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Correspondence Address - Yazışma Adresi
Beşyol Mahallesi, İnönü Caddesi, No: 38 Sefaköy, 34295
Küçükçekmece/İstanbul **Tel:** 0212 4441428 - **Fax:** 0212 425 57 97
Web: www.aydin.edu.tr - **E-mail:** aarchdesign@aydin.edu.tr

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Research Article

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Prof. Dr. Ayşe Sirel

Urban Metamorphosis: Navigating the Interplay of Morphology and Ecology in Bengaluru's Water Network

B.Arch, M Arch, Ph.D. Candidate, Prathima N ,
National Law School of India University, Research Scholar, Bengaluru, India,
PR Architecture Studio, Partner, Bengaluru, India
E-mail 1: reddyprathima@gmail.com
https://orcid.org/0000-0002-4969-6921
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Abstract: *This study investigates the intricate relationship between urban morphology and urban ecology, focusing on the water networks within Bengaluru's Koramangala Challaghatta Valley. The research addresses the need to understand how urbanization has altered these historically significant water systems and their impact on urban ecology. Despite their critical role, these water networks have experienced significant transformations due to land reclamation and buffer zone creation, highlighting a gap in current urban planning practices. To bridge this gap, the study used a combination of field reconnaissance, including systematic site observations and un structured stakeholder interviews at 20 strategically selected sites along the water network. The analysis involved mapping and evaluating the land-water interface to identify specific typologies of transformation and their implications for urban ecology. The results reveal that urbanization and planning regulations have considerably disrupted the water network. The study found that the primary transformations include land reclamation and land use along the water network, which have altered the ecological functions and spatial configuration of the water systems. Based on these findings, the study recommends the adoption of targeted planning tools and policy adjustments that consider the ecological carrying capacity of sensitive zones. Specifically, it suggests policies for improved collective management of urban commons and more precise regulations to integrate and protect water networks in urban development. These recommendations aim to address the gaps in the current urban planning policies and enhance the sustainability and effectiveness of urban planning in rapidly expanding cities.*

Keywords: *Urbanization, Urban Morphology, Water Network, Bengaluru, Urban Planning Law, Urban Ecology.*

Kentsel Metamorfoz: Bengaluru'nun Su Ağı'ndaki Morfoloji ve Ekoloji Etkileşimini Keşfetmek

Özet: *Bu çalışma, Bengaluru'nun Koramangala Challaghatta Vadisi'ndeki su ağlarını odaklanarak, kentsel morfoloji ile kentsel ekoloji arasındaki karmaşık ilişkiyi araştırmaktadır. Araştırma, kentleşmenin bu tarihsel olarak önemli su sistemlerini nasıl değiştirdiğini ve bunların kentsel ekoloji üzerindeki etkilerini anlamanın gerekliliğini ele almaktadır. Kritik rolüne rağmen, bu su ağları, arazi kazanımı ve tampon bölgelerin oluşturulması nedeniyle önemli dönüşümler geçirmiştir ve bu durum mevcut kentsel planlama uygulamalarında bir boşluğu ortaya koymaktadır. Bu boşluğu kapatmak amacıyla, çalışma, su ağı boyunca stratejik olarak seçilen 20 alanda sistematik saha gözlemleri ve yapılandırılmamış paydaş mülakatlarını içeren bir saha keşfi kombinasyonu kullanmıştır. Analiz, dönüşümün belirli tipolojilerini ve bunların kentsel ekoloji üzerindeki etkilerini tanımlamak için arazi-su arayüzünün haritalanmasını ve değerlendirilmesini içermektedir. Sonuçlar, kentleşme ve planlama düzenlemelerinin su ağını önemli ölçüde bozduğunu ortaya koymaktadır. Çalışma, birincil dönüşümlerin su ağı boyunca arazi kazanımı ve arazi kullanımı olduğunu ve bunların su sistemlerinin ekolojik işlevlerini ve mekansal yapılarını değiştirdiğini bulmuştur. Bu bulgulara dayanarak, çalışma, hassas bölgelerin ekolojik taşıma kapasitesini dikkate alan hedeflenmiş planlama araçlarının ve politika ayarlamalarının benimsenmesini önermektedir. Özellikle, kentsel ortak kullanım alanlarının daha iyi kolektif yönetimi ve su ağlarını kentsel gelişimde entegre ve korumaya yönelik daha kesin düzenlemeler için politikalar önermektedir. Bu öneriler, mevcut kentsel planlama politikalarındaki boşlukları gidermeyi ve hızla genişleyen şehirlerde kentsel planlamanın sürdürülebilirliğini ve etkinliğini artırmayı amaçlamaktadır.*

Anahtar Kelimeler: *Kentleşme, Kentsel Morfoloji, Su Ağı, Bengaluru, Kentsel Planlama Hukuku; Kentsel Ekoloji.*

1. INTRODUCTION

Bengaluru's water network exemplifies the dynamic interplay between urban morphology and ecology, shaped by the city's evolving geography and urban planning processes. Initially developed in the 16th century as a small trade city with a footprint of 2.7 sq km, Bengaluru has expanded into a sprawling metropolitan area of over 1200 sq. km (Figure 1, 2). The city's water network, integral to its historical development, has been fundamentally altered by urbanization.

Figure 1. Map of India indicating the location of Bengaluru. Source: Wikipedia. Open Source (OS).

Figure 2. Pete, Kote, and Thota- Survey of the boundaries of purgunna of Bengaluru in1800. Source: Mythic Society, Bengaluru. OS.

This study focuses on the Koramangala Challaghatta Valley, a key component of Bengaluru's water system. The valley is part of a larger hydrological network that includes three primary watersheds—Hebbal, Koramangala Challaghatta, and Vrishabavathi—each featuring a series of interconnected tanks and

rajakaluveys (Figure 3,4). Originally designed to manage stormwater, collect runoff, [1] and support agrarian settlements [2], this network has transitioned from a vital ecological system to a series of underutilized and often polluted backyards [3].

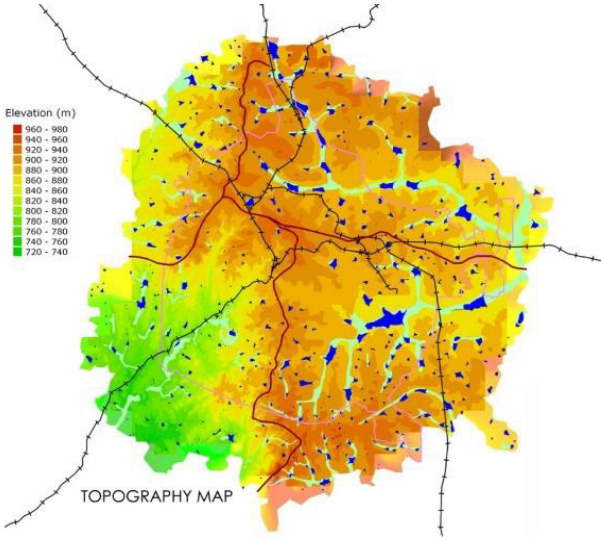


Figure 3. Topography of Bengaluru. Source: BBMP, Bengaluru. OS.

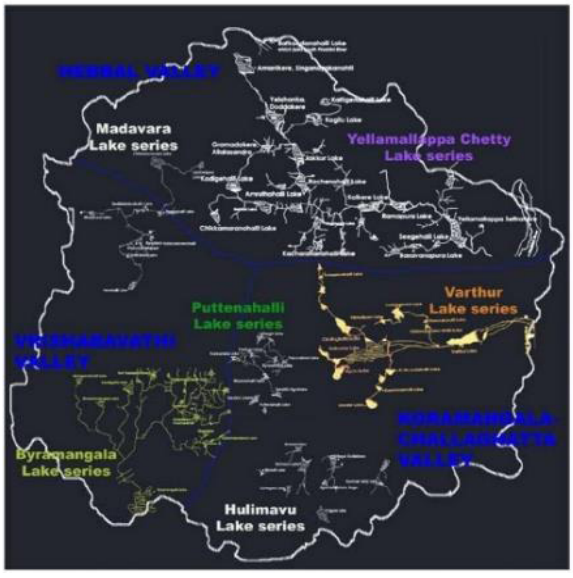


Figure 4. Watershed with tank series of Bengaluru Source: BBMP, Bengaluru. OS.

The research focuses on how formal urban planning and governance processes have impacted this water network, particularly emphasizing the Varthur tank series in the Koramangala Challaghatta Valley. Field studies, spanning from the city core to its peri-urban areas, involved mapping the interface between land and water to analyze transformations in morphology and ecology. A critical problem addressed by this study is the disconnect between urban planning laws and the ecological importance of water networks. Historical planning frameworks, such as the Outline Development Plan (ODP) 1972 and the Comprehensive Development Plan (CDP) 1984, overlooked ecological considerations [3]. Although the

Revised Master Plan (RMP) 2015 introduced non-buildable buffer zones and sensitive areas, centralization of governance has undermined local management practices that traditionally maintained these water systems [4].

This research aims to highlight how formal processes have reshaped the water network and to advocate for policy reforms that better integrate ecological considerations into urban planning. The paper is structured into six sections: the first outlines the historical and ecological context, the second describes the research methodology and study area, the third presents field observations, the fourth analyses these findings, the fifth concludes the study, and the sixth offers policy recommendations for improved integration of ecological aspects into urban governance.

1.1. Exploring the Ecology Layer

The ecology layer is vital for the health of the city, and the Government of Karnataka (GoK) has launched a project to reclaim the interlinked water network, inspired by similar efforts in Chengyachone, Seoul. The "Daylighting" projects across the USA and UK, as well as the Slum Networking Project in India, serve as other notable examples of water network reclamation. Citizen and judicial activism have drawn attention to the water network issues in Bengaluru. In response to the National Green Tribunal's (NGT) directive for the rejuvenation of Bellandur and Varthur lakes, the Karnataka State Pollution Control Board (KSPCB) and BWSSB carried out a comprehensive survey of the Koramangala and Challaghatta valley to locate buildings discharging untreated sewage. This survey, conducted between Shantinagar and Bellandur within the study area, highlighted the longstanding neglect of this crucial ecological layer. The compact development along the stretch makes installing underground drainage challenging, and sewage pumping into nalas was observed in over 538 residences, underscoring the neglect of the water network.

TV Ramachandran and his team have found that urbanization between 1973 and 2017 led to a significant decline in green spaces (88%) and wetlands (79%) [5]. Construction activities in the valley zone like the special economic zone (SEZ) by KIADB contradict sustainable development principles, as they harm natural resources, leading to ecosystem degradation. These valley zones are designated as 'No Development Zones' per CDP 2015. The Agara-Bellandur Wetland Violation, reported by IISc in 2017, exemplifies the adverse impacts of topography alterations and wetland encroachment, which cause flooding, property damage, and health issues.

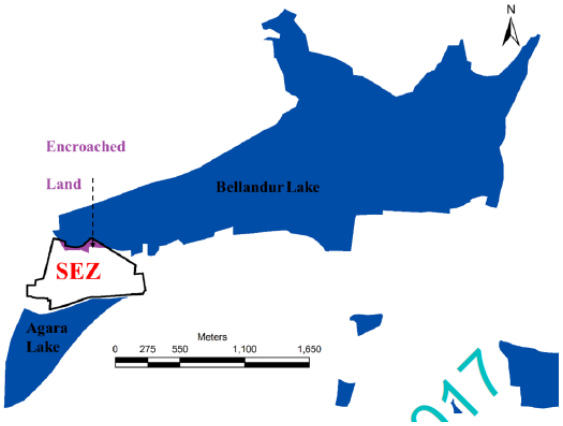


Figure 5. SEZ and encroached land – Agara Bellendur wetland violation as mapped by IISC. Source: Indian Institute of Science. OS.

In Civil Appeal Number 1132/2011 at SLP (C) 3109/2011, the Honourable Supreme Court of India on January 28, 2011 raised concerns regarding the encroachment on common property resources, especially lakes and rajakaluves. The Court directed state governments to remove encroachments from all community lands. Eviction of encroachments is provided for under the Karnataka Public Premises (Eviction of Unauthorized Occupants) Act 1974 and the Karnataka Land Revenue Act 1964.

The Honourable High Court of Karnataka (W.P No. 817/2008) issued a directive for the protection of lakes that included:

- "Lake protection across the State of Karnataka
- Prohibiting the dumping of garbage and sewage in lakes
- Surveying and fencing lake areas and declaring them as no development zones
- Removing encroachments
- Forest development to plant trees around lakes and watershed regions in consultation with experts
- Setting up district lake protection committees
- The monitoring of implementation of these measures to be overseen by the member secretary of the State Legal Services Authority in coordination with the Revenue and Forest Departments."

Judicial intervention to protect eco-sensitive zones highlights the narrow framework within urban planning laws for planning, implementing, monitoring, and protecting these areas.

2. RESEARCH METHOD

The study employed an empirical approach to investigate the intersection of urban morphology and ecology, with a particular focus on the land-water interface. This approach utilized a combination of surveys and observational techniques to map and analyze morphological patterns along the water's edge. Building upon the foundational work of Bostancı [6], which highlights both descriptive and analytical methods in urban research, this study integrated these methods with targeted field observations. Initially, the research identified and categorized 20 distinct hotspots along the land-water interface into 10 typologies, as detailed in Table 1. This classification was based on the unique characteristics of each hotspot and their responses to the surrounding geography and ecology. Data were systematically gathered and assessed, including observations of the water network transformation and its impact on urban morphology and planning regulations. The research used qualitative, constructivist techniques to explore these issues, providing a comprehensive view of how urban morphology interacts with ecological factors along the water interface. This methodology emphasizes the contextual understanding of the phenomena and contributes to the broader urban design and planning knowledge.

2.1. Research Design

The research design included sampling, data collection, documentation, and analysis.

Sampling

The study focused on the water network from the urban core to the peri-urban area to evaluate urban planning law's impact on land water interface. Using representative random sampling, 20 locations along the water network were selected for morphology studies. Preliminary field studies guided the selection of samples to examine the transformation of the water network and land-water edge during urbanization.

Data Collection and Documentation

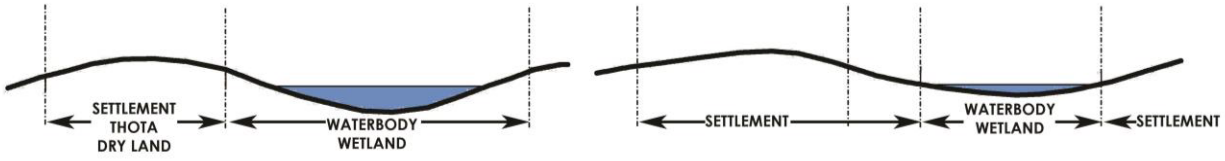
Field studies and observations mapped transformations in the water network and land-water edge. A base map was created using preliminary field data, Google Maps, and revenue maps. Detailed studies and unstructured interviews with residents supported the findings. Data from field studies were cross-verified

with maps, and morphology data of the built form along the water-land interface was collected. The study also referred to master plans and conducted unstructured interviews with authorities to analyze regulations governing the water network. Twenty hotspots were identified along the water network for documentation and analysis.

Data Documentation
Observations and interviews were documented with diagrams, photos, Google Maps, and land use maps. Sketches and photographs documented the morphology of built forms along the water edge. Information from informal discussions with locals was integrated, and land use data from master plans was overlaid on sketches to analyze the impact of land use regulations.

Data Analysis
Documented data was compiled, compared, and grouped into typologies. The impact of formal processes on each typology was analyzed using interpretation as the analytical tool.

2.2. Study Area Identification
Preliminary field observations indicate the condition of the water network and land interface (Figure 6), This reflects urban metamorphosis in the process of urbanization and varies along this stretch Additionally, the interface between the water network and the land also varies. To map the intersection of morphology and ecology, the research examined both the existing conditions of the water network and the water-land interface. The core of the city was formed in 1570 AD and the city has grown periodically around the core. The study area indicated in a Google map (Figure 7), spans a 20 km stretch across the city from the core through the urban zone into the agrarian zone.



a - Agrarian land use **b – Urban land use**

Figure 6. Schematic representation of the land water interface pattern in agrarian (a) and urban (b) land use. Source: Conceptualized from preliminary field observations.

The study focused on the Koramangala Challaghatta valley in Bengaluru's South East, featuring a water network comprising the Varthur, Puttenahalli, and Hulimavu lake series. This network, with over 800 km of tanks and rajakaluveys, is crucial to Bengaluru's ecology. The Varthur lake series, originating in the city's core and extending to the periphery, connects to the Kalavarapalli reservoir and eventually the Cauvery River, illustrating the impact of urban planning on ecology and morphology. Bellandur tank, the largest in the Varthur series, covers about 1000 acres with a 280 sq km catchment area. Its watershed is formed by three main streams-Eastern (from Ulsoor tank), Central (from the core), and Western (from Madivala). Field observations indicated that the rajakaluve connecting the core to Bellandur tank had been narrowed to 30 meters, half its original width, contributing to flooding as reported by an IISc study. Despite RMP 2015 regulations for rajakaluveys, development often occurred before these regulations were enforced. For instance, KIADB developed wetland between Agara and Bellandur tanks without a carrying capacity study, despite RMP 2015 designating it for a sewage treatment plan (STP).

The Koramangala Challaghatta valley, particularly the Varthur tank series, has faced significant environmental concerns. An extensive 2009 report by IISc on urban floods in Bengaluru, presented to the Ministry of Home Affairs and Bruhat Bengaluru Mahanagara Palike (BBMP), highlighted severe flooding issues in south Bengaluru due to overflowing stormwater drains and inundated roads and houses [7]. Buffer zones, areas of land adjacent to water bodies like lakes, tanks, ponds, or rivers, act as flood plains. These zones experience flooding or stagnation during periods of precipitation. The delineation of buffer zones depends on factors like the size of the water body, catchment shape and size, and rainfall intensity. They are delineated using topographic contours from Survey of India Topographic maps [5]. Buffer zones and wetlands are designated as no-development zones with regulations outlined in RMP 2015. TV Ramachandran and his team emphasized the need to preserve buffer zones around water bodies. Frequent flooding, even with normal rainfall, is attributed to increased impervious surfaces from high-density urban development and the loss of wetlands and vegetation [8].

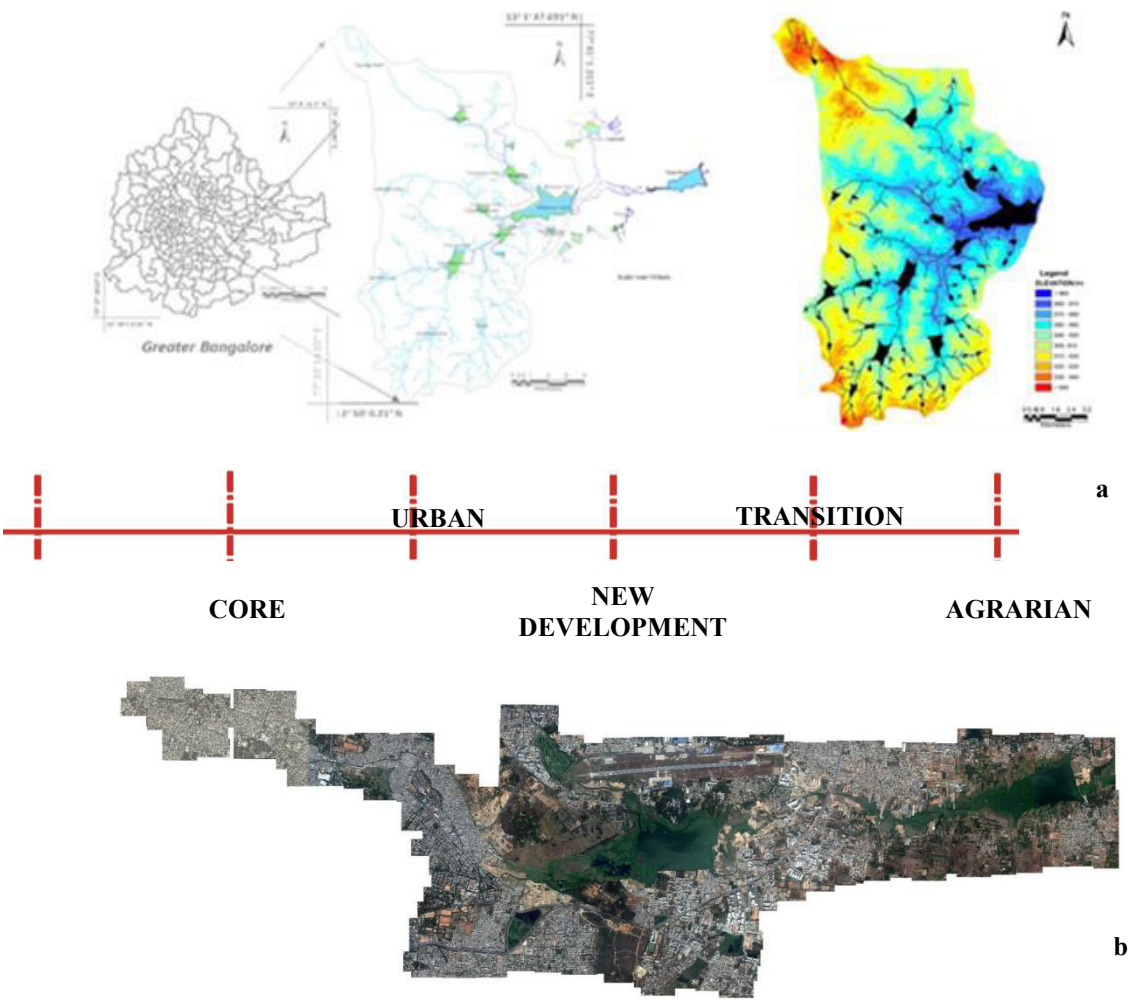


Figure 7a. Location and topography of Varthur tank series in context of Bengaluru. Source: Indian Institute of Science. OS.
Figure 7b. Site identified for the study- Koramangala Challaghatta valley. Source: Google Maps.

