in terms of cultural heritage, have been evaluated. It is hoped that this study, which also has an archive quality, will be a source for future studies in this field.

Literature Review

Preserving historical and cultural structures and transferring them to future generations, in other words, how a building is evaluated influences its sustainability [17]. Today, there are many different approaches to the concept of preserving historical buildings. The preservation of historical environments, which are an important component of identity elements, and the re-evaluation of these environments while preservation them, i.e., turning them into "living spaces", is a universal acceptance for the realization of the preservation action [18]. Re-using is changing the function of historical buildings that have lost their original function over time, in the light of certain principles, by preserving their structural features or by reorganizing historical buildings whose functions continue but whose comfort conditions have become obsolete in a way that can meet current needs. In other words, it can be considered as a powerful preservation method that will prevent the destruction of historical buildings [5]. Functions that are loaded on buildings by re-using and responding to today's requirements make them a living entity [19]. Thus, the buildings are preserved from getting old, turning the buildings into an unusable pile of stones and their surroundings into a center of depression [20].

The practical consequences of reuse, which is a sustainable strategy, and the conceptual values of preservation support the reuse of buildings of historical value [21]. In this process, one of the most basic requirements for the preservation and continuity of the structure is that the buildings can meet today's conditions and requirements. In the transformation process, the new functions that are added to the buildings may overlap with the original functions of the buildings and may contain contradictions [22]. However, the functions of the buildings should interact with the social, cultural, and economic characteristics of society [23]. The important point is to ensure the continuity of the concepts that symbolize the historical memory in the interaction of the old building and the new function and to ensure the sustainability of the building [24-26].

Some interventions are required for the requirements of the new function to be met in the historical building. The interventions that can be made to historical structures that contain original historical values and need to be preserved are determined by internationally valid conservation decisions. When these decisions are examined, material selection and the compatibility of the new material with the original material are among the most important factors. While protecting the building with the least amount of intervention to the original state of the building is adopted as the basic principle, it is emphasized that excessive intervention should not be made on the original material, and if it is done, the interventions should be recyclable. In this context, there are some decisions for interventions to be made with contemporary techniques and materials in international protection decisions.

According to Article 10 of the Venice Charter, adopted in May 1964, which set an international framework for the preservation and restoration of historical buildings for the first time, "Where traditional techniques prove inadequate, the consolidation of a monument can be achieved by the use of any modern technique for conservation and construction, the efficacy of which has been shown by scientific data and proved by experience." It is mentioned that contemporary techniques can be included in the restoration process of historical buildings with this expression [27]. In the Traditional Architectural Heritage Regulation published in 1999, under the title of "changing and renewing materials and architectural elements", it is stated that acceptable changes and innovations should be compatible with the general expression of the

whole, and the new materials used should not be contrary to appearance, texture, and form. In addition, it is stated that care should be taken to ensure that the building materials are compatible with each other [28]. In the Principles for the Analysis, Conservation and Structural Restoration of Architectural Heritage, published in 2003, there are statements that every intervention in historical buildings should, as far as possible, respect the original design, construction technique, and historical value of the structure and preserve traces that will enable it to be understood in the future [29].

The contemporary philosophy of preservation, the Venice Charter (1964), states that each intervention must be minimal and distinguishable in order to reveal the period of the structure and avoid falsified interpretations [27]. Applications carried out using traditional materials or construction techniques in restoration work carry risks and can lead to complexity in perceiving the difference between old and new when not applied correctly. At this point, the use of transparent material has been a promising solution for restoration works because the structure can be strengthened, all the layers of the structure can be seen without losing its original character, and it is recyclable [30]. Glass from transparent materials is an important material in terms of its potential to be used as a restorative material in the preservation of historical buildings, since it has a wide range of uses on different scales, from interior to facade, from an architectural element to furniture.

