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Evaluation of the Şerefiye Cistern in the Context of Reuse

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Abstract
The cisterns, which were built under the ground to meet the city's water needs, are cultural heritage historical structures that have lost their original functions today. Re-functioning historical buildings that lost their function in the process and contributing to urban life has been practiced in Turkey as well as in the world in recent years. The historical Şerefiye Cistern, a Byzantine water structure on the Historic Peninsula in Istanbul, was restored and re-functionalized in 2017 and opened to use as a cultural building. The aim of this study is to examine the Şerefiye Cistern in the context of reuse. The architecture of the Şerefiye Cistern, which could not maintain its original function, was compared before and after the restoration. After the restoration, a partial modern addition was made to the building. In the study, the socio-economic and cultural benefits of physical intervention in the cistern were questioned. After all; It has been seen that the reuse concept applied to the building both ensures its own sustainability and has positive effects on the historical environment in which it is located.
Key words: Cistern; Byzantine Cisterns; adaptive reuse; re-functioning; Historical peninsula.

1. Introduction

Water is one of the most important needs of people and civilizations have always been established near water. There has always been a thirst problem and people have acted with this awareness. In order to use the water easily, open or closed water tanks, namely cisterns, were built. Cisterns were initially used for irrigation of agricultural lands. In Istanbul, the emperors had cisterns built all over the city to protect the city and to meet its water needs. Emperor Theodosius solved the water problem between the years 379-396 and opened the water line to the Sultanahmet region. One of the cisterns that has survived from the Byzantine period is the Şerefiye Cistern, which is the subject of this study.

Re-functioning is the restoration of old and historical buildings to meet their new needs. Bringing extinct historical artifacts back to life is an important issue. In this regard, they can continue to contribute to urban life by re-functioning such structures in the world and in Turkey, and at the same time with new additions. From this point of view, the Şerefiye Cistern, which is discussed in the article, has been analyzed with criteria such as "space organization", "design approach" and "formal features" . While the Şerefiye Cistern, which is in the natural integrity of the Historic Peninsula, was idle, it was restored by the Istanbul Municipality in 2013, and was re-functionalized in 2017 and after this restoration, from an idle state to a functional state. The aim of this study; The aim is to reveal the old and new architectural texture of the cistern and compare it before and after the restoration. In line with the purpose of the study, the structural and historical characteristics of the Şerefiye Cistern, which is among the closed cisterns in the Historic Peninsula, were determined by literature research. In the study, first of all, the conceptual re-functioning of historical buildings with new additions is explained. Explained conceptually, this subject includes the work of reintroducing the idle state of the Şerefiye Cistern, which is important in terms of water reservation in the Historic Peninsula, to the city by giving it a function today. Before starting the research, articles, thesis data, various documents and internet resources were used. The obtained literature information was evaluated and interpreted.

2. Literature Review

2.1 Historical Development of Cisterns

As a result of scientific studies, it is known that waterways and springs feed the cisterns. One of the first cisterns of the world architectural heritage The cistern in Pavurallakonda Bheemili region in India was carved into the highest rock (Figure 1). During the archaeological excavations in Jerusalem, cisterns with small entrances and carved into natural stone were found. Spiral funnel-shaped structures are seen in the Nazca region of Pru (Figure 2). These cisterns found indicate that water storage has been important since ancient times (Güngör, 2017). It is possible to come across the cisterns of the Roman period, which have survived to the present day, in Anatolia. In the Byzantine Period, the cisterns were transferred underground with the support of columns. Over the years, they have improved in techniques and facilitated the transportation of water with the help of pressure water balances. Thus, the cisterns started to lose their importance, but there are cisterns that stand out with their architectural features. The cisterns, which lost their functions over time in the Ottoman Empire, were destroyed over time or their entrances were closed. Some of them were used as warehouses or for different functions.