3. OBSERVATIONS

The research identified 20 hotspots in the study area and categorized them into 10 distinct typologies based on the morphology and water-land interface, as documented in image 6. This categorization highlights the transformation of the water network and the ecological aspects of settlements in response to their geographical contexts. Additionally, the research mapped the morphology along the land-water interface to study the built form's response to the land-water interface. Observations for each of the typologies identified were documented with the corresponding governance and urban planning regulation and strategies that impact the existing condition as detailed in Table 1. Urban morphology resulted from urban planning laws regulating city development. The primary study revealed that these laws do not recognize the water network or the land-water intersection, leading to their exclusion. Consequently, the water network has become the city's "backyard," with the urban planning law influencing this neglect. The current morphology and land-water interface patterns reflect this oversight, manifesting in the city's disregard for its water network.

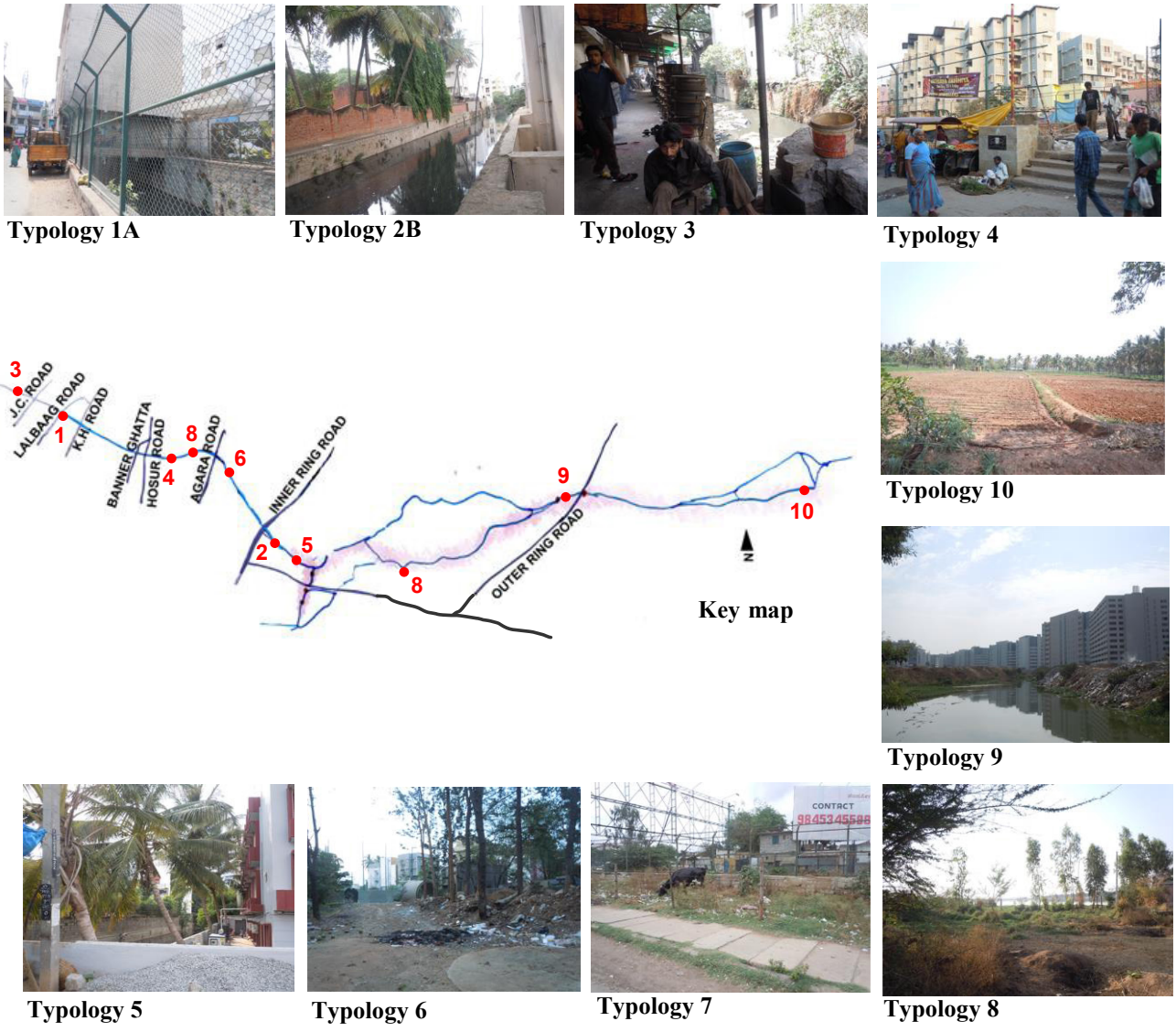


Figure 8. Pictorial representation of the Typologies as observed from the field study
Source: Photographed during the field study.

Table 1. Observations from the field study

Typology	Observation	Impact Due To
Typology 1a	Land Creation over the water network. Accessibility is restricted to one side sides of the blue network.	Government regulations - 30-year lease period and ownership pattern- Corporation
Typology 1 B	Land Creation over the water network. Accessibility on both sides of the blue network	Government regulations - 30-year lease period and ownership pattern- Corporation
Typology 2 A	Backyard formation	Land use policy and Settlement Pattern.
Typology 2 B	Backyard formation	Urban Planning and Government Regulations
Typology 3	Visual and olfactory experience is far from desirable. Accessibility is restricted to one side sides of the blue network.	Existing land use policy which is Industrial Land use.
Typology 4	Visual and olfactory experience is far from desirable. Accessibility on both sides of the blue network.	Existing land use policy which is Industrial Land use.
Typology 5	Buffer space on one side of the blue network	Planning at the project scale as a response to landform.
Typology 6	Buffer space on one side of the blue network	Ownership pattern, settlement pattern, and Government regulations,
Typology 7	Buffer space on one side of the blue network	Ownership pattern and settlement pattern.
Typology 8	Tank and land interface	Formation of backyards in the process of development on land.
Typology 9	Setback acts as the buffer space	Ownership on either side of the blue network and Government regulations,
Typology 10	Rural inclusion of the Blue Network	Existing land use.

The study reveals that government regulations permitting 30-year building leases over water networks have resulted in significant alterations to these areas. These regulations ignored the water network and land interface. The typology study highlighted the impact of land use regulations on land water interface, revealing that Typologies 1A and 1B involve land creation over the water network due to government regulations allowing 30-year building leases which is long over, as informed by the BBMP. Despite the High Court's orders for building removal, non-compliance persists, reflecting an ongoing neglect of the water network in urban planning. The data shows a clear disjunction between legal provisions and their enforcement, which reinforces the water network's non-recognition in urban development.

Typologies 2A and 2B illustrate how land use policies and planning principles allowed settlements to encroach and abut the water network, creating backyards. The inability to desilt the rajakaluve results from these principles which permitted construction along the water's edge. The Koramangala tank bed became a settlement for the urban poor, as seen in Typology 2A, with residences built under the Jawaharlal Nehru National Urban Renewal Mission (JNNURM)[1] urban policy. This project transformed the water network into a backyard instead of integrating it with the settlement. The regulations allowing this construction did not recognize the water network or land water intersection and failed to protect tank beds, which is classified as no-development and ecologically sensitive zones by RMP 2015. Typology 2A underlines how land use regulations fail to integrate water networks, leading to the degradation of these ecological zones. The findings align with studies on urban planning neglecting ecological infrastructure, such as works by [9] on the impact of urban sprawl on natural systems. The exclusion of water networks in planning laws echoes critiques from the literature on the failure of regulatory frameworks to account for ecological considerations in urban growth [10].

Typology 3 in Bamboo Bazaar and Typology 4 on Marble Road feature industrial land use are highlighted due to their significant impact on pollution and the environment causing pollution by discharging untreated waste into the rajakaluve and creating undesirable visual and olfactory experiences. The discharge of untreated waste into the rajakaluve represents a severe case of environmental degradation directly linked to land use policies and industrial activities. Typology 5 includes a buffer space next to the water network, which is an unplanned residual space turned into a park. Known as ST Bed, this tank bed was converted into a housing layout and is prone to flooding during rains. The lack of urban planning regulations for these low-lying, sensitive zones is a significant concern, as these areas are not recognized by existing urban planning laws.

Typology 6, from the 1997 National Games Village (NGV) site formed under CDP 1995, featured a planned buffer space, providing safety from flooding for one side of the housing cluster, while the other side has revenue development abutting the water network. Typology 7 showed undeveloped Defense land on one side of the rajakaluve and Ejipura, a low-rise, high-density settlement and notified slum on the other. Ejipura settlement has been in the news for evictions due to part of the land being leased for a mall and housing for the displaced.

Typology 8 is unique as it features the interface between private land and Bellandur tank, resulting in the development turning its back to the tank. The Shantinagar tank is now a bus terminal, and the Koramangala tank houses the National Dairy Research Institute (NDRI). This stretch, from Shantinagar bus terminal to ST Bed, is prone to flooding. Urbanization and the transformation of tanks and tank beds into land have led to surface runoff flooding these former water bodies. This highlights the failure of formal urban planning and governance processes in recognizing the ecology layer of the settlements.

Typology 9 reflects RMP 2015, which mandates buffer spaces on both sides of the rajakaluveys. In the Hi-tech zone, corporate developments have used these buffers as private landscaped areas, making them gated and inaccessible. The narrowing of rajakaluveys has reduced their carrying capacity and shrunk the buffer zones. Although the RMP 2015 designates sensitive zones and recognizes the water network, it lacks specific recommendations based on carrying capacity and defining buffer spaces as commons. The interpretation of buffer zone regulations has left to landowners, developers, and authorities in a contested space. Additionally, primary, secondary, and tertiary nalas are neither clearly mapped nor defined, leading to varied interpretations by citizens and authorities.

Typology 10 represents agrarian land use where land, water networks, and settlements are interconnected. Agriculture, horticulture, and dairy farming are practiced, necessitating access to the water network.

However, the water quality within this network is polluted and unsuitable for domestic use. Farmers utilize this polluted water for cultivating vegetables and greens, which are then sold in city markets, establishing a concerning food chain where the city provides polluted water for rural production, which is then consumed by urban residents. A farmer while acknowledging this practice, cultivates vegetables for their own consumption using clean water. This situation underscores the unsustainable reliance on polluted water for urban food production, as articulated by the farmer stating, "You give us polluted water for us to grow your food".

The study identified and analyzed unique hotspots within the area, each influenced by factors like ownership, plot size, plot division, and regulations such as land use and buffer spaces. These elements impact the intersection of ecology and morphology along water networks. Ownership patterns, particularly in buffer zones delineated by RMP 2015, vary, with privately owned land parcels in both urban and agrarian zones. In urban areas, roads often serve as buffer spaces, though they may not meet the prescribed buffer space widths. The city's older sections, planned before RMP 2015, often turn their backs on water networks, as documented in typology studies. Discussions with Bangalore Development Authority (BDA) officials revealed that no new layouts have been formed by BDA post RMP 2015, though private layouts with BDA sanctions exist. Downstream agrarian zones show built forms responding to water networks, but the primary land use is Hi-tech, with secondary residential use, lacking density guidelines for environmentally sensitive areas. The study highlighted that the water network is not well-integrated into the urban fabric, with roads and built forms acting as barriers. Where accessible, the water network is in poor condition, reflecting the city's health. While the master plan recommends buffer zones along water networks, a concept introduced in RMP 2015, this has been contentious. Local area plans, essential for macro-scale planning, are missing, as neither BDA nor BBMP formulate them, despite the 74th Constitutional Amendment Act (CAA)[2] enabling municipal governments to do so. Additionally, there is a lack of specific regulations for sensitive zones, defining carrying capacity, and land use compatible with the land's sensitive nature.

4. RESULTS

The study revealed several key findings:

Typology Analysis: The research uncovered how urban planning laws have led to a disregard for the water network and land-water interface. For instance, Typologies 1A and 1B demonstrated how land creation over water networks was permitted due to outdated regulations. Similarly, Typologies 2A and 2B highlighted the adverse effects of land use policies that allowed settlements to encroach upon and pollute water bodies. Typologies 3 and 4, which focus on industrial land use, are highlighted due to their significant impact on pollution and the environment. The discharge of untreated waste into the rajakaluve represents a severe case of environmental degradation directly linked to land use policies and industrial activities. Typologies 5 and 8 are emphasized because they demonstrate the inadequacies of planning regulations in addressing flood risks and the transformation of water bodies into urban spaces.

Impact of Regulations: The analysis showed that current urban planning laws fail to adequately address or protect sensitive ecological areas, contributing to the degradation of the water network and inadequate buffer zones as seen in Typologies 3 through 10. The study also noted the inadequacies in handling polluted water used for agricultural purposes in Typology 10. The analysis reveals that urban planning inadequately addresses the intersection of land and water networks. For instance, Typology 6's planned buffer space mitigates flooding on one side of the housing cluster but fails to address the ecological impact on the other side. This disparity underscores the lack of a holistic approach in urban planning. Typologies 9 and 10 highlight the failure of the RMP 2015 and previous regulations to effectively manage buffer zones and protect sensitive ecological areas. The implementation gaps in these regulations, particularly regarding the

carrying capacity of water bodies and the management of agrarian land use, demonstrate a critical oversight in planning policies.

Field Observations and Interviews: Observations and discussions with local authorities and stakeholders provided insights into the practical challenges and failures of existing urban planning practices. This included the lack of effective implementation of regulations and the need for better integration of ecological considerations into urban planning. Feedback from residents in Typology 5 (ST Bed) highlights dissatisfaction with flooding issues due to the conversion of tank beds into housing layouts. Interviews with these residents reveal concerns about inadequate flood management and lack of maintenance. Discussions with BDA and BBMP officials indicate a recognition of these issues but also reveal the constraints faced in policy implementation and enforcement. The absence of local area plans and the slow adaptation to newer regulations like RMP 2015 are seen as barriers to effective management. In Typology 10, farmers' insights on using polluted water for irrigation reflect a critical issue in the urban-rural interface. Farmers report health concerns and challenges related to water quality, emphasizing the need for improved water management practices. It is estimated that an additional 109 hectares of land will be needed to produce sufficient food for urban populations [11]. Additionally given that by 2050, around 80% of the global population is projected to reside in urban areas, urban agriculture, including edible gardens and vertical and horizontal farming, can be a viable solution, to meet the demand for food. To facilitate the process of connecting land, water, and people, local community actors and stakeholder participation are critical [12].

5. CONCLUSION

Navigating through the intersection of urban morphology and ecology as a manifestation of the formal processes highlighted significant issues in urban planning law's recognition and integration of water network and land interface. Key findings reveal a significant oversight in urban planning laws regarding the recognition and incorporation of these ecological components. Specifically, land use regulations have allowed critical water features to be transformed into urban backyards or built-up areas, disregarding their ecological value. Despite existing legal mandates and court orders aimed at reclaiming these water networks and removing unauthorized structures, enforcement challenges persist, exposing systemic weaknesses in urban planning regulation implementation.

The transformation of tank beds and sensitive ecological zones into urban or industrial areas underscores the failure of current regulations to preserve these critical zones, leading to issues such as increased flooding and pollution. While the introduction of buffer zones was intended to protect these areas, ambiguous interpretations and private land ownership disputes have often rendered these zones ineffective. Moreover, the study uncovers a disconnect between macro-scale planning and detailed local area planning, revealing a critical gap in integrating ecological considerations into urban development strategies. The lack of well-formulated local area plans exacerbates this issue.

Urban planning law's inadequately recognition of these networks, leading to urban morphology that neglects critical ecological features. Land use regulations profoundly shape the inclusion of ecology features, often allowing construction that transforms essential water features into backyards or built-up areas. Despite legal mandates and court orders to reclaim water networks and remove unauthorized constructions, enforcement remains a significant challenge, revealing systemic issues in the implementation of urban planning regulations. Overall, the study underscores the need for urban planning laws to integrate the ecology considerations more comprehensively, prioritizing the recognition and protection of water networks, sensitive zones, and buffer areas to ensure sustainable urban development. These inferences emphasize the urgent need for urban planning and governance to prioritize inclusivity, regulatory enforcement, and strategic integration of water networks and sensitive zones into urban landscapes.

6. RECOMMENDATIONS

The research paper draws out recommendations for the planning and governance of the intersection of ecology and morphology along the water network. Thorough assessments of historical use, transformations, and current needs associated with spaces should be conducted to inform future planning and development decisions.

Specify Density Regulations for Sensitive Zones: Implement zoning regulations that restrict development density in sensitive ecological areas based on their carrying capacity. For example, in Typologies 1A and 2A, where the ecological impact has been significant, density should be limited to a specific ratio (e.g., X persons per hectare) to mitigate environmental degradation. This ensures that development does not exceed the ecological capacity of these areas, thereby preserving their ecological integrity.

Encourage Mixed-Use Developments: Create incentives for mixed-use developments that combine residential, commercial, and recreational spaces along the water network. This could include tax breaks for developers who incorporate green spaces and pedestrian pathways, similar to those seen in Typology 5 and 6. Mixed-use developments enhance urban vitality, reduce vehicle dependency, and foster pedestrian-friendly environments, which are essential for integrating urban morphology with ecological considerations.

Transform Buffer Zones into Urban Agriculture Areas: Convert non-buildable buffer zones into urban agriculture zones where local food production can occur. Develop policies to encourage and facilitate this transformation, such as incentives for urban farming initiatives and community gardening projects, similar to initiatives observed in Typology 10. This approach supports sustainability by integrating ecological preservation with local food production, reducing urban food miles, and promoting green spaces.

Conduct Comprehensive Assessments: Perform detailed assessments of historical land use, recent transformations, and current needs for areas surrounding water networks. This includes mapping changes over time and evaluating current ecological impacts, as demonstrated in the analysis of Typologies 3 and 4. These assessments provide a data-driven basis for informed planning decisions and ensure that future developments align with ecological and urban goals.

Enforce Compliance with Existing Regulations: Strengthen enforcement of the Wetlands (Conservation and Management) Rules 2010 and the Wetlands Regulatory Framework 2008 by enhancing monitoring mechanisms and increasing penalties for non-compliance. This could involve creating a dedicated task force to oversee wetland conservation, addressing the challenges observed in Typology 8. Effective enforcement is crucial to ensure that wetlands are protected and managed sustainably, addressing issues of pollution and unauthorized construction.

Develop Policy Tools for Buffer Zone Compensation: Establish a compensation scheme for landowners who maintain buffer zones in addition to strategies seen in Typology 9. This could include financial incentives, for example, tax reductions, or land-use credits. Compensating landowners encourages the preservation of buffer zones and ensures that they are maintained as effective ecological buffers.

Integrate traditional maintenance systems and local self-governance into urban planning frameworks, as enabled by the 74th CAA[2]. State ownership and community maintenance of buffer spaces should be enabled to ensure their preservation and effective management. This calls for a need to develop community-based management plans for buffer zones and water networks that involve local stakeholders in decision-making processes. Collective management empowers communities, ensures local needs are met, and integrates traditional knowledge into modern planning practices.

Coordinate Multi-Authority Governance: Establish a coordinated governance framework for the management and conservation of tanks and rajakaluveys involving all relevant authorities. Currently, tanks are governed by multiple authorities and rajakaluveys managed by the BBMP This framework should include regular meetings, shared data systems, and joint conservation efforts. Coordinated governance ensures that management strategies are unified, reducing conflicts and improving the effectiveness of conservation efforts.

6.1. Scope for Future Research

Building on the recommendations provided, future research should explore several critical areas to enhance the integration of ecological considerations into urban planning. To assess the impact of implementing density regulations on sensitive ecological areas, detailed case studies and empirical evaluations are needed. Research should also investigate the effectiveness of mixed-use developments along water networks, focusing on their potential to enhance urban vitality and integrate ecological features. Additionally, exploring the feasibility and impacts of converting buffer zones into urban agriculture areas through pilot projects will provide insights into their sustainability and benefits for local food production.
Comprehensive assessments of land use surrounding water networks are crucial, utilizing advanced GIS tools and historical data to inform future planning. Strengthening the enforcement of wetland conservation laws should be examined, including the evaluation of current monitoring mechanisms and the potential for enhanced penalties or dedicated task forces. Research into compensation policies for maintaining buffer zones—such as financial incentives or land-use credits—will help in developing effective strategies for ecological preservation.