Glass Technology as a Building Material

Glass has been one of the most frequently used building materials. Although it has been known for several thousand years, its structural use has only shown a dynamic development in recent years [31]. The use of glass provides visual contact between building users and the external environment; this is an important psychological factor that has a positive impact on the health and quality of life of people living and/or working in buildings. In 1935, the distinguished architect of the modernism era, Charles Édouard Jeanneret (LeCorbusier), defined glass as "the basic material of modern architecture" in his articles [32]. Similarly, glass was described by Michael Wigginton in his book "Glass in Architecture" as "the best material ever invented by man" [33]. In addition, the use of glass is compatible with sustainability in buildings [34]. This is because glass can be recycled. Modern glass products such as insulated glass with special functional coatings provide significant energy savings by reducing heating costs in winter and cooling costs in summer [35].

Experiments carried out in laboratories have proven the strength of glass and demonstrated the possibility of using it as a structural material. Today, although many designers are hesitant to use glass as a building material, the use of glass is becoming more and more widespread. The use of glass in buildings began with steel-supported glass and curtain walls, apart from windows [36]. With the development of glass technology, designers have started to push the limits in the use of glass, and today, glass is used for almost all main building components, including shades, floors, and stairs. These uses are due to glass-specific differentiating properties such as translucency, high compressive strength, relatively tensile strength, durability, and resistance to environmental factors [37].

Since the beginning of the 20th century, modern architecture has been instrumental in the mass production of concrete, glass, and steel buildings. This ideology has also helped to meet the housing needs of the developing middle class, and glass and steel construction have become a symbol of development in many countries, where people tend to view these buildings as symbols of wealth and luxury [38]. In this process, many different glass types have been developed, and different types of glass have been used in differentiating spaces. In Table 1 below, the characteristics of the glass types that are frequently used in buildings and the areas of use that have developed in parallel with those historical buildings are given.

Glass Type	Features and Usage Areas
Float Glass	It has a flat and clear appearance. It is used in the construction of canopies, shop fronts, glass blocks, balustrade partitions, etc.
Tinted Glass	Some additions to the glass mixture can add color to the flat glass. It is used indoors, on facades, etc. for aesthetic purposes.
Tempered Glass	In order to increase the strength of the glass, a stronger and safer glass form is formed by thermal processing. Therefore, this glass is used in the construction of fire-resistant doors, etc.
Laminated Glass	It is manufactured by sandwiching glass panels in a protective layer. It is used in glass facades, aquariums, bridges, stairs, floor slabs, etc.
Extra Clear Glass	These glasses, which allow the water to move without leaving any traces, make it easy to clean and maintain. It is used in high-rise building types that are difficult to clean.
Double Glazing	It is produced by providing an air gap between two glasses to reduce heat loss and gain. It is used in areas where insulation is required, such as window and door openings.
Chromatic Glass	This glass can effectively control daylight and transparency. It can be used in meeting rooms and intensive care units.
Glass Blocks (Glass brick)	Hollow glass wall blocks are produced as two separate halves of glass, and the two pieces are pressed together and annealed while the glass is still molten. Glass bricks provide a visual blur while transmitting light.

Methods

Within the scope of this study, the use of glass materials in the process of re-using historical buildings was investigated through the example of the Trabzon Kızlar Monastery. The study consists of 3 stages (Fig. 2).



The first stage is the data collection stage. Data collection is a research technique used to collect data that brings the research subject to a conclusion. According to the content of the researched subject, data collection can be carried out in different ways, such as document analysis, survey, interview, observation, and empirical. In this context, first of all, theses,

