

Preserving Cultural Heritage and Shaping Sustainable Urban Futures: The Transformative Impact of Symbiotic Architecture On Historical Buildings



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Abstract: This article examines the transformative impact of symbiotic architecture on historical buildings, highlighting the integration of contemporary additions that enhance both functionality and design while preserving cultural heritage. Today, as historical structures face challenges in adapting to modern needs, symbiotic architecture emerges as a solution that bridges the gap between the past and present. This architectural approach aims to revitalize these structures without compromising their essence. Through various examples, the article demonstrates how such augmentations redefine the structural and experiential nature of historical buildings. The main goal of symbiotic architecture is to preserve the historical fabric while making it suitable for modern usage scenarios. Such projects ensure that the aesthetic and cultural heritage from the past is passed on to future generations, while transforming buildings to meet the expectations of contemporary users. Additionally, the article emphasizes the importance of the delicate balance established between historical elements and contemporary features in creating innovative and sustainable urban environments. Achieving this balance between conservation and innovation presents challenges not only in terms of architectural aesthetics but also within cultural and social contexts. The article underscores the role of symbiotic architecture in creating modern cities that honor the values of the past while meeting the needs of the present. This approach facilitates not only the preservation of historical structures but also their integration into modern urban life, breathing new life into them.

Keywords: *Historical Building, Contemporary Extension, Symbiotic Relationship, Refunctioning, Revitalization.*

Kültürel Mirasın Korunması ve Sürdürülebilir Kentsel Geleceğin Şekillendirilmesi: Simbiyotik Mimarinin Tarihi Yapılar Üzerindeki Dönüştürücü Etkisi

Özet: Bu makale, tarihi yapıların dönüşümünde simbiyotik mimarinin dönüştürücü etkisini inceliyor ve çağdaş eklemelerin hem işlevselliği hem de tasarımı geliştiren, aynı zamanda kültürel mirası koruyan entegrasyonlarını vurguluyor. Günümüzde tarihi yapılar, modern ihtiyaçlara uyum sağlama zorluklarıyla karşı karşıya kalırken, simbiyotik mimari, geçmiş ile günümüz arasında bir köprü oluşturan bir çözüm olarak ön plana çıkıyor. Bu mimari yaklaşım, yapıların özüne zarar vermeden onlara yeni bir hayat kazandırmayı amaçlıyor. Çeşitli örnekler aracılığıyla makale, bu eklemelerin tarihi binaların yapısal ve deneysel olarak nasıl yeniden tanımladığını ortaya koyuyor. Simbiyotik mimarinin temel amacı, tarihi dokuyu korurken onu modern kullanım senaryolarına uygun hale getirmektir. Bu tür projeler, geçmişten kalan estetik ve kültürel mirası gelecek nesillere taşırken, yapıların günümüz kullanıcılarının beklentilerini karşılayacak şekilde dönüştürülmesini sağlıyor. Ayrıca, makale, yenilikçi ve sürdürülebilir şehir ortamları yaratmak için tarihi yapılarla çağdaş unsurlar arasında kurulan hassas dengenin önemini vurguluyor. Koruma ve yenilik arasındaki bu dengeyi sağlamak, sadece mimari estetik açısından değil, aynı zamanda kültürel ve sosyal bağlamda da zorluklar barındırıyor. Simbiyotik mimarinin, hem geçmişin değerlerini onurlandıran hem de günümüz ihtiyaçlarına yanıt veren modern şehirler yaratmada oynadığı rolün altı çiziliyor. Bu yaklaşım, tarihi yapıların yalnızca korunmasını değil, aynı zamanda modern kentsel yaşama entegre edilerek yeniden hayata döndürülmesini sağlıyor.

Anahtar kelimeler: *Tarihi Yapı, Çağdaş Uzantı, Simbiyotik İlişki, Yeniden İşlevlendirme, Yeniden Canlandırma.*

1. INTRODUCTION

Historic buildings represent tangible examples of a society's cultural, historical and architectural identity. However, due to changing societal demands and the rapid advancement of technology, these structures often struggle to maintain their relevance in contemporary urban environments. Industrial revolutions and socio-technological changes of the 20th century have increased the demand for innovative revitalisation strategies [1]. Symbiotic architecture, which seamlessly incorporates modern elements into historic buildings, offers a viable solution. This approach not only preserves the aesthetic and cultural integrity of heritage buildings, but also enhances their functionality to meet modern requirements. Symbiotic architecture connects the past to the future by reconciling structural integrity and user experience. The interaction between historic buildings and modern architectural trends has long been a focal point of architectural discourse. Contemporary symbiotic additions create new functional possibilities and redefine the existence of historic buildings both structurally and experientially. Recently, there has been an increasing emphasis on incorporating symbiotic enhancements into historic buildings to harmoniously combine traditional and modern design [2]. This paper explores the transformative impact of symbiotic architecture on historic buildings, highlighting its potential to preserve architectural heritage while promoting sustainable urban futures through a delicate balance of conservation and innovation.