Furthermore, integrating traditional and contemporary management practices into urban planning frameworks should be explored, focusing on community-based management of buffer zones and water networks. Finally, developing and testing coordinated governance frameworks for managing water bodies under multiple authorities will be essential to improve conservation and management efforts. These research avenues will contribute significantly to bridging the gaps identified in urban planning and ensuring more effective ecological integration.

Government Institutions interacted with for data collection:

- Bruhat Bengaluru Mahanagara Palike (BBMP)- the Municipal Corporation of Bengaluru
- Bangalore Development Authority (BDA) – the planning and development authority of Bengaluru
- Bengaluru Water Supply and Sewerage Board, (BWSSB)
- Bengaluru South Taluk Office for the village maps- the local Revenue Department

Notes

1. **JNNURM:** The Jawaharlal Nehru National Urban Renewal Mission (JNNURM) was a major urban modernization program initiated by the Government of India (GoI) through the Ministry of Urban Development. The mission aimed to enhance urban infrastructure and living standards. With an investment plan exceeding $20 billion over seven years, it sought to integrate infrastructure development, asset creation and management reforms, and improve access to basic services for the urban poor. The mission comprised two sub-missions: one dedicated to upgrading urban infrastructure and governance (including water supply, sanitation, and waste management), and the other focused on providing basic services to the urban poor.
2. **74th CAA:** The 74th Constitutional Amendment Act (CAA) of the GoI, enacted in 1992, is a significant piece of legislation aimed at decentralizing governance and enhancing the role of urban local bodies in the country.

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PRATHIMA N, M Arch,
Bachelor of Architecture from R V School of Architecture in Bengaluru, India, Masters of Architecture specialization in Urban Design from R V School of Architecture in Bengaluru, India. Research Scholar from the National Law School of India University, Bengaluru, India. The research is focused on the study of the formal urban planning processes for inclusive cities. She is a practicing Architect, Urban Designer, and partner at PR Architecture Studio based out of Bengaluru, India.

Research Article

Basic Design Workshop Experiences from Thought to Object, from Abstract to Concrete: Texture


Assoc. Prof. Dr Pınar KISA OVALI[1], Lecturer Dr. Bilge ATAÇ ÖZSOY[2]
Trakya University, Faculty of Architecture, *Edirne, Türkiye*
Trakya University, Faculty of Architecture, *Edirne, Türkiye*
pinarkisaovali@trakya.edu.tr, bilgeatac@trakya.edu.tr
https://orcid.org/0000-0002-6230-219X[1],ttps://orcid.org/0000-0001-7259-4387[2]
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Abstract: *This article aims to evaluate and investigate the student achievements as a result of different applications of the 'texture' element in the workshops conducted within the scope of the basic design course, which forms the basis of architectural education. Different applications made within the scope of the 'texture' element in the Basic Design I course of spread over a period of ten years (2013-2023) constitute the subject of the study. This study, in which the place and importance of 'texture' as one of the ways of enabling architecture students to gain a new understanding by developing their thought system and creativity, is investigated by comparing different method constructs; It is evaluated through the applications titled 'inductive and deductive texture', 'texture in the footsteps of famous painters' and 'texture in the creative process'. As a result of the study, it was determined that 'texture' in deduction, induction, recreation and creative processes, the limits imposed on the student at the design stage create a partial restriction on creativity, but do not limit creativity in texture products, rational knowledge together with the creativity of the student, Rational knowledge is combined with the student's creativity, intuition and experience, allowing an original approach to be developed for each new product in a continuous feedback process. It also demonstrates the need to question and re-evaluate the traditional teaching methods used in basic design courses and to broaden the student's perspective.*

Keywords: *Basic Design, Texture, Deduction, Induction, Architecture Education*

Düşünceden Nesneye, Soyuttan Somuta Temel Tasarım Atölye Deneyimleri: Doku

Özet: *Bu makale mimarlık eğitiminin temelini oluşturan temel tasarım dersi kapsamında 'doku' ögesinin farklı uygulama yöntemleriyle atölye çalışmaları sonucunda edinilen öğrenci kazanımlarının değerlendirilip sorgulanmasını amaçlamaktadır. Temel Tasarım I dersinde 'doku' ögesi kapsamında yaptırılan ve on yıllık sürece yayılmış (2013-2023) farklı uygulamalar çalışmanın konusunu oluşturmaktadır. Mimarlık öğrencisinin düşünce sistemini, yaratıcılığını geliştirerek yeni bir anlayış kazanmasına olanak sağlama yollarından biri olarak 'doku' ögesinin yerinin ve öneminin farklı yöntem kurgularının karşılaştırılması yolu ile araştırıldığı bu çalışma; 'tümevarım ve tümdengelim doku', 'ünlü ressamların izinde doku' ve 'yaratıcı süreçte doku' başlıklı uygulamalar üzerinden değerlendirilmektedir.Çalışma bulguları olarak; tümdengelim, tümevarım, yeniden yaratım ve yaratıcı süreçlerde 'doku'nun, tasarım aşamasında öğrenciye konulan sınırların yaratıcılık üzerinde kısmi kısıt oluşturduğu ancak doku üretimlerinde yaratıcılığı sınırlamadığı, rasyonel bilginin öğrencinin yaratıcılık, sezgi ve deneyimleriyle bir araya gelerek sürekli bir geri besleme sürecinde her bir yeni ürün için özgün yaklaşımın ortaya çıkmasına olanak sağladığı belirlenmiş olup, sonuçları itibariyle temel tasarım dersi kapsamında klasik eğitim alışkanlıklarının sorgulanarak yeniden değerlendirilmesi ve öğrencinin bakış açısının genişletilmesi noktasındaki gereklilikleri de göstermektedir.*

Anahtar kelimeler: *Temel Tasarım, Doku, Tümdengelim, Tümevarım, Mimarlık Eğitimi.*

1. INTRODUCTION

This article discusses the relationship between the concept of texture and architectural education, focusing on creativity, awareness and attention. The overall aim is to enable free choices to be made using texture, to draw attention to ways of approaching design and to develop awareness in the design process. Dufrenne (1973), who sees aesthetic experience as a way of helping individuals to see the world and themselves in new ways, emphasizes the rich variety of emotional impressions, feelings and expressions that aesthetic experience encompasses [1]. As a concept, texture is an inescapable part of everyday life and architectural education with the aesthetic experience it provides. Merleau Ponty (1995) emphasizes that not everything can be communicated verbally, describing this situation as a 'silent and veiled language' by saying that 'some things cannot be described because they exist in a way beyond what can be described'. However, he also states that this silent and implicit language can be revealed through visual traces in different types of art forms such as painting, sculpture and photography [2]. This evaluation indicates that aesthetic experience is characterized as a process through which individuals gain new insights into themselves and the world around them. It also suggests that architectural students may benefit from a freer view, attention and awareness in the design process. In order to facilitate comprehension of the significance and value of textures in the context of architectural education and to provide students with the opportunity to explore the diverse applications of texture through design, the studies conducted at the Trakya University Basic Design Workshop are evaluated within the scope of this article. Consequently, new insights into the various techniques and methods employed in the creation of textures are developed, offering a valuable contribution to the field of architectural education.

2. RESEARCH METHODOLOGY

The principal objective of this study is to provide an understanding of the significance of texture in the context of basic design education, employing a range of pedagogical approaches. Additionally, the aim is to facilitate a transformation in the architectural student's cognitive processes and creative abilities. In this manner, the teaching methods and principles of the Basic Design Course will be developed in accordance with contemporary understanding and approaches, thereby facilitating the advancement of the student's design and creativity competence. The methodology of the study encompasses the theoretical examination of the 'texture' element, a fundamental aspect of design, within the context of the course curriculum. It also evaluates the process of obtaining the final product through the analysis of diverse application methods, as reflected in the application examples developed in the workshop and discussed in terms of their impact on architectural education (Figure 1).

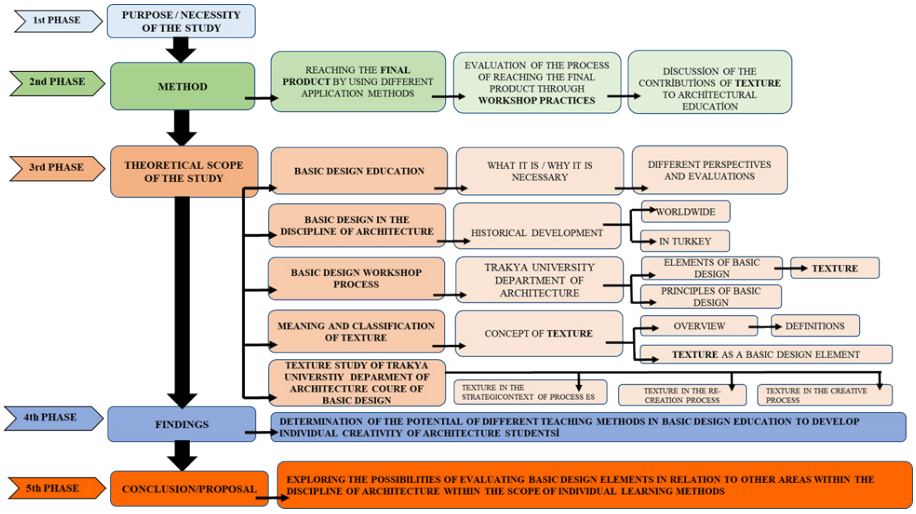


Figure 1. Flowchart of the study. (developed by the authors)

3. BASIC DESIGN EDUCATION

The education of the architect has been a subject of debate for centuries. Vitrivius (2021), in his work 'Ten Books on Architecture', highlights the importance of architects receiving multifaceted training [3]. Basic design, which is one of the first year courses with its understanding based on workshops in architectural education. This introductory design course is crucial for fostering the understanding and competencies that architects require for creative problem-solving.

'Basic Design' as an educational program can be developed through students' curiosity and experience rather than the theoretical content of the subject being taught. It is widely accepted that this form of teaching and learning fosters creativity by providing students with a diverse range of shapes, colours, rhythm and unconventional perspectives [4], [5]. Along with these assumptions, 'design workshops' are also evaluated with different approaches.

Arıdağ and Aslan (2012) define today's design studio, similarly to Dewey's (1991) definition of school, as a place that does not give information to students, but accustoms them to find the way of behavior in life and gives them the habit of thinking within this purpose [6, 7]. Hodgkin (1985) states that design education, in addition to the teaching of subjects based on traditional lecturing, focuses specifically on the enhancement of students' creativity and the acquisition of knowledge that is expressed non-verbally as a source of skill-based action, covering all parameters of design knowledge [8]. Ledewitz (1985) summarizes and limits design education to three aspects: learning and practicing a set of new skills such as visualization and representation in the design studio, learning a new language and learning to think architecturally [9], while Yürekli and Yürekli (2004), evaluating design education from a questioning perspective, liken design education, which is intertwined with abstract concepts, to a complex and contradictory structure that is inherently broad, not very clear, difficult to define, understand, classify and formalize [10].

Workshops, where all the affective and intellectual practices related to the act of designing and the language of design are taught, have to keep up with the changes demanded by the times. This need for change and renewal means that design methods and design workshops are constantly being questioned [11]. According to today's understanding, it is not enough for the output of design activities in the workshop to be a good design product, what is important is not only to design, but also to acquire a form of behavior about how to design [12]. At this point, the workshops of the basic design course, which not only ask for what they have given back, but also expect the prospective professional to take the information, turn it over in his mind and shout 'paperwork', stand out among the workshops where architectural education takes place intensively [13].

In the context of architectural design education, the legacy of Bauhaus is evident in the approach to design in the atelier, where the elements and principles of 'Basic Design' are more clearly defined through an evaluation and interpretation of these concepts in the present era. This analysis reveals that a contemporary basic design course should encompass three fundamental understandings. These can be defined as developing students' design skills, identifying and solving design problems creatively, raising awareness of how things around them work, and increasing their ability to communicate [14,15].

3.1. Basic Design in the Discipline of Architecture

Buchanan (2001), who divides design education into four stages, identifies the first stage as apprenticeship. In this phase, where formal education did not exist [16], the master-apprentice relationship was prominent in art schools and academies rooted in the École des Beaux-Arts (18th century / Paris). This relationship involved the apprentice observing and assisting the master during practical work, defining a process through which architects were trained as craftsmen [17, 18].

The beginning of architectural education at the École des Beaux-Arts is based on the educational system of the Académie Royale d'Architecture, founded in 1671. At the Royal Academy of Architecture, in addition to craft training that preserved the master-apprentice relationship, design studies continued within the studio of an academic (the master) [18,19]. Founded in France by Louis XIV in 1671 as the Académie Royale d'Architecture, the Royal Academy of Architecture introduced a two-dimensional composition approach, which formed the first theoretical framework for composition education and provided Classical and Neo-Classical training [20]. It gained official status under the name École des Beaux-Arts in 1819, with its influence lasting until 1968 [21]. In the Beaux-Arts School, the fundamental principles of design composition were only given within the context of the sub-headings 'space, color and design theory' within the formal educational process.

Another school whose influence can still be observed in architecture programs is the Bauhaus approach [22]. Founded in 1918, the 'Weimar Bauhaus School' was the first art education institution to implement a foundational program focused on teaching creativity, forming the basis of today's basic design education [20]. Unlike the academy's two-dimensional composition approach, Bauhaus' concept of composition emphasized the teaching of three-dimensional perception [23]. The principal distinction between the Bauhaus and the Beaux Arts Schools is that the Bauhaus liberates the student from the constraints of tradition, thereby facilitating the exploration of creativity, imagination, and the full spectrum of individual expression [20].

In the understanding of art and design education within architecture and related disciplines from 1870 to 1950, the influence of Bauhaus is quite pronounced [4, 24]. Basic design education is considered a primary outcome shaped by Bauhaus and, from the 1920s onward, by modern architectural thought [25]. and it holds a significant place in first-year architectural education due to its workshop-based pedagogical approach. The Bauhaus educational approach, which originated in Germany and subsequently spread to numerous countries and continents, including the United States, England, France, Italy, and Japan, was first introduced in Turkey in 1956 at METU under the name 'Basic Design' and in 1963 at ITU under the name 'Basic Course.' Since 1982, this educational approach has been implemented as the 'Basic Design' curriculum across all architecture faculties in Turkey.

3.2. Basic Design Studio Workflow

In the first-year architecture curriculum at Trakya University's Faculty of Architecture, the basic design course spans four hours per week during both the fall and spring semesters, comprising theoretical lectures and practical exercises. Although its foundations are in the Bauhaus design approach, the course has been updated in parallel with changes to the educational system from the academic period to the present day [26], reaching its current form in alignment with the structure of the unique Bologna process.

In the fall semester, the course theory is further enhanced with the inclusion of visuals, as illustrated in Figure 2, Phase 1. The basic design elements (line, direction, interval, form, scale, color, value, texture, light-shadow, movement, and fundamental composition) are introduced and discussed through a question-and-answer format, thus allowing students to process the presented knowledge cognitively. The practical component of the course (Figure 2, Phase 2) is designed to incorporate a variety of teaching methods that are aligned with different learning styles. This supports students in making transitions from the abstract/concrete, subject/object, and concept/sketch phases. This structure allows for the accommodation of individual differences in the products and exercises produced.

Upon completion of this creative process, in which learning experiences are optimally organized, structured, and guided, students come to recognize that their direct experiences and experiments have

transformed into a form of creative expression. They experience the concepts of ‘self-expression’ and ‘self-actualization’ being fulfilled [27]. The primary goal is to create a studio environment in which individuals can explore their own learning paths, in addition to experimenting with creative processes within the field of architecture. The transformation of individual or group projects into final outcomes within a discussion-based environment supports the creative processes of architecture students. In this way, the practical studio becomes a space in which theoretical knowledge is translated into abstract, concept-based design objects. Basic design elements are essential for establishing compositional structures and allowing students to express themselves through their designs. Studio exercises are repeated for each basic design element using different methods, thereby fostering students' creative processes through multiple perspectives. This study provides a general evaluation of unique productions that focus specifically on the element of ‘texture’, examining various application methods and their results for the potential they carry.

3.3. Texture As A Narrative Tool: Its Meaning And Types

As a concept, texture has the same origin as the word 'text'. The Latin word 'textus' means weave, texture. According to Vasseleu (2005), texture is ‘*the arrangement or characteristic of something woven into a fabric*’ [28]. While the word texture was initially accepted as a textile term referring to the quality of fabric as judged by the sense of touch, the concept was later evaluated in a broader range of philosophical and cognitive terms. Perceptual scientists consider texture to be a visual 'entity' [29].

The term texture is defined as the visual and tactile qualities of surfaces. In addition to encompassing both natural and cultural phenomena, texture also pertains to a significant portion of human experience. In all forms of visual art, craft, design, and architecture, texture serves as an element of scientific aesthetics. In addition to its role in the visual arts, texture has a variety of meanings in other disciplines, including music, language, and even gastronomy [30]. Therefore, examining texture from a visual standpoint offers a constrained view; when viewed in a more comprehensive manner, texture encompasses the multifaceted aspects of the ‘whole’. As an element of basic design, texture is divided into two modes of perception: the tactile, which is inherent to natural forms, and the visual, which is a construct of artificial or perceived textures. The initial category, that of physical or natural texture, is objective and concrete, whereas the latter category, that of visual texture, is subjective and abstract. Additionally, textures resulting from hand knitting and fabric weaving are included in the category of natural textures. In addition to these, there are textures that are classified as ‘artificial.’ For instance, when painting an object, the degree of roughness of its surface is indicated using scans and punctuation. This painted texture on paper is therefore an example of an artificial texture [31].

The texture of a surface or object is determined by its geometric configuration and physical-chemical properties. Even in the absence of visual or tactile perception, textures are described with adjectives such as soft, hard, smooth, rough, spiky, and irregular [32, 33]. The experiences of individuals with a product or material used in a product are complex and multifaceted [34, 35].

Perceived texture represents a synthesis of physiological and psychological responses to the characteristics of a surface or material. In certain circumstances, such as visual perception, the responses to geometric properties may prevail over the physical-chemical properties of texture, or vice versa, as in blindfolded tactile exploration. The relationship between objective texture qualities, typically represented by physical parameters, and subjective texture perception provides a framework for a more comprehensive understanding of textures.

In particular, within the context of art-related disciplines, assessments conducted through both seeing and touching represent essential elements for acts of exploration and creativity. This underscores the

significance of texture as a key factor in such endeavors [36]. The creation of texture also has the effect of influencing innovative practices, as it encourages rational consideration of the application [37].

4. TEXTURE AS A BASIC DESIGN ELEMENT: STUDIO STUDIES

In architecture, basic design studios often approach texture in theoretical lectures through physical/natural/concrete and visual/artificial/abstract perspectives. The 'texture' element in the Basic Design I course is addressed within the fundamental classifications discussed in the study, covering the sources of texture effects, texture characteristics, and their psychological impacts.

The course's practical component, outlined in the phases presented in Figure 2, offers students diverse experiences through both abstract and concrete processes. The second phase, which constitutes the core of this study, involved an investigation of diverse application methods over a decade of teaching practice. This phase serves as a foundation for comparison between different approaches to teaching texture (Figure 2).

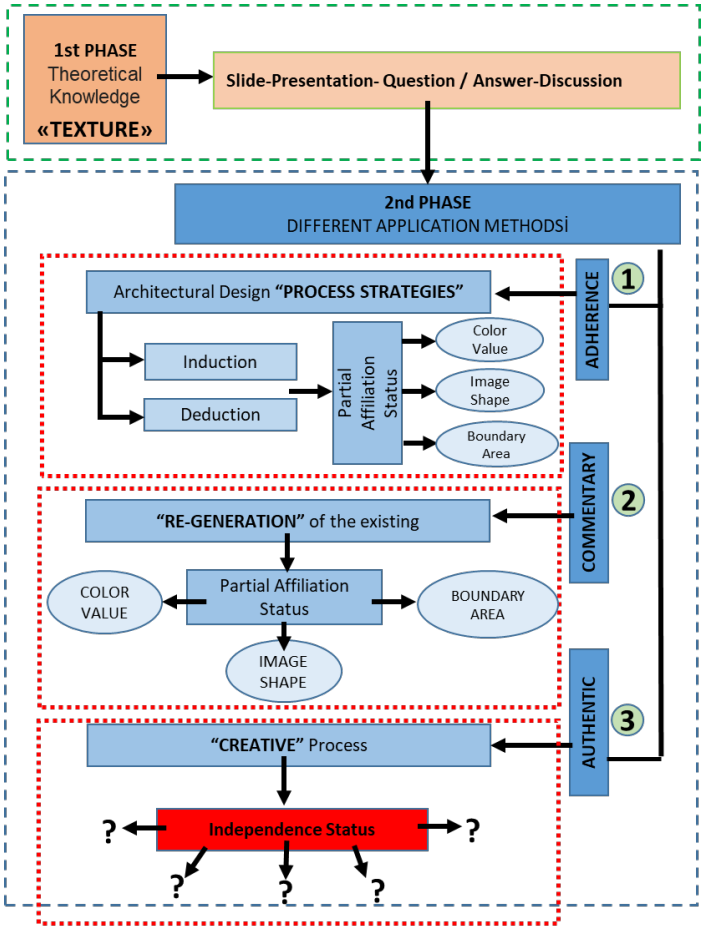


Figure 2. Application workflow for the texture study in the basic design course (developed by the authors)

4.1. Texture in the Context of Design Process Strategies

The architectural design process, which encompasses a multitude of analytical actions, is a complex and problem-solving journey. In this context, knowledge may be conveyed through either 'deductive' or 'inductive' strategies. The former progresses from the whole to the part, while the latter advances from the part to the whole. This entails transitioning from concepts to concepts or from laws to laws [38]. In the

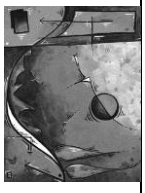
context of architectural design, the direction of development—whether from part to whole or whole to part—serves as the foundation for what is known as 'design process strategies' [39].