articles and books related to topics such as the preservation of historical buildings, re-using approach and the use of glass materials in the restoration process were examined and the theoretical infrastructure of the research was created. The second stage is the stage in which data for the study area is collected. This stage consists of two steps. In the first step, the location of the Kızlar Monastery, which was determined as the study area, and the buildings in the structure complex were investigated, and the obtained data was tabulated. In the second step, the tracking method was used. The tracing method, also known as the process monitoring method, is a research method in which the causal situations of an event are examined by including its process. The process monitoring method, which ensures the reliability of both data collection and sample research, defines the organizational processes of the relevant research topic within a certain timeline. In this context, the transformations of the Kızlar Monastery during the period were investigated through archival documents, fieldwork, and current and outdated photographs. In the third stage of the study, the use of glass in the interventions made during the last restoration process of the Kızlar Monastery was analyzed. During this analysis, the Guesthouse Building located in the monastery complex was specifically studied. The reason for this is that while glass is used as an architectural element only in window openings in all of the other buildings in the monastery, different and detailed uses of glass are also found in the Guesthouse Building. Thus, the advantages and disadvantages of glass, which has been frequently used in the restoration processes of historical buildings in recent years, have been evaluated by revealing the usage areas in the Kızlar Monastery.

Materials

Panagia Theoskepastos, known as the Kızlar Monastery, is located on the northwest slopes of Boztepe in Trabzon province in the Eastern Black Sea Region of Turkey, at a point overlooking the city center (Fig. 3). The building was built between 1349 and 1390 during the reign of Alexios III and was restored over time and took its present form in the 19th century [43, 44]. Apart from the Christian Armenian monastery (Kaymaklı Monastery) in Trabzon-Kaymaklı, the building was used as the only medieval religious house in Trabzon that survived until 1922 during the population exchange [45]. The monastery complex, built on two terraces, was surrounded by a high protective wall.



Fig. 3. Map showing the location of the Kızlar Monastery in Turkey

Until 1843, the rock church, with frescoes depicting Alexios III with his mother and wife, some individual buildings and a ruined hall formed monastic structures. Small buildings in the northeast were added in 1843 [46]. The original top cover of the building, which was abandoned after being used until 1923, has not survived. In 1970, the monastery was re-used as a children's hospital [47]. The Republic of Turkey's Ministry of Culture and Tourism recognized the monastery's historical and tourism potential and began renovation work on the structure [46]. Restoration of the historical rock church, which was neglected for a long time, and the monastery, which includes rare frescoes, began again in 2014. The timeline showing the change in the structure in 2014 and after 2014 is given in Figure 4.



Fig. 4. The evolution of the Kızlar Monastery's southeast courtyard over time (images by Anadolu Agency).

First of all, the rock church with holy water in the south, the chapel at its entrance and a few cellars, then the metropolitan residence, monk rooms, guesthouse, dining hall, a second church, bell tower, mausoleum and five service buildings of different sizes (only the ruins of the service buildings have reached the present day) were constructed (Fig. 5). The buildings at the entrance, the monastic cellars, the church with a single apse on the east side and the second terrace, and the "baldaken" (column and covered with a small dome) tomb belong to the 19th century [48].



Fig. 5. The spaces in Kızlar Monastery and their location in the structure.

Kızlar Monastery, which has important traces of the social, religious, and cultural characteristics of the period in which it was built, is one of the important tourist destinations in Trabzon (Table 2). At the same time, the building, which is easily accessible due to its central location, also constitutes an important place in terms of urban identity. In 1986, the restoration works of the monastery were planned by Istanbul Technical University, but they were not realized. The monastery, which was opened in 2021, has been restored to its original form with the support of the Republic of Turkey Ministry of Culture and Tourism. Today, the monastery serves as a living museum, hosting performance events and art galleries.

Table 2. The spaces in Kızlar Monastery and explanations

Explanation

Konstantinos Chapel

Konstantinos Chapel, which is in the form of a small chapel with a single nave and a single apse, is located in the southeast corner of Kızlar Monastery. The building was presented to the visitors by making the necessary simple repairs to the ruins, reflecting its original features.

City Terraces

The city terraces, located in the northeastern direction of the monastery and overlooking the city view, serve various purposes such as sitting and cocktail areas.

Student Rooms

Student rooms are known as "A Cellars". There are 7 rooms in total, and the cellars at both ends are different from each other. Some of the cellar have niches in their walls. The building attracts the attention of museum visitors with its original features in today's use.