Symbiotic Augmentations in Historical Architecture

Symbiotic augmentations denote the incorporation of contemporary architectural elements into the fabric of historical edifices. These augmentations are meticulously crafted to meet the demands of modern usage while respecting and preserving the inherent architectural and functional features of the historical structures [2, 3, 4, 5]. For instance, an illustrative example of symbiotic augmentation can be observed in the case of the Castello di Rivoli in Italy, where a modern glass extension was designed by Andrea Bruno [6]. This addition not only introduces a contemporary aesthetic to the historic structure but also enhances its functionality by allowing natural light to flood the museum and providing extra exhibition space. Bruno's design is rooted in a philosophy of minimal intervention, aiming to preserve the integrity of the original building while offering a clear dialogue between the old and the new. Scholarly critiques, such as those by architectural historian Paolo Portoghesi, highlight the extension's ability to respect the historical context while offering a bold architectural statement [7]. Additionally, its reception by the public and architectural community has been largely positive, with many praising its sensitive yet innovative approach to integrating modern elements within a historic framework. As a result, this adaptation meets modern living standards while preserving the historical integrity of the building.

Due to the spatial constraints created by urban density and population growth, some historical buildings have been invaded by parasitic additions. Parasitic additions, unlike symbiotic augmentations, are characterized by their unilateral benefit to the new structure, often prioritizing functionality and space utilization over the preservation of the host building's integrity [8, 9, 10]. These additions typically "attach" themselves to the existing structures in a way that can disrupt the architectural harmony, sometimes even causing physical or visual damage. In contrast, symbiotic augmentations aim for a mutualistic relationship, enhancing both the functionality of the historical building and its aesthetic or structural value. For instance, while a parasitic addition might involve a haphazardly attached extension to increase usable space, a symbiotic intervention would carefully integrate modern elements that respect and complement the original architecture. This situation raises questions about "how to preserve" historical buildings while preserving them for future generations. Since the late 19th century, national and international organizations, institutions, and regulations have increasingly emphasized the need to preserve historical buildings.

While preserving historical buildings, structures that have partially or completely lost their original function can be revitalized by giving them a new purpose. Adaptive reuse not only extends the life of these buildings but also offers significant economic benefits by reducing the costs associated with new construction and

utilizing existing resources. Socially, such projects can reinvigorate communities by providing spaces for public use, fostering a sense of belonging and identity. Culturally, adaptive reuse helps to preserve the historical narrative of a place, allowing new generations to connect with their heritage while experiencing these spaces in contemporary contexts. For example, the transformation of old factories into cultural centers or coworking spaces illustrates how adaptive reuse can blend historical preservation with modern functionality, ultimately contributing to urban regeneration.

Within the scope of revitalization and in line with contemporary needs, new functions given to historical buildings lead to a symbiotic relationship between “historical buildings” and “contemporary symbiotic additions”. Symbiotic architecture offers numerous possibilities: creating new living spaces in historical environments, providing economic solutions for existing buildings, making disused buildings reusable, and reactivating the facades of historical buildings, thus enhancing their historical significance.

The significance of symbiotic augmentations extends beyond functionality, influencing urban planning and historical preservation. By adapting historical buildings to meet the needs of the present while safeguarding their cultural heritage, these augmentations play a pivotal role in shaping the identity of our urban landscapes. Notable examples include the Louvre Pyramid in Paris, designed by I.M. Pei, which seamlessly integrates a contemporary glass structure within the historic palace grounds, enhancing both functionality and aesthetic appeal. Similarly, the Reichstag building in Berlin, renovated by Norman Foster, exemplifies how modern interventions can rejuvenate a historic structure, introducing sustainable features like the iconic glass dome while preserving its symbolic significance. These projects serve as poignant reminders of the architectural continuum, bridging the chasm between bygone eras and contemporary sensibilities, and demonstrating how thoughtful design can honor the past while embracing the future.



Figure 1. Antwerp Art Deco Tower, Antwerp, Belgium [7]

These exemplary buildings, where the demolition of historical value is prevented and their identities are preserved, also serve as examples of environmentally, socially, and economically sustainable buildings. Repurposing with symbiotic architecture is considered a new beginning that adds a new layer to a building’s history. This new layer can take various forms, encompassing functional enhancements, aesthetic updates, or symbolic significance. Functionally, it might involve integrating modern systems or expanding the building’s usability to meet contemporary needs. Aesthetically, it could introduce contemporary design elements that complement the original architecture. Symbolically, it represents the evolution of the building, showcasing its ability to adapt and thrive in different historical contexts while preserving its core identity. Historical buildings not only embody significant cultural and architectural values but also

constitute an important symbolic value as a rich part of our cultural heritage and memory. Therefore, symbiotic architecture can be useful in preventing the loss of historical buildings as long as it does not cause irreversible changes to the historical building and is based on a design that can be recycled. This loss not only means the destruction of architectural values but also, first and all above, the elimination of the material and spiritual cultural heritage of the past. The concept of symbiotic relationship, dependent on the presence of the environment in which it exists, can be defined as a way of life for organisms that derive their sustenance from where they exist [11].

