

ISTANBUL TECHNICAL UNIVERSITY ★ GRADUATE SCHOOL

**ADAPTIVE SUSTAINABLE REUSE OF A POST-INDUSTRIAL AREA
WITH A BIOPHILIC APPROACH: 'GREEN MUSEUM' EVALUATION
APPLYING VIRTUAL REALITY TECHNOLOGY**



M.Sc. THESIS

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Department of Urban Design

Urban Design Programme

JANUARY 2023

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UYARLANABİLİR-SÜRDÜRÜLEBİLİR YENİDEN KULLANIMI: SANAL
GERÇEKLIK TEKNOLOJİSİ İLE DEĞERLENDİRİLEN 'YEŞİL MÜZE'**

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Dedicated to my lovely parents,



FOREWORD

This thesis is made as a master project, as part of the requirements for the awarding of a degree in the Master of Science in Urban Design programme at the department of Urban Design at the Istanbul Technical University. A special thanks to dear Assist. Prof. Dr. Eren KÜRKCÜOĞLU, my advisor for his countless hours of reflecting, encouraging, and most of all patience throughout the entire process.

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January 2023

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ABBREVIATIONS

AI	: Artificial intelligence
API	: Application Programming Interface
AR	: Augmented Reality
BIM	: Building Information Modeling
CAD	: Computer-aided design
DT	: Digital Twin
GIS	: Geographic Information System
HMD	: Head-Mounted Display
ICT	: Internet Communication Technology
IoT	: Internet of Things
OCP	: One Central Park
QUT	: Queensland University of Technology
ROI	: Returns on Investment
TCH	: Trans-Canada Highway
VR	: Virtual Reality
2D	: Two Dimensional
3D	: Three Dimensional



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ADAPTIVE SUSTAINABLE REUSE OF A POST-INDUSTRIAL AREA WITH A BIOPHILIC APPROACH: 'GREEN MUSEUM' EVALUATION APPLYING VIRTUAL REALITY TECHNOLOGY

SUMMARY

The population of cities around the world has been growing exponentially. Population growth, city-scale expansion, and industrial development congestion have significantly changed large regional ecosystems and patterns, resulting in increased pollutant production and affecting the city's ecological environment. People nowadays spend most of their time in man-made environments surrounded by drywall, concrete, wood, and steel. Furthermore, in industrialized countries, four-fifths of the population lives and/or works in densely populated cities. These man-made habitats significantly harm human's ability to connect with their natural surroundings. Environmental and sensory deprivation abound in these settings, resulting in a reduced human-nature relationship. It also threatens the health, survival, and quality of citizen's life. Since the tendency of urbanization to increase and the expansion of urban areas leads to a sharp drop in ecological bases, Cities need to establish a close relationship with the environment. Nature can help make sense of the environment and improve the identity and quality of the city. Mechanization has damaged nature and overshadowed cities' economic growth and development, leading to urban instability. Human beings must communicate daily with nature and protect environmental and ecological values in cities because of the mutual influence of human culture and nature on each other. Human beings are instinctively eager to connect with nature as a part of the natural world; this innate desire defines as "biophilia." While human beings define their identity through building their surrounding environment, they are also a product of the natural environment and intend to interact with nature. This study identifies biophilic design as a lost concept in improving the quality of cities through the preservation and stability of the historical context to satisfy the urban experience for humans on their nature-friendly instinct level. The unity of the three perspectives of urban life, history, human culture, and nature shows that cities do not need new constructions to improve. Instead, biophilia and sustainability not only can be rebuilt by renovating existing buildings also by reconnecting their occupants to the environment. The biophilic design shows that the connection with the environment is beneficial not only for sustainability but also for human health and happiness. What is better for the environment can be better for human beings. Observing conservation and historical stabilization methods through the lens of biophilic design creates a constant development by reconnecting to the natural world while retaining its historical character.

In Chapter one, this research first begins with the introduction of the thesis, scope, objective, subject matter, methodology, research questions, and study's contributions. Qualitative research methods are used to study the applications of urban design and planning ideas in human culture and environmental interactions, including social ecology, sustainability, green architecture, biophilic design principles, landscape

urbanism, and wild urban forest elements. By reviewing the documentation, gathering data, and doing literature reviews on social ecology, biophilic planning and design, and sustainable development circumstances, the theoretical framework for the study was created. Numerous urban concepts are developed and used in cities all around the world in response to these issues as well. Some of these ideas, such as including a green corridor into city textures, offering social sustainability leading designs, utilizing green cultural centers and museums for knowledge growth, and utilizing contemporary technology to build cities, are evaluated and explored in this thesis. According to these concepts, questions arise such as whether the influences of the transformation of an abandoned post-industrial area into a cultural public space with a sustainable biophilic approach on the neighborhood's quality are positive or how Green Museum contributes to the public and what green design techniques can be used in the development of green Museums, or whether the smart city tools a VR sufficient 100% and the responsiveness of smart city tools such as VR technology to the sustainability approaches.

In Chapter two, the role of urban and environmental concepts such as social ecology, sustainable development, social sustainability, landscape urbanism, biophilic design, green public space, historical monuments, wild urban woodland, etc. in evaluating features of urban spaces, and also the smart city features and some of its application tools, such as Virtual Reality technology and their approach to urban design and planning, are reviewed. Furthermore, the Green Museum scheme is studied as a public green space by examining and studying similar examples and data collections. In the next step, Chapter three assigned to the evaluation of the study area and the case study named " Şişecam bottle and glass factory Group of Paşabahçe" located in Beykoz district, Istanbul, Turkey. Also, the historical background of the facility and other analyses are given for more and better perception of the case study features and situation. In Chapter four, evaluation and discussions have done on the results of the study and the proposals for adaptive reuse of the Şişecam bottle and glass factory group of Paşabahçe. Pursuing those evaluations, a trial proto-design was proposed and accomplished by a 3D digital model.

Results are displayed by VR model generated in SketchUp application, and presented by panoramic Virtual Reality tool on Lumion application and VR generating Websites such as EasyVR and VRdirect, to check either the positive or negative responses of the proto-design alternative to the mentioned problems and get observed virtually without any physical presence in the actual place. The importance of VR technology in this study is to deal with concerns about the effectiveness of the Green Museum design and the inability to accurately measure the services of this space due to its immaterial and intangible. Results represent humans as parts of nature, and nature is where their instincts come from. Human culture and city planning directly impact other living things in urban environments and human-city-nature concepts are always exchanging with each other. The sustainable development paradigm as an important mutual feature in almost every concept ensures future generations' survival by ensuring the stability, and sustainability of things that must endure during the evolution of phenomena. We need to alter citizen culture to alter the structures of cities because culture is always influenced by history and nature. The finest locations for group learning in cities are museums. People can engage in group activities, mingle, and study in museums. The virtual 3D model of the green museum provides sustainability contributions and also responsiveness to the smart city features. By providing a trial proto-design 3D model of the proposal, this research aims to present an experimental

and more visual and tangible space to have a better perception of the design strategies and the application of concepts and approaches used in the reuse of the recommended area. This study's results can guide designers and assist the future researches for digital and smart city developers and urban planners.





POST-ENDÜSTRİYEL BİR ALANIN BİYOFİLİK YAKLAŞIM İLE UYARLANABİLİR-SÜRDÜRÜLEBİLİR YENİDEN KULLANIMI: SANAL GERÇEKLİK UYGULANARAK DEĞERLENDİRİLEN 'YEŞİL MÜZE'

ÖZET

Dünyadaki şehirlerinin katlanarak artan nüfus artışı, şehir ölçeğinde genişleme ve endüstriyel gelişme sıklığı, büyük bölgesel ekosistemleri ve kalıpları önemli ölçüde değiştirerek kirletici üretiminin artmasına ve şehrin ekolojik ortamının etkilenmesine nedeni olmaktadır. Günümüzde insanlar zamanlarının çoğunu beton, ahşap ve çelikle çevrili insan yapımı ortamlarda geçirmektedirler. Ayrıca, sanayileşmiş ülkelerde, nüfusun beşte dördü yoğun nüfuslu şehirlerde yaşamakta ve/veya çalışmaktadır. Bu insan yapımı habitatlar, insanın doğal çevresiyle bağlantı kurma becerisine önemli ölçüde zarar vermektedir. Bu ortamlarda çok sayıda çevresel ve duysal yoksunluk söz konusudur ve bu durum da insan-doğa ilişkisinin azalmasına neden olmaktadır. Aynı zamanda insanların sağlığını, hayatta kalmasını ve yaşam kalitesini tehdit etmektedir.

Kentleşmenin artma eğilimi ve kentsel alanların genişlemesi ekolojik temellerde keskin bir düşüşe yol açtığından, kentlerin çevre ile yakın ilişki kurması gerekmektedir. Doğa, çevreyi anlamlandırmaya ve şehrin kimliğini ve kalitesini geliştirmeye yardımcı olabilen önemli bir unsurdur. İnsan kültürü ve doğanın birbirini karşılıklı olarak etkilemesi nedeniyle, insanoğlu doğa ile sürekli iletişim halinde olmak ve şehirlerde çevresel ve ekolojik değerleri korumak zorundadır. İnsan, doğal dünyanın bir parçası olarak doğa ile bağlantı kurmaya içgüdüsel olarak isteklidir; doğuştan gelen bu arzu "biyofili" olarak tanımlanmaktadır. İnsan, kimliğini çevresini inşa ederek tanımlarken, aynı zamanda doğa ile etkileşime girme niyetindedir. Biyofilik mimari, insanları doğayla buluşturarak ruhları üzerinde olumlu bir etkiye sahip olmanın yanı sıra, sakinlerini faaliyetlere katılmaya teşvik edebilir, yapıcı bir model olarak çevreyi koruyabilir ve uzun vadede sakinlerin davranış kalıplarını olumlu yönde değiştirebilir. Bu çalışma, biyofilik tasarımı, insanlar için doğa dostu içgüdü düzeyinde kentsel deneyimi tatmin etmek için tarihsel bağlamın korunması ve istikrarı yoluyla şehirlerin kalitesini iyileştirmede kayıp bir kavram olarak tanımlanmaktadır.

Kent yaşamını oluşturan tarih, insan kültürü ve doğa olmak üzere üç perspektifin birliği, kentlerin gelişmek için yeni yapılara ihtiyaç duymadığını göstermektedir. Biyofilik tasarım, çevre ile olan bağlantının sadece sürdürülebilirlik için değil, aynı zamanda insan sağlığı ve mutluluğu için de faydalı olduğunu göstermektedir. Koruma ve tarihsel stabilizasyon yöntemlerini biyofilik tasarım merceğinden gözlemlemek, tarihsel karakterini korurken doğal dünyayla yeniden bağlantı kurarak sürekli bir gelişim yaratmaktadır.