Experiential learning depends on the individual's relationship to the experience in question. Learning can be either deductive or inductive. According to Prince and Felder (2006), deductive learning is a more traditional method, beginning with theoretical principles and then moving from general to specific [40]. Conversely, inductive learning involves a process of observation, experience, and case study analysis, which then informs theoretical understanding.
For this reason, the practical phase of the study is designed to encourage creativity while also conveying and allowing first-year architecture students to experience the fundamental strategies of the discipline. It employs both deductive and inductive methodologies, thereby introducing these core approaches.

4.1.1. Texture from whole to part: Deduction

Within the framework of architectural design process strategies, the 'deductive' approach in texture creation involves moving from whole to part, seeking solutions by breaking down the whole into its constituent parts and examining them through the lens of 'texture'. The study was conducted as two separate applications, each with forty students per group, with restrictions on color and value. In the workshop, the base visuals chosen for the work were intentionally abstract to avoid familiar or easily recognizable images that might unconsciously constrain the students' creativity (Table 1).

Table 1. 'Deductive Texture' studies from Whole to Part (source: authors)

	Original		Student Work / Deduc on			Results
Study Base (the original visual)	 [41]	In the first phase of the study, the selected visual was divided into 40 equal parts, corresponding to the number of students in the workshop. This segmenta on established the fundamental units of the study, with each student working on one segment.	**Color:** Each student, unaware of the overall form, organized their individual segment using texture.		In the study, as a limita on, the abstract visual's traces and colors were preserved, resul ng in a final product that retained the dominance of the overall form.	In this study, students adhered to the color and traces of the holis c piece, but they were able to freely evaluate their individual preferences in the use of texture in their work independently of each other.
Study Base (Achroma c conversion)		The abstract visual was studied with another group of 40 students with the constraint of 'value' using a black and white colorless background.	**Value:** The abstract visual was studied with another group of 40 students with the constraint of 'value' using a black and white colorless background.		In this study, students organized their own parts using texture without being aware of the whole. However, in addi on to other constraints, this group completed the texture study by using the values of the color blue with a black and white colorless background.	In this study, students adhered to the traces of the universal part, but they were able to freely evaluate their individual preferences in the use of texture in their work independently of each other.

In both study groups, the 'whole,' created by combining the final products on the board, was discussed and evaluated with the students in terms of the original form of the image and the reproduction. Therefore, the final product was determined intuitively with a general judgment, individual judgments were tested

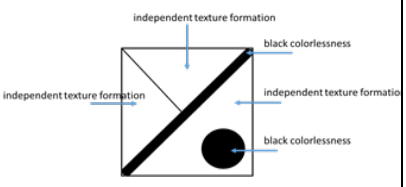
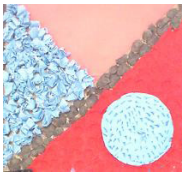
according to the main idea of the previous holistic formation, and it was also possible to recreate the holistic form using 'texture' without damaging its integrity. While the study has deductive limitations in terms of clear boundaries in the whole, it is significant in that each piece was designed by different students with individual preferences regarding texture.

4.1.2. Texture from Part to Whole: Induction

In the context of architectural design, induction is associated with the establishment of a unifying framework [38]. This process entails a transition from the examination of individual components to the integration of the entire structure, encompassing the synthesis of smaller units into larger, more comprehensive ones. The process of induction involves the gradual addition, combination, or articulation of parts that will form the design whole. This approach essentially builds up the composition through a process of trial and error, allowing the designer to achieve the desired overall structure. This approach, defined as a method of reaching a universal idea from singular data, was structured scientifically by Bacon [39]. It is a foundational teaching and learning method in all scientific fields where design activity is central [40].

In establishing the part-whole relationship, there is a need for unit modules, modulation-based parts or formations that can complement each other (such as the relationship between indentation and recess, reference lines-areas, etc.). In the effort to achieve the whole, the final product is a surprise. The whole that is formed by the parts that are combined and brought together cannot be clearly predicted. It may even offer many alternatives for coming together. In this study, the basic geometric form of a square (25x25) was chosen as the unit module because of its ease of assembly and the variety of combinations. Using the diagonal of the square as the main reference point, the surface is divided into triangular areas of different sizes. In the large triangular area, a circle shape was placed as a secondary reference point and all reference points were textured with black colorless. In the other triangular areas, the choice of texture type, color, and value was left to the student's interpretation, and each student did his or her own original work (Table 2).

Table 2. Unit module constructed for inductive work and 'Inductive Texture' application example from part to whole. (source: authors)

Study Base	Application	Student Work / Induction
 Unit module designed for inductive study In this study, the basic geometric form of a square (25x25cm) was chosen as the unit module due to its ease of assembly and variety of combinations. With the diagonal of the square as the main reference point, the surface was divided into triangular areas of different sizes. Inside the large triangular area, a circle form was placed as the second reference point and all reference points were textured with black colorlessness.	 The choice of texturing type, color and value in triangular areas is left to student interpretation.  In this context, each student realized their own original work	 Upon completion of the workshop, the individual works of the 32 students were assembled on the exhibition board with reference to the diagonals, resulting in the formation of a pattern.

During this experience, students were provided with theoretical information about the inductive strategy. Furthermore, the teaching of the process strategy was reinforced with 'supervision-based learning'.

4.2. Re-Creation: Texture in the Footsteps of Famous Painters

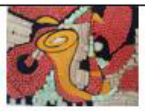
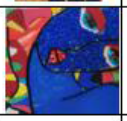
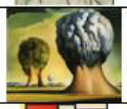
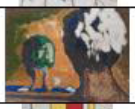
The concept of texture is recognized as a component of any image in the human mind. The image in the mind is constituted by life experiences and knowledge. In this context, the accumulated life experience, knowledge, and imagination of the designer (student) will facilitate mutual inspiration and facilitate the emergence of creative thinking. The 'In the Footsteps of Famous Painters/Texture' application is based on the concept of reproducing an existing painting by interpreting it in the mind through the lens of texture (Figure 3). The act of reproducing an existing work is a subjective process, shaped by the individual's unique perspective and knowledge base. Each iteration represents a novel interpretation and a distinct production of the artist's work. By its very nature, this process requires partial adherence to the boundaries of space, color or value structure and the general image and shape narrative of the painting. It is crucial to maintain the perceived overall image of the painting.

Figure 3. Re-Creation and Production 'In the Footsteps of Famous Painters / Texture' (source: authors)

In order to gain insight into the direct relationship between the discipline of architecture and the branches of art, as well as to demonstrate the partial commonalities in the foundations of aesthetic teaching across all art disciplines, students were tasked with examining the paintings of renowned painters and selecting a painting that aligns with their aesthetic preferences and inclinations. The objective was to facilitate the growth of general cultural awareness among first-year architecture students by exploring the domain of painting, a significant artistic discipline, and its prominent practitioners. The students conducted research on the painter they selected, the period in which the painter worked, the artistic movement associated with the painter, the title of the painting, and the fundamental concept that the painter sought to convey through the creation of the painting. They then created their own versions of the paintings, incorporating a variety of physical textures in the process. The 'In the Footsteps of Famous Painters/Texture' posters, which were presented as final products, were created through a process of reinterpretation and production. This process included the reproduction of the original painting, accompanied by the relevant imprint information, as well as the inclusion of the painter and the movement to which they belonged. In these texture studies, it was determined that the students generally preferred the paintings of famous painters working in a variety of contemporary art movements, including Expressionism, Cubism, Surrealism, Impressionism, and Neo-Plasticism, as well as Japonism. The most preferred painters were Vincent van Gogh, Pablo Picasso, and Edvard Munch. Out of the hundreds of works created within the scope of the course (from 2015 to the present), 24 were selected as exemplars (Table 3). Table 3 which features different artistic movements and painters, highlighted different interpretations and productions of the same painting, emphasizing the role of texture as a means of personal expression and subjectivity. This approach allowed students to make unique

textural choices within the constraints of specific areas and colors of the original artwork. Many students created textures by manipulating paper-through folding, bending, crumpling, etc.-while others used materials that inherently offered different textures, such as shiny, matte, hard, or soft qualities, and smaller objects that could be used as modular units to fill the surface. The project, titled 'In the Footsteps of Famous Painters,' was first implemented in the fall 2014-2015 semester as part of the Basic Design I course and was later exhibited at BRAU 3 (Biennale of Architectural and Urban Restoration, October 2015), where it received national and international attention (Figure 3). The project continued to be part of the curriculum during the pandemic remote learning period (fall semester 2021-2022) and was resumed in person in the fall semester 2022-2023, maintaining the same content and focus.

Table 3. 'In the Footsteps of Famous Painters/Texture' studies

Painter Movement	Original Paint	Reproduction 1	Reproduction 2	Reproduction 3	Reproduction 4	Reproduction 5
Rene MAGRİTTE Surrealism Travel Souvenir [42].						
Pablo PİCASSO Cubism Blue Guitar [43].						
Pablo PİCASSO Cubism Musical Instruments [44].						
Pablo PİCASSO Cubism Woman with flowers [45].						
Vincent Van GOGH Impressionism Starry night [46]						
Vincent Van GOGH Impressionism Sunflowers [47].						
Vincent Van GOGH Japonism Almond tree [48].						
Edward MUNCH Expressionism Scream [49].						
Tom FEDRO Cubism Illustrate [50].						
Frida KAHLO Kahloism Auto porter [51].						
Salvador DALİ Surrealism Three sphinxes [52].						
Piet MONDRİAN Neo-plastsism Composition [53].						

4.3. Texture in the Creative Process

When considered as a surface effect responding to the search for innovation in design, texture can also serve as a starting point for technical solutions. A texture can be transformed from a two-dimensional drawing on paper into a three-dimensional material surface or even a part of the structure itself. In these cases, an innovative approach offers students/designers opportunities to create different surfaces.

In the workshop's 'texture in the creative process' exploration, students were first asked to redefine the outer surface of a balloon using string and adhesive to create a different texture. The surface covered with rope

and glue dried and hardened to form a shell on the surface of the balloon, the air of the balloon was deflated and the transformation of the surface texture into a shell with a pattern, in a sense into a structure and the volume covered by the structure was observed (Table 4). In this way, it was realized that structures, surfaces and textures that did not exist before could be designed, and that the texture could be part of the design or, from another point of view, the design itself.

Table 4. Examples of structure formation (surface-texture-shell) and designs redefined with concave/convex textures in the creative process, titled 'Texture in Original Experience' (source: authors).

Phase 1 - Getting Started **Obtaining structure**	**Progress -2. Phase** **Texture production**	**Result -3. Phase** **Surface-texture-shell**
 The surface covered with rope and adhesive dried and hardened to form a shell on the surface of the balloon, the balloon was deflated and the transformation of the surface texture into a shell with a pattern, in a sense, into a structure and the volume covered by the structure was observed.	 In the second stage, the paraboloid and hyperboloid surfaces, which the student obtained by disassembling and reassembling in line with his/her individual preferences, were transformed into an original design composition with texture production.	 In the third and final stage, the surface of the resulting design was redefined with recesses, protrusions and deep textures, and the students reached the final version of their work.

5. CONCLUSION

In order to comprehend and define the concept of texture, it is crucial to take into account the parameters that define its physical and chemical properties, as well as the sensory characteristics that emerge from human responses to it, perceived through the senses. Texture can be produced or learned from nature, the mind, and innovations in science and technology.

This article examines the concept of texture in relation to architectural education, with a particular focus on creativity, attention, and awareness. The objective is to encourage independent decision-making through the strategic use of texture, to facilitate the experience of inductive and deductive approaches to design, and to cultivate awareness throughout the design process. In accordance with the outlined framework, the following outcomes have been achieved in the context of texture-focused workshop studies.

- Texture, as a means of expression for surfaces, has been shown to be assessable within the architectural design process strategies. Furthermore, it can serve as a tool for artistic production, transitioning from mere surface expression to embodying spatial design through structural formations and volume.
- It has been demonstrated that while general boundaries may partially restrict creativity, they do not constrain the production of textures.
- The integration of rational knowledge with designer-dependent creativity and intuition facilitates a continuous feedback process through experiences, allowing designers to adopt a distinctive approach for each new creation (Figure 4).

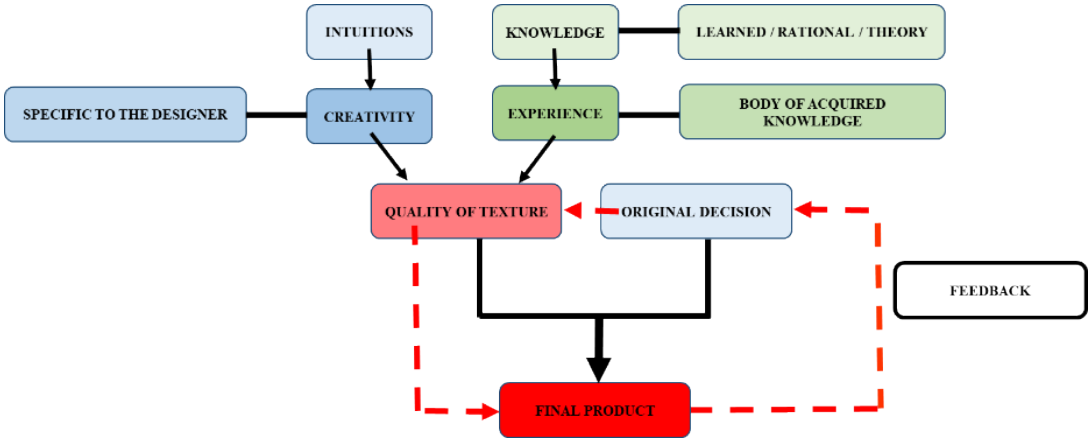


Figure 4. The relationship between texture creation and creativity (developed by the authors).

- The studies titled Inductive and Deductive Texture, Texture in the Footsteps of Famous Painters, and Texture in the Creative Process in the Basic Design I course have specifically supported learning outcomes such as utilizing examples, identifying formal composition systems, and employing design elements within composition structures. Additionally, these exercises have enhanced students' perceptual awareness and imagination, thus improving their creative design skills.
- It has been found that the forms of teaching enriched with different methods in a workshop environment have the potential to develop the individual creativity of architecture students.

Basic design workshops are significant within the discipline of architecture, both in terms of their position within the field and their widespread impact on architectural education. This study, which deals with the element of texture, can serve as an illustrative example for many other studies in terms of its approach to the subject matter.

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Pınar KISA OVALI, Assoc.Prof. Dr.,
Pınar KISA OVALI graduated from Trakya University Faculty of Engineering and Architecture in 1994 as an architect. She continues her academic career, which she started in 1995, as an Associate Professor in the Department of Architecture at Trakya University Faculty of Architecture. She teaches basic design, architectural projects and sustainability related courses at undergraduate and graduate levels. She has many national and international articles, book chapters and proceedings on sustainable architecture, vernacular architecture, ecological design, ecological tourism and basic design education.

Bilge ATAÇ ÖZSOY, Lecturer Dr.,
Bilge ATAÇ ÖZSOY works as a lecturer at the Department of Architecture at Trakya University, Faculty of Architecture. She teaches undergraduate courses on Basic Design, Architectural Projects, and courses that question the relationships between architecture and cinema, and architecture and literature. She graduated from Yıldız Technical University, Faculty of Architecture as an architect and received her PhD in architecture from Trakya University.

Integration Thermal and Daylight Performance of Responsive Facades: A Comprehensive Literature Review

Mustafa Serhan ÜNLÜTÜRK
Lecturer, Balikesir University, Ayvalik Vocational School,
Department of Architecture and Urban Planning, Ayvalik, Balikesir, Turkey
serhan.unluturk@balikesir.edu.tr
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Abstract: *Technological advances in robotics have enabled us to see the concept of kinetics in architecture. Responsive Facades, an example of kinetic architecture, are multifunctional in terms of energy efficiency. The façade system improves thermal and visual performance with less energy in the interior. Various responsive facades are being developed according to changing environmental impacts and spatial conditions. This study aims to comprehensively review recent thermal and daylighting performance studies of responsive facades in the literature. The study aims to use the results of such existing studies to guide future studies by providing feedback on responsive facades. This can help to improve the technical development of such facades and make them suitable for construction or retrofitting. Therefore, in this sense, it contributes to the literature. Studies in the literature are tabulated and interpreted. The study concludes that there are indoor thermal and daylight parameters that designers should consider during building design and that the building should be designed to provide the building with physical conditions for the users to perform their actions most comfortably. It was also found that a responsive façade design can provide indoor thermal visual comfort by using the optimization method more frequently.*

Keywords: *Responsive Facades, Daylight Performance, Thermal Performance, Energy Efficiency, Building Envelope.*

Duyarlı Cephelerin Entegrasyon Termal ve Gün Işığı Performansı: Kapsamlı Bir Literatür İncelemesi

Özet: *Robotik alanındaki teknolojik gelişmeler, kinetik kavramını mimaride de görmemizi sağladı. Kinetik mimarinin bir örneği olan Duyarlı Cepheler, enerji verimliliği açısından çok işlevlidir. Cephe sistemi, iç mekanda daha az enerji ile termal ve görsel performansı artırır. Değişen çevresel etkilere ve mekânsal koşullara göre çeşitli duyarlı cepheler geliştirilmektedir. Bu çalışma, literatürdeki duyarlı cephelerin son termal ve gün ışığı performansı çalışmalarını kapsamlı bir şekilde incelemeyi amaçlamaktadır. Çalışma, bu tür mevcut çalışmaların sonuçlarının, duyarlı cepheler hakkında geri bildirim sağlayarak gelecekteki çalışmalara rehberlik etmesini hedeflemektedir. Bu, bu tür cephelerdeki teknik gelişmelerin iyileştirilmesine ve inşaat veya iyileştirmeler için uygulanabilir hale getirilmesine yardımcı olabilir. Dolayısıyla bu anlamda literatüre katkı sağlamaktadır. Literatürdeki çalışmalar tablolaştırılmış ve yorumlanmıştır. Çalışmada, tasarımcıların bina tasarımı sırasında göz önünde bulundurması gereken iç mekan termal ve gün ışığı parametreleri olduğu ve binanın kullanıcıların eylemlerini en rahat şekilde gerçekleştirebilecekleri fiziksel koşulları sağlayacak şekilde tasarlanması gerektiği sonucuna varılmıştır. Ayrıca, duyarlı bir cephe tasarımının optimizasyon yöntemini daha sık kullanarak iç mekan termal görsel konforunu sağlayabileceği bulunmuştur.*

Anahtar kelimeler: *Duyarlı Cepheler, Gün Işığı Performansı, Termal Performans, Enerji Verimliliği, Bina Kabuğu.*

1. INTRODUCTION

Architecture, which is a part of life, is changing and developing daily. As human activities change, the concept of movement has gained a place in design. The existing building stock cannot meet the developing needs. For this reason, designers have developed different design proposals to meet user needs and ensure energy efficiency. The building envelope, which plays a distinctive role, affects user comfort [1]. Designers have sought solutions to the problems by adding the concept of movement to the building facade [2]. The conventional static facades cannot adapt to changing climatic conditions. A responsive façade system has been developed as a design proposal that simultaneously solves changing conditions [3]. While this façade system adapts to changing environmental conditions, its structural integrity is not damaged. Responsive facades' geometric shapes and locations can produce instant solutions to evolving conditions. However, static facades do not have such a feature [4, 5].

In the context of energy efficiency, resources should be utilized with maximum effectiveness at every stage, beginning with the production phase. The Paris Agreement aims to achieve a climate-neutral environment by 2050. In 2009, the EU established its 20-20-20 targets, which seek to reduce energy consumption and greenhouse gas emissions while increasing the use of renewable energy. Responsive facades that maximize daylight and enhance natural ventilation can help optimize a building's energy consumption. It is well-known that the building sector consumes more energy than other sectors. Therefore, it is believed that this new facade system will reduce the overall energy demand of buildings.