In the field of architecture, similar to biology, symbiotic relationship refers to a situation where the host organism or structure serves as the carrier of the organism or contemporary addition defined as its symbiont, while mutual benefits are provided by these symbioses. Symbiotic architecture, a contemporary design approach in repurposing historical monuments, involves integrating modern designs into the existing structural systems of buildings situated within the current urban fabric, particularly in unused or underutilized spaces. This relationship mirrors the interaction between parasitic organisms and their hosts in biology, but with a significant distinction: in architecture, these additions aim to enhance rather than exploit the host structure. For instance, the glass extension of the Royal Ontario Museum by Daniel Libeskind exemplifies this concept, where the sharp, modern addition interacts dynamically with the original stone facade, creating a dialogue between past and present. Similarly, the addition to the British Museum by Sir Norman Foster demonstrates how modern interventions can coexist with historical frameworks, providing functional and aesthetic enhancements. These examples illustrate how contemporary and historic elements can coexist symbiotically, revitalizing architectural heritage while respecting its historical significance. In the discipline of psychology, the concept of symbiosis is defined as dependency on another individual to the extent of pathology, while in business, it is expressed as industrial symbiosis. In the field of architecture, symbiosis is often used in the context of redesigning historical buildings with new additions. Furthermore, the concept of symbiosis is used in other contexts beyond these applications. Living together sometimes expresses multiculturalism and shared living spaces, signifying the culture and philosophy of shared living with different cultural identities and common social life. Although they are terms of biological origin, some terms in the discipline of architecture have entered the literature through analogy. Symbiotic architecture, inspired by biological mutualism, highlights the reciprocal benefits between historical and modern elements. For instance, the Louvre Pyramid enhances both functionality and historical context, while the Reichstag's glass dome integrates sustainability with heritage preservation. Accordingly, the existing structure is referred to as the "host building", and the added building is called either a "symbiotic addition" or a "parasitic addition" [12]. The crucial point here is how the "addition" lives with the host building. A "parasitic addition" refers to a situation where the host building is utilized for the benefit of the addition, but this results in damage or loss to the historical value of the building. On the other hand, a "symbiotic addition" is a modern improvement that benefits both the existing building and the new structure. It aims to preserve and enhance the historical significance while introducing modern features. Integrating a symbiotic addition into a historical building introduces new functional and design possibilities, creating a new structural and experiential existence. The subject of symbiotic architecture in historical buildings has been emphasized as the integration of contemporary symbiotic additions into the host building. In terms of the perspective of contemporary addition, the design approaches of contemporary addition are mentioned, while from the perspective of the historical building, issues such as the repair and reinforcement of the historical building and the structural problems that may arise from the combination can be discussed [13]. When examining the physical arrangement created by the symbiotic relationship, it is revealed that certain criteria must be met not only for structural and physical performance but also for conservation. One of the most important issues in the implementation of contemporary symbiotic additions in historical buildings is that the existing historical environment, the existing urban fabric and/or rural historical fabric, and all other environmental and structural components that make up the historical environment must be perceived, traced, and distinguishable within the whole

[14]. The historical urban character encompasses the physical and cultural traits of a city, with elements such as building facades, materials, and architectural styles playing a crucial role. In symbiotic architecture, these components interact through carefully defined criteria, such as maintaining material compatibility, ensuring visual harmony, and prioritizing minimal intervention to balance historical authenticity with contemporary needs. However, the perception of the historical urban character should go beyond the examination of these components. The historical urban character also includes the story of a city or town. Historical buildings reflect the past of a them. Additionally, these buildings are part of the cultural heritage of these cities or towns.

Sustainability in Symbiotic Architecture

Sustainability is a socio-ecological process aimed at achieving a common ideal. Although it is difficult to provide a clear definition of the concept of sustainability, it can be described as the long-term use of natural and renewable resources by societies. Sustainability has begun to influence the field of architecture, where the concept of “sustainable design and production”, which ensures that any structure built minimizes harm to the environment, has emerged [15]. Sustainability in architecture, where the concept of “sustainable design and production,” which ensures that any structure built minimizes harm to the environment, has emerged. This is evident in the use of materials such as cross-laminated timber for reducing carbon footprints, and practices like passive solar design, which optimize natural light and heat to decrease energy consumption. Sustainable architecture refers to the relationship that buildings establish with their surroundings and people. The primary goal of sustainable architecture is to minimize energy consumption and produce buildings that cause minimal harm to the urban environment. A notable feature of sustainable architecture is its prioritization of renewable energy sources and efficient energy use. Sustainable architecture aims to minimize the environmental impact of buildings in terms of energy, materials, development area, and ecosystem use. Sustainable architecture ensures a conscious approach to energy and ecological conservation in the design of the architectural environment. Sustainability and ecological design ensure that resource use does not harm collective well-being or hinder future resource availability. Conceptually, sustainability means “the ability to exist” over the long term. In light of recent trends of exponential population growth and unsustainable urbanization, the preservation of historical buildings has become of utmost importance." These buildings, which hold significant value for future generations, have accommodated diverse cultures and function as connections between the past and the future. In other words, sustainability means leaving behind all-natural, cultural, and other resources necessary for intergenerational stability and preserving the right to life of future generations [16]. The concept of sustainability, proposed in many fields, also emerges within the architectural discipline as “sustainable architecture”. Sustainable architecture includes activities that produce structures prioritizing renewable energy, environmental friendliness, and efficient use of energy, water, materials, and space. It also aims to preserve the health and comfort of people, considering future generations. Sustainable architecture aims to preserve buildings for future generations without deterioration. It also considers factors like energy use in design and construction, carbon emissions, harmony between building materials and nature, and the building’s impact on the environment and human health.