Çalışmanın birinci bölümünde tezin tanıtımı, kapsamı, amacı, konusu, metodolojisi, araştırma soruları ve çalışmaların katkıları gibi konulara yer verilmiştir. Sosyal ekoloji, sürdürülebilirlik, yeşil mimari, biyofilik tasarım ilkeleri, peyzaj şehirciliği ve

vahşi kentsel orman unsurları dahil olmak üzere insan kültürü ve çevresel etkileşimlerdeki kentsel tasarım ve planlama fikirlerinin uygulamalarını incelemek için nitel araştırma yöntemleri kullanılmaktadır. Sosyal ekoloji, biyofilik planlama-tasarım ve sürdürülebilir kalkınma koşulları hakkında veri toplanarak ve literatür taraması yapılarak çalışmanın teorik çerçevesi oluşturulmuştur. Bu sorunlara yanıt olarak dünya çapında çok sayıda kentsel kavram geliştirilmekte ve kullanılmaktadır. Kent dokularına yeşil bir koridor dâhil etmek, sosyal sürdürülebilirliğe öncülük eden tasarımlar sunmak, bilgi birikimi için yeşil kültür merkezleri ve müzelerden yararlanmak ve şehirler inşa etmek için çağdaş teknolojiden yararlanmak gibi kavram ve teknikler bu tezde değerlendirilmiş ve incelenmiştir.

Bu kavramlara göre, terk edilmiş bir post-endüstriyel alanın sürdürülebilir biyofilik bir yaklaşımla kültürel bir kamusal alana dönüştürülmesinin mahalle kalitesi üzerindeki etkilerinin olumlu olup olmadığı, yeşil tasarımın ne olduğu ve bir yeşil müzenin toplumsal yaşama nasıl bir katkı sağladığı gibi sorular ortaya çıkmaktadır. Mevcut tekniklerin yeşil müzelerin geliştirilmesinde ne ölçüde kullanılabileceği veya Sanal Gerçeklik (Virtual Reality) teknolojisi gibi akıllı şehir araçlarının sürdürülebilirlik yaklaşımlarına yanıt verebilirliği tartışılmıştır.

Genel olarak çalışmanın amacı, kentsel tasarım kavram ve yaklaşımlarından etkilenen, terk edilmiş bir sanayi bölgesinin uyarlanabilir yeniden kullanımı için bir teklif sunmaktır. Bu amaca ulaşmak için tanımlanan belirli hedefler, insan-doğa bağlantılarının faydalarını belirlemek, sürdürülebilirlik kavramı ve biyofilik tasarım modelleri/özelliklerini incelemek, peyzaj şehirciliği kavramı ve uyarlanabilir yeniden kullanım olgusunu irdelemek ve bir vaka çalışması olarak İstanbul’da terk edilmiş bir sanayi alanı üzerinden ve literatür taraması ve alan çalışması bulgularına dayalı olarak analiz etmektedir.

Çalışmanın ikinci bölümünde; sosyal ekoloji, fiziksel ve sosyal sürdürülebilirlik, peyzaj şehirciliği, biyofilik tasarım, yeşil kamusal alan ve yeşil koridor oluşturma, vahşi kentsel ormanlık alan gibi kavramların kentsel mekânların özelliklerinin değerlendirilmesindeki rolü, akıllı şehir özellikleri ve sanal gerçeklik teknolojisi gibi bazı uygulama araçlarının kentsel tasarım ve planlamaya katkıları irdelenmiştir. Aynı zamanda “Yeşil Müze” olgusu, dünyadan örnekler ve veri koleksiyonları incelenerek bir kamusal yeşil alan olarak incelenmiştir.

Çalışmanın üçüncü bölümü, İstanbul, Türkiye'nin Beykoz ilçesinde yer alan "Paşabahçe Şişecam Şişe ve Cam Fabrikası Grubu'na ait terk edilmiş post-endüstriyel vaka alanının değerlendirilmesini içermektedir. Çalışma alanının tarihsel süreçte geçirmiş olduğu önemli kırılma noktaları ile birlikte mevcut durumu açıklayan fiziksel ve çevresel analizler, alanın mevcut durumu, özellikleri ve potansiyellerinin daha iyi algılanması için aktarılmıştır. Bölgedeki yaş grupları ve nüfus (demografik yapı), bitki dokusu ve hayvan türleri (flora ve fauna özellikleri), coğrafi konum, erişim ve bağlantılar, fiziksel mahalle dokusunu analizleri ile birlikte tarihi anıtlar ve simge yapılar, halka açık doğal parklar, endüstriyel ve post-endüstriyel bağlamlar, arazi kullanımı ve GZFT gibi analizlere de yer verilmiştir. Analizlerden elde edilen sonuçlar, alana dair olumsuz yönleri tespit etmek ve bunları iyileştirmek/etkili stratejilerle değiştirmek için önemli katkılar sağlamaktadır.

Çalışmanın dördüncü ve son bölümünde ise, alan araştırmasının sonuçlarına yer verilmiş ve Paşabahçe Şişecam post-endüstriyel miras alanı için uyarlamalı yeniden kullanım önerileri üzerine değerlendirmeler ve tartışmalar yapılmıştır. Geliştirilen akış

planı, incelenen kavramlara göre tasarım stratejilerinin adım adım açıklanmasıyla sunulmaktadır.

Bu değerlendirmeler sonucunda bir deneme tasarımı geliştirilmiş ve üç boyutlu sanal gerçeklik modeli ile sanal ortamda canlandırılmıştır. Sanal Gerçeklikte, Katılımcılar izleme gözlüğü takarak stereoskopik görselleri izleyebilir veya Sanal Gerçeklik modelini bilgisayarlar veya akıllı telefonlar aracılığıyla gözlemleyebilir, 3 boyutlu sesleri dinleyebilir ve 3 boyutlu bir dünyayı özgürce keşfedebilmekte ve etkileşimde bulunmaktadır. VR, mühendislere yalnızca bina tasarlamada yardımcı olmakla kalmaz, aynı zamanda performansı artırmak, güvenliği beslemek ve deneyim açığını kapatmak için eğitim için de kullanılabilir.

Bu model, daha önce kuramsal çerçevede incelenen kavramların ve yaklaşımların, yeniden tasarlanan/tanımlanan fabrika alanı üzerinde yansımalarını görmek ve olumlu-olumsuz sonuçlarını kavramak için sunulmuştur. Bu sanal model, akıllı telefonlar, bilgisayarlar veya sanal gerçeklik gözlükleri gibi dijital araçlar üzerinden görüntülenebilir ve yeniden tanımlanan sanal yeşil müze ortamında yer alarak fiziksel yapının eşzamanlı olarak gözlemlenmesi ve sanal yapı ile karşılaştırılması mümkün hale gelebilmektedir. VR kullanımında, fiziksel bir ziyaretten daha iyi bir durumda bakış açılarına fayda sağlanmaktadır. Sanal gerçeklik, modeli yukarıdan ve çok yükseklerden izlemeye mümkün kılmaktadır.

Sonuçlar, SketchUp uygulamasında oluşturulan sanal gerçeklik (VR) modeli, Lumion uygulamasındaki panoramik sanal gerçeklik aracı, EasyVR ve VRdirect gibi sanal gerçeklik üreten internet siteleri tarafından takip edilebilmektedir.

Bu çalışma özelinde sanal gerçeklik teknolojisinin önemi ve “Yeşil Müze” tasarımının etkinliği arasındaki bağları ve uygulama aşamasında sunulan hizmetlerin doğru bir şekilde ölçülüp ölçülemeyeceği endişesi odak alınmaktadır. Sonuçlar, insanları doğanın bir parçası olarak temsil etmektedir. İnsan kültürü ve şehir planlaması, kentsel ortamlardaki diğer canlıları doğrudan etkilemektedir ve insan-şehir-doğa kavramları sürekli birbiriyle değişim-dönüşüm halindedir ve bu üç kavram arasındaki bağı güçlendirmek, bu çalışmanın en önemli odak noktalarından biridir.

Her kavramda önemli bir ortak özellik olarak sürdürülebilir kalkınma paradigması yer almaktadır. Yeşil müze için oluşturulan üç boyutlu sanal model aracılığıyla, sürdürülebilirlik katkıları ve akıllı şehir özelliklerine yanıt verebilirlik sağlanabilmektedir.

Bu araştırma, önerilen projenin üç boyutlu bir deneme tasarım modelini sunarak, tasarım stratejilerinin daha iyi algılanması ve önerilen alanın yeniden kullanımında kullanılan kavram ve yaklaşımların uygulanması için deneysel, görsel ve somut bir alan sunmayı amaçlamaktadır.

Sonuç kısmı olan beşinci bölümde, sorulan ilgili sorulara cevap verildi ve artıları ve eksileri cetveli kullanarak Şişecam fabrikasının post-endüstriyel alandaki değişimleri ve sanal gerçeklik modeli değerlendirildi.

Bu çalışmanın sonuçları, dijital-akıllı şehir geliştiricileri, şehir plancıları ve tasarımcılara rehberlik edebilecek ve gelecekteki araştırmalara yön gösterecek niteliktedir. Sanal Gerçeklik teknolojisinden yararlanan mimarlar, mühendisler ve şehir plancıları, bu tür örnek modeller üzerinden akıllı şehirlerin karmaşık işleyişini daha net anlayabileceklerdir.

Son olarak, gelecekte bu çalışmanın sürecini ilerletmeye ve dijital çalışmaların yaygınlaşmasındaki uygulamasına yönelik önerilerle birlikte, sürdürülebilirlik ve yeşil şehirler kavramlarıyla bağlantılı olarak akıllı ve dijital şehir çalışmalarının geleceğine dair bir vizyon sağlamak için açıklamalar ve yorumlar sunulmaktadır.



1. INTRODUCTION

With the increase of urbanization, the consumption of resources and the pollution caused by them is also increasing as well as the need to settle, and the consequent increase in the speed of development in today's cities, we are witnessing the production of more abandoned areas, spaces, and buildings. These buildings, which their users have abandoned for various reasons, cause many physical and psychological disorders in the city and its citizens. In addition to the visual damage to the city's appearance and the urban aesthetics, these abandoned places can become a center of attention for crime and create a sense of insecurity and terror. Many of these abandoned sites are located in significant and critical areas of the city or have a rich historical background, and rehabilitating them with practical approaches can have many potential benefits.