Studies on sensitive facades built according to changing environmental conditions and needs have been conducted recently, and the features of this facade system have also been examined. It is valuable in terms of exploring the place of sensitive facades within the scope of energy efficiency studies in the literature. The study systematically reviewed the studies on the thermal and daylighting performance of responsive facades in the literature. The evaluation criteria, methods and tools used by previous studies to examine the thermal and daylighting performance of responsive facades are analyzed in depth. The study is essential in compiling previous studies on the building's physical conditions of sensitive facades, the methods used, the frequency of the studies, and the climatic regions covered by the study. The study constitutes a review for future studies on the building physics behavior of responsive facades.

2. METHODOLOGY

The definitions of daylighting performance, thermal performance, and responsive facades guide the study. Previous articles on the subject were compiled from 4 different databases using these words. The limitations of earlier studies and the methods/tools used were the evaluation criteria. Certain limitations were also imposed on the main topics identified in the study. Research on thermal performance includes i) the definition of thermal performance, ii) the thermal performance-energy relationship, and iii) thermal performance and optimization. Research on daylighting includes i) daylighting performance, ii) daylighting-energy relationship, and iii) daylighting optimization. Studies examining responsive facades include i) The definition and characteristics of a responsive facade, ii) the thermal performance of responsive facades, and iii) daylighting performance of responsive facades are analyzed in 3 groups. This study aims to investigate responsive facades' thermal and daylighting performance and provide an in-depth understanding of their energy consumption comfort relationships. Figure 1 shows the methodology used to achieve the research objective. Articles outside the scope of the study were excluded. In addition, the methods used by the articles within the scope of the study to achieve the objective were also evaluated.

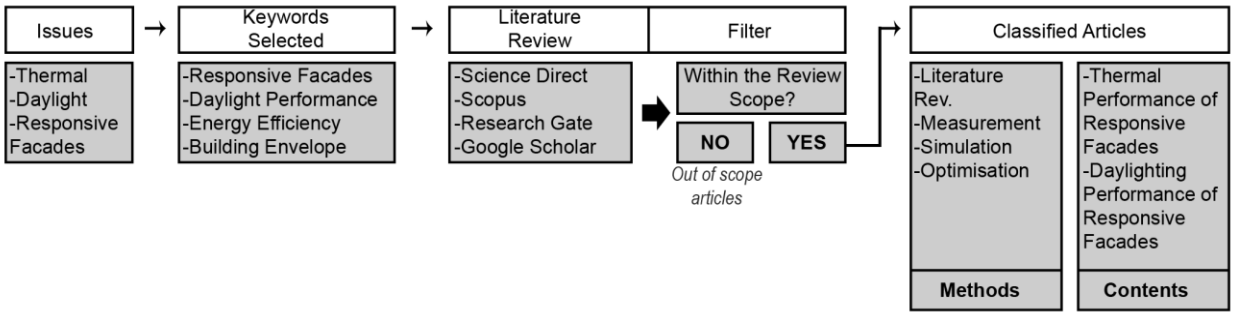

Figure 1. Workflow of the study

3. THERMAL and DAYLIGHT PERFORMANCE

People spend most of their time indoors. Users will perform different actions during the time they spend in these spaces. To perform these actions, the space must provide user comfort. If the space in which the users are located is not heated/cooled sufficiently, users may be unable to perform their actions comfortably. In such cases, the amount of energy used to provide thermal comfort indoors increases. Artificial lighting elements may be needed if daylight is not sufficiently received indoors during daylight hours. This increases the amount of energy used for lighting. When daylight is taken indoors more than necessary, glare problems may occur. This negatively affects the user's eye health.

3.1. Effect of Thermal Performance on Energy Consumption

Heating and cooling may be required to ensure user comfort in the interior of buildings. Typically, a building's heating, cooling and ventilation systems are the main energy consumers. The energy required for heating or cooling can be reduced by measures taken at the design stage of the building envelope.

A review of the literature shows that there are studies that use simulation methods to improve the thermal performance of the building. Diler used Ulu Cami as a case study in his research in Manisa. As part of the study, the researcher monitored the mosque with a data logger and created the thermal model in the DesignBuilder program. In the scenarios created, user dissatisfaction decreased from 45% to 10% [10]. In addition, a 46.9% energy saving was achieved in the designed scenario compared to the current situation. The study by Han et al. used an office building as a field study. Monitoring was carried out in the study to verify the simulation data with accurate data. PHPP and IBE perform a thermal simulation of the office building. The results of the study show that the office building is 69% more energy efficient than a standard office building [11]. Given the size of the existing building stock, the importance of improving existing buildings to increase energy efficiency must be considered. Motalebi presents a BIM-based mathematical optimisation model to improve the energy efficiency of existing buildings. The optimisation included the selection of alternative materials. The model obtained from the optimisation provided a 24% - 58.2% reduction in energy consumption [12].

Recent studies have examined the impact of various materials on energy consumption. In 2020, Li incorporated a phase change material (PCM) into the building's glass, which proved effective in enhancing thermal performance. The experimental model indicated that as the amount of PCM increases, the temperature lag also increases. However, the effect of the PCM layer thickness on transmitted solar energy varies. The total transmitted energy reaches its peak between 00:00-14:30 and 20:00-24:00, while the highest level of transmitted solar energy occurs between 05:00-11:00. In 2022, Hou integrated PCM into the walls of the building. The results of this study showed that the PCM effectively contributed to thermal management.

3.2. Effect of Daylight Performance on Energy Consumption

Using artificial lighting contributes to carbon emissions, which in turn exacerbates global warming. Sustainability involves using energy efficiently and minimizing carbon emissions. In Europe, buildings account for 40% of total energy consumption, with 19% of that energy used for lighting. Studies indicate that the electricity consumption of European buildings ranges from 20 to 50 kWh per square meter. Natural light is a crucial element in modern architecture, as it reduces the reliance on artificial lighting indoors. By effectively utilizing daylight, we can potentially save 223 million tonnes of CO2 emissions and decrease energy demand by 24,000 MW. Krarti found that the use of artificial lighting can increase a building's annual energy consumption by 40%.

IHM conducted its 2009 study in 18 different regions. The study aims to investigate the effect of building geometry, window size and glazing type on daylighting performance in other countries. The study, which focuses on office buildings, used the DOE-2 program in the simulation process. The unit of measurement used in the study is the lumen. The results of the study show that significant energy savings can be achieved through the use of daylighting control, where natural light can be appropriately introduced into the interior. Ihm found that lighting control systems can reduce the amount of energy used for artificial lighting in buildings [20]. In 2013, Alrubaih analyzed the main characteristics of daylighting and lighting control strategies, including daylight factor, illuminance and glare index. As a result of the literature review in the study, it was found that the correct design and selection of daylighting systems not only reduces the need for artificial lighting, but also the amount of energy required for cooling. In addition, the daylight factor is widely used to characterize the daylight situation in a building [21].

However, daylight alone cannot provide energy efficiency indoors. Photo sensors that regulate artificial and natural lighting indoors should be integrated [22]. Building Research Institute (BRE) and CIBSE have examined different lighting control systems and recommend using manual-automatic lighting control systems [23, 24]. Excessive daylighting indoors can also cause visual problems such as glare. To prevent these problems, shades can control daylight in designs with a high window/wall ratio [25].

Cheng's study in China aimed to reduce energy consumption by increasing the amount of daylight entering the building. To achieve this, STPV facades were integrated into the traditional facade. The study was simulated using DAYSIM. The results of the study suggested an optimal design with 50-60% transmission, 40-50% WWR range and south orientation of STPV facades in buildings located in cold climate zones to maximize the energy potential of STPV facades [26]. In 2019, Gutiérreza also investigated the relationship between the materials used in the louvre systems and daylight performance and energy consumption. DAYSIM models and daylight simulate the building under study, taking into account the DA and UDI daylight metrics. In all modelled cases, the proposed ceramic louvres outperformed the other systems, providing a more uniform distribution of light within the illuminated area. In terms of artificial lighting energy savings, aluminum louvres offered the best performance [27].

In 2019, Sun is also investigating the relationship between daylight performance and energy consumption in 5 regions of China. The study examines the energy and daylighting performance of offices in 5 different climate zones in China with PV windows and different façade designs. Radiance and EnergyPlus are used to model the analyzed building. Daylight and energy simulations are provided by the developed model. The results of the study show that the application of PV windows can lead to energy savings at a high window-to-wall ratio [28].

4. RESPONSIVE FACADES

In the late 19th century, urbanization started to develop along with industrialization and technological developments. The development of responsive facades also dates back to this period. Architects of this period aimed to design mobile responsive systems by leaving aside the static stance of the building. Movements such as Bauhaus, futurism, and constructivism considered the aesthetics of the industrial age and reflected this aesthetic in the buildings. In the 1920s, Naum Gabo's sculpture 'Standing Wawe', a kinetic artwork, pioneered architects in the movement of buildings [29].

Environmental sustainability movements and the energy crisis in the 1960s emphasized the efficient use of energy and the reduction of natural resource use. In addition, sustainability and energy efficiency started to be effective in architecture. The increasing awareness as a result of the oil crisis in the 1970s pioneered the energy-efficient design of buildings [30]. In this period, responsive facades became the most important part of environmentally friendly designs.

Ferguson defines functional responsiveness as adapting the design variables of a system to environmental conditions [31]. A responsive facade created with different calculations plays an active role in buildings [32]. Responsive components are the elements that provide adaptation according to people's needs and environmental changes [33]. High-tech responsive components can use sensor networks for environmental control. Responsive facades include elements that can move to meet the performance of the building. This facade system can provide the passage and storage of heat, light, water and air. It also offers optimal internal conditions and energy efficiency for building users. Responsive facades are essential for environmental sustainability and efficiency of resource use [34]. Figure 2 shows different responsive facade examples.

Figure 2. Some pictures of responsive façades: a) Arab World Institute, Paris (FR) [35], b) Al Bahar Towers, Abu Dhabi (AE) [36]. and Al Bahar Towers façade [37].

The working principle of a responsive facade is based on specialized subsystems, such as structural elements and sensors, that modify the building envelope according to incoming stimuli and programming [38]. A responsive building envelope includes functionalities and performance characteristics similar to those of a 'smart' building envelope, including real-time sensing, kinetic climate adaptive elements, intelligent materials, automation, and user override capability. A building with a responsive facade incorporates kinetic elements and similar functionalities and performance characteristics to a smart building envelope. The system is also capable of self-adjustment and learning using computational algorithms. In this way, it can physically manipulate the building envelope elements [39]. The development of technology facilitates the design of this facade system. In addition, building energy efficiency and comfort conditions can be increased by simulations and optimization processes before design. In 2016, Chen aimed to create a design with higher energy performance than the existing responsive facades. In this context, BIM (Building Information Modelling), parametric design, and integration of sensor devices were examined. The study conducted research on the design process of responsive facades, and criteria for compliance with green

building regulations were developed. The research both simulated energy in a computer environment and calibrated the model by making accurate measurements in the physical environment. Dynamo creates a parametric model of a responsive facade. BIM-based green building control system is applied through this model. Thus, the study proposes an optimization system for responsive facade design [40].

Since the late 19th century, the evolution of responsive facades has continued. Social-political developments and technological and environmental factors affect the development of responsive facades. Heidari, who examined the historical development and benefits of these facades, chronologically reviewed the development of responsive facades together with important events such as art movements, technological advances, and energy crises, which impacted the development of facade systems in his study in 2020. According to the results obtained in the study, energy efficiency in buildings with responsive facades is 20-60% higher than in buildings with traditional facades. The author emphasizes that the most critical factor is the adaptability of this facade system to different climatic conditions. The study emphasizes that responsive facades have high energy efficiency and low carbon emissions compared to buildings with traditional facades. It is stated that the carbon emission of a building can be reduced by up to 20% by using this facade system. The study also states that responsive facades can be applied not only at the building scale but also at the intelligent city scale. By integrating the sensors and actuators of responsive facades into urban-scale buildings, neighborhoods and urban spaces that can respond to environmental impacts can be designed. Responsive facades can reflect a society's cultural values and provide energy efficiency and user comfort. This shows that this facade is a functional building element and a cultural heritage [41].

The technologies used in responsive facades are also very significant. Heidari evaluates these systems through control, sensing, and mobilization technologies. Heidari, who wants to present the advantages and disadvantages of different systems and propose an efficient facade proposal, has examined 38 different responsive facades in this context. The study compares the control, sensing, actuator, material, and structural technologies used in these facades. The study analyzed the control technologies of these facades by analyzing how the control systems of responsive facades process signals from environmental data or user preferences. In this context, the ability of the facades to adapt to changing environmental conditions was evaluated. Sensing technologies were evaluated by assessing the performance of sensors that detect stimuli such as environmental factors such as light, temperature, and user interactions. Actuators provide the movement or physical change, one of the most important features of responsive facades. The study analyzed the material and electro-mechanical properties of the actuators. The study also analyses the material properties of the facade. It states that the adaptation of these facades to the environment increases with innovative materials such as shape-memory alloys and electroactive polymers. The study results show that responsive facades can improve energy efficiency and provide users with better thermal and visual comfort. The study's results support the results of Heidari's 2020 survey by showing that responsive facades are more energy-efficient than traditional facades. When the energy performance of responsive facades is evaluated, it is concluded that they are 40-65% more energy efficient than conventional facades [42].

4.1. Thermal Performance of Responsive Facades

The energy crisis has led people to aim for optimum conditions with minimum energy use. In addition, climate change (CC) and sustainable development require us to be careful about energy consumption. Today, it is known that energy consumption in the construction phase of the construction sector is relatively high, as well as energy consumption in the use phase of the building. When the existing building stock is analyzed in terms of thermal and energy performance, it is evident that the majority of them need to be improved. For this reason, thermal and energy performance should be taken into consideration during the design phase of buildings, and energy-efficient retrofits should be made in existing buildings. The main reason for this is the aim of providing optimum indoor user comfort and minimizing environmental problems [43]. In this context, responsive facades developed to provide energy efficiency and optimum

user comfort can adapt to physical environmental conditions through the kinetics of the facade. In this way, this facade system can effectively prevent thermal discomfort in the interior. There are studies examining the thermal comfort of responsive facades in the literature. In 2013, Jang aimed to present a responsive facade design proposal using sensors and actuators in his study in Seoul. The study creates an energy model in Rhino/Grasshopper to achieve the goal. The study results emphasize that through a collaborative design system, design feasibility and decision-making processes can be accelerated [44]. A study in Italy in 2014 aimed to develop advanced integrated façades (AIF), a concept of responsive building elements, and improve thermal performance by creating a façade module. The study includes energy modeling and simulations of an actual building. As a result, in the proposed façade module, the u value is 0.08 W/m2K in the opaque part and 0.6 W/m2K in the transparent part [45].

It is known that the climatic suitability of responsive facades is high thanks to the movements and reactions in their structure. In 2018, Prieto investigated the energy performance of commercial buildings with responsive facades in hot climates. The study addressed dry and humid regions of hot temperatures. DesignBuilder and EnergyPlus have modeled and energy-simulated commercial buildings in Delft. While the average cooling demand in hot, dry climates is 22-50%, simulations show that commercial buildings with responsive facades require 26-33% energy for cooling. While the average cooling demand in hot and humid climates is between 12%-33%, simulations show that the cooling energy requirement of responsive facades is between 2-22% [46]. In Yoon's study in Seoul in 2019, he aimed to propose a responsive facade model using active and dynamic facade systems using Shape Memory Polymers (SMP) to develop temperature-sensitive facade elements. The study aims to improve energy efficiency with the use of SMP. SMPs can change shape within a specific temperature range and can optimize the energy balance in the interior space according to the temperature change in the building facade. For example, when the temperature increases, SMPs expand and provide more shade area. This prevents the indoor cooling load from increasing. Likewise, when the temperature decreases, its volume decreases, allowing more daylight to enter the interior. Yoon performed a simulation using Cubicreator, a plug-in of Grasshopper. The results of the simulation showed that the proposed SMP material reaction façade has a solar radiation level between 258.77 - 517.54 kWh/m², which is lower than the existing situation. In addition, since SMPs do not require mechanical assembly, it is stated that the maintenance cost is very low and that they can maintain energy performance in the long term [47]. In 2022, Shahrzad aimed to increase energy performance by integrating phase change materials into responsive facades. In this context, he aimed to incorporate a phase change material called MICRO-V, a temperature-sensitive material, into the responsive facade using the optimization method. In this context, the study used the COMSOL Multiphysics program in optimization. The results of the survey show that controlling the climate using phase change materials causes an average increase of 3 ◦C in air temperature during winter months and decreases the extreme temperature by 5 ◦C during extremely hot summer periods [48].

Responsive facades can be applied to traditional facades and different facade systems. In the literature, there is research on different facade systems where responsive facades are applied. Aruta aims to integrate a responsive facade to improve the energy performance of an office building with a DSF system in 2023. Within the scope of the study, an existing office building in Naples is considered. DesignBuilder created the energy model of the office building. EnergyPlus simulated the obtained model. The study results show that the proposed models' heating load is reduced by 17.8% to 37%, and 20% of the primary energy is saved [49]. Table 1 shows the studies on responsive facades.

4.2. Daylight Performance of Responsive Facades

The design goal of Responsive Facades is to improve the interior visual and thermal comfort. Figure 3 shows the daylight penetration into the interior of a building with a responsive facade. There are studies in the literature investigating the daylight performance of responsive facades. In 2018, Valitabar aimed to

investigate the visual performance of responsive facades. In this context, it used Ladybug, the Grasshopper plugin. Ladybug simulates the daylight of the model created in Grasshopper. The results of the study show that responsive facades can provide better visual comfort conditions indoors than traditional facades [50]. In addition, another study conducted in 2018 draws attention to the shading element used in this facade system. Matin, who investigated the effect of interior visual performance on educational performance in buildings with responsive facades, created an experiment process involving students in his study. Matin parametrically designed the academic space and responsive facade in Rhino/Grasshopper and investigated the effects of design variables on visual performance. The study also aims to create optimum visual comfort conditions by considering different space occupancy rates. The study performed daylight simulations in Ladybug and Honeybee plugins of Grasshopper. The study results show that using angled shading elements in a responsive facade will increase the visual performance by 5 - 20% compared to no shading elements. With this result, the study emphasizes the importance of shading elements in providing daylight performance in responsive facades [51].

In Kim's study, he aimed to solve the geometric flexibility problem of rigid body kinetic building facades, which is disadvantageous in free-form architecture. He considered daylight and thermal criteria (UDI, DA, 0C) in his modeling. Within the scope of the study, models were produced with a 3D printer to achieve the goal. The resulting recommendations obtained the thermomechanical response of SMA activation, the stretchable fabric shell's stretchable morphology, and the maximum aperture area ratio of ~20% [52]. Chuan aimed to investigate the daylight factor (DF) of 3 different sun-sensitive façade models reflecting Siamese culture. Daylight simulation was used as a method in the study. Velux simulates daylight. According to the results obtained, the DF value varies between 1.0 and 3.5 in all models, and the religion-inspired pattern exhibits the best result among these models [53].

Studies on daylight optimization in responsive facades are also available in the literature. In 2022, Heidari aimed to optimize lighting in buildings with responsive facades. In this context, he used Rhino/Grasshopper and DIVA programs. The study states that louvers significantly increase indoor lighting in buildings with responsive facades in all possible scenarios [54]. Kahramanoglu also aimed to design a responsive facade model with origami principles to improve visual comfort in the interior space. Within the scope of the study, he used the optimization method to achieve the goal. The Kangaroo plugin carries out the simulation and optimization process. As a result of the study, it was found that the daylight performance of the proposed origami-based responsive facade is better than the current situation [55].

There are three historic squares in the city. The first is called Al-Armoutia, which still exists today and is bordered by Sibats. The inhabitants of the city continue to use it for popular events and gatherings. The second square is known as the Tanning Square, a large area surrounded by shops specializing in leather tanning. After the implementation of an organizational plan and the opening of a road at the edge of the square, most of the shops created an entrance on the road, which led to the square's neglect and the deterioration of many of its landmarks. The third square is called the Old Market Square. This square was also affected by the organizational plan; however, a corner of it remains, still surrounded by the old shops today.

Figure 3. Daylight penetration into the interior of a building with a responsive facade [56].

Toodekharman worked on visual performance in hospitals in Tehran in 2023. In his study, it is aimed to optimize visual performance in patient rooms by using a responsive facade system in hospitals. Rhino/Grasshopper created the hospital's parametric model. HoneybeePlus performed a daylight simulation of the obtained parametric model. In the study, ASE, sDA, DGI, and DGP from daylight metrics were compared. Unlike its counterparts, the study considers glare parameters (DGI and DGP). The results emphasize the importance of window/wall ratio in indoor daylight performance. It was found that the façade proposal of a hospital with a responsive facade in Tehran with a window/wall ratio of 60% showed the best result [57].