Figure 1. The cistern in Pavurallakonda Bheemili area, India (URL 1)

Figure 2. The cistern in the Nazca area of Pru (URL 2)

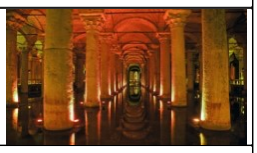
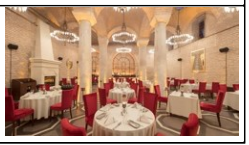
2.2 Cisterns

The word cistern, which comes from the Arabic origin "şahrinc", means "small pool". Cisterns were built for the purpose of storing rain water and in this direction, they are located underground, above ground or partially underground. The cisterns were generally underground and their walls were plastered with special mortars and were built as water tanks. The cisterns built to store rain water are either open or closed to meet the city's water needs (Güngör, 2017). In the past, cisterns were used all over the world and as time passed, they lost their function. The residents of Santorini abandoned the cisterns on their island in favor of desalination and well-drained water. Later, researchers worked towards improving water efficiency by restoring the cisterns (Enriquez et al., 2017). The cisterns were built in different ways, from very simple pots to large underground structures (Mays, Antoniou & Angelakis, 2013) (Table 1).

Open cisterns; It is called an open-air water pool. Open cisterns can be rectangular or square in plan. It is thought that the open cisterns that collect rain water are pools that allow the water to reach the city canals. Water is taken through a cylindrical wood or a cover pressed on a horizontal hole, and water can be taken from various levels with the help of these mechanisms. Six opposite piers are seen on the short sides of the cistern (Polat, 2004). Open cisterns are usually built at high points in the city, thereby reducing the pressure of the water on the walls and preventing them from collapsing. The walls of the cisterns were made of block stones, bricks and Khorasan mortar using Roman construction techniques. And in order to prevent leakage, a mixture of hammered brick and marble pieces with lime and flax oil was used by plastering the interior parts (Polat, 2004).

Closed cisterns are storage areas that allow water to accumulate underground (Yıldırım, 2021). Closed cisterns are generally built under important structures, so that water access is easier and they meet the water needs of the building. The larger the building, the larger the cistern built, and they become a solid foundation for the building. The cisterns are provided with marble columns from the inside. These columns are connected to each other by arches and cross vaults. The top of the cistern was covered with vaults made of stones and bricks. Stone stairs were built to descend into the cistern (Önlü, 2010).

Table 1. Open and closed cisterns and their new functions (created by the authors using URL 3)

TYPE	Name	DATE OF BUILDING	NEW FUNCTION
OPEN CIRCLES	Aetios Cistern	Byzantium, 5th century.	Vefa Sports Club's stadium 
	Aspar Cistern	Byzantium, the period of Leon I.	 children's playgrounds and the annex building of Fatih municipality
	The cistern of Hebdemon's Elephant	Byzantium, 5th century.	Sports field and jogging track 
CLOSED CIRCLES	Theodosius (Şerefiye) cistern	Byzantine - Thedosius Period, 4th century.	 Museum
	Basilica cistern (Basilica cistern)	Byzantium, Period of Justinian I, 5th Century	Museum 
	Antique Hotel Cistern	Byzantium, 5th century.	 Restaurant
	Hagia Sophia Cistern	Byzantium, 5th century.	Restaurant 

2.3 Historical Peninsula Cisterns

During the Byzantine period, from the 3rd century AD to the 14th century AD, different cisterns were built in Istanbul and water was stored. The cisterns were supported by underground columns and emerged as vaulted structures (Güngör, 2017). In the past, as it is today, it was important to prevent some diseases and fire accidents, so powerful empires built many cisterns and brought water to the cisterns by constructing aqueducts (Hakan, 2020). The Historic Peninsula in Istanbul is one of the regions where many cisterns were located during the Byzantine period (Figure 3). The most important reason for the Byzantine Period cisterns in Istanbul to survive is the use of the right system and the fact that they were built on the bedrock.

One of the reasons why open cisterns were given importance in the Byzantine period was that they could meet the water needs easily and easily. The number and size of Byzantine Cisterns are decreasing over time, and it shows that before the 7th century, there were large cisterns both in number and size (Ward, Crapper, Altuğ, Crow, 2017). The walls of the cisterns are approximately 4-6 m thick and their height varies between 10-15 m. Closed cisterns are preferred because these cisterns are also hygienically inconvenient. It is known that some cisterns belonging to the Byzantine Period were used outside of their functions. Sometimes they were places used as silk workshops or warehouses.