Moreover, our cities are progressively engulfed by concrete, glass, and metal skyscrapers and tall buildings that have cut off human engagement with the natural environment and nature, which has consequences such as destructive effects on the city, environment, and the citizen's mental health. But it is not just citizens who have been affected unhealthy by these changes. An urban ecosystem consists of a complete set of spaces, humans, plants, and domestic and wild animals that live within or on the outskirts of cities. Architects and urban planners should try to push cities towards social ecology concepts. The design industry has the power to enhance this city-human-nature link through built environment solutions that stimulate interdependency between people and natural components, and this sense of connection with nature could be strengthened. In other words, many people, particularly architects and interior designers are responsible to present all options for creating healthy and productive learning and interaction spaces.

According to Kellert, biophilia is “the missing link in sustainable design” and is about re-establishing the mutual relationship between nature and humans (Kellert, 2008). In contrast, many designers and professionals do not incorporate components of biophilia in their plans. Biophilic design is an innovative and quickly increasing approach to creating the places we live, work, and learn to resolve the modernity disconnect with

nature and satisfy people's need to be immersed in nature. Humans are biologically, mentally, and spiritually interwoven with nature, according to biologist Edward O. Wilson (O. Wilson, 2009).

Cities constantly need places with an interactive approach and social sustainability. Creating collective cultural spaces in which to work for the education of society, exchange of information and culture of citizens in a sustainable environment is a necessity for today's cities. With the sustainable biophilic approach, public urban green spaces can positively affect the development of human relations in society and the formation of a healthy atmosphere in cities. Presenting a green Socio-Cultural corridor as a public space called 'Green Museum' responds to an Eco-social biophilic approach.

Also, given the importance of technology in the engineering industry in the present age and its growing and evolving trend, knowing these technologies with mass production and their increasing development can be valuable cases in this field. The requirement and dependence of sustainable architecture on advanced technology in various aspects of architecture, sustainability, technology, and cheap or available technologies is essential and is a new topic to be researched in many countries. Technology in architecture is one of the topics for which a very bright future is predicted. The extent of its impact on the formation and development of sustainable architecture has been so great that it is said that it can affect most aspects of future human life.

Today, energy-saving and sustainable development are some of the most essential and everyday topics at the international level, so the conservation of energy resources, prevention of land and environmental pollution, reducing fossil energy consumption, and coexistence with natural and climatic conditions to one it has become one of the most critical measures in architecture and urban planning. Thus, the creation, development, and transfer of new technologies can be important to reduce energy consumption. Considering that the axis of formation and sustainable urban development to use the environment optimally, economic, social, and cultural return to production processes, technology as an effective tool in this study is discussed. The use of smart materials in the construction industry can improve the design and construction methods of buildings, so showing an overview of smart cities, smart tools, and how designers, architects, and promoters use them in planning, urban design, and development with an environmental approach can be a general goal.

Virtual Reality is a smart tool that has captured the interest of architects and urban planners in recent years. This concept can reconstruct all aspects of a physical object and provide a development program by connecting it and receiving data and information as a smart development tool. One way to implement smart design information is to use Virtual Reality. This thesis has tried to investigate city-human-culture interactions and how nature affects human well-being, aimed at exploring ways in which biophilic design patterns and new technologies have been integrated. The case study selected in Istanbul, Turkey, was visited, and to achieve results, qualitative surviving methods have been used.

Finally, this proposal will be tested through the conceptual proto-design of a green public space called a Green Museum in the urban setting. In addition to literature research and observation, a 3D virtual model designed according to the reviewed concepts and referenced by the physical existing establishment of the Şişecam bottle and glass factory group of Paşabahçe. The responses of this design are evaluating by observing through the VR model of the design.

As a result, this research aims to renew the human relationship with nature and close the widening gap caused by modernity. Some methods for bridging the gap are biophilic design and sustainable development. The contribution of the proposed green museum as a green urban corridor to the urban context and affecting the surrounding areas and neighborhoods is also getting reviewed in this study's results and conclusion. Also, the creation of an interactive framework for smart city visualization that has been suggested in the realm of visualization and interaction with the environment and information, facilitates the experience and engagement with information through VR technologies and smart displays, offering improved tactile visualization.

1.1. Purpose and Scope of the Study

In general, the aim is to submit a proposal for the adaptive reuse of an abandoned industrial area, Influenced by urban design concepts and approaches. in order to achieve this aim, the following are the specific objectives:

- Identify the benefits of human-nature interconnections,
- Study the sustainable development concept, landscape urbanism and adaptive reuse application, and the wild urban woodland influences,
- Study the concept of biophilic design and patterns and features,

- Determine an abandoned area in Istanbul, Turkey, as a case study and analyze it based on finding criteria and literature review,
- Present a 3D-designed Virtual Reality model of the proposed plan and participate visitors through VR settings (computers, smart phones, VR glasses),
- Preparing checklists on the case study proposal and applying studied Concepts.

As shown in Figure 1.1 this study consists of three phases that are explained in five chapters. Chapter one, is an introduction explaining the purpose and scope of this research, the research questions, content and methods, and the contribution of the research Achievements to this study's framework.

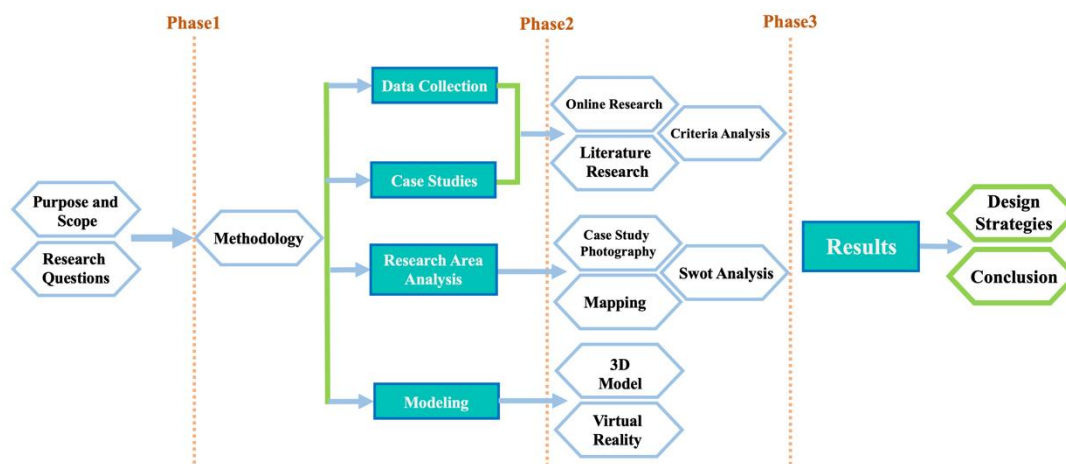


Figure 1.1: The outline of the thesis.

In Chapter two, this thesis examines the urban design and architecture-related concepts to the study's proposed approaches. This research focuses on evaluating interconnections between nature, human culture, and cities to create healthy and sustainable environments that enrich the city's public spaces through the use of biophilic design (Figure 1.2).

Then, aiming to revitalize the human relationship with nature and strengthen their bonds, the sequence of the thesis explains what the guidelines of biophilic design, social ecology, and sustainable design are through defining each of these patterns, illustrating how they can impact humans and nature interactions.

Thereafter, in Chapter three, a suitable area in Istanbul, Turkey, is chosen and studied as an abandoned glass factory in the Beykoz district, named 'Glass and bottle factories A.S. Pasabahce Factory.'

The case study was visited, and certain areas were selected to make a model or a table checklist to evaluate the presented elements.

In chapter four, the table of guidelines and strategies of sustainable development, biophilic design, and eco-social validity was initially used as a simple pass or fail benchmark. Chapter four also describes the digital era and smart city tools and applications such as ‘Virtual Reality’ (VR) and their relation to sustainability. Also, the application of these technologies as tools for the evaluation of the responsiveness of proposals and ideas is studied.

Also, the contribution of the proposed green museum as a green corridor and the transition of the green texture and vegetation along the studied area is getting reviewed in the study. Finally, the proposed solution is given in a three-dimensional Virtual Reality design in which visitors can participate via VR tools.

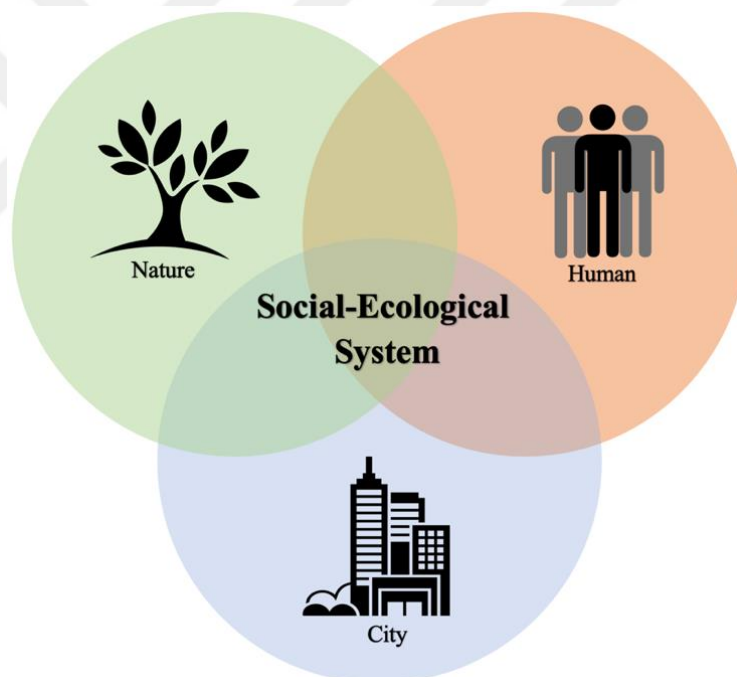


Figure 1.2: The Human-City-Nature interaction resulting a Social-Ecological System.

1.2. Questions of the Study

Instead of accompanying nature, the industrial age has changed so much that it looks at the environment as a struggle and takes technology to eliminate dependence on the ecological system and affected humans' relationship with the natural world.