Sommese dealt with biomimicry in his study. Gazania flower develops completely when it receives sunlight. While the flower remains closed in the shade, it opens when it sees the sun. Within the scope of the study, Sommese aims to propose a light-responsive kinetic facade based on the functional principles of the Gazania flower. Rhino/Grasshopper creates the parametric model. Honeybee and Ladybug perform daylight simulations of the obtained parametric model. Since shadow areas and glare are effective in the opening and closing of the Gazania flower, the DGP metric is also considered in the study. As a result of parametric simulations, in an office building in a temperate Mediterranean climate, the biometric kinetic system can provide daylight to 87.5 to 100% of the office place [58].

Table 1. Studies about responsive facades

Year of Study	Region/ Period	Latitude	Analysis /Parameter	Examined system	Aim	Method	Tool	Type of Building	Main Findings & Results
2012, [59]	Philadelphia, ABD	40^0 (N)	-	Responsive facade	Adapting the movement in cell biology to architecture.	Simulation	Rhino/ Grasshopper	Modern Buildings	Although they require high construction costs, material procurement challenges and skilled labor, complex facades have performance-based advantages.
2013, [44]	Seoul, South Korea	37^0 (N)	^{0}C	Responsive facade	To present a responsive facade design proposal with the use of sensors and actuators.	Prototyping Simulation	Facade model Rhino /Grasshopper Firefly	Modern Buildings	Through a collaborative design system, the feasibility of the design and the decision-making process can be accelerated.
2014, [45]	Torino, Italy	45^0 (N)	^{0}C	Responsive facade	To develop advanced integrated façades (AIFs), a concept of responsive building elements, and propose a façade module.	Prototyping	Model	Modern Buildings	In the proposed façade module, the u value is 0.08 W/m2K in the opaque part and 0.6 W/m2K in the transparent part.
2015, [60]	Sheffield, UK	53^0 (N)	-	Responsive facade	To compare changing environmental characteristics with responsiveness to changes in user needs and activities.	Literature Review	-	Modern Buildings	Architectural components suitable for environmental and user changes should be used in buildings. Architects should take these changes into consideration during the design phase.
2015, [61]	Torino, Italy	45^0 (N)	KWh/ m2	Responsive facade	Analyzing the orientations and thicknesses of chambers with PCM and aerogel layer-filled glass.	Simulation	Rhino/ Grasshopper DIVA	Modern Buildings	EDgl observed a reduction in energy consumption in the range of -39% to -46% compared to the Responsive Building Elements single glazing developed in the study.
2016, [62]	Cambridge, UK	52^0 (N)	W/m^2 K	Responsive facade (MFM system)	Evaluate the building performance of multifunctional façade modules with measurements.	Measurement	TWINS test cell system	Modern Buildings	As a result of the measurements, it was found that MFM systems performed very well in general.
2016, [40]	Jhongli, Taiwan	24^0 (N)	-	Responsive facade	To create a BIM based energy efficient responsive facade optimization algorithm.	Simulation	Dynamo	Modern Buildings	Digital production and sensitive sensors are required to achieve optimum performance, and this façade system can be developed with BIM-based optimization methods during the design phase.
2018, [50]	Tehran, Iran	35^0 (N)	Lx	Responsive facade	To compare sensitive facades aesthetically.	Simulation	Rhino/ Grasshopper Ladybug	Modern Buildings	Responsive facades can provide better visual comfort conditions indoors.
2018, [46]	Delft, Netherlands	52^0 (N)	kWh/ m2 year	Responsive facade	To investigate the passive cooling performance of commercial buildings located in hot climate zones.	Simulation	DesignBuilder EnergyPlus	Commercial Buildings	While the average cooling demand in hot dry climates is between 22%-50% in the current situation, these values were obtained between 26%-33% in the simulations. In hot humid climates, while the average cooling demand is between 12%-33% in the current situation, these values are between 2%-22% in simulations.
2018, [51]	Ypsilanti, USA	42^0 (N)	UDI	Responsive facade	To investigate the effect of shading elements on daylight performance in buildings with responsive facades.	Simulation	Rhino/ Grasshopper Ladybug	Educational Buildings	Responsive facades with shading elements have 5-20% better daylight performance than those without.

2019, [47]	Seoul, South Korea	37^0 (N)	^{0}C	Shape memory polymer	To propose a responsive façade model suitable for the Seoul climate using active and dynamic façade systems.	Prototyping Simulation	3D printer Rhino/ Grasshopper Cubicreator	Modern Buildings	The resulting responsive façade proposal with SMP material has a solar radiation level between 258.77 and 517.54 kWh/m², which is lower than the current situation.
2019, [63]	Tabriz, Iran	38^0 (N)	^{0}C	Responsive kinetic facade	Proposing a kinetic façade using moving components.	Simulation	Ecotec	Educational Buildings	In the study, it is stated that the curtain wall system proposed for educational buildings will address the changing needs of users and will be sustainable.
2020, [41]	Ypsilanti, USA	42^0 (N)	-	Responsive facade	To examine the development of responsive facade systems chronologically.	Literature Review	-	Modern Buildings	It is concluded that art, technological developments and economic factors are influential in the development of responsive facades. The chronological chart can be used to predict the evolution of responsive façades in the future.
2021, [64]	Toronto, Canada	43^0 (N)	^{0}C	Climate responsive facades (CRFs).	Develop a preliminary design tool for creating CRFs.	Design Method	Technology screening	Modern Buildings	The responsive façade for Toronto's climate is provided by a transparent and opaque module designed on a Trombe wall containing a ventilated cavity.
2021, [65]	Naples, Italy	40^0 (N)	-	Double skin and Responsive facade	To compile studies that reduce energy losses from the building envelope with double skin and responsive façade systems.	Literature Review	-	Modern Buildings	Ecological and future-oriented designs can be made through renovations to the building stock.
2021, [66]	Lahore, Pakistan	31^0 (N)	-	Responsive facade/kineti c jali	To emphasize the importance of jali/screens by using parametric methods to obtain new facade designs.	Literature Review	-	Modern Buildings	Kinetic sensitive jali designs can be made using parametric design methods.
2022, [42]	Ypsilanti, USA	42^0 (N)	-	Responsive facade	To examine responsive facade system technology and to examine existing facade examples.	Literature Review	-	Modern Buildings	Responsive façade technologies are divided into five classes: mechanical, electromechanical, passive, information and advanced materials. The advantages and disadvantages of these technologies are discussed.
2022, [54]	Ypsilanti, USA	42^0 (N)	UDI Lx	Responsive facade	Optimising lighting in buildings with responsive facades.	Optimisation	Rhino/ Grasshopper DIVA	Modern Buildings	It was found that in buildings with responsive facades, louvers significantly increase indoor illumination in all possible scenarios.
2022, [67]	Cairo, Egypt	30^0 (N)	^{0}C	Responsive facade	To propose a responsive façade model to improve building facades in Egypt by considering the rules of building physics.	Simulation	Rhino Envi-met Climate Consultant	Garage Building	The negative effects of the built environment can be minimised with a responsive façade system designed with a good understanding of the rules of building physics.
2022, [68]	Tehran, Iran	35^0 (N)	^{0}C kWh	Microalgae bioreactive facade	To propose a model that reduces solar radiation in the building by developing a microalgae bioreactive façade and keeps the user thermal needs at an optimum level.	Experiment Simulation	EnergyPlus Rhino/ Grasshopper Honeybee	Modern Buildings	The daylight transmittance of the façade remains mostly constant, as microalgae cultures usually remain constant throughout the day. This makes it easier to control indoor thermal comfort.
2022, [48]	Toronto, Canada	43^0 (N)	^{0}C	Responsive facade	Optimisation of the multifunctional integrated climate-sensitive opaque and ventilated dynamic	Optimisation	COMSOL Multiphysics	Modern Buildings	Controlling the climate using phase change materials resulted in an average increase in air temperature of 3°C during the winter

					façade called MICRO-V.				months and a reduction in extreme temperatures of 5°C during extremely hot summer periods.
2023, [55]	Kocaeli,Turkey	41^0 (N)	UDI	Responsive facade	To increase the visual comfort of the interior, design a responsive façade model using origami principles.	Optimisation	Rhino/ Grasshopper Kangaroo	Office Buildings	The daylight performance of the proposed origami-based responsive façade is found to be better than the current situation.
2023, [52]	Gyeonggi, South Korea	37^0 (N)	UDI DA ^{0}C	Responsive facade	Solution to the problem of geometric flexibility of rigid body kinetic building facades, which is a disadvantage in free-form architecture.	Prototyping	3D printer	Modern Buildings	In the proposals, the thermomechanical response of SMA activation achieved the stretchable morphology of the stretchable fabric skin and a maximum opening area ratio of ~20%.
2023, [49]	Naples, Italy	40^0 (N)	^{0}C kWh	Responsive double skin facade	To propose a dynamic double skin façade for an existing office building in a Mediterranean climate.	Simulation	DesignBuilder EnergyPlus	Office Buildings	The heating load of the proposed models ranges from -17.8% to -37% and the cooling load from 9% to -3%. In the best proposal, savings of 20% of primary energy are achieved.
2023, [53]	Penang, Malaysia	5^0 (N)	UDI	Solar responsive facade	To investigate the daylight factor (DF) of 3 different solar responsive façade models reflecting Siamese culture.	Simulation	VELUX	Modern Buildings	According to the results obtained, the DF value varies between 1.0 and 3.5 in all models and it is seen that the religion-inspired pattern exhibits the best result among these models.
2023, [57]	Tehran, Iran	35^0 (N)	ASE sDA DGI DGP	Responsive facade	Improving visual performance in the standard patient room with a responsive facade.	Simulation	Rhino/ Grasshopper HoneybeePlus	Hospital Buildings	Window/wall ratio is very important in indoor daylight performance. In the study, the façade proposal with a window/wall ratio of 60% showed the best result.
2023, [69]	Izmir, Turkey	38^0 (N)	UDI ASE	Responsive facade	Propose responsive facade systems with semi-regular and demi-regular tessellations.	Simulation	Rhino/ Grasshopper ClimateStudio	Modern Buildings	Semi-regular and demi-regular tessellations provide optimum daylight comfort in all proposed facade models.
2023, [70]	Lisboa, Portugal	38^0 (N)	^{0}C K W/m^2	Responsive facade	Developing a climate-appropriate building envelope pre-design tool.	Auto-responsive technologies (ARTs) Simulation	Climate consultant	Modern Buildings	In cold climates, thermal adaptive strategies showed short-term suitability. In the equatorial region, thermal adaptive systems showed high suitability as air temperatures increase in the future.
2024, [58]	Naples, Italy	40^0 (N)	sDA UDI EUDI DGP	Responsive facade	To propose a light-sensitive kinetic facade based on the functional principles of the Gazania flower.	Simulation	Rhino/ Grasshopper Honeybee Ladybug	Office Buildings	As a result of parametric simulations, in an office building in a temperate Mediterranean climate, the biometric kinetic system can provide daylight to between 87.5% and 100% of the office space.
2024, [71]	Tehran, Iran	35^0 (N)	UDI ASE sDA DGP	Responsive facade	Investigation of the integration of an adaptive facade and an inclined wall for efficiency improvement.	Simulation	Rhino/ Grasshopper Ladybug	Modern Buildings	The integrated system effectively distributes daylight. It shows that the façade system reduces glare to 34% in Mogadishu and 29% in Tehran.

5. DISCUSSION

The reviewed studies are divided into four groups: "Responsive Facades in Literature", "Thermal Performance of Responsive Facades", "Daylight Performance of Responsive Facades", and "Thermal and Daylight Performance of Responsive Facades" according to their main research areas (Figure 4). 8 studies are literature reviews of the research on responsive facades. While 13 studies examine the thermal

performance of responsive facades, five studies examine the daylight performance of this facade system. Only 1 of the reviewed studies examines both the thermal and daylight performance of responsive facades.

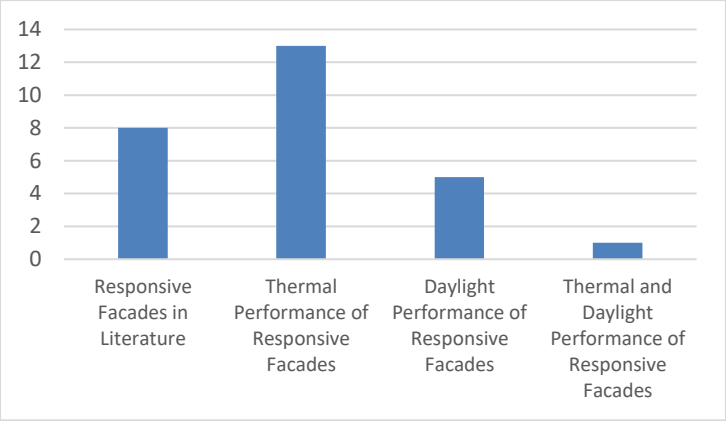

Figure 4. Classification of the analysed studies according to the subjects (Prepared by the author).

Figure 5 shows the tools used to achieve the goal in the studies analysed. The most used program in simulation and optimisation algorithms is Rhino/Grasshopper. 13 studies use the Rhino/Grasshopper program. Honeybee&Ladybug, Kangaroo plugins integrated into Rhino/Grasshopper design and energy simulations. Five studies used Honeybee&Ladybug and 1 study used the Kangaroo plugin. In 3 different studies, Climate Consultant and Climate Studio programs were used to compare thermal comfort criteria.

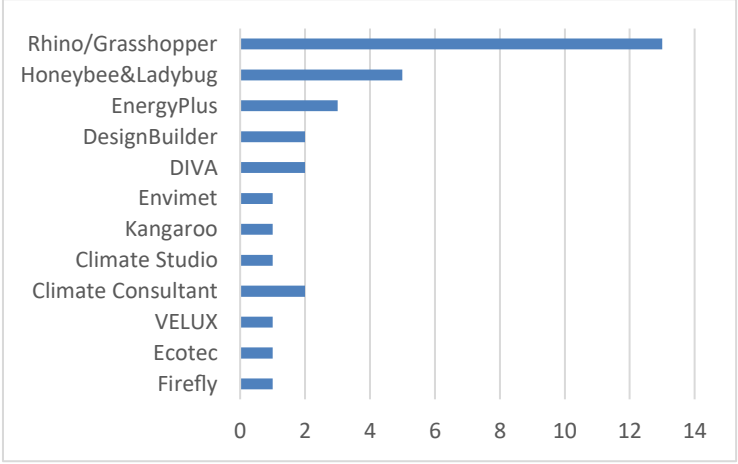

Figure 5. Tools used in the studies (Prepared by the author)

6. CONCLUSION

The effects of the building envelope on user comfort are undeniable. The design and characteristics of the façade, which forms the boundary between the interior and exterior, directly affect the thermal and daylight performance of the interior. Parameters such as window/wall ratio, properties of the materials used on the facade, and orientation have an impact on the physical conditions of the building. The main problem is to get the desired amount of daylight and heat indoors. If daylight is less than sufficient, artificial lighting elements are needed. If the daylight is more than required, it causes glare and vision problems. The transfer of heat from indoors to outdoors during the heating period increases the energy needed for heating, while the transfer of heat to indoors during the cooling period increases the energy required for cooling.

Environmental conditions and user needs are not static. Designers have developed responsive facades that allow the facade to move according to changing environmental conditions and user needs. This façade system provides optimum intake of daylight and heat into the interior and minimizes air leakage. In this way, both user comfort and energy efficiency are increased. Studies in the literature show that energy consumption in buildings with responsive facades is less than traditional facades [61].

Today, the Rhino/Grasshopper program creates parametric-based 3D models. These models allow different design proposals for responsive facades to be easily created and different simulations can be made. Optimization studies enable us to obtain models that achieve the best results of the goals set over millions of other alternatives. Considering climate change and global warming, it is thought that the energy consumption of the designs made today may increase in the coming years due to increasing air temperatures. For this reason, this study indicates that researchers working on responsive facades should consider future weather scenarios.

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MUSTAFA SERHAN UNLUTURK, Lecturer**,**
In 2018, he completed his undergraduate education at Balıkesir University, Faculty of Architecture, Department of Architecture. In 2020, he completed his master's degree in 'building envelope airtightness', one of the parameters affecting energy efficiency in buildings. Since 2020, he has been working as a Lecturer at Balıkesir University. His studies are mostly on building energy optimization, facade systems, daylighting and thermal performance.

Research Article

DESIGN ELEMENTS FOR VISITOR CENTERS IN HERITAGE AREAS: GALLIPOLI HISTORICAL AREA

Yaşar Dilek ERBEY
Istanbul, Türkiye
Mimar Sinan Fine Arts University, Faculty of Architecture*, Istanbul, Türkiye*
Department of Urban and Regional Planning
yasar.dilek.erbey@msgsu.edu.tr
https://orcid.org/ 0000-0001-9897-2403
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Abstract:*Balancing the goal of attracting more visitors to historic sites with the need to protect the historical areas under sustainability principles is crucial. Key questions are: "What factors influence the visitor experience?" and "How can the visitor experience be enhanced?" The visitor experience encompasses the interactions a visitor has with a site, event, or service, along with the emotional, cognitive, and physical responses to these interactions. This experience affects visitor satisfaction, loyalty, and overall perception, covering the entire journey from arrival to departure. Design strategies for visitor centers should consider both landscape and architectural aspects, offering multifunctional and innovative activities. The aim of this study is to establish a general framework for the design principles of visitor centers in historical areas, by examining the design elements in order to meet the needs of the tourism industry, local communities, cultural groups, and visitors. In line with the aim of the study, only examples of visitor centers located in historical areas were examined. The examinations were conducted through the official websites of the visitor centers. A literature review identified these characteristics, which were analyzed based on parameters such as Landscape, Architectural Formation, Functional Diversity, Accessibility and Security, Interactive and Technological Facilities, and Originality. The findings have led to the development of an original evaluation and approach, specifically tailored for the Gallipoli Historic Site. It has been concluded that these centers should be included in visitor management plans and planned with local participation, allowing community-oriented interpretation from upper-scale to lower-scale design projects.*

Keywords: *Gallipoli Historical Site, Heritage Areas, Visitor Centers, Visitor Management.*

Kültürel Miras Alanlarında Ziyaretçi Merkezleri İçin Tasarım Öğeleri: Gelibolu Tarihi Alanı

Özet: *Tarihi alanlara ziyaretçi çekme hedefi ile bu alanları sürdürülebilirlik ilkeleri çerçevesinde koruma gereği arasındaki dengeyi sağlamak planlama ve tasarım alanlarının önemli bir çalışma konusu haline gelmiştir. Turizme konu olan tarihi alanlar için en temel konulardan biri alanın hassas değerlerinin korunmasının yanı sıra, ziyaretçi deneyiminin iyileştirilmesidir. Ziyaretçi deneyimi, bir ziyaretçinin bir yer, etkinlik veya hizmetle olan etkileşimlerini ve bu etkileşimlerden doğan duygusal, bilişsel ve fiziksel tepkilerini kapsar. Bu deneyim, ziyaretçi memnuniyetini, sadakatini ve genel algısını etkiler ve ziyaretçinin varışından ayrılışına kadar olan süreci kapsar. Ziyaretçi merkezleri için tasarım stratejileri hem peyzaj hem de mimari yönleri dikkate alırken, çok işlevli ve yenilikçi işlevleri de sunmayı gerektirir. Bu çalışmanın amacı, örnek olarak belirlenen ziyaretçi merkezlerinin tasarım unsurlarını irdeleyerek, turizm endüstrisinin, yerel toplulukların, kültürel grupların ve ziyaretçilerin ihtiyaçlarını karşılamaya yönelik olarak, tarihi alanlardaki ziyaretçi merkezlerinin tasarım ilkeleri için genel bir çerçeve oluşturmaktır. Çalışmanın amacı doğrultusunda belirlenen ziyaretçi merkezi örnekleri, Peyzaj, Mimari Oluşum, İşlevsel Çeşitlilik, Erişilebilirlik ve Güvenlik, Etkileşimli ve Teknolojik Tesisler ve Özgünlük gibi parametreler temelinde analiz edilmiştir. Analizlerden elde edilen genel tasarım ve planlama ilkelerinden yola çıkılarak, Gelibolu Tarihi Alanı ziyaretçi merkezlerine yönelik özgün bir yaklaşımın geliştirilmesi amacıyla değerlendirme yapılmıştır. Bu değerlendirmeler, Mimari Tasarım İlkeleri, Tarihsel Bilgilendirme ve Referanslar, Eğitim ve Etkinlik Alanları, Dinlenme ve Sosyal Alanlar, Bilgilendirme ve Rehberlik ve Güvenlik ve Acil Durum Planlaması başlıkları altında gerçekleştirilmiştir. Bu merkezlerin ziyaretçi yönetim planları bünyesinde ele alınmasının ve üst ölçekli planlardan alt ölçekli tasarım projelerine kadar topluluk odaklı – yorumlamaya izin veren, yerel katılımla planlanmasının gerekli olduğu sonucuna ulaşılmıştır.*

Anahtar kelimeler: *Gelibolu Tarihi Alanı, Kültürel Miras Alanları, Ziyaretçi Merkezleri, Ziyaretçi Yönetimi.*

1.INTRODUCTION

It is important to address the balance between increasing the interest and number of visitors to historic sites, protecting these sites within the context of sustainability principles, and formulating design approaches in these areas in line with these principles. “What factors affect the visitor experience?” and “How can the visitor experience be improved?” are essential questions to find answers to. Visitor experience is the combination of a visitor's interactions with a place, event, or service and the emotional, cognitive, and physical reactions resulting from these interactions. The visitor experience includes a variety of elements that affect visitor satisfaction, loyalty, and overall perception. This experience covers the entire visiting process from the visitor’s arrival at the site and their interactions to their departure.