Historically, in the context of architecture, the concept and/or design approach of “sustainability” has evolved through various phases: “environmental design” in the 1970s, “green design” in the 1980s, “ecological design” towards the late 1980s and early 1990s, and “sustainable design” from the mid-1990s onward. This evolution can be observed in landmark projects such as the Centre for Alternative Technology in Wales, a pioneer in environmental design, or in the works of architects like Norman Foster, whose projects, including the Reichstag renovation, emphasize energy efficiency and sustainable building practices. These examples illustrate how sustainability in architecture has transitioned from basic environmental considerations to more holistic and integrated design approaches. With the rapid and effective use of information technologies in the 2000s, the concept of sustainable design and production,

while influencing users in space, also affects function and form in the architectural context [14]. These changes in terminology point to the expanding architectural theory and practice related to this topic. In general, sustainable architecture can be considered as a holistic, strategic, and planned structure that is supported as a solution to global environmental problems and development issues. Thus, it is considered an architectural practice that is environmentally sensitive not only in terms of its morphological characteristics but also with its positive contribution to the social, cultural, and economic infrastructure of the region.

Integration, Preservation, and Evaluation

The preservation of historical edifices and their transmission to future generations relies on ongoing maintenance, education, and the dissemination of knowledge. Historical buildings face challenges from natural disasters, adverse environmental conditions, and physical and chemical deterioration. Additionally, societal attitudes towards these structures can accelerate their decline. In the struggle for historical buildings, two principles and declarations published by national and international institutions and organizations from the 20th century onwards, namely the Dublin Principles and the Valetta Principles, emphasize the importance of sustainability in contemporary symbiotic additions to historical buildings. According to a clause in the Dublin Principles published in 2011, "... the most suitable way to sustainably preserve industrial heritage areas and structures is to maintain their original uses or find appropriate new uses," and "... expert contributions are necessary for managing the sustainable use of industrial heritage areas and structures while considering and respecting the cultural heritage value". In the same year, in the Valetta Principles, there is a clause stating that "... new functions, in line with the understanding that the historic city is a unique and irreplaceable ecosystem, must also meet the need for sustainable development". These clauses in the principles emphasize the importance of sustainability in symbiotic architecture. The amalgamation of contemporary symbiotic augmentations with historical buildings epitomizes a seamless fusion of bygone eras with modern innovation, where preservation intertwines with progress. A notable example is the integration of the glass pyramid at the Louvre Museum in Paris, designed by I.M. Pei. This modern addition not only respects the historical significance of the original structure but also enhances its functionality and accessibility, demonstrating how contemporary design can coexist harmoniously with historic architecture. Throughout our exploration, we've witnessed how these augmentations infuse historical structures with newfound vitality, ensuring their continued relevance amidst the dynamic tapestry of our urban landscapes. Nevertheless, as we celebrate the achievements of symbiotic augmentations, we must also acknowledge the complexities they entail. Striking a delicate balance between preserving historical integrity and embracing contemporary needs requires nuanced approaches and careful consideration. Furthermore, ensuring equitable access to these revitalized spaces for all members of society is paramount in fostering inclusive and sustainable urban environments. The evaluation of symbiotic relationships in the process of repurposing historical environments and structures holds great importance in terms of preserving the historical structure and transmitting it to future generations. The value of historical environments and structures lies in their ability to carry the traces of the past and reflect the memory of a society. Therefore, establishing a symbiotic relationship is necessary to both preserve the original character of the historical structure and adapt to contemporary needs. Conservation areas and preservation strategies are crucial in preserving and repurposing historical structures.

2. METHODOLOGY

In the first stage of the study method, the conservation criteria were determined in the first stage and the design criteria considered to be related to the conservation criteria were determined in the second stage.

First stage of the study

From the 1931 Carta del Restauro and the Athens Charter to the present day, both national (specific to the country that published the charter) and international declarations in different periods and in different

countries have determined some articles on re-functionalisation. It is seen that each of the aforementioned charters and declarations offers different approaches to the re-functionalisation of historical buildings and addition applications. As a result of the literature researches, there is a triangle (the triangle created by the symbiotic relationship between the historic building, the contemporary extension and the symbiotic relationship) that is relevant to the subject of the thesis; 1931 Carta del Restauro and Athens Charter, 1964 Venice Charter, 1975 Amsterdam Declaration, 1982 Quebec Charter (Deschambault Declaration), 1983 Appleton Charter, 1987 Washington Charter, 1999 Icomos Traditional Architectural Heritage Charter (Mexico), 2010 New Zealand Charter, 2011 Dublin Principles, 2011 Valetta Principles, 2013 Burra Charter and 2013 ICOMOS Turkey: ICOMOS Turkey: Declaration on the Protection of Architectural Heritage Iv.3.2 in 2013, articles and definitions on the subject have been identified in 13 declarations in total. The determination of conservation criteria has been structured to provide essential guidance for restoring historical buildings with symbiotic extensions while preserving their original values [17-22].