During the Byzantine period, hundreds of cisterns were built in Istanbul as the capital of the empire to meet the water needs. The fact that the water system is independent from each other ensures that only a certain amount of water is distributed. Some water cisterns used in the Byzantine period belong to the Roman period. Byzantine cisterns were repaired and used in the Ottoman period, as the repair technique is different, differences can be distinguished in wall repair. In the late Byzantine period, when the canals became unusable, the cellar walls of some buildings were plastered with waterproof mortar and used as cisterns. Some of the closed cisterns that have survived from the Byzantine period have been destroyed during road construction or construction.

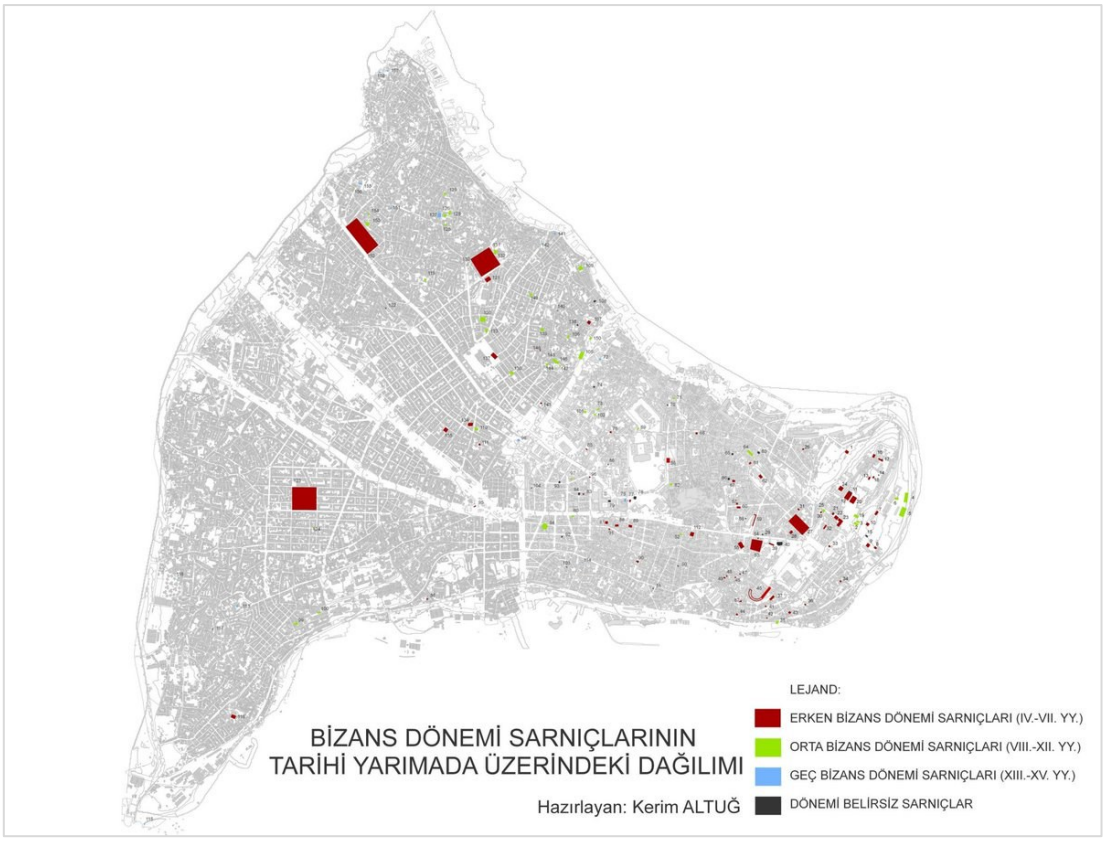


Figure 3. Distribution of Byzantine Period Cisterns in the Historical Peninsula (Kerim Altuğ, URL 4)

In the Ottoman period, the cisterns lost their original functions and were used as warehouses. The repairs in the Byzantine cisterns, which were also used in the Ottoman period, can be easily distinguished as they are different from the late Ottoman period technique. Small rubble stones were used on the inner surfaces of the walls of the cisterns and mostly smooth block stones were used on the outer surfaces. On the surfaces where brick is used, the thickness of the mortar is equal to the thickness of the brick (Polat, 2004). In the Republican period, it was also used as a warehouse where the fire brigades sometimes drew water during the great fires. Today, some of the cisterns are used by re-functioning because they have completely lost their functions.