Design approaches determined to shape visitor centers in terms of landscape and architecture should also provide multiple functions and innovative activities. This study aimed to identify a general framework for visitor centers’ design elements. This general framework will help to ensure that it meets the needs of the tourism industry, local communities, and cultural groups as well as visitors.

The general characteristics of visitor centers in historical areas were examined within the scope of this study. Based on the literature review, these characteristics were investigated in terms of the parameters of Landscape, Architectural Formation, Functional Diversity, Accessibility and Security, Interactive and Technological Facilities, and Originality. As a result of the examinations, an original evaluation and approach have been developed within the framework of the Gallipoli Historic Site and Management Plan.

2. METHOD

Several models have been developed to measure visitor experience and satisfaction [1]. The quantitative and qualitative data obtained using these models provide further data to develop methods for projects and applications in the field. The SERVQUAL model is a model developed to evaluate and measure service quality. This was first proposed by Zeithaml, and Berry in 1985 and later developed. [2] The model considers the quality of service in five basic dimensions (reliability, responsiveness, assurance, empathy, and tangibles) and measures service performance accordingly (Table. 1). This model is used to understand visitors’ perceptions and expectations of service quality by measuring the difference between visitors’ expectations and actual service performance. The model helps to identify areas for improvement to enhance service quality.

Table 1. Service Quality Dimensions of the SERVQUAL Model (Improved by Author)

Principles:	**Service Quality:**
Reliability	The capacity to perform the promised service dependably and accurately
Responsiveness	The ability to help customers and provide prompt service
Assurance	The knowledge and courtesy of employees and their ability to convey trust and confidence
Empathy	The provision of caring, individualized attention to customer
Tangibles	The appearance of physical facilities, equipment, personnel, and communication materials

The Experience Economy Model proposed by Pine and Gilmore (1998) classifies experiences into four categories: entertainment, education, aesthetics, and escapism. [3] It evaluates how visitor experiences can be optimized based on these dimensions. For example, museums and exhibitions can enhance the educational dimension, and landscape and architectural elements can enhance the aesthetic dimension.The Visitor Experience Model (VEM) handles the visitor experience as a combination of the visitor's personal motivations, expectations, and interactions with the place. VEM is used to understand visitors' expectations and motivations and to shape their experience accordingly [4].

3.RESULTS

The visitor center's design process and the criteria for effective success in this context are complex. To ensure these centers are built within the framework of a regional vision, brand, and location, they should also be a part of a comprehensive, collaborative, and inter-agency strategy. Additionally, managing visitor capacity is a fundamental necessity of visitor center design principles.

The term carrying capacity can be broadly defined as the limit to which an object, a living thing, or an environment can withstand, endure, or tolerate something while keeping its functionality or characteristics. In general, recreational carrying capacity can be examined under four categories: physical capacity, social capacity, ecological capacity, and management capacity. Serious deterioration emerges in the recreational resource, and the quality of the recreational experience decreases as a result of the intensive recreational demands in national parks and other protected areas, and this threat is constantly increasing. In this context, ensuring the idea of conservation-utilization and sustainability adopted in the management of protected areas can be achieved by determining and implementing a bearing capacity analysis-based visitor model.

Landscape

Examples of visitor centers designed and implemented in historical sites include large areas that were often the place of wars and other historical events, and their natural qualities are as important as their historical values. For these reasons, this study has evaluated the relationship between these visitor centers and the landscapes in which they are located. As can be seen in the examples, historical sites include large plains, mountains, and forested and coastal areas that have become national parks. The preservation of the natural landscape in which historical sites are located is critical to preserving the authenticity and natural beauty of these areas. Existing trees, vegetation, and natural topography should be preserved as much as possible when building visitor centers. Structures should be established so as not to disrupt the natural characteristics of the landscape, and sustainability should be at the forefront of landscape design. The use of local plant species, water-saving systems, and energy-efficient design elements is an environmentally sensitive approach. On the other hand, as part of the landscape, educational spaces and programs, including historical and environmental awareness provided to visitors, can draw their attention to both historical values and environmental sustainability [5]. The first example identified for evaluation in relation to landscape values is the Thy National Park Visitor Center in Denmark. This center provides visitors with an experience of being a part of the area as it was designed in harmony with the landscape of the natural park. This natural park has an area of 244km^2 and the visitor center structure is built on an area of 710m^2. The structure provides an example for visitors to get to know the area. Designing the visitor center as a whole within the features of the area is important for a positive first impression. It is an example that aims to use landscape elements as much as possible and to provide visitors with a space for mobility when entering and leaving the site, which makes it considered a good example for visitors.[6]

Figure 1. The Thy National Park Visitor Center [7]

The second example is the Zonguldak Caves Visitor Center in the Black Sea Region of Turkey. This center displays the unique geography of the area's caves and characteristic formations. This network of caves spread across the city offers many travel routes for local and foreign tourists, adventurers, and explorers. [8] The visitor center was built at the entrance of Gökgöl Cave, one of the symbolic caves of Zonguldak, and hosts an average of 40,000 people annually. The Zonguldak Caves Visitor Center is located on the Zonguldak-Ankara road and was completed in 2021 with a construction area of 700 m². The Gökgöl Cave is over 3 million years old and is one of the most important sites in Zonguldak and Turkey. The visitor center stands out with its simple architecture and material choices due to its stalactite, stalagmite, and curtain formations of various colors, textures, and sizes. The visitor center is located at the entrance of the cave and provides information about the other caves in the vicinity. The narrative expressed through various infographics and panels along the axis that welcomes visitors and guides them toward the cave is supported by the relationship the building establishes with nature. This project allows the visitor to experience being in a building and in contact with nature without interrupting the visitor's contact with the environment. The building materials have also been selected with references to the geography of the building. Stones extracted from a quarry near the project area were used and combined with other selected materials with skillful craftsmanship during the construction of the building. The project includes a visitor center area with information boards, a cafeteria, a souvenir shop, a library, executive rooms, and technical spaces.

Figure 2. Zonguldak Caves Visitor Center [9]

Architectural Formation

Visitor centers should adapt to the architectural and aesthetic characteristics of the historic site. Many components, from material selection to building form, should be taken into consideration to achieve harmony, which is the basic principle of design. Depending on the approach of the designer and decision-makers, sometimes site-specific architectural solutions and sometimes modern and minimalist designs can offer functional and aesthetic solutions without harming the environment of the historic site. Landscape elements, such as information boards, walkways, seating areas, and observation points, should be planned to increase visitors' interest and inform them about the site. These elements help visitors understand more about the site and enjoy the visit. Visitor centers should be designed to serve all visitors. Facilities such as access for the disabled, areas suitable for families with children, and resting points for elderly visitors should be planned in accordance with accessibility standards. These centers should be designed to disappear into the historic area and should be integrated into the environment without attracting too much attention. Landscape elements and the building should come together in natural harmony without disrupting the historical focal point for visitors.

The Stonehenge visitor center in Wiltshire, England, is another example. The center serves approximately 2 million visitors a year. Exhibition areas are used to introduce the heritage site and provide visitors with preliminary information about the site. The cafeteria areas are designed for visitors who want to wait and rest. These areas are generally located before the toll booths, which is a positive feature in terms of accessibility. The visitor center has a minimalist and contemporary design. The main materials of the structure include glass, steel, and wood, giving it a light and transparent appearance. It is designed with environmental considerations in mind, resulting in an aesthetic that harmonizes with the natural surroundings. The building is constructed with sustainability principles in mind. Environmentally friendly technologies, such as solar panels and rainwater harvesting systems, are used to achieve energy efficiency. The visitor center is designed to be in harmony with the historical and cultural significance of Stonehenge. The structure is positioned in a way that does not detract from the natural landscape and enhances the visitor experience [10].

Figure 3. Stonehenge [11]

Another example is the Yeşilova Mound Visitor Center and Excavation House in the Bornova district of Izmir, Turkey. This center was built on a Grade 3 Archaeological Site, the land of which was previously acquired by the municipality for use for parks and gardens. The site is a mixed-functional architectural structure that includes exhibition areas, educational units, social units, the excavation house, and other

support facilities [12] This project aimed to create a building where people can come to see the visitor center, and a space where they can observe the archaeological excavation site and the finds found there. The excavation house, where scientific studies are carried out, offers a unique experience as one enters a village similar to what existed 8,500 years ago. The Yeşilova Mound Visitor Center is a unique structure with 300 visitors daily, who are guided by experts for tours and activities. It is also a living cultural center, including activities such as concerts, ceremonies, and exhibitions.

Figures 4 and 5. Yeşilova Mound Visitor Center and Excavation House [12]

Functional Diversity

Visitor centers in historic sites, aim to guide visitors, provide them with information, offer a comfortable and enhanced overall visiting experience. Their main function is to welcome visitors and serve as an information point, providing them with the necessary knowledge about the historic site through maps, brochures, boards, digital displays, or multimedia presentations, informing the visitors about the history, significance, and characteristics of the site. In addition to introducing and guiding the visited site, these spaces provide opportunities for organizing educational and cultural events. Temporary or permanent exhibitions where historical artifacts are exhibited, and stories about the site are told, places where workshops on history and culture can be held, especially for children and students, and areas that can be used for speeches, seminars, and other educational activities related to the historical site are also located within these centers, making a significant contribution to both historical sites and their immediate surroundings.

Several facilities are needed to be provided to improve the visitor experience in historic sites. Areas for visitors to rest should be equipped with seating, benches, and shaded spaces. These areas allow visitors to take short breaks and relax while visiting. Comfort meets visitors' needs and encourages them to stay longer. Restrooms and hygiene facilities should be clean and easily accessible and designed to meet basic hygiene needs, such as baby care rooms. Such facilities play a critical role in increasing visitor comfort and satisfaction. Gift shops should be places where books, souvenirs, and other products are sold. These shops allow visitors to recall their experience and leave the site with a tangible souvenir while at the same time ensuring the economic sustainability of the area. Such facilities play an important role in meeting the needs of visitors and enriching the visiting experience.

Accessibility and Safety

Ensuring accessibility and safety for a good visiting experience is the most fundamental principle of landscaping and architectural design. These principles include arrangements for visitors with disabilities, such as wheelchair-accessible ramps, elevators, and toilets, and security measures, such as first aid rooms, security personnel, and emergency plans, parking areas for easy access by visitors, and public transport connections.

Interactive and Technological Facilities

Directors of historic sites keep up with interactive and technological developments in the presentation of information and sites, and museums and visitor centers update themselves accordingly. Virtual reality and augmented reality applications offer visitors the opportunity to experience historical events or places; digital kiosks and screens where visitors can interactively receive information and mobile applications that provide maps and guidance services, where visitors can access information on their own devices, are becoming increasingly common. The effective use of community and social spaces in visitor centers at historic sites is critical to preserving and promoting the site and improving the visitor experience. These spaces and programs contribute to keeping the historical heritage alive and passing it down to future generations. Located approximately two kilometers from the archaeological site, the Mount Nemrut Visitor Center opened in 2012. Visitors, who were previously welcomed in a closed area of approximately 20 m^2, were now welcomed in the new 4.000 m^2-center. Tourists are given preliminary information using films and visuals terrace and viewing area of 1500 m^2. [13]

Figures 6, 7. Mount Nemrut [13]

Authenticity

Each historic site has its own unique spatial, natural, and cultural characteristics. Visitors want to feel the authenticity of the site as they follow the traces of the past from the point of entrance. A site's authenticity refers to its preservation and intact of its historical, cultural, or natural values. Authenticity is a fundamental criterion for the recognition and protection of a site as a world heritage site.

Authenticity in the design of visitor centers ensures that a center is unique in terms of both function and aesthetics. The use of natural and local materials of the region increases the authenticity of the design. Wood, stone, or vegetation indigenous to the region can be given as examples of this. Cultural references and the integration of local arts, crafts, and architectural elements strengthen the visitor center's connection to the site. Authenticity in the design of visitor centers can be achieved by drawing inspiration from local identity and culture, using environmentally sensitive and innovative solutions, providing engaging visitor

experiences, and focusing on artistic aesthetic values. The combination of these elements results in unique and memorable spaces.

The main objective of the Cabañeros National Park Visitor Center and Interactive Museum in Spain is to promote ecotourism in the populations forming the park's environment through information, exhibitions, research, and care of the fundamental values of its natural area. The center, which receives about 75,000 visitors a year, has an interactive museum. The design prioritized the protection of the building from the sun's rays by avoiding expenses for air conditioning during the hot months. Passive measures such as the partitioning of volumes, the orientation of the buildings, the use of underground land as thermal insulation, and the inclusion of natural light graded in the exhibition, the use of electric heat pumps and not releasing polluting gases into the atmosphere have contributed to the energy efficiency of the building. [14]

Figure 8. Cabaneros[14]

At the Gettysburg National Military Museum and Visitor Center in Pennsylvania, USA, battle scenes are projected on a large cyclorama screen, allowing visitors to feel as if they are on the battlefield. A Cyclorama is a panoramic image on the inside of a cylindrical platform and also a building designed to show a panoramic image. It is used in cinemas, theaters, and exhibition areas to describe an entire scene without interruption. The museum houses a vast collection of artifacts from the Battle of Gettysburg, providing visitors with a tangible connection to the past. These include weapons, uniforms, personal items, and other relics from the Civil War era. The museum and visitor center provide a range of educational programs, including lectures, reenactments, and guided tours led by knowledgeable historians and park rangers. The visitor center includes a research library and archives containing primary source documents, photographs, and other materials related to the Battle of Gettysburg and the Civil War. The visitor center includes a research library and archives containing primary source documents, photographs, and other materials related to the Battle of Gettysburg and the Civil War. These resources are invaluable for researchers and historians seeking to study and interpret the battle in greater depth. [15]

Figure 9. Cyclorama at the Gettysburg National Military Museum [15]

4. DISCUSSION

After examining the general characteristics of visitor centers in historical sites, a unique evaluation and approach was developed within the Management Plan of the Gallipoli Historical Site in the scope of the study. The Gallipoli Historic Site is a place that welcomes 3.5 million visitors annually. A visitor management plan has been developed to ensure the sustainability of its natural and historical values and to ensure that visitors have a high-quality visiting experience. The scope of the plan aimed to determine the locations, functions, and design principles of the visitor centers within the historic site [16]. The Site Management Plan, which sets out the principles and road map for managing the historic site holistically, preserving and transferring heritage values to future generations, and transforming the site into an open-air museum, has been prepared by the Gallipoli Historic Site Presidency pursuant to the Article 3, paragraph (ğ) of the Law No. 6546 on Certain Arrangements Regarding the Dardanelle Wars Gallipoli Historic Site stipulates that "The procedures for the preparation, renewal, and amendment of all types and scales of plans of the Historic Site shall be carried out by the Presidency and shall enter into force upon the approval of the Ministry".

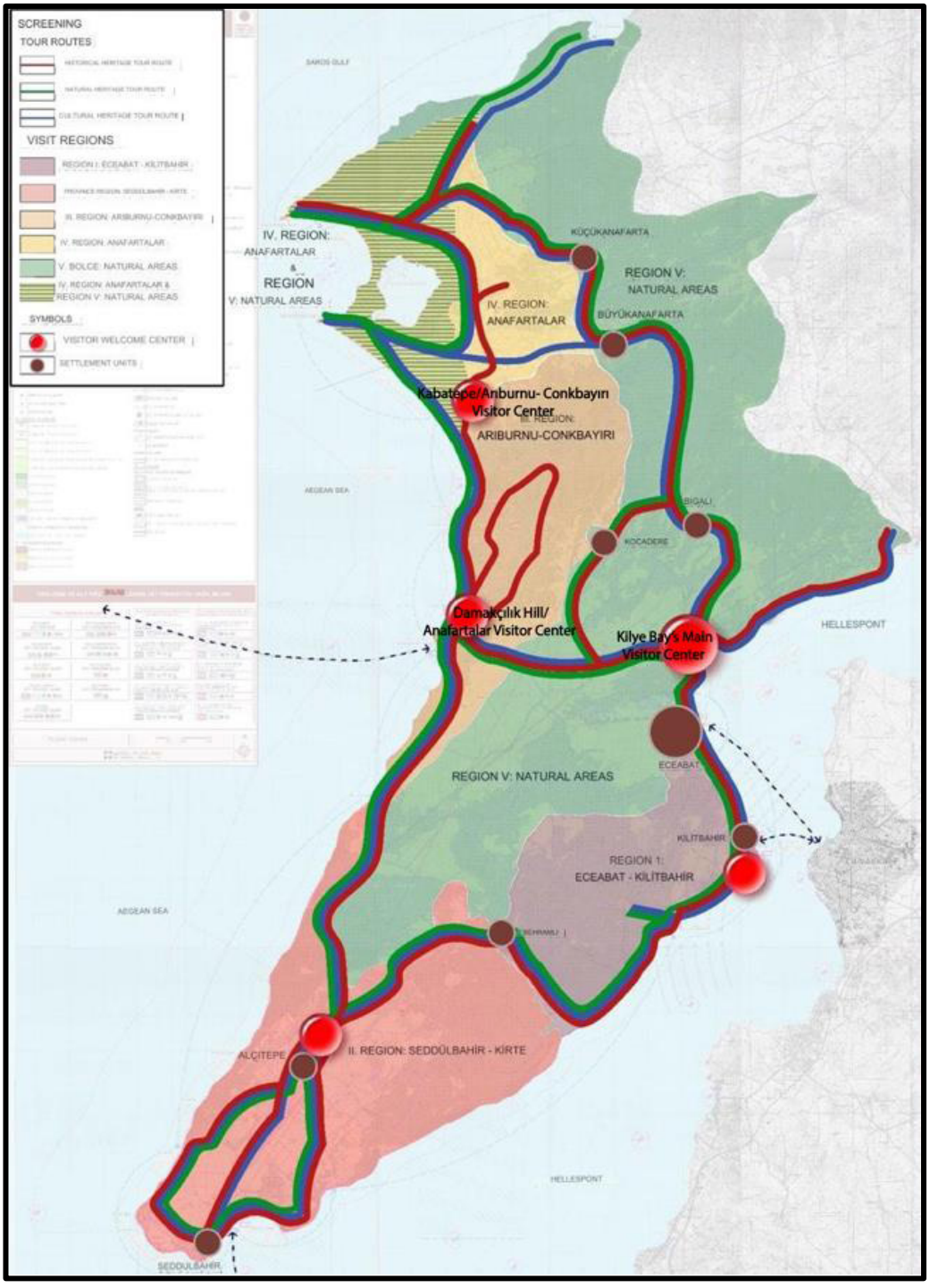

Figure 10. Visitor Centers in the Gallipoli Area Management Plan [16]

The management plan approved in 2023 shows that visitor centers are considered a component of tourism planning:
"In line with this approach, the role of the visitor centers has been determined as to manage visitor mobility ***based on the sustainable tourism principles of the Gallipoli Historical Area Management Plan Visitor Management Main Framework*** *and to ensure that site visitors experience a well-designed conservation area with attraction centers and focus areas without speculating."* [16].
Accordingly, the following four main principles have been identified:

- compliance with sustainable tourism principles,
- observing the bearing capacity,
- developing the right visitor management strategies by considering the number of visitors,
- informing and guiding visitors

The historical site's management plan aimed for the establishment of five different visitor centers and prioritized the construction of three visitor centers in different locations. These centers are described in detail below.

The Kilye Bay's Main Visitor Center:
Kilye Bay, the main introduction and visitor center in Gallipoli, is the starting point of three main visiting routes that were primarily planned. These are historic, natural, and cultural heritage tour routes proposed for the Kilye Bay Visitor Center. The first is a historic heritage tour route that covers the three land battlefields, naval battlefields, and support service areas. The second proposed route, the natural heritage tour route, includes the villages of Bigalı, Büyükanafarta, and Küçükanafarta, forests and wooded areas surrounding these villages, Ece Harbor, Suvla Bay, Salt Lake, Büyükkemikli Cape and Küçükkemikli Cape, Havuzlar vicinity, Soğanlıdere Valley, cliff formations and bays, Kocadere Campground, promenades, and Kum Harbor. The third route proposed as a cultural heritage tour route covers all rural settlements and various archaeological values of the historic area.

The Kilye Bay Visitor Center is close to Eceabat and Kilitbahir settlements and Çanakkale city center, including the Kilye Castle Archaeological Site, Kilye Bay Pier, administrative buildings, and open green areas. The historical site includes service areas that supported the front lines of the Ottoman forces in addition to the Bigalı Village Atatürk House Museum, the Kocadere Campground, which was the starting point of the 57th Regiment Loyalty March, Bigalı Castle, which was proposed to function as Çanakkale Wars Weapons and Ammunition Repair Museum in the Historic Area Plan, Çamtekke Cemetery, Kireçtepe Gendarmerie Monument and Cemetery, martyrs' graveyards and village cemeteries. Bigalı and Kocadere villages are proposed to be developed as service centers of this region within the plan's scope. In addition, the 27th Regiment Deployment/Memorial Routes proposed by the plan start from this region.