- **Preservation of Original Function:** Emphasizes the necessity of maintaining the original function of buildings. This criterion serves as a fundamental guide in restoration and conservation efforts, aiming to preserve the historical context and social memory of structures.
- **Suitability for New Use:** Indicates that living monuments should be suitable for new uses that are not far removed from their original functions. This principle focuses on adapting historical buildings to modern needs while preserving their architectural and cultural features.
- **Respect for Integrity and Character:** Highlights that new functions and activities must be compatible with the character of the historic city or urban area. This ensures that buildings remain in harmonious unity despite changes over time, maintaining the fabric and character of the historical environment.
- **Minimal Intervention:** Stipulates that interventions should be kept to a minimum, adhering as closely as possible to the original form and texture of the structures. This principle aims to preserve the original form, documentation, and architectural characteristics of historical buildings.
- **Compatible Use:** Refers to new uses that respect and are compatible with the cultural significance of the buildings. This principle facilitates the adaptation of historical structures to the evolving needs of society.
- **Integration of Contemporary Functions and Traditional Activities:** States that new functions should be integrated without harming traditional activities. This criterion ensures that historical buildings continue to play a culturally and socially significant role.
- **Preservation of Cultural Diversity:** Emphasizes that new functions should safeguard the cultural diversity and pluralism of the historic city. This principle aims to protect the different cultures and traditions housed within historical buildings.
- **Respect for Local Community Needs:** Highlights that changes made to buildings must respect the needs and desires of the local community. This ensures that historical structures remain meaningful and functional for society.
- **Sustainable Development:** States that while assigning appropriate contemporary functions to buildings, sustainable development must be ensured. This principle supports the environmental, economic, and social sustainability of historical structures.
- **Human-Scale Use of Architectural Heritage:** Emphasizes the importance of maintaining human scale and enclosed spaces to preserve the urban fabric and architectural heritage of old cities. This principle aims to integrate historical buildings into the daily lives of people.

Second stage of the study

The 10 design criteria that are considered to be related to the identified conservation criteria have been determined as follows.


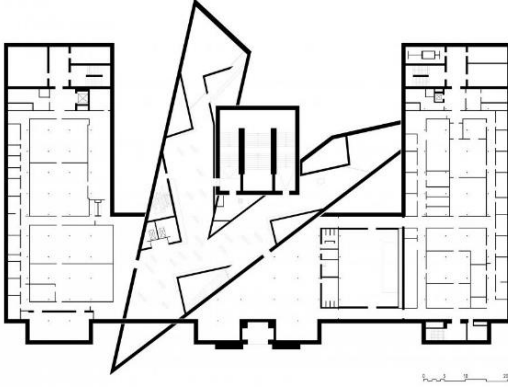
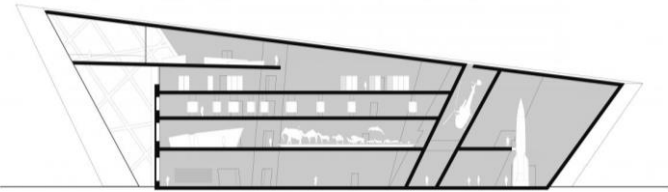

- **Harmony and Unity:** There should be visual harmony and an aesthetic balance between the historical building and the contemporary addition. Harmony in the use of color, material, and form is essential. This principle aims for the components to be perceived as complementary elements.
- **Authenticity:** The contemporary addition should have its own unique design language instead of imitating the original design of the historical building. This emphasizes the identity and character of the historical structure while highlighting the contributions of modern design.
- **Proportion:** The contemporary addition should align with the scales of the historical building and respect architectural proportions. This ensures a harmonious balance between historical and contemporary elements, enriching architectural heritage.
- **Material Contrast and Harmony:** The selection of materials for the contemporary addition should either complement or aesthetically contrast with those used in the historical building. This principle supports the idea that a deliberate contrast can be appropriate from a design perspective.
- **Technological Innovation:** The contemporary addition can reflect the spirit of the time by incorporating modern materials and technological innovations alongside the historical building. This contributes to preserving the cultural and architectural value of historical structures while preparing them for the future.
- **Openness and Light:** The addition may include openings in appropriate places to enhance natural light in interior spaces, without overshadowing the historical building. This principle provides aesthetic spaciousness within interiors and strengthens the ambiance of architectural heritage.
- **Functional Harmony:** The contemporary addition should either align with the original function of the historical building or suitably meet modern needs. This ensures that new elements enhance the building's usability while preserving architectural integrity and historical values.
- **Environmental Sensitivity:** The addition should respect environmental factors such as landscape and site layout. This principle advocates for architectural interventions to embrace environmental sustainability and conserve natural resources.
- **Architectural Expression:** While the addition should be distinct in its architectural expression, it should also create a dialogue with the historical building. This ensures that while the modern additions carry their own architectural identity, they still preserve the aesthetic and stylistic qualities of the architectural heritage.
- **Social Acceptance and Engagement:** The views and participation of the local community should be considered during the design and implementation process of the addition. This principle supports architectural interventions that interact with the users of historical buildings and their surrounding communities.

Based on literature reviews and international charters, the 10 conservation and 10 design criteria were explained in detail. These criteria formed the fundamental evaluation framework of the study. Each criterion was structured to be assessed on a scale of 5. The evaluation table consisted of a total of 20 criteria, with each criterion scored out of 5. In this way, an objective evaluation was conducted for each building, with a total score out of 100.