Guesthouse Building

The building consists of a total of 4 floors. The ground floor and first floor of the building are used as exhibition space. -1 basement floor is used as a cinevision room. -2 basement floor is used as an area where WCs and storage are located.

Metropolitan Residence

The building, which has a nearly square plan, belongs to the 19th century with its construction technique and style. Today, the building is used as an area where administrative units and personnel rooms are located.

The Bell Tower

The Bell Tower, built adjacent to the chapel, is arranged in the form of a "baldaken" rising on four columns.

Rock Church

It forms the core of the monastery. It was obtained by shaping a natural cave. There is a holy well formed by the water leaking from the rocks inside the church. There are mural paintings on the walls of the church. Today, it is used for various purposes.

Basilica

The building next to the bell tower is located between the courtyard. The naos (holy section) has a rectangular plan and is covered with a barrel vault. Today, it is used as an animation room.

Mausoleum

The outer cover of the tomb, which was built in the form of a "baldaken" with an elliptical dome on four columns, has a gable roof.

Other Ruins

They are known as "B Cellars". In the section that does not have an independent entrance, traces of rooms can be seen. Hamam (Turkish traditional baths) section is located behind the cellars.

Courtyards

The large courtyard in the center of the monastery is used for various purposes today. The opening ceremony of the Kızlar Monastery was held in this section on September 10, 2021.

Circulation areas

Since the monastery was built on rocks, there was no regular walking path. During the restoration work, a wooden floor covering was used to create a line where visitors could easily walk around the monastery.



Results and Discussion

It was observed that glass materials were used intensively during the restoration process of the Kızlar Monastery, which started in 2014. It has been clearly determined that the glass in the spans of window in all the buildings in the monastery is also used for different functions, especially in the Guesthouse Building. Glasses, which were determined to be used as floors, roofs, railings, and walls, were processed on the plan, section, appearance, and 3D model of the building (Fig. 6). When the glass materials used are considered on the plan plane, it is observed that glass is used in the flooring of the first floor of the L-plan type Guesthouse Building. In the floor where unbreakable tempered glass is used, the loads are transferred to the floor with steel columns, and the glass blocks are brought together with the spider mounting arm. Thanks to the glass flooring used, the historical ruins on the ground floor under the flooring are visible to the visitors. This comfort has been continued on the upper floors, with the gallery space arranged in the area where the glass floor is located in the secondfloor plan. When the use of glass is considered in terms of sections and elevations, it is seen that the floors supported by the steel structures re-created in the building are not fixed to the original stone walls, and therefore a railing is required for the opening to be formed between the wall and the new flooring. As seen in the ground floor, first floor, and second floor plans and sections, this situation was solved by using glass railings. In addition, in the L-plan type building, it was seen that the original wall of the building was completely destroyed at the southeast end, and it was completed as a spider glass facade with tempered unbreakable glass. The new glass mass is designed at the same height as the original height of the building and is covered with the same glass material.



Fig. 6. Kızlar Monastery – Processing the use of glass on sections and appearance (Restoration drawings obtained from Envar Architecture).

In the 3D model (Fig. 7) created within the scope of the study, the use of glass flooring, railings, walls, and roofs can be seen in the Guesthouse Building.



Fig. 7. Kızlar Monastery - Processing the use of glass on 3D model (Created by the authors).

In the restoration and re-using process of the historical Kızlar Monastery in Trabzon, glass has been used for different functions, such as flooring, railings, roofs, and walls. The advantages of these uses are evaluated below:

- Thanks to the use of glass in the flooring, the historical ruins on the ground floor are visible from the first and second floors. This has been achieved with the use of transparent materials like glass and a disassembleable steel structure system, without damaging the original values of the historical building. The use of glass in flooring with the development of technology has shown that glass can be used in situations that may be exposed to high pressure over time. It is clear that glass, which was used only for window openings until a few years ago, is a material open to development in building technology.
- The addition of a new mass with unbreakable tempered glass, replacing the destroyed original stone wall and roof, shows that the building was completed with a contemporary material, distinguishable from its original state and respecting the original state of the building. The outer boundaries and height of the original walls of the building, which was completed with a glass mass, were preserved and referenced

the original situation. In this way, the values of the original structure were not prevented, and intervention was made that could be distinguished from its original state as a period supplement.