2.4 Adaptive reuse

Adaptive use; It carries the historical continuity of the work to present and future generations by re-functioning and changing a historical building and bringing it into a shape suitable for new needs (Kaplan, 2021). It is a survival method used for the sustainability of historical buildings by adapting them. However, in the adaptive use process, sometimes applications that contradict its original function are seen. The new functions given to the old buildings are not related to the original function of the old building. On the other hand, a degraded historical building may need to be adapted (reused) for a new purpose. When change becomes inevitable in buildings, it is necessary to expand their usage capacity with a principled adaptive design (Askar, Bragança, Gervasio, 2021). Revitalizing the old building provides a new life to the building itself and its surroundings. Adaptive reuse prevents the demolition of many historic buildings. For this reason, the renovation and reuse of an existing building is also suitable in terms of cost savings in building materials. Renovating an old building can be more economical in the long run than building a completely new one. With the re-use of the building, socio-cultural continuity can also be ensured (Figure 4-5).

Figure 4. Canadian Crystal Museum (URL 5)

Figure 5. Elbphilharmonie concert hall (URL 6)

The application of an adaptive reuse approach to bring old buildings back to life benefits the renewal of an urban area by making these buildings usable. Adaptive reuse is one way to salvage a neglected old building. Re-use, which is a means of preserving a building with historical value, brings with it economic and socio-cultural benefits.

Re-functioning is the transformation of a building that has lost its function into something else, while preserving the structural features of the space, and bringing it back to urban life (Figure 6-7). Re-functioning, re-use of existing structures is one of the most discussed issues in architecture today. There are different approaches in re-functioning and it preserves the structure and prepares it for use in a modern way. Refunctioning; preserving the architectural and cultural values of historical and old buildings, making these buildings usable. These structures were to ensure the continuity of the historical texture with new uses suitable for their structural features, transforming themselves and the surrounding space into a living environment. In the new functionality and new addition, many principles have been put forward that should be followed by different researchers. These principles are; space organization, design approach and stylistic criteria are considered important (Sağlam and Tavşan, 2019)

Sağlam and Rabbit gave an explanation of the principles in their study as follows:

- Space Organization: Circulation element, eaves element, Roof completion, Transition element, Facade integration, Facade completion.
- Design Approach: Copy, Affinity, Contrast, Abstract reference, Neutral.
- Formal Criteria: Height (long-equal-short), Color (same-similar-different), Material (same-different), Joint (top-inside-outside), Building line (outward-equal-backward), Detail (plain-medium-ornate), Orientation (parallel-outlier), Visual intensity (high-medium-less).

These principles were used as criteria in the evaluation of the new addition that the Şerefiye Cistern received as a result of the restoration.

Figure 6. Venice Flour Factory (URL 7)

Figure 7. LocHal Library (URL 8)

3. Case Study

3.1 Material and Method

In the scope of study; the new addition and reuse issues, which constitute the conceptual basis of the study, and the Cistern structures were examined by literature research. The sample material of the study is the Şerefiye Cistern located in the historical peninsula of Istanbul. First of all, data on the original condition of the Şerefiye Cistern were collected.

Then, the new situation after taking the supplement was analyzed through the plan, sections, visuals and on-site observations, with criteria such as "space organization", "design approach" and "formal features". The findings obtained from the analyzes are presented in the form of a table and the result of the study is presented.