This study employs a multi-layered methodological approach to analyze how historical buildings are transformed through symbiotic architectural interventions. The research focuses on four key case studies: Dresden Bundeswehr Military History Museum, Antwerp Havenhuis, Royal Ontario Museum, and Asian Civilizations Museum. The methodology for analyzing these examples comprises the following components:

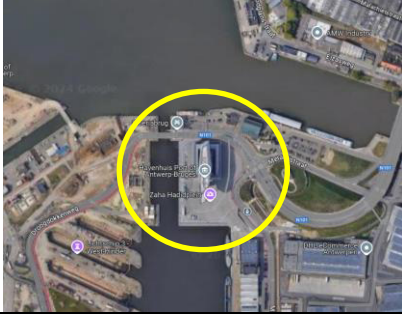
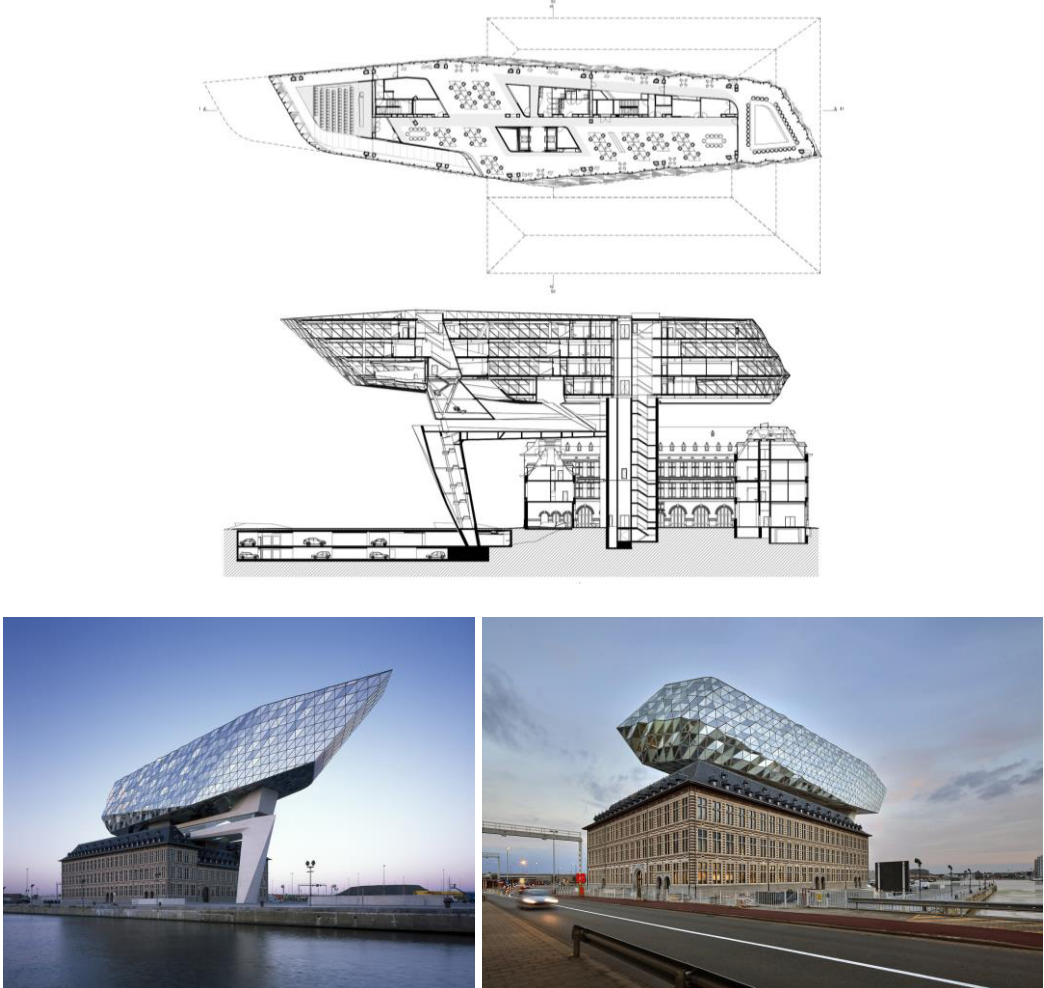
The museum's symbiotic addition, designed by Daniel Libeskind, features a striking angular glass and steel wedge that cuts through the historical armory building (Table 1). This intervention creates a dramatic visual contrast, symbolizing the conflict and division inherent in military history. The addition enhances the building's functionality, providing new exhibition spaces while maintaining respect for the historical structure [23].

Table 1. Dresden Bundeswehr Military History Museum [24]

Building Information	Coordinates: 51°04'43"N 13°45'36"E
Construction Year: 1876	
Revitalization Year: 2011	
City/Country: Dresden / Germany	
Architect(S): Theophil Hansen	
Architect(s) of Symbiotic Extension: Daniel Libeskind	
Original Usage: Armory	
Current Usage: Museum	
	
	
	


The futuristic glass and steel addition by Zaha Hadid Architects sits atop the historic port authority building, resembling a ship floating above the structure. This bold intervention not only enhances the building’s symbolic connection to Antwerp’s maritime heritage but also provides modern office spaces with panoramic views of the city, demonstrating an innovative approach to spatial integration (Table 2) [25].