Worldwide large cities usually suffer from unhealthy and stressful climate situations such as air pollution, lack of green areas, decreasing water basins, lack of biodiversity, etc. Also, a lack of suitable public spaces clearly can be seen in the urban environment. In contrast, the upward trend of urbanization and the expansion of urban areas have led to a sharp decline in ecological fundamentals. Therefore, cities and citizens need a close relationship with the environment. In line with these problems, many urban concepts are presented and applied in cities around the globe. Some of these concepts are getting reviewed and studied in this thesis such as implementing a green corridor in the city textures, providing social sustainability leading designs, use of green cultural centers and museums for knowledge expansion, and the use of modern technologies to plan the cities. According to these concepts, the following questions arise due to the framework of this study:

- Is the transformation of an unhealthy abandoned post-industrial area into a sustainable biophilic approached Socio-Cultural public space in a city can affect that region's quality?
 - Can the concept of social ecology affect by the formation of public spheres with a biophilic approach?
 - How are Green Museums contributing to the public and what green design techniques can be used in the development of green Museums?
 - Does the technique of smart city tools such as VR technology respond to the sustainability approaches?
 - Can a proposed plan be presented and reviewed only using a 3D model and in a VR environment, with minimal physical intervention?

1.3. Contribution of the Study

This study helps to improve the conditions of cities and urban issues, by examining the mutual effects of humans, culture, nature on each other, and sustainability concepts in architectural and urban planning, as well as examining and testing modern methods of urban planning such as smart city and digital tools such as 3D modeling and VR, makes future planning more contributing to the smart city principles and sustainability approaches.

Also, the proposal proto-design of the adaptive reuse plan of the case study as a post-industrial area contributes to the cities with reuse approaches instead of building more

and more concrete deserts in modern cities by applying new dense buildings instead of old abandoned establishments. This study contributes to future cities with the idea of cities with saved historical context with biophilic approaches and most interactions with the wild nature.

1.4. Methods of the Study

In this thesis, at first qualitative studies are applied to examine urban design and urban planning concepts, such as social ecology, sustainability, green architecture, biophilic design principles, landscape urbanism, and wild urban woodland features in cities around the globe and their applications in human culture and environmental interactions. The next step is reusing a post-industrial area and converting it into a green sustainable urban public space, which is presented through an alternative proposal in Istanbul city.

The theoretical framework of the research was made by examining the documents, data collection, and literature research on social ecology, biophilic planning and design, and sustainable development conditions.

The approach consists of different steps beginning with city analysis and its potential, resulting in a prototype trial plan for developing a biophilic public space. The operations include data collection, observation, case study reviews, and analyzing qualitative data in terms of primary and secondary data. To begin, thorough and efficient literature research and data collection in order to investigate numerous ideas linked to sustainability, eco-social systems, landscape urbanism, and biophilic design, as well as patterns, components, and attributes associated with these notions, are conducted. The methodology and significant principles for the framework were established in this study based on literature research and expert knowledge gathered from documents such as books, articles, research, thesis, or evaluations of similar sites as samples, articles in the media, and related websites.

Then, by evaluating the analytical study of each approach's examples (adaptive reuse, biophilic cities, eco-social cities, smart cities, etc.), each concept's table of guidelines and strategies was initially used as a simple pass-or-fail criterion. It starts with searching for suitable areas and analyzing available green spaces in the city.

The next step is physically visiting the area and photography. Afterward, a proto-design trial model will then be proposed by exploring urban challenges and opportunities, analyzing areas and buildings with potential green development, and reuniting green spaces in the urban fabric. The prototype design proposed site is evaluated by the concepts and features studied in the literature review section and visualized through a 3D virtual model and the application of Virtual Reality technology as an administration method, and an implementation tool. This study is concluded by the data obtained from studies and analyzed results from the proposed new areas and buildings.

Broadly, the methodology of the research process is done as follows:

- ***Efficient literature research and data collection on the studied topics***

Gathering information through books, conferences, articles, and websites about the approaches studied in this research; Sustainability, biophilic design approach, the concept of social ecology and eco-social designs, and landscape theory, as well as the study and selection of smart implementation tools such as Virtual Reality technology, are the first step of this study's methodology.

- ***Careful examination of the literature and theories in order***

All the theories studied in this study have been examined as a set and a sub-set in order. Also, the implemented samples are comparatively examined according to each approach.

- ***Analytical study of facilities that used studied concepts***

Each approach's case points and principles are carefully reviewed and used in the analysis and evaluation of case studies.

- ***Design approach proposal and 3d virtual proto-design trial model***

Urbanization is an endless phenomenon, and smart cities are growing day by day. Digitalization, artificial intelligence, Virtual Reality, etc., are the aspects of this rapid expansion. We can start making cities smart by making each of their buildings smart first. Introducing a Virtual Reality tour or walkthrough model of a city can make this process much faster and more accessible, and in order to do so, people and users must be educated.

A 3D model is created in SketchUp utilizing the observations of the physical establishment, maps, and case study pictures after reviews and analyses of the study location, the Şişecam bottle and glass factory. Afterward, a Virtual Reality visualization of the 3D model is provided.

- ***Evaluation of the proto-design trial proposal by the literature review features and observation via VR technology***

After providing an alternative proto-design for the factory's adaptive reuse, simultaneously visiting the real establishment and the 3D replica in Lumion software, and visually tracking changes to the VR model, and at the last stage, the simulation can administer via devices such as computers, tablets, smartphones and VR glasses to interact directly with the proposal of the reused factory.

The evaluation will be based on the before-after visual comparison of the proposed proto-design alternative. The proposed design is evaluated in tables and checklists due to all the literature review concepts and features and also the used methods and tools such as smart city principles and VR.

1.5. Limitations of the Study

In contact with the human resources unit of Şişecam bottle and glass factory to obtain an entry permit, it was determined that due to being personal property, an old study area, and lack of sufficient security, it is not possible to enter the factory buildings. Therefore, the images taken are only from the limited area of the factory and its vicinity. Moreover, since parts of this study have been done during the COVID 19 pandemic, findings and results may be affected by the pandemic's limitations. The factors and data of this study were collected between October 2021-April 2022.



2. DUTY OF URBAN CONCEPTS IN EVALUATING FEATURES OF URBAN SPACES

Empirical research on the concept of urbanization, has been conducted simultaneously with the world's scientific and technological developments, particularly during the last decade following the curiosities about urban spaces livability, quality of life, and urban spaces quality expansion. Furthermore, the experience of being citizens is obtained as a result of individual growth, cultural identities, and communication with one another in the urban environment and context. Combining these urban concepts can result in a high-quality urban environment. Urban space is the key instrument for integrating a city that incorporates numerous theories and concepts (İnceoğlu and Aytuğ, 2009).

2.1. Social Ecology

Social ecology is a dynamic field of research based on both social science and natural science traditions. In this paradigm, the main principles are:

- Human social and biological system interactions and development over time
- communities and environments
- The environmental impact of human activities

Social ecology, also known as human ecology, describes the ecological compatibility of plants and animals by analyzing human communities in the behavioral and social sciences and used in the early twentieth century to explain the social changes in the environment over time with the topic of social and spatial structure, mainly in the context of urbanization. The University of Chicago carried out researches with an approach of ecological concept from the 1920s to 1930s. Since the 20th century, this concept has been used with a new approach in social sciences, sociology, and urban geography and by paying attention to the cultural factor in human relations and the environment. Patrick Geddes, Mark Jefferson, Patrick Abercrombie, and Lewis Mumford are pioneers who used this concept in urban studies (Müller, 2015; Fakouhi, 2004).

Almost all of today's environmental problems are getting caused by severe social issues. Social ecology claims that the ecological crisis results from the hierarchy of power based on the structures of our society and the organization of the authoritarian mindset, while our current environmental problems are not clearly understood and are solved much less without dealing with the issues in society. Living beings and the environment are complex systems in which all lifeforms are related and Equally crucial to having a healthy and sustainable environment. Bookchin believes that human consciousness is the result of nature trying to increase complexity and consciousness (Bookchin, 1996; Bookchin, 2007).

Still, the existing environmental issues is not easily understandable or much less getting solved without finding solutions to issues within the society and is a demand not only for moral restructuring but also, most importantly, for social restructuring along ecological lines. The human is the nature of self-awareness and part of a biological evolution that Bookchin called 'First Nature, but he also has an unrivaled social consciousness called 'Second Nature.' Like every other species having nests, we build cities and towns to create a comfortable place to live. Still, the problem is that we produce much more significant environmental changes than different living types. Our Second Nature, the technology developments, sciences, social institutions, and towns, has become a problem for ourselves and another non-human lives. In social ecology, the idea that humans must control nature is studied as a "Hegemonic Mentality" that grows in the roots of our society. This ideology is a fundamental cause of environmental problems. In the social ecology concept, hierarchy is meaningless. Living beings and the environment are complex systems in which all lifeforms are related and equally crucial to having a healthy and sustainable environment (Clowney & Mosto, 2009; Bookchin, 2007).

2.1.1. Urban ecosystem

Within the severe land-use biome, and in ecology, urban ecosystems are considered as a functional ecosystem group (Keith & Corlett, 2022). For understanding of the ecosystem's concept better, we must get acquainted with the meaning of the word 'System' first. As the human mind may turn to objects, such as computers, clocks, etc., when it hears the word 'System,' so does the idea of nature, animals, and plants; play a role in our minds with hearing the word 'Ecology.'

Ecology defines as the ecosystem's science. Ecosystem is a geographical area that combines plants, living creatures, air, and lands interconnecting with each other to form a bubble of life. What complicates the ecosystem is the human being. Humans are creatures with particular characteristics and abilities (thinking, choice, flexibility, adaptability, decision making, influence, etc.), so they are able to build their systems on the natural ecosystem. People create a lot of different cultural systems and organizations on a large scale, including family, friendly groups, schools, associations, social institutions, ethnic origins, nationalities, religions, international institutions, and organizations, etc. Urie Bronfenbrenner, elaborated a theory called ecological systems theory which also known as context theory or human ecology theory, provides a framework in which community psychologists examine the individual's relationships within society.

The ecological systems theory, hierarchical defines four environmental systems shown in Figure 2.1 (Ettekal & Mahoney, 2017; Paquette & Ryan, 2001; Berk, 2000; Bronfenbrenner, 1990):

- ***Microsystem***

Explained by referring to the organizations that effect on the development of people, including their family, religious institutions, school, their neighborhood, and friends.

- ***Mesosystem***

Interrelationship between the microsystems (family, school, their neighborhood, friends, etc.) is called mesosystem.

- ***Exosystem***

It is including the bonds between social settings.

- ***Macrosystem***

It depicts the extensive culture that affects the growing human and the microsystems and mesosystems ingrained in that culture. Geographical location, social and economic standings, ethnicity, and poverty can impact cultural contexts.

People that belong to the same cultural community may have similar identities, histories, and values. Over time, macrosystems change and are passed on in generations.