3.2 Şerefiye Cistern

The current situation:

Şerefiye Cistern, a Byzantine water structure, is located in the void of a building island in the Binbirdirek District of Eminönü district of the Historic Peninsula. Some structures that were on it before were removed with the decisions of the Conservation Board in 2010 and they were made noticeable in the dense structure texture around it. The Şerefiye Cistern, which is located under the old Eminönü Municipality additional service building, does not have a construction inscription. It is thought to have been built during the reign of Theodosius (408 – 450) (Figure 8). Built on an area of approximately 24 meters by 40 meters and with a ceiling height of 11 meters, the Şerefiye cistern contains 45 sail vaults and 32 columns (Yıldırım, 2016) (Figure 8). Semi-worked capitals in Corinthian style with imposts on them are made of marble (Altuğ,2015). The heads are decorated with acanthus leaves. The interior walls of the structure are covered with waterproof plaster and the corners are curved to withstand water pressure. The building remained inactive for a long time without any use. In 2013, a project competition was held for its reuse and Cafer Bozkurt Architecture office won the competition.

Figure 8. Şerefiye Cistern entrance structure, plan and section (URL 9)

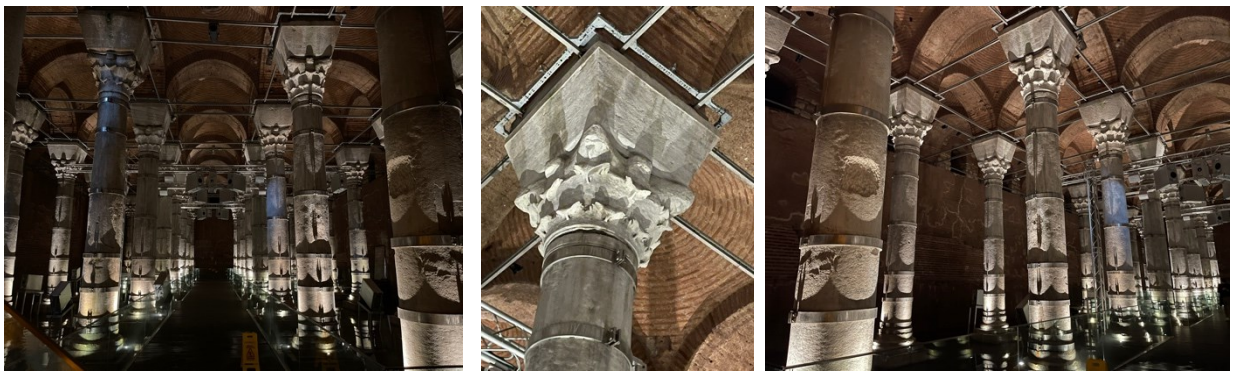


Figure 9. Columns and capitals of the Şerefiye Cistern, (Authors, 2022)

New condition: New addition and reuse

The Şerefiye Cistern, whose construction period lasted 8 years, was opened for use as a cultural and artistic structure in 2018. In the reuse project of the cistern; An entrance section to the ground floor and stairs and an elevator have been added to the building for descending to the old water storage area (exhibition hall) under the ground. The project was not only considered as an additional and new function to the existing structure, but also as an arrangement of its immediate surroundings. The historical Cistern Square was arranged so that the cistern structure would emerge and be visible. The square is separated from the additional entrance structure using a reflecting pool. Since the historical building is a water structure, the entrance to the cistern was provided over this water element. The entrance structure of the historical cistern is made of light steel system as a transparent and contemporary construction. The design of the additional building was made in proportion to the square and surrounding structures. Natural air circulation in the

building is ensured with the glass façade elements of the additional entrance, where minimal intervention is made on the historical building, and the ventilation shutters on the roof.