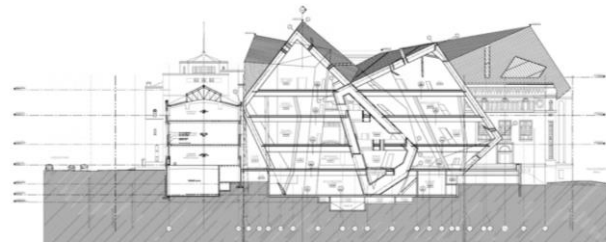
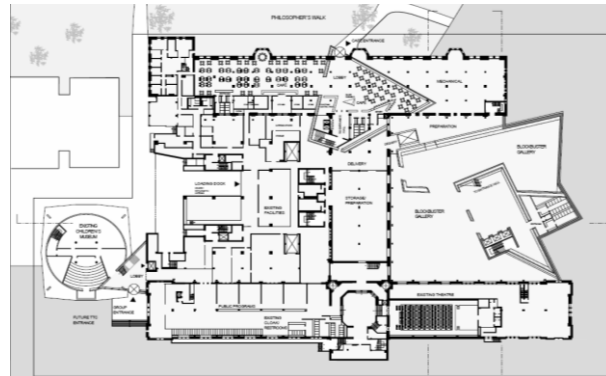
Table 2. Antwerpen Havenhuis [26]

Building Information	Coordinates: 1°17'15"N 103°51'05"E
Construction Year: 1922	
Revitalization Year: 2016	
City/Country: Antwerp / Belgium	
Architect(s): Unknown	
Architect(s) of Symbiotic Extension: Zaha Hadid	
Original Usage: Museum	
Current Usage: Museum	
	

Libeskind’s “Crystal” addition to the Royal Ontario Museum is an angular, glass-and-metal structure that dramatically contrasts with the museum’s original stone facade. This intervention provides expanded gallery spaces and a striking new entrance, redefining the museum’s public image while creating a dynamic interplay between contemporary and historical architectural elements (Table 3) [27].


Table 3. Royal Ontario Museum [28]

Building Information	Coordinates: 43.667679°N 79.394809°W
Construction Year: 1914	
Revitalization Year: 2007	
City/Country: Toronto / Canada	
Architect(s): Darling and Pearson (Company)	
Architect(s) of Symbiotic Extension: Daniel Libeskind	
Original Usage: Museum	
Current Usage: Museum	

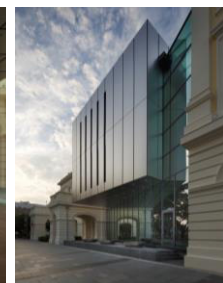
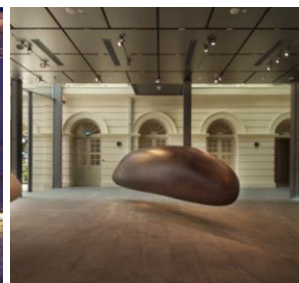
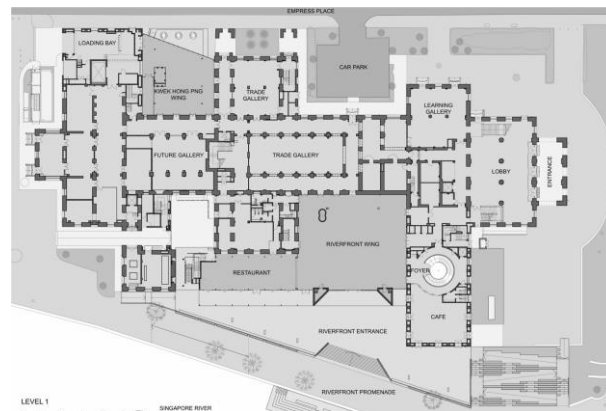


Greenhill Architects' symbiotic addition to the Asian Civilizations Museum in Singapore introduces modern glass and metal elements that respect the original neoclassical architecture. The addition enhances the museum's functionality by providing new exhibition spaces and visitor amenities, while subtly blending modern design with the building's historical context (Table 4) [29].

Table 4. Asian Civilizations Museum [29]

Building Information	Coordinates: 1°17'15"N 103°51'05"E
Construction Year: 1867	
Revitalization Year: 2015	
City/Country: Singapore / Singapore	
Architect(s): Unknown	
Architect(s) of Symbiotic Extension: GreenhillLi (Company)	
Original Usage: Museum	
Current Usage: Museum	

Floor Plans



3. RESULTS

The Dresden Military Historical Museum, Antwerpen Havenhuis, Asian Civilisations Museum, and Royal Ontario Museum are significant examples of historical buildings that have been refunctionalized with contemporary extensions. These projects aim to preserve historical heritage while meeting modern needs. Each building has been evaluated based on specific conservation and design criteria.

The Dresden Military Historical Museum scored 39/50 in conservation criteria and 39/50 in design criteria, achieving a total of 78/100. The building's original function has been largely preserved, and its suitability for new uses and design harmony stand out. Particularly, high scores in social acceptance and engagement indicate the effective involvement of the local community in the design process.