Kabatepe/Arıburnu- Conkbayırı Visitor Center

The Kabatepe/Arıburnu/Conkbayırı visitor center is the entry point, suitable for the tour vehicle system, and close to the archaeological site. The area includes the Çanakkale Epic Museum, historical elements, and heritage routes. The entire Arıburnu-Conkbayırı area is located within the historic site and has been the scene of battles with national and international importance. The Arıburnu Landing and the Battles of Kanlısırt and Conkbayırı took place here.

Among the most important places to visit in this region are Anzac Cove, Sphinx, First Lieutenant NafizÇakmak Trenches, Conkbayırı Atatürk Victory Monument, ConkbayırıMehmetçik Inscriptions, 8th Division Headquarters Water Bed Monument, Talat Göktepe Monument, Kılıçdere-1 Cemetery, Kılıçdere-2 Cemetery, Mesudiye Cannons, Mehmet Çavuş Monument, 57th Infantry Regiment Cemetery, Respect the Turkish Soldier Monument, Kesikdere Cemetery, Quinn's Post Cemetery, Courtney's and Steel's Post Cemetery, Johnston's Jolly Cemetery, Lone Pine Cemetery, Captain Mehmet Cemetery, Lieutenant

Colonel Hüseyin Avni Bey Cemetery, Çataldere Cemetery and Monument, Kanlısırt Inscriptions, Keklikdere Cemetery, Karayörükderesi Cemetery, Deep Respect for Mehmetçik Monument, Albayrak Sırtı Cemetery, Süngübayırı Cemetery, Conkbayırı New Zealand Cemetery, Baby 700 Cemetery, and the Nek Cemetery. The Arıburnu-Conkbayırı Battlefield and Visitor Center is located at the intersection of historic, natural, and cultural tour routes and will provide services to visitors using all these routes.

Damakçılık Hill/Anafartalar Visitor Center

The most important sites at Anafartalar are Anafartalar Plain, Suvla Cove, Salt Lake, Landing areas called Beach A, Beach B, and Beach C, Ibrikçe-1 and 2 Cemeteries, Kanlıköprü Stream Cemetery, Yusufçuktepe Inscriptions, Naim Sırtı Cemetery, Damakçılık Hill Inscriptions, Green Hill Cemetery, Hill 60 Cemetery and Monument, İsmailoğlu Stream Cemetery, Abanoz Stream Cemetery, AşağıKapanca Cemetery, Havantepe Cemetery, Aslantepe Cemetery, Küçükanafarta Cemetery, and Azmak Cemetery. The Suvla Lake Wetland and Natural Areas (the inner and northeastern parts of the historic site are significant forest areas and 1st and 3rd degree natural protected areas) are associated with the Damakçılık/Anafartalar Visitor Center.

In addition to the important ecological diversity, the site includes other elements, such as the Büyükkemikli Cape, Küçükkemikli Cape, Büyükkemikli Inscriptions, Hill 10 Cemetery, Alopekonnesos Ancient City, Limnai Ancient City and Necropolis, Lalababa Cemetery, Büyükanafarta, Küçükanafarta, Bigalı (Çamyayla) and Kocadere villages, Ece Harbor, Kocadere Campsite, Kilye Plain, Akbaş Bay, Kilye Bay, Eion Ancient City, Çamtekke Cemetery, Akbaş (Sestos) Castle, Değirmenlik Vicinity, Kilye Castle, Poyraztepe Bastion, and Ayazma Fountain. Other important elements are Suvla Lake, Hill 60 Cemetery, Naim Sırtı Cemetery, Büyükkemikli Inscriptions, Green Hill Cemetery, and Yusufçuktepe Inscriptions [17].

It is envisaged that the Damakçılık Hill/Anafartalar Battlefield Visitor Center will include a *Thematic Museum Arrangement of the Anafartalar Land Battlefields* and a *Museum of History, Nature, and Archaeology* for the narration of the land battles in this region. This visitor center will be located at the intersection of historical, natural, and cultural tour routes and will serve visitors using all of these routes. [18].

5.CONCLUSION

The planning and design of visitor centers created to enhance the visiting experience in historic sites is an integrated process. Elements such as providing original and ethical solutions, sustainability, environmental sensitivity, distinctive and appropriate design, diversity, functionality, accessibility, safety, and flexibility should be in this process. The distinctive design welcomes visitors and allows them to experience a 'sense of place', increasing their awareness of local environments and ultimately encouraging them to explore the space. In general, the literature does not sufficiently address visitor center designs and approaches in the planning process, especially for those in Turkey. The focus of this study was to evaluate the design of the visitor centers at the Gallipoli Historic Site in terms of parameters of landscape, architectural formation, functional diversity, accessibility and safety, interactive and technological facilities, and authenticity. The design and architecture of the visitor centers in the area examined within the scope of the Gallipoli Historic Site and management plan should have features that emphasize historical and cultural significance and offer an impressive and meaningful experience to visitors.

When evaluated in terms of landscape, the plan is an integrated work that is respectful of the natural texture and its history and functions directly with the goal of continuity. Landscapes are an excellent way to combine the historic and archaeological sites with the details of the modern city. It is a beautiful and innovative design method, as the landscape plans prevent an overall change in the infrastructure of the

archaeological site and protect the vegetation in the area by prohibiting random development around the monuments. The project has a structure dedicated to the discovery and understanding of the area's history, configured as an ideal element for a possible starting point, opening the site to the visitor or configured as an alternative. Thus, the destination point that ends the tour is transformed from a passive transit point, where the user simply buys a ticket, to an interactive experience where the visitor is intrigued by the possibility of discovery.

In terms of architectural formation, recognizing the value of this historical landmark is aimed at the design of all three centers. A solution that will enable a holistic reading of the design space and its proportions has been produced, thus guiding the design theme (discovery and memory). As the site is integrated with the surrounding context, the city has been provided with new spaces and new opportunities the inhabitants can use on a daily basis, beneficial and necessary for all who live and work in these places. In terms of functional diversity, all three visitor centers have functionally diverse facilities (parking, seating areas, cafés, etc.). However, in terms of accessibility and safety, access for pedestrians, street furniture, corridors, bridges, streets, paving services, and public transportation should be given further consideration. In terms of Interactive and Technological Facilities, applications that stimulate people's imagination and offer rich experiences to visitors should be designed in these three centers. Authenticity is the main design approach in all three areas. In the study, the approach was open and related to the essence of the place. The design principles for the Kilye Cove, Kabatepe/Arıburnu-Conkbayırı visitor centers have been evaluated according to the criteria set within the scope of the study. The evaluation results indicate whether the design principles are present (yes/ +) or absent (no/ -). Based on this summary evaluation, the design principles that need development for the Gallipoli Historical Area have been identified.

Table 2. Evaluation of Visitor Centers in the Gallipoli Historical Area due to Study Criteria (Improved by Author)

Criteria	**Kilye Cove Main Visitor Center**	**Kabatepe/Arıburnu -Conkbayırı VisitorReception Center**	**Damakçılık Bayırı/Anafartalar VisitorReception Center**
Landscape	+	+	+
Architectural Form	-	-	-
Functional Diversity	+	-	-
Accessibility and Safety	+	+	+
Interactive and Technological Opportunities	-	-	+
Authenticity	+	+	+

Reviewing Table 2, it is seen that the strategic plan for visitor centers in the Gallipoli Historical Area determines the location and role of the visitor centers within the historical area. Specifically, the principles related to architectural form have not yet been established, and as a result, functional diversity and interactive and technological opportunities have not been addressed. It is also seen that, location decisions are taken in consideration of the geographical criteria and landscape values and the originality is also considered.

The design and planning of the visitor centers at the Gallipoli Historic Site should reflect the historical and cultural significance of the area and provide a meaningful experience for visitors. Although the Kilye Bay, Kabatepe/Arıburnu- Conkbayırı, and Damakçılık Bayırı/Anafartalar regions have different geographical

characteristics, the design principles to be developed should be common. Table 3 summarizes these principles.

Table 3. Gallipoli Historic Site Visitor Centers Design Principles (Improved by Author)

Architectural Design Principles	The primary principle is that centers should be in harmony with the unique natural qualities of their geography. The center should consider environmental sustainability and be designed in harmony with the natural landscape.	The use of elements reflecting the history of the region in the design of buildings and the use of materials strengthens the centers' authenticity.	The centers should be accessible to all visitors.	Technologies that save energy and minimize the environmental footprint should be used.
Historical Information and References	Use of Multimedia: Interactive experiences should be offered to visitors using videos, touch screens, and augmented reality applications.	Boards and interactive displays including detailed information about the history of the Dardanelle Wars and the Gallipoli Peninsula should be placed.	Art and Artifacts: Artifacts, photographs, and artworks from the period of the Dardanelle Wars should be exhibited.	
Training and Event Areas	Historical information and educational programs should be organized for students and visitors.	Events, including the participation of historians, academics, and experts should be organized.	Workshops such as handicrafts and historical model-making should be organized.	
Recreation and Social Areas	Cafés and sitting areas where visitors can rest and enjoy the view should be established	Sales units for souvenirs and books specific to the region should be established.	Picnic areas, hiking trails, and viewing points should be designed.	
Information and Guidance	Tours offered by professional guides should be provided.	Boards informing visitors about the different parts of the center and the historical background, mobile applications, and digital guidance systems should be developed.		
Safety and Emergency Planning	Principles based on the Disaster Risk Management Plan should be developed.	Adequate security personnel and equipment must be provided to ensure the visitors' safety.		

Visitor Centers, especially those welcoming many guests, should be addressed within visitor management plans. Planning, from upper-scale plans to lower-scale design projects, should be community-driven, allowing for the local people's participation. The local community needs to be involved in the process and outcomes, and planners should develop more effective ways of identifying and involving communities in the design and presentation of interpretation. On the other hand, different types of ownership such as public ownership, private ownership, and trust ownership, along with their advantages and disadvantages must be examined for the project areas. Different ownership models such as transfer, leasing, or joint ventures and their benefits must be implemented if necessary. Financial management principles and strategies that should be adopted for effective management of income and expenses, reporting of annual income and expenses, evaluating financial performance, and public disclosure of reports is crucial. All methods and long-term strategies that can be implemented for financial sustainability. The impact of ownership status, budgeting, and income-expense management on the success of visitor centers. A comprehensive visitor management plan should include multifaceted sustainable principles such as design principles of visitor centers, management, and finance.

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YAŞAR DİLEK ERBEY Assoc. Prof. Dr.
Was born in Ankara. Graduated from Mimar Sinan Fine Arts University. She completed her PhD with a dissertation titled " Urban Regeneration Projects as a Tool for Urban Conservation" at Mimar Sinan Fine Arts University at City and Regional Planning Dept. Urban Conservation and Renewal Programme in 2003. Working as a Lecturer in the same department since 2003. Teaching urban conservation, cultural heritage management and studio courses in both graduate and post graduate programmes.

Research Article

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


Veli Rauf VELİBEYOĞLU[1], Fatma SEDES[2]
Istanbul, Türkiye
Istanbul Aydın University, Faculty of Architecture and Design, *Istanbul, Türkiye*
raufvelibeyoglu@aydin.edu.tr, fatmasedes@aydin.edu.tr[2]
https://orcid.org/0000-0002-5847-2591[2], https://orcid.org/ 0000-0002-4064-7381[2]
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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 deneyimsel 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.

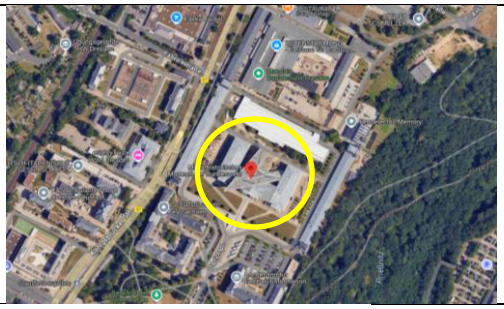
- **Harmony and Unity:** There should be visual harmony and an aesthetic balance between the historical building and the contemporary addition. Harmony in the use of color, material, and form is essential. This principle aims for the components to be perceived as complementary elements.
- **Authenticity:** 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.

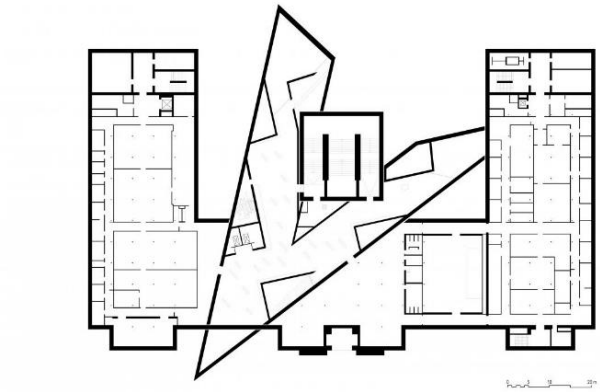
Based on literature reviews and international charters, the 10 conservation and 10 design criteria were explained in detail. These criteria formed the fundamental evaluation framework of the study. Each criterion was structured to be assessed on a scale of 5. The evaluation table consisted of a total 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.

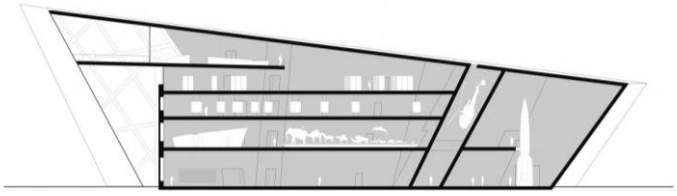
This study employs a multi-layered methodological approach to analyze how historical buildings are transformed through symbiotic architectural interventions. The research focuses on four key case studies: Dresden Bundeswehr Military History Museum, Antwerp Havenhuis, Royal Ontario Museum, and Asian Civilizations 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):Theophill Hansen	
Architect(s) of Symbiotic Extension: Daniel Libeskind	
Original Usage: Armory	
Current Usage: Museum	

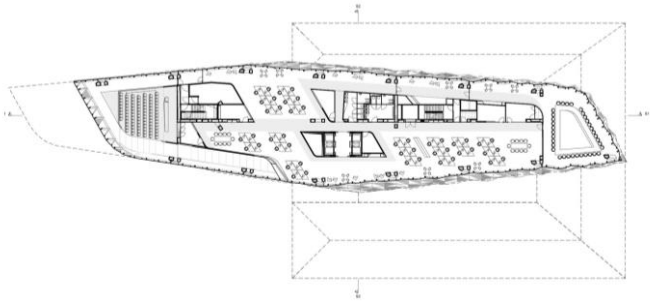


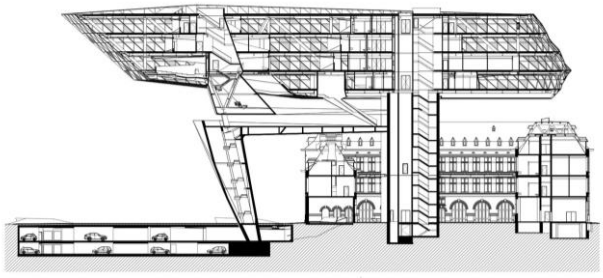


The futuristic glass and steel addition by Zaha Hadid Architects sits atop the historic port authority building, resembling a ship floating above the structure. This bold intervention not only enhances the building's symbolic connection to Antwerp's maritime heritage but also provides modern office spaces 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	

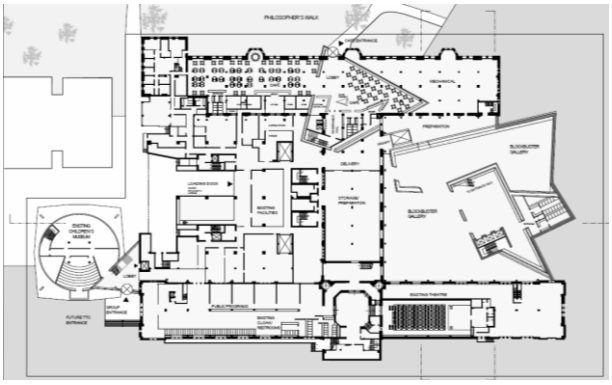


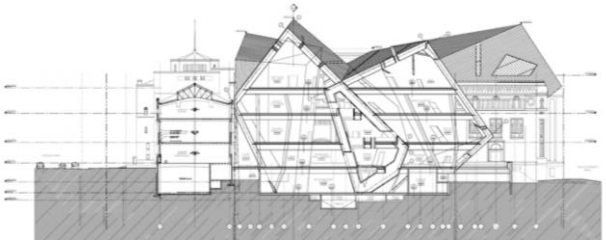


Libeskind's "Crystal" addition to the Royal Ontario Museum is an angular, glass-and-metal structure that dramatically contrasts with the museum's original stone facade. This intervention provides expanded gallery spaces and a striking new entrance, redefining the museum's public image while creating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

Table 3. Royal Ontario Museum [28]

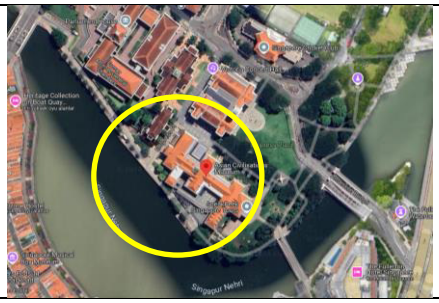
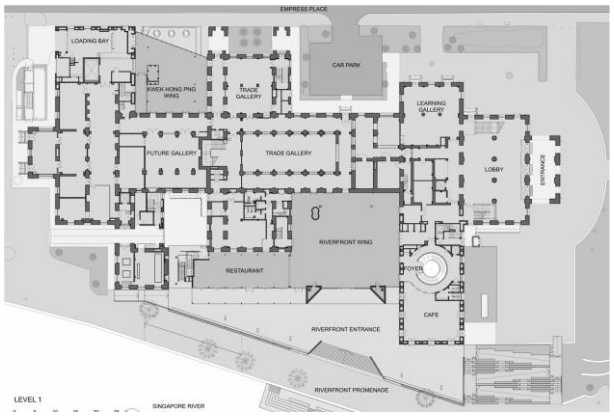
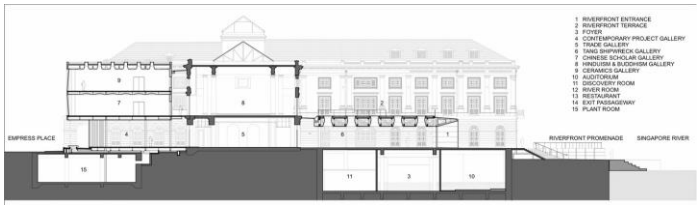
Building Information	Coordinates: 43.667679°N 79.394809°W
Construction Year: 1914	
Revitalization Year: 2007	
City/Country: Toronto / Canada	
Architect(s): Darling and Pearson (Company)	
Architect(s) of Symbiotic Extension: Daniel Libeskind	
Original Usage: Museum	
Current Usage: Museum	





GreenhilLi 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: GreenhilLi (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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Veli Rauf Velibeyoğlu, Lecturer,
Velibeyoğlu obtained his Bachelor's degree in Architecture from Istanbul Aydin University. Immediately after, he started his master's degree, and during this time, he worked on architectural application projects. After obtaining his master's degree, he started teaching as a lecturer and gave many lectures. He is currently studying in the Architecture PhD program at Istanbul Aydin University and continues to teach as a lecturer at the same time.

Fatma Sedes, Dr.,
She graduated from I.T.U. Faculty of Architecture in 1977. In 1978, she started to work as an architect at the Istanbul Directorate of Survey and Monuments of the Ministry of Culture. In 1979, she passed the 'Post-Graduate Education' exam opened by I.T.U. Faculty of Architecture and received a master's degree for two years in the History of Architecture and Restoration Department of the same faculty, chaired by Prof. Dr. Doğan KUBAN. In 1979, she completed her bachelor's thesis under the title of 'Thermal Insulation Sampling and Details in Wooden Buildings'. In 1981, she continued her duty as an Architect-Restoration Specialist in İzmir Directorate of Survey and Monuments. In 1982, Architect Fatma Sedes completed her PhD program at Dokuz Eylül University, Faculty of Architecture, Department of Restoration, and completed her seminar studies in 1985. In 1991, he received the title of Doctor Architect by completing his PhD thesis under the title of 'Islamic Worship Structures in the Ottoman Period Urban Space, Its Position in the Interior - The Example of Izmir, Reflections on Today's Structure'. He worked as an expert in important projects such as Nafi Baba Tomb, Suleiman the Magnificent Tomb, Hürrem Sultan Tomb, Mimar Sinan Tomb, Arif Pasha Mansion Topkapı Palace Harem Department. He is currently working as a lecturer at Istanbul Aydın University, Department of Architecture.

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