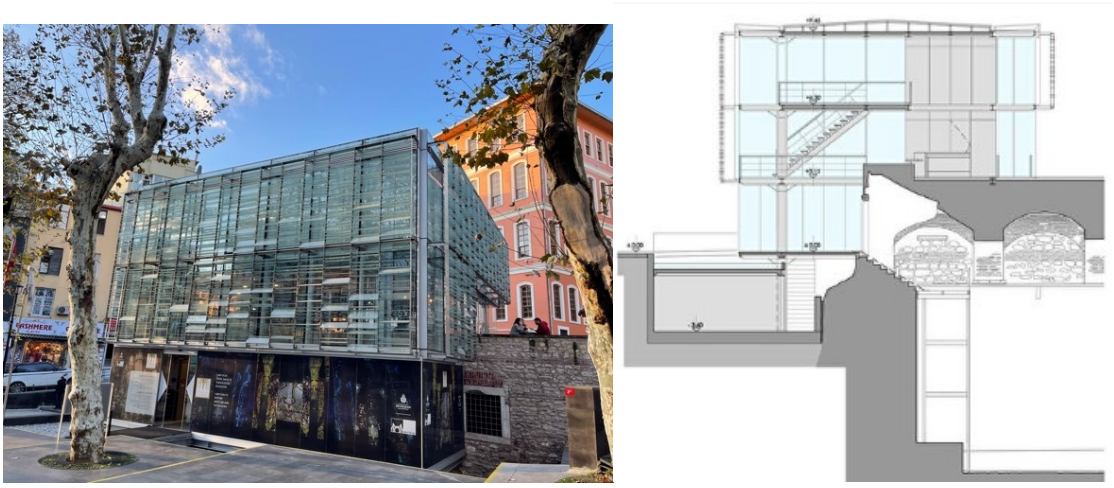


Figure 10. Şerefiye Cistern entrance structure and section (URL 10, Authors, 2022)

The historical Cistern Square was arranged so that the cistern structure would emerge and be visible. The square is separated from the additional entrance structure using a reflecting pool. Since the historical building is a water structure, the entrance to the historical cistern is provided over this water element. The entrance structure of the historical cistern is made of light, steel structure as a transparent and contemporary construction. The design of the additional building was made in proportion to the square and surrounding structures. A contemporary structure has been created with minimal intervention to the historical structure and the structure has a Steel structure, glass outer shell, metal roof and wooden flooring.

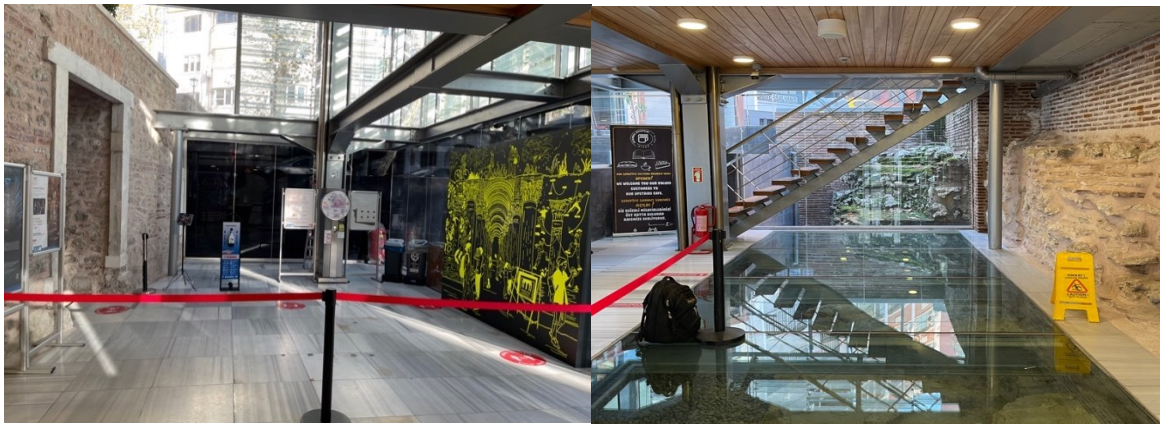


Figure 11. Şerefiye Cistern entrance structure and consultation (Authors, 2022)

In the new venue organization; On the ground floor of the three-storey transparent annex, there are functions such as information desk, ticket, book sale, and cafe. On the upper floors; There is storage space, restrooms and a multi-purpose hall for cultural activities such as exhibitions. In the original part of the historical cistern, there were art exhibitions, children's activities and performance areas from various branches of performing arts.