- The use of glass in the railings did not greatly increase the dead load of the building and provided advantages in terms of providing light distribution in interior design. The steel structure added in the original stone structure and the fact that the new flooring was not fixed to the walls also prevented the formation of permanent interventions and ensured the realization of reversable interventions.
- The use of glass in the window openings as an architectural element has been determined in all of the other structures of the monastery. However, although they provide a visual appearance close to their original features, it is clear that these glasses are produced with today's technology. Using glasses produced in 2020 technology instead of glasses produced with techniques close to the original window characteristics of the building may not reflect the original state of historical buildings. In recent years, it has been observed that new restoration glasses are being used as window glasses in restoration works carried out in developed countries. Window glasses used in the Orangery of Schwerin Palace in Germany can be given as examples of restoration glasses. Since these glasses were developed in accordance with the flat glass production technique of the period in which the building was built, and contain visual errors equivalent to the original glass properties, they are in harmony with the building.

Although the use of glass in the restoration and re-functioning process of historical buildings is generally seen as a positive approach, there are also some disadvantages that it may cause. These disadvantages are listed below.

- Glass, which is a transparent material, can cause some play of light when it is used heavily/excessively in a space. In this respect, it is possible that the mass, which is almost entirely glass, added later to Kızlar Monastery could create a greenhouse effect when the weather is hot. This situation can create an uncomfortable and disturbing environment, especially in the summer months.
- No matter how visually pleasing the glass may seem, unclean glass can turn all the advantages it provides from an aesthetic point of view into disadvantages. This is a situation that is likely to occur in the Kızlar Monastery, especially in the parts in which the upper cover and the facade are glass, and the necessity of being extra meticulous in cleaning the glass comes to the fore.

Conclusions

The limitations on the usage areas of glass have disappeared with the changing conditions and developing technology. Glass, which was previously used only in windows, has now become a material that has taken its place in almost every field of contemporary architectural applications. In this study, which deals with the use of glass in the new period restoration process of the Kızlar Monastery, it has been seen that the use of glass, which is suitable for its original condition and does not exceed its values, has been carried out in the monastery to a large extent. The raw materials that make up the original building materials, such as stone, brick, adobe, wood, metal, glass, etc., their combination ratios, preparation and application processes, and determination of the physical, mechanical, chemical properties, deterioration over time, and original construction techniques of these materials should be done at the beginning of the process. However, since the original glass material properties of the Kızlar Monastery could not be determined, it is seen that glass produced with the features of 21st century glass technology is used, and it is thought that this situation causes the building to not have the reflective properties of its original glass.

Glass is a frequently used material in restoration and re-functioning applications made in order to protect historical structures that provide the connection between the past and the present, and between the present and the future, and to transfer them to future generations. International conservation decisions also support the decisions and criteria to protect the potential of use of glass in the restoration process of historical buildings. The main reasons for the use of glass in preservation works are that it is a contemporary material, provides a recyclable design, eliminates the physical limitations between the building and the environment with its transparency feature, compatible with traditional materials, does not harm historical and spatial integrity, distinguishes the connection between the old and the new, presents harmonious and aesthetic restoration scenarios, respects the historical traces of the building and emphasizes the original by revealing these traces. Apart from these, the disadvantages that may be caused by the use of glass should not be forgotten. For this reason, the use of glass should be carried out under the control of relevant institutions and organizations with correct practices and appropriate techniques in order to ensure the protection of historical buildings and to minimize their loss.

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