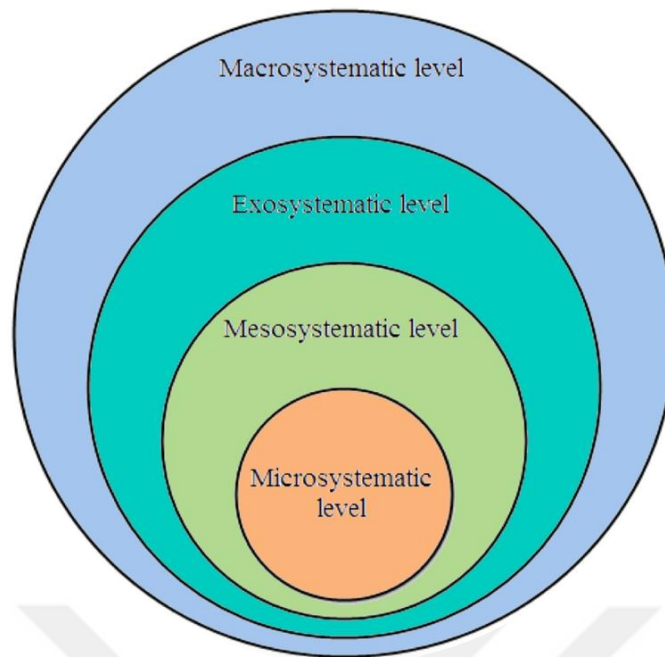


Figure 2.1: Hierarchical level of ecosystems (Bronfenbrenner, 1993).

2.1.2. The development of a social ecology approach to urban ecosystem

While social ecology, which is the study of numerous social species, is in the broader context of social-ecological analyses, the urban ecosystem method concentrates on the analyses of human ecological systems as a life science. As mentioned in previous topics, human instinct and the natural environment are not separated. As a result, we cannot research human beings as distinct social species compared to the ecology of other social species.

A social-ecological approach to urban ecosystems, often known as a human ecosystem approach, has just lately been articulated based on the ongoing growth of cities, and Human ecological systems are always in dialogue with other plants, animals, and human ecologies, as well as social sciences (Grove, 1997).

2.1.3. Urban wildlife

Cities are habitats. Thoughtful sustainable urban development makes cities safe and healthy homes for a group of species such as insects, birds, aquatics, amphibians, small mammals, and people. City dwellers may be aware of typical urban wildlife such as rats, dogs and cats, pigeons, crows, and seagulls, but they might not notice that a fox or a squirrel may be around. Animals that either live with people or in feral colonies are classified as 'urban wildlife.'

Urban wildlife adds a natural dimension to the city and allows residents to be in touch with nature every day. Different urban wildlife types are existing in every city, but their characteristics are all the same (USDA The U.S. Forest Service; Urban Wildlife Working Group, 2012; Ditchkoff, et al., 2006):

- Urban wildlife feeds general, which means they don't follow a fixed diet and eat various foodstuffs.
- They can and learn how to survive and adjust to new settings quickly despite drastic changes in their surroundings.
- They are tolerating living with the citizens much more, which makes them easily adapt living in the middle of crowded cities.

2.1.4. Eco-social designs with respect to urban wildlife

When it comes to cities, we frequently focus on the built and social environment, city structure, architecture, and social dynamics of citizens' lives; however, when we discuss city and nature interactions, we frequently refer to landscape and open spaces, green spaces, urban parks, water pollution issues, and other diverse ecosystem services that maintain and have an impact on 'human life.' Yet, the city is way more than just a collection of people, their possessions, and some natural areas. Cities are intricate ecologies that produce distinctive landscapes not just for people but also for a diverse range of wild animals, herbs, and other living being that coexist with humans. Urban wildlife biodiversity tends to decline as urbanization advances. However, many wild Creatures and plants prosper in cities worldwide, such as coyotes, foxes, raccoons, deer, squirrels and hedgehogs, monkeys, rats, and various insects and Reptiles. There are also different kinds of plants and herbs growing in urban settings. These species can all live in various metropolitan settings. Many domestic animals live in cities, and their numbers often significantly outnumber those of closely related natural species. Compared to their closest evolutionary, dogs and cats are the most prevalent species worldwide. "Urban wildlife ecology" refers to the complexity of interactions between wildlife and humans in urban areas (Lynn, 2014).

Every year, many wild or local animals drawn to urban environments from the margin forests are wounded or killed because of low animal passway standards. Cities should be designed in respect of urban wildlife needs and principles. John Hadidian focuses on biophilia, which he claims improves urban life for people and offers suggestions

for peacefully resolving issues with wildlife (Hadidian, 1998; Hadidian & Smith, 2001).

Animals can safely cross roads and highways using green overpasses, wildlife ecoducts and nature bridges. They often built out of dirt, and vegetation as an adequate habitat for a variety of different species. In some nations, the larger structures which are typically forests, meant for huge mammals such as deer, moose, coyotes, wolves, bears, etc. Below are some examples of urban wildlife overpasses in the world:

Ecoduct De Woeste Hoeve Bridge, Netherlands

The A50 motorway completely runs through the Netherlands, with traffic speeds exceeding 50 MPH, which hitting an animal would cause significant injuries and danger. The Woeste Hoeve is a wildlife overpass that was built in the year 1988 to make connection between the separated parts of Veluwe nature reserve. The Netherlands contains over 600 wildlife cross passes and ecoducts used to protect populations of wild animals (Figure 2.2) (Renard et al., 2008).

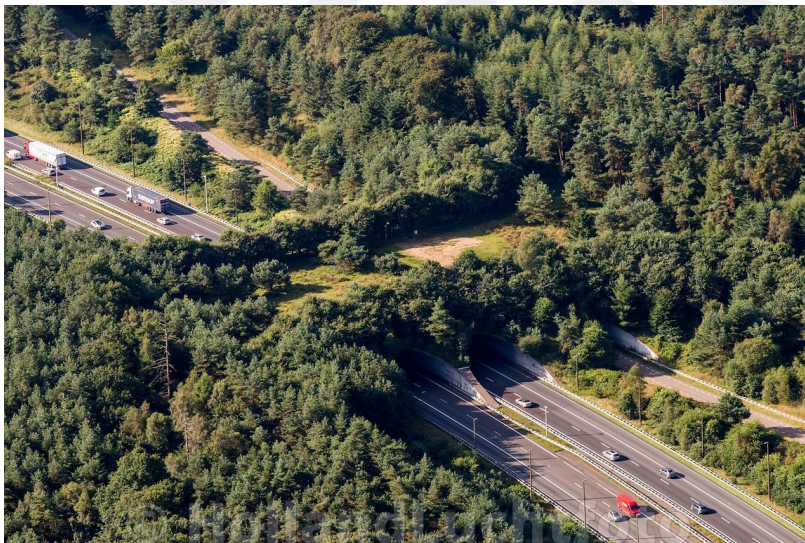


Figure 2.2: Ecoduct De Woeste Hoeve Bridge, Netherlands (Url-1).

Banff National Park, Alberta, Canada

The TCH highway in Alberta, is a long east-west connecting transportation passage, crossing Banff and Yoho National Parks in Alberta, Canada. In recent years, the TCH impacts on wildlife and habitat fragmentation have decreased by constructing safe wildlife crossing structures in Banff National Park. Currently, there are 41 wildlife passing structures, including six overpasses and 35 underpasses, in the Banff National Park, helping wildlife safely cross the busy TCH (Figure 2.3) (Clevenger et al., 2009).



Figure 2.3: Banff National Park, Alberta, Canada (Url-2).

Crab bridge on Christmas Island, Australia

Christmas Island is a destination for thousands of red crabs which migrate each year. The biodiversity of Christmas Island is directly affected by human-related changes to its landscape. Human activities caused an increase in the numbers of crabs getting killed crossing roads during their annual migration. Bridges and underpasses were built to protect the crabs from being crushed by vehicles, with the maximum ability for traffic to pass underneath while providing proper passage for crabs (Figure 2.4) (Beeton et al., 2010; Christmas Island National Park).



Figure 2.4: Crab bridge on Christmas Island, Australia (Url-3).

Generally, social ecology is a transdisciplinary field of science that analyzes society-nature interaction at all appropriate organizational, spatial, and temporal levels.

Combining expertise in social ecology, social sciences, and natural sciences with the humanities aims to provide the knowledge base for efforts progressing towards sustainability (Degato, 2017).

2.2. Sustainability

In recent decades, when environmental pollution and its neglect have reached their historical peak in the opinion of many experts, sustainability has found a better place in the mental model, language, and discourse of humans. The meaning of the word “Sustainability” is defined as ensuring the continuity of diversity and productivity and maintaining a constant ability. Sustainability generally refers to providing human needs without affecting the ability of future generations to meet their own needs. Sustainability not only includes nature and the environment but as we move forward, concerns about social justice and economic development intensify the attention on social and economic resources. Sustainability is a method of living that allows the living systems in which humans live to continue evolving indefinitely within the confines of the physical, environmental, and social resources that are now accessible (Wass et al., 2010; World Commission on Environment and Development, 1987).

Globally, the concept of sustainability, as a policy has its origins from Brundtland’s “Our Common Future” report in the year 1998. In that report, there was discussion of the conflict between nature's constraints and humankind's desire for a better existence. The three primary characteristics of sustainability over time have been social, economic, and environmental. The fourth sphere added by another theory, which claims that cultural vitality is just as important for a sustainable society as environmental effectiveness, social justice, and economic durability, is culture. Another essential concept in the discussion of sustainability is the well-being of future generations, which means that today's mankind must take care of the environment not only because of its intrinsic value but also in order to preserve the resources for the next generations. In general, sustainability is a concept followed by a complementary concept called "sustainable development," Even in some cases, these two meanings are used interchangeably. Brundtland's Report also states that humanity is able to achieve sustainable development by meeting its daily needs without compromising nature's the capacity to meet future generations' demands (Wass et al., 2010; World

Commission on Environment and Development, 1987; Hawkes, 2001; Kuhlman & Farrington, 2010; Wheeler, 2013; Weingaertner, 2014).

2.2.1. Sustainable development

In 1980, the title "sustainable development" was first turned into a vital subject in the world conservation strategy. With the release of two outstanding reports by Brundtland—"north and south a program for survival and common crisis" in 1985 and "our common future" in 1987, it attained a new position. Sustainable development has been created after the problems associated with the urban industrialization and the industrial revolution through the connection of different dimensions of action such as economic, social, and a particular focus on environmental issues, which researchers have recently discussed: (a) Environmental sustainability, which includes the application of best practices in energy management, transportation, waste, and pollution; (b) Social sustainability related to the promotion of trade and green service activities and the responsibility of individuals in society; (c) Economic stability that includes self-reliance and equality. which this study more focused on Social Sustainability and environmental sustainability (The World Commission of Environment and Development, 1987).