The Antwerpen Havenhuis scored 33/50 in conservation criteria and 35/50 in design criteria, totaling 68/100. This project excels in preserving the original function and showcasing contemporary design originality. However, it received lower scores in minimal intervention and integrity, suggesting that some design elements struggle to fully integrate with the historical fabric.

The Asian Civilisations Museum achieved 42/50 in conservation criteria and 46/50 in design criteria, totaling an impressive 88/100. This reflects a strong balance between preserving historical elements and successfully integrating contemporary additions. Design criteria such as harmony, material contrast, and functional cohesion particularly stand out.

The Royal Ontario Museum scored 29/50 in conservation criteria and 37/50 in design criteria, with a total of 66/100. This building faced challenges in preserving its original function and character integrity. However, it excelled in design originality and social acceptance, indicating that while its historical integration may have limitations, its contemporary elements are well-received by the public.

In conclusion, each building demonstrates unique strengths and challenges in balancing conservation and design. These projects highlight the complexity of revitalizing historical structures while introducing modern functionalities. They serve as important examples of how historical buildings can be adapted for contemporary use, with varying degrees of success in meeting conservation and design goals (Table 5).

Table 5. General evaluation of examples (Improved by authors)

		Dresden Militärhistorisches Museum Der Bundeswehr	Antwerpen Havenhuis	Asian Civilisations Museum	Royal Ontario
Conservation Criteria	Description				
1	Preservation of Original Function	4/5	5/5	3/5	2/5
2	Suitability for New Use	4/5	5/5	4/5	3/5
3	Respect for Integrity and Character	4/5	2/5	5/5	2/5
4	Minimal Intervention	3/5	1/5	4/5	2/5
5	Compatible Use	4/5	3/5	5/5	3/5
6	Integration of Contemporary Functions and Traditional Activities	4/5	4/5	4/5	3/5
7	Preservation of Cultural Diversity	4/5	3/5	4/5	3/5
8	Respect for Local Community Needs	5/5	4/5	4/5	4/5
9	Sustainable Development	4/5	4/5	4/5	4/5
10	Human-Scale Use of Architectural Heritage	3/5	2/5	5/5	3/5
Conservation Criteria Result		39/50	33/50	42/50	29/50
Design Criteria	Description	Results			
1	Harmony and Unity	3/5	2/5	5/5	2/5
2	Authenticity	5/5	5/5	3/5	5/5
3	Proportion	3/5	2/5	5/5	3/5
4	Material Contrast and Harmony	5/5	4/5	5/5	3/5
5	Technological Innovation	4/5	4/5	4/5	4/5
6	Openness and Light	3/5	3/5	5/5	3/5
7	Functional Harmony	4/5	4/5	5/5	4/5
8	Environmental Sensitivity	3/5	3/5	5/5	4/5
9	Architectural Expression	5/5	4/5	4/5	4/5
10	Social Acceptance and Engagement	4/5	4/5	5/5	5/5
Design Criteria Result		39/50	35/50	46/50	37/50
Total Result		78/100	68/100	88/100	66/100

4. CONCLUSION

As a result of the study, Royal Ontario and Antwerpen Havenhuis received lower scores in both conservation and design criteria compared to the other two selected Sites (Table 6).

Table 6. Summary of evaluation of examples (Improved by authors)

	Dresden Militärhistorisches Museum Der Bundeswehr	Antwerpen Havenhuis	Asian Civilisations Museum	Royal Ontario
Conservation Criteria Result	39/50	33/50	42/50	29/50
Design Criteria Result	39/50	35/50	46/50	37/50
Total Result	78/100	68/100	88/100	66/100

Based on the evaluation results, Preservation of Original Function was one of the most important criteria in conservation. The Dresden Military Historical Museum and Antwerpen Havenhuis performed well in this area, showing they managed to retain their original functions. Another key criterion was Respect for Local Community Needs, which received high scores across all buildings. This highlights that the projects considered the expectations and needs of the local communities, making it a critical factor in their success.

In terms of design, Authenticity and Material Contrast and Harmony stood out as the most important. Buildings like the Dresden Military Historical Museum, Antwerpen Havenhuis, and Royal Ontario Museum ensured that their contemporary additions had unique and original designs. This approach preserved the identity of the historical structures while introducing modern elements. The use of materials, whether through harmony or deliberate contrast, was particularly effective in Dresden and the Asian Civilisations Museum, enhancing their overall design quality.

On the other hand, some criteria were less influential in both conservation and design. Minimal Intervention scored low in several buildings, including Antwerpen Havenhuis and Royal Ontario Museum. This suggests that these projects made more noticeable changes to the original structures. Similarly, Proportion was less significant, especially in Antwerpen Havenhuis and Royal Ontario Museum, where the balance between the historical buildings and contemporary additions could have been improved (Table 6).

Preservation of Original Function and Respect for Local Community Needs were the most important for conservation, while Authenticity and Material Contrast and Harmony were key for design. However, Minimal Intervention and Proportion were less impactful, showing room for improvement in some projects. This analysis helps to understand which criteria are most important when integrating modern additions into historical buildings.

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