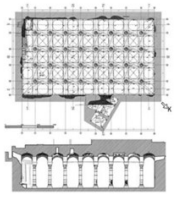
Design approach; The original part of the cistern was interfered in two ways. First; It is an elevator placed for visitors next to the existing steep stairs to reach under the floor . Latter; It is a walking platform that is raised and furnished on the ground of the historical building. This platform is made of moisture resistant wood and steel material. In this intervention, which did not harm the essence of the building , the new additions and materials did not get in the way of the building, by acting neutrally . The cracks in the columns of the cistern were filled with epoxy added repair mortar and the limestone formations were cleaned with precision mechanical methods.

Formal features; The additional entrance structure is higher than the original structure, which is due to the natural location of the cistern, which is a water reservoir. With the transparent surface of the additional entrance building (glass), which is a different material, the visibility of the original building is ensured. The main annex has a transparent and plain surface positioned on the outside of the cistern at ground level. This section is medium in terms of visual intensity.

4. Findings

In this study, the new addition and re-functioning of historical buildings are discussed. The new addition and new function of the Şerefiye Cistern, which lost its function as the sample area of the study, were analyzed before and after the restoration. Criteria such as “Space Organization”, “Design Approach” and “Formal Features” were accepted as the analysis parameters of the new addition and re-functionalization of the Şerefiye Cistern. The findings obtained as a result of the analysis carried out with the plan, sections, visuals and on-site observations of the building are given in Table 2.

Table 2. Şerefiye Cistern analysis table (Used from Sağlam and Tavşan, 2019 article, URL 11)

Şerefiye Cistern																
Plan	**Appearance**	**Type of place organization**						**Design approach**								
		Circulation Element	Fringe Element	Roof Completion	Transition Element	Facade Integration	Facade Completion	Copying	Affinity	Opposition	Abstract Reference	Neutral				
						●						●				
		Formal criteria														
		**Height**			**Colour**			**Material**		**Joint/ location**						
		Long	Equal	Short	Same	Similar	Different	Same	Different	Top	In	Out				
		●				●			●			●				
		Building Line			**Detail**			**Orientation**		**Visual Density**						
		Out-going	Equal	Back	Simple	Middle	Decorated	Parallel	Inconsistent	A Lot	Middle	Little				
		●			●				●		●					

4. Conclusion

Historical buildings that have lost their function all over the world are transformed into prestigious buildings living in the city by giving new functions and making new additions. Design criteria and criteria are important in these studies carried out for adaptive use. Although different design approaches have been adopted in different countries, the starting point of all these is respect for the original identity of the existing structure and sustainable preservation.

In this study; re-functioning, re-use, and especially adaptive use, which is an intervention method for ensuring the continuity of historical buildings, have been examined in the context of the Şerefiye Cistern. The Şerefiye Cistern, which is one of the important water structures of the architectural heritage in the Historic Peninsula, remained non-functional for a long time. As a result of a project competition opened for its reuse in 2013, a new addition was made to the cistern for its new museum-culture function. In the study, the intervention in the Cistern; It was examined whether the building preserves its spatial integrity with the construction technique . When the intervention is evaluated in terms of criteria such as "space organization", "design approach" and "formal features"; It has been seen that the new annex, which was built to meet the needs of the visitors and to provide the entrance, forms an integrity with the historical cistern building. Contemporary construction techniques and glass material selection have shown that the main building does not override its historical identity and integrates with its immediate surroundings.

References

Altuğ, K. (2015). Planlama İlkeleri ve Yapım Teknikleri Açısından Tarihi Yarımada'daki Bizans Dönemi Sarnıçları. DergiPark, sayfa: 3- 22. https://dergipark.org.tr/en/pub/restorasyon/issue/48722/619946

Askar, R., Bragança, L., Gervasio, H. (2021). Adaptability of Buildings: A Critical Review on the Concept Evolution. MDPI, 11(10), 4483. https://doi.org/10.3390/app11104483

Enriquez, J., Tipping, D., Lee, J., Vijay, A., Kenny, L., Chen, S., Mainas, N., Holst-Warhaft, G., Steenhuis, T. (2017). Sustainable Water Management in the Tourism Economy: Linking the Mediterranean's Traditional Rainwater Cisterns to Modern Needs**.** *Water*, *9*(11), 868. https://doi.org/10.3390/w9110868