Sustainable development contains useful ideas for long-term health protection, promotion, and improvement as well as for addressing human demands without compromising the capacities of next generations. Therefore, operations managers must also examine product production's environmental and social impacts in addition to the economic dimension.

This study aims to discuss sustainability-related issues and to identify indicators and drivers of sustainability. All of the various aspects of development must be considered at once in order for sustainable development to be understood. These dimensions include environmental, economic, and social aspects. According to this definition, sustainability must be developed so that it is accompanied by social growth so that it meets the needs of all society members. Urban sustainable development is achieved by adopting the correct land use policy and land protection according to urban planning and space organization. The importance of cities is not limited to the political, economic, social, and environmental contexts of interpersonal relations.

Still, it is also necessary to know the human-nature relationship and humankind from a cultural perspective within the designed human environment. Unfortunately, cities are expanding, and urbanism is constantly growing, regardless of the environment, natural resources, and terrain (Cozens, 2002; Shearlock et al., 2000).

2.2.2. Social sustainability

While a larger body of literature exists on ideas like social capital, social cohesiveness, etc., there is little literature that focuses especially on social sustainability. Sustainable development often involves studying environmental issues, and after a while, the economy became important in sustainable development. However, social issues were on the sustainable development agenda only from the late 1990s, after Agenda 21 and the 2000 Lisbon Strategy, and most recently, the EU summit in Gothenburg (Figure 2.5); Social sustainability received significant attention in 2001 (Colantonio & Lane, 2007).

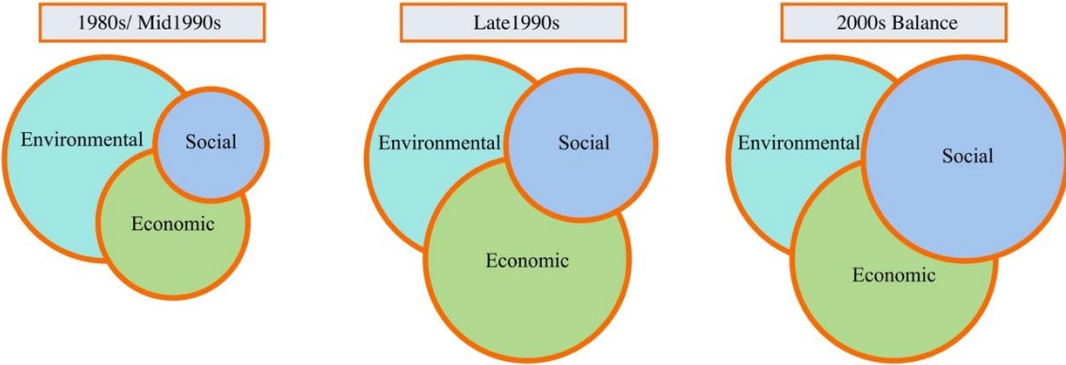


Figure 2.5: Various aspects of sustainable development and the rising significance of social sustainability in global context (Colantonio & Lane, 2007).

Features like education, security, participation, and institutional growth are all elements of social sustainability. The increase of urban civilization is consistent with social sustainability as a development or expansion; in fact, the goal of coexistence with social groups is to promote social integration and raise everyone in society's living standards. The goal of social sustainability is to close social gaps and minimize inequality (Polese & Stren, 2000).

The collective facets of social life have something to do with social sustainability. Some specific components of social sustainability are listed below as five dimensions, so that this type of social life can be explored:

- ***Social Interactivity /Social Networks***

When one person's action provokes a reaction or response from another person, this term is called social interaction. This social interaction is necessary to respond to human needs and their sense of Pride and community or place attachments. Social connection is what keeps a coherent community together; without it, they are merely a collection of individuals living their various separate lives. The underlying mechanism that supports both human nature and social order is sociability. Social networks and the people we know can directly affect other aspects of our lives, such as feelings of security and well-being. Social networks can be powerful, like our family or close friends, or weak, like the ability to recognize someone by sight. In the local stage, weaker networks could just as significant as big ones. Social networks and interactivities are related to the design, density, and use of different spaces in a city or neighborhood. A multipurpose public space facilitates social interaction due to the increasing range of people and users (Lang, 1987; Dempsey, 2006; Hirschfield and Bowers, 1997).

Occasional and informal meetings create the base for friendships development and everyday relationships of people. Social interactions are created to respond to individual needs and meet our social needs. People's Meeting and their increasing interactions with physical-social places promote people's attachment to those places (Lang, 1987; Dempsey, 2006; Hirschfield and Bowers, 1997; Wirth, 1964; Fischer, 1982; Skjaeveland et al., 1996; Alexander, 1979; Marcus & Sarkissian, 1986). Therefore, social contacts are a crucial component of social sustainability and foster inhabitants' feelings of engagement and sense of belonging. Increasing people's social interactions in one place will create the effect of social sustainability.

- ***Identity***

Many forces and factors shape an individual's identity, including genetics, environment, culture, etc.

Creating a sense of identity in human beings forms a two-way system of human-environment, and relations between individuals are developing by systematizing the presence of human beings in the environment. Since having an identity for human beings causes a sense of belonging and support in the environment, a sense of identity

and enjoyment of community support is required in order to live in the environment and interact with it.

In general, places with strong identities can strengthen social bonds and help shape social identities. People who commute to a place for a long time have enough time to identify that place. This collective identity creates collective growth and dynamism, increases social communication and a sense of social solidarity. (Schultz & Schultz, 2013; pol, 2002; Yancey, 1985)

- ***Pride/Sense of Place***

Sense of belonging means a strong connection and an influential factor between people and place, which is a positive connection and causes the expansion of the depth of communication and interaction with the environment, and deepens and expands over time.

Belonging to the environment is also a psychological feeling that brings people and the environment closer. Schultz considers belonging to a place to have an existential basis. With a sense of belonging, human beings are considered part of the environment and find a sense of ownership over it. A component of social-sustainability regards positive interactions with a place because it plays a crucial role in people's pleasure of their surroundings. Spatial features can enhance spatial belonging. Some places have such a sense of attraction that it makes a person lively, fresh, and interested in returning to those places. Belonging to a place is not just an emotional and cognitive experience. Cultural beliefs, as well as long-term experience in the place, can lead to this connection (Relph,1976; Tuan,1980; Nash and Christie, 2003).

Steel divides general factors affecting the sense of belonging into two categories: physical factors and cognitive-perceptual factors. The most important physical factors include size, scale, components, variety, distance, texture, color, smell, sound, temperature, and visual diversity. The most critical cognitive-perceptual factors include cultural, identity, history, entertainment, security, vitality, and memories. Since pride and a sense of place are thought to have an impact on how a location is seen as having value, they are closely tied to the built environment (Relph,1976; Tuan,1980; Nash and Christie, 2003; Low & Altman 1992; Steel,1981; Talen, 1999). In other words, a sense of belonging is making by creating collective life and social

interaction. It makes security and social acceptance for the members of that society, which is one of the human beings' most important psychological needs.

- ***Safety and Security***

Social sustainability critically depends on residents' perceptions of their community's safety. One of the most important human drives and desires is security. Maslow puts the need for security in his pyramid, “the Hierarchy of Needs,” immediately after physiological needs (Figure 2.6).

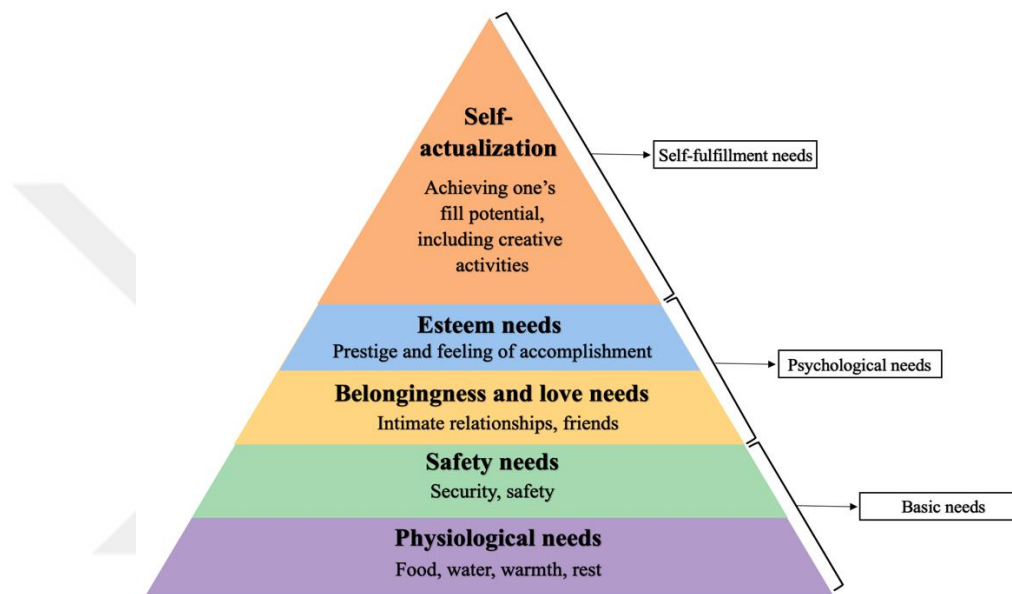


Figure 2.6: Maslow, Hierarchy of Needs (McLeod, 2007).

The sense of security is a psychological-social phenomenon with various dimensions. This feeling stems from people's direct and indirect experiences with the environment, and people experience it differently. The more secure a person feels about his environment, the easier it is to engage in social interactions in that environment. In a free-of-disorder and crime neighborhood, people can feel safe in social interactions and participate in social activities (Barton, 2000a; Lang, 1987; Chapman & Lombard, 2006; Worpole, 2003; Nash and Christie, 2003).

One way to create security is to strengthen a person's sense of belonging to the physical environment because some human needs, such as identity and motivation, are met in this way. Inter-connections of safety and built environment, provides several aesthetics and building facades; For instance, active frontages such as the building's Exterior materials or windows that directly open to the streets. The built environment's poor upkeep and condition have a negative psychological impact on people's perception of

safety. The notion of no attention to a particular neighborhood will increase insecurity and crime in that area, as the “broken window theory” states that injuries in the city’s appearance can lead to more anti-social severe and even criminal behavior (Barton, 2000a; Lang, 1987; Chapman & Lombard, 2006; Worpole, 2003; Nash and Christie, 2003).

The broken window effect is a theory in criminology. This theory states that seeing a broken window in a house, factory, or the like gives people the message that there is no order. This theory states that monitoring and maintaining urban environments in good condition may prevent further sabotage and aggravate more severe crimes. This theory was developed by James Q. Wilson and George L. Kling in 1982.

- ***Participation in the Community***

The literal meaning of the word “participation” is a gathering of individuals for a specific mutual purpose. there are two other points of view for participation: (a)from a sociological point of view; participation means a sense of belonging to a group in which voluntary participation leads to a social activity, (b)From the psychological standpoint, it is a mental phenomenon and a process of self-learning that has become part of people's culture. According to the principles of developmental psychology, citizen participation is a positive event for society and citizens. In other words, social participation is the people's involvement in creating and managing their surroundings' natural and artificial environments. Creating solidarity relationships for urban dwellers and social relationships is one of the sustainable aspects of urban life. Individuals' participation in their local community depends on their perception of public safety (Arnstein, 1969; Mannarini et al., 2009; Chapman & Lombard, 2006; Marans & Rodgers, 1975; Wasserman, 1982). However, it cannot necessarily be concluded that if organized actions do not occur in a neighborhood, such behavior is necessarily not socially sustainable. These days people have over-participated in different types of social networks, that they may not able to regularly get involved in local group activities or share their specific interests. In addition, individuals may no longer be willing to participate physically.

2.2.3. Environmental sustainability and sustainable city

Protecting natural resources is a requirement for environmental sustainability, which means people must use less energy, water, and renewable resources than what

biological systems can support. Urbanization Increasing, air pollution and industrialization are causing climate change and global warming, destroying ecosystems. This lost ecological balance leads to the destruction of all ecosystems, which will take hundreds of years to restore. According to UN-Habitat, cities are the largest contributors to greenhouse gas emissions and the most vulnerable to climate change, with cities currently accounting for 80% of global CO₂ emissions. Rapid urbanization raises city carbon emissions and puts more city residents at risk for climate change. Yet, because they can act quickly to implement the best local solutions, cities with a focus on sustainability have a better chance of preventing and resolving climatic challenges as well as enhancing human well-being. Therefore, cities need to minimize interventions in nature and create conditions that can create an integrated system, ensure the survival of all creatures and move towards sustainability. A sustainable city can only survive by using resources economically, avoiding excessive waste and recycling as much as possible, and adopting beneficial policies in the long run. In contrast to today's modern metropolis, a sustainable city has a significant intake rather than a significant output. The goal of sustainable city planning should be to create cities that utilize less energy, waste, and pollution. A sustainable city is one that is created so that all of its citizens can fulfill their needs and raise their degree of wellbeing, both now and in the future, without endangering the environment or endangering others' way of life. Planning and designing a sustainable city has certain rules and principles. These principles include the following (Unido, 2016; Turner,1996; Burton et al., 2000):

- Today's decisions should not jeopardize future generations and their living choices.
- Natural resources should be used fairly; other societies ' sustainability should not be sacrificed for one sustainable society.
- Using non-renewable resources as little as feasible is recommended. The utilization of renewable resources shouldn't exceed their output.
- Establishing strong cooperation and extensive communication between people at all levels of society.
- Paying attention to cultural, economic, and environmental diversity.
- A healthy, lively, and safe environment is necessary for human interaction, education, employment, fun and healthful leisure time, and the development of culture.

2.3. Green Architecture/Sustainable Architecture/Green Building

A building style known as "green architecture," "sustainable architecture," or "green building" is a theory that is based on eco-friendly design concepts. Green architecture arises from sustainable architecture and meets the needs of today's societies in confronting the negative consequences of industrialization. A strategy known as "green architecture" seeks to reduce negative effects on both the environment and human health (Ragheb et al., 2016; Roy,2008).

A green building is defined as ‘a procedure to improve the quality of a structure’ whose situation and location, as well as the way it incorporates natural components, lowers the negative impacts of buildings on human health and the environment" by the United States Green Structure Council (USGBC).

In general, there are various principles in creating green buildings, the consideration of which will create balance and green architecture (Susan, 2008; Sheweka & Magdy, 2011):

- ***Water Systems***

It is possible to collect, store, filter, and reuse water. It offers a priceless tool to be grateful for during the green building design process.

- ***Natural Building***

Sustainability is heavily emphasized in a collection of building techniques and materials utilized in natural buildings.

- ***Passive Solar Design***

Passive solar design is the process of using solar energy to warm and cool interior spaces. In order to absorb heat produced by exposure to the sun, the building makes use of its own natural energy sources or those of some of the components that make up its structure.

- ***Green Building Materials***

Since the environmental impact is considered over the course of the product's lifetime, renewable resources are commonly used in place of non-renewable ones in green construction materials.

- ***Living Architecture***

Like human beings, the ecosystem is capable of metabolizing nutrients and waste. In order to store and filter water, clean the air, and process other nutrients, living architecture incorporates ecological processes into its buildings. Living Architecture also addresses biophilia, which is connected to environmental awareness, good physical and mental health. This is the reason that greening building walls, roofs, and other exteriors has always been done. By creating habitats for birds and insects, these strategies improved insulation (keeping a building cool in the summer and warm in the winter), reduced greenhouse gas emissions, and enhanced ecological values.

Recently, Green/sustainable building construction has become more popular in many countries. Below are some worldwide case examples of green architecture and green buildings:

Parkroyal Collection Pickering, Singapore

The Parkroyal hotel has 15,000 m² of sky gardens, reflecting ponds, waterfalls, planter terraces, and green walls as part of its landscaping (Figure 2.7). Other environmentally friendly features include rainwater and natural light collection, an energy-efficient air conditioning system, automatic sensors to control carbon monoxide levels, energy and water usage, and solar cells to power landscape lighting. A thorough leak detection and water usage monitoring system is also developed to quickly identify and address problems. To reduce potable water consumption for purposes such as cooling towers, rainwater gathering and NEWater use have been implemented.

Furthermore, drip irrigation for landscaping, combined with irrigation controls using rain sensors, is predicted to cut potable water consumption significantly (The Singapore Engineer, 2012).



Figure 2.7: PARKROYAL Collection Pickering (Url-4).

One Central Park, Sydney, Australia

The ecologically sound tall skyscraper known as One Central Park is located in Sydney's CBD (OCP). A planted air conditioner, solar system design, and shade-producing plants all contribute to the natural integration of urban life (Figure 2.8). In order to earn an Australian Green Star rating, OCP provided a 26% reduction in energy use in comparing with the New South Wales average and boosted energy efficiency compared to the generally low energy efficiency of residential high-rises.

The essential element of green facades is living walls comprised of various plants, including vines on supports and cascading plants. The plants are watered using a storm water collection system tank. Additionally, there is a 5-kilometer network of linear greenery, which offers constant shading and lessens the impact of temperature of the residence (Figure 2.9) (Nouvel & Beissel, 2014).



Figure 2.8: Hanging reflectors from the sky garden (Url-4).



Figure 2.9: Building's carved deep vertical slots to allow light and air (Url-4).

CopenHill WtE plant, Copenhagen, Denmark

The Copenhill Waste-to-Energy (WtE) facility, which is being built in a residential neighborhood of Copenhagen, is redefining the concept of a WtE plant. Copenhill is an example of integrating waste-to-energy facilities into an urban environment and collaborating with locals to achieve societal acceptance of the waste-to-energy sector's activities. Copenhill is, in other words, the first WtE-plant of a newly redesigned concept. Copenhagen, Denmark's capital city, which is where the man-made mountain

of Copenhagen was built, is currently supported by one of the largest design and construction firms in Copenhagen and New York City, which works in the fields of architecture, urban research, urban planning and development, and public recreational spaces such as a ski resort, hiking and athletics area, snowboarding area, as well as a place for rock climbing (IEA Bioenergy, 2020).

Copenhill, which is approximately 2 kilometers from the Royal Palace, has an unusual architectural design that features a recreational space on the facility rooftop that includes an all-year skiing slope as well as a climbing wall on the facade.

The plant's location was linked to both technological and economic considerations. Building the new incineration plant on the same site as the previous one allowed Copenhagen to save money by utilizing existing infrastructure to supply power and heat to the city's network. Furthermore, the plant's placement in a city decreases waste transportation significantly, lowering both costs and emissions (IEA Bioenergy, 2020).

Copenhill's contribution includes economic, environmental, policy and social aspects. Copenhill earns money in two ways: charging a gate fee for incoming rubbish and selling heat and power to the market. The plant's connection to the district heating network allows it to sell heat year-round at nearly total capacity.

Because Copenhill is adjacent to the areas where district heating is required, it is simple to transmit the energy generated by the facility to the local network, resulting in a more viable business case. Furthermore, the facility is located in a residential district of Copenhagen and has a recreational area on its rooftop, necessitating additional work to ensure that environmental performance is satisfied (IEA Bioenergy, 2020).

No dust from trash transportation and low as possible emissions from the facility was essential to provide a healthy environment for individuals living in the vicinity and using the recreational areas.

Copenhill's most significant accomplishment has been to apply existing technologies in a novel situation. The sulfur dioxide is removed with lime, the dust in the smoke is removed with a dust filter, and the moisture is condensed into water. The process produces condensate and wastewater dumped into the sea after treatment. To demonstrate that the released water does not pollute the sea, it must meet metal content limits established for drinking water (Figure 2.10) (IEA Bioenergy, 2020).



Figure 2.10: CopenHill WtE plant (Url-4).

Bosco Verticale, Milan, Italy

Bosco Verticale or the green skyscraper is a vertical forest built in Milan, Italy. There are more than 13,000 plants from 90 different species on all building's facades. The restraint system, linked to the structural design, provides three levels of protection from falling trees. Inside each plant container are two humidity sensors that measure the substrate's humidity: one next to the water distribution point and the other on the opposite side of the distribution point (Giacomello, 2015).





Plant selection, as well as structural and system design, were completed effectively, all of which were linked by a strong architectural identity. The Bosco Verticale, on the other hand, faces new obstacles. Maintenance efforts, which consume energy and money, will play a critical part in its plants' health, attractiveness, and longevity (Figure 2.11) (Giacomello, 2015).



Figure 2.11: Bosco Verticale (Url-4).

A list of studied green buildings from around the world that combine sustainable architecture with new concepts has been evaluated according to the green architecture principles in Table 2.1. The four study cases sustainable and green features are evaluating according to water system elements, natural buildings, passive solar designs, green building materials and living architecture. the results showing that all of the cases almost response to above mentioned features and components, which can be concluded that most of the sustainable and green buildings are following all of the green design features.