Güngör, S.S. (2017). Tarihi Yarımada'daki Roma Ve Bizans Dönemi Sarnıçları. Stratejik Ve Sosyal Araştırmalar Dergisi. https://doi.org/10.30692/sisad.362702

Hakan, T. (2020). Cisterns as Vital Structures: Byzantine Cisterns and Subarachnoid Cisterns. Turk Neurosurg 30(4):471-475. https://doi.org/10.5137/1019-5149.JTN.29786-20.3

Kaplan, N. (2021). Risk Altındaki Tarihi Bir Bina İçin Uyarlanabilir Yeniden Kullanım Önerisi: Ambar Köyü Kilisesi Örneğl, Mimarlık ve Yaşam Dergisi**,** 6(2), 459-483. http://doi.org/10.26835/my.880058

Polat, I. (2004). Silifke Aya Tekla Bazilikası Sarnıcı Restorasyon Projesi (YLT). İTÜ, FBE. http://hdl.handle.net/11527/10160

Mays, L., Antoniou, G.P., Angelakis, A.N. (2013). History of Water Cisterns: Legacies and Lessons. *Water* 2013, *5*(4),1916 -1940. https://doi.org/10.3390/w5041916

Önlü, Ş. (2010). Yerebatan Sarnıcı'nın Taşıyıcı Elemanlarının Analizi (YLT). İTÜ, FBE. http://hdl.handle.net/11527/3282

Sağlam, K., Tavşan, C. (2019). Tarihi Çevrede Çağdaş Eklerin Biçimsel ve Kavramsal Kriterlere Bağlı Karşılaştırılması. Yakın Mimarlık Dergisi, Cilt: 3, Sayı: 1.

Ward, K.A., Crapper, M., Altuğ, K., Crow, J. (2017). The Byzantine cisterns of Constantinople. Water Supply,17 (6): 1499–1506. https://doi.org/10.2166/ws.2017.053

Yıldırım, İ. (2016). İstanbul Kapalı Sarnıçlarının Işlevsel Dönüşümünün Mekansal Bağlamda Irdelenmesi. Beykent Üniversitesi Fen Bilimler Enstitüsü Iç Mimarlık Ana Bilim Dalı, Yüksek Lisans Tezi, İstanbul. https://acikbilim.yok.gov.tr/handle/20.500.12812/709600

Yıldırım, F. (2021). Yerebatan Sarnıcı Restorasyon Aşamaları ve Koruma Süreci. Fatih Sultan Mehmet Vakif Üniversitesi Lisansüstü Eğitim Enstitüsü**,** Yüksek Lisans Tezi**,** İstanbul. https://hdl.handle.net/11352/3832

Internet Sources:

www.ibb.gov.tr/kudeb . (2016)

URL-1, The cistern in Pavurallakonda Bheemili district, India, Date Retrieved: 2022.04.20.

URL-2, The cistern in the Nazca desert, Sozcu.com.tr, Date Retrieved: 2022.04.20.

URL-3, Some open and closed cisterns and their new functions, tr.wikipedia.org, Date Retrieved: 2022.04.20.

URL-4, Distribution of Byzantine Period Cisterns on the Historical Peninsula, Date Retrieved: 2022.04.20.

URL-5, Canadian Crystal museum, m.facebook.com, Date Retrieved: 2022.04.20.

URL-6, Elbphilharmonie concert hall, Date Retrieved: 2022.04.20.

URL-7, Venice Flour Factory, Dergipark.org.tr, Date Retrieved: 2022.04.20.

URL-8, LocHal Library, archdaily.com, Date Retrieved: 2022.04.20.

URL-9, Şerefiye Cistern entrance structure, plan and section, arkitera.com, Google map, Date Retrieved: 2022.04.20.

URL-10, Şerefiye Cistern entrance structure and section, gzt.com, Date Retrieved: 2022.04.20.

URL-11, View of the Şerefiye Cistern, arkiv.com.tr, Date Retrieved: 2022.04.20.