Table 2.1: Case examples evaluation according to green architecture principles.

BUILDINGS	PHOTO	WATER SYSTEM	NATURAL BUILDING	PASSIVE SOLAR DESIGN	GREEN BUILDING MATERIAL	LIVING ARCHITECTURE
Parkroyal Collection Pickering		<ul style="list-style-type: none"> ✓ leak detection and water usage monitoring system ✓ drip irrigation ✓ rain sensors 	<ul style="list-style-type: none"> ✓ leak detection and water usage monitoring system ✓ energy efficiency ✓ air-conditioning system 	<ul style="list-style-type: none"> ✓ solar cells 	<ul style="list-style-type: none"> ✓ green walls 	<ul style="list-style-type: none"> ✓ irrigation and cooling tower ✓ automatic sensors to regulate energy and water usage
One Central Park		<ul style="list-style-type: none"> ✓ on site storm water collection tanks 	<ul style="list-style-type: none"> ✓ energy efficiency ✓ air cleaning veil ✓ system of linear slab edge planters 	<ul style="list-style-type: none"> ✓ sun tracking heliostats ✓ passive solar power system 	<ul style="list-style-type: none"> ✓ mixed living walls ✓ green facades 	<ul style="list-style-type: none"> ✓ water fertilizer unit according to the plants demands ✓ programmable solenoids
CopenHill WtE plant		<ul style="list-style-type: none"> ✓ waste-water metal content limits system 	<ul style="list-style-type: none"> ✓ green roof 	<ul style="list-style-type: none"> ✗ 	<ul style="list-style-type: none"> ✓ integrating waste-to-energy facilities 	<ul style="list-style-type: none"> ✓ sulfur dioxide reduction technologies ✓ wastewater dust removal
Bosco Verticale		<ul style="list-style-type: none"> ✗ 	<ul style="list-style-type: none"> ✓ deployment of greenery in all directions ✓ retention, safety, and irrigation systems 	<ul style="list-style-type: none"> ✗ 	<ul style="list-style-type: none"> ✓ live green façade 	<ul style="list-style-type: none"> ✓ irrigation systems ✓ falling trees restraint system ✓ humidity sensors

2.3.1. Green museum

People behave in the natural environment based on their culture and their societal views and values. A perspective on nature is also influenced by one's background and experiences. Many issues are related to the human culture of consumerism. Scholars argue that the effects of these acts might result in Earth's failure to survive, and human

activities must reform to prevent this crisis. Increasing educational achievements is a sustainable development preference and has benefited other social and environmental issues, including climate change. A sustainability culture shows a collective responsibility to understand the humanity's cultural legacies and natural values. As stated earlier, culture, defined as the transmission of human beliefs, values, and life goals, is the fourth tenet of sustainability. Meanwhile, it is clear that culture refers to arts and history heritage. The way of humans understanding of environment is defined by culture and their beliefs about the concept of sustainability. Every citizen and human community must take responsibility for their impact on the environment. To achieve sustainability, which calls for changes in human culture, their attitudes and behaviors must reflect the interdependence between the population, the environment, and the future. Recently the climate change policies and sustainability issues have found their way into museums (Scarpino, 2004, p. 147; Worts, 1998, 2003, 2004, 2006; B. O'Neill et al., 2020; De Varine, 2006; Hawkes, 2001).

Museums are defined as permanent nonprofit institutions dedicated to society's advancement. Museums are open to the public, communicate, exhibit, and research to study, educate, and enjoy their surrounding environment (Copenhagen's 10th General Assembly of International Council of Museums, 1974). American Association of Museums defines museums as non-profit institutions essentially educational or appreciative, with a professional organization that exhibits regularly utilizes the public. According to this definition, a museum is a service provider for the distribution of knowledge. Museums are different in their sizes and functions. They do, however, have some features in common. Museums include collections in a various range of disciplines, including art, history, nature, science, and technology, are kept in museums. While some museums, like aquariums and botanical gardens, also house living collections, others, like planetariums and children's museums, are not.

Museums attract a broad audience, including tourists and local citizens, for a social experience and not limited to any specific age range. In museums, visitors can make emotional and intellectual contact with each other and share inspiring objects or ideas. Also, people can communicate with others who share similar thoughts or interests (McLean, 1993; Skramstad, 1999).

The primary goal of museums is education. Using their collections, museums provide educational programs (American Association of Museums, 1992). Museums education

can show people, as citizens, how everyday choices affect the Earth and its future. As ethical organizations, developing new perceptions about the nature is one of museums responsibilities to. Museums reflect and create history and culture through the exhibition and interpretation of objects. Museum education can lead visitors to shape and transmit culture, connecting new knowledge and their thoughts while giving people's individual and collective life purpose and worth. The daily activities and programming of museums can be made more sustainable, which helps them take a more proactive approach to environmental challenges. Such establishments are referred to as "Green Museums" (Link, 2006; Scheiner, 1997; Sullivan, 1994; Skramstad, 1999; Brophy & Wylie, 2008).

Green museums are among the organizations working on long-term educational projects, ecologically friendly infrastructure, and green companies. Children's museums were the first to adopt green practices and try green design in order to create healthy indoor environments for its young visitors, but recently, museums, like all other uses, have gone green. As a recent innovation in museum administration, Green Museums is receiving a lot of attention from the professional community (California Association of Museums, 2008, Brophy & Wylie, 2008; Judy, 2006; Madison Children's Museum, 2008; De Varine, 2006; Sutter, 2006; Worts, 2006).

Green museums are part of the solution for global environment degeneration while developing their missions and engaging their communities. There are several ways museums can practice green practices, including some common collection care practices like employing recyclable materials and proper ventilation techniques. Museums implement new green efforts and ways they can incorporate sustainable practices into their performances.

Forming a "green team" is another way museum can establish sustainability in their operations. Green teams are made up of a number of enthusiastic employees who promote eco-friendly decisions at their workplace. They are in charge of introducing green practices and instructing the personnel about them. Going green can benefit museums in a number of ways, including financial savings, increased public support, increased attendance, and a favorable impact on the environment (Brophy & Wylie, 2008). Table 2.2 is adjusted according to green museums possible characteristics (Byers, 2008).

Table 2.2: Green Museums possible characteristics (Byers, 2008).

Green Museums	
Energy Efficiency	Natural Lighting
Recycling	Water Efficiency
Reuse Materials	Native Landscaping
Green Architecture and Technologies	Green Roof and Walls
Historic Preservation	Source Use Reduction

Exhibitions are a component found in all museums and the most well-known and generally available museums offerings. Exhibits are artistic forms that seek to inspire spiritual interactions and capture the core of the museum experience because they are the main appeal for the majority of visitors. Exhibits are three-dimensional mass media of visual and artistic expressions where provide an engaging environment where people interact, communicate and educated (Figure 2.12).

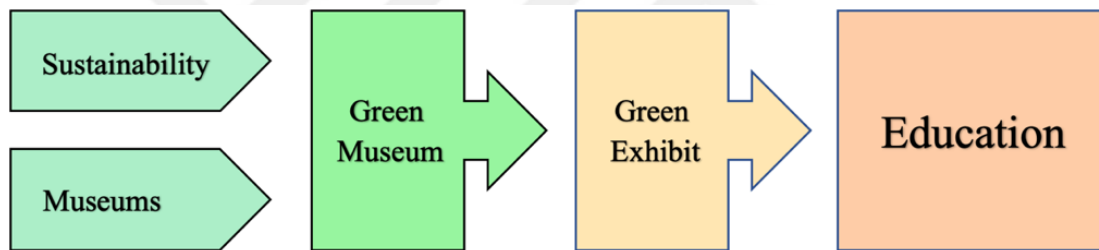


Figure 2.12: Green museums objectives (Byers, 2008).

One of a significant aspect of exhibitions and museums is social experience. Exhibitions are communicating sustainability through their designs and contents. A green designed exhibit is built and exposed using green design principles. In green design exhibits, the museum itself has become a subject of the exhibition (McLean, 1993, 1999; Gurian, 1999; McLean, 1993, p. 17; Abeyasekera, 2006). The green exhibits characteristics are shown in Table 2.3 (Byers, 2008).

Table 2.3: Green Exhibit possible characteristics (Byers, 2008).

Green Exhibit	
Design for Reuse	Multiple Purposes
Reused and Recycled Materials	Healthy Indoor Environment
Energy Efficiency	Sustainable Wood Stands

2.4. The Role of Adaptive Reuse in Landscape Urbanism and the Performative Cultural Landscape

The ideal method to arrange cities, according to the "landscape urbanism" urban planning philosophy, is to design their landscapes rather than their structures. In the mid-1990s, the term landscape urbanism was coined. Since then, the landscape has evolved into both a lens and a medium for representing and presenting contemporary cities. Landscape urbanism has derived in the last decade as a critique of traditional urban design's academic and professional commitments, as well as an alternative to "New Urbanism." Landscape urbanism's critique of urban planning focuses on how quickly cities are expanding and how much of urbanization in Western Europe and North America is currently being fueled by automobiles. Landscape urbanism emerged in reaction to the quick development of, and change inside, cities and the increase of environmentalism and ecological awareness (Waldheim, 2006; Corner, 1999).

Landscape architects, such as James Corner's, provide four interrelated themes around which to structure the growing landscape urbanist actions:

- Time related Ecological and urban processes
- Horizontal surfaces staging
- Methods of operations or working
- The imaginary

According to James Corner, landscape urbanism is not natural in and of itself but rather a region where nature predominates while still being affected by human activity. While the contemporary landscape is often concerned with creating alluring sceneries, landscape urbanism is based on an awareness of the process and how things work in space and time. Landscape urbanism acts as a new point of view to see the urban sphere, and it aids in giving abandoned sites a new lease on life. Several initiatives throughout the world have shown to be successful in altering the direction of urban design and landscape architecture. As a result of the advent of this new instrument, post-industrial areas can now be reclaimed in a creative and long-term manner. Landscape urbanism offers an alternative to traditional urban planning's rigidity by recognizing that urban ecology extends beyond the natural sciences to include human-designed interactions as well as plant-nonhuman animal interactions. Landscape urbanism represents cultural, social, political, and economic symmetry with the natural

world as a synthesis of performative and representational issues (Waldheim, 2006; Corner, 1999).

Today's culture is accustomed to recycling as we seek to protect the environment. We breathe new life into everything from bottles and cartons to clothes, cars, and structures by minimizing, reusing, and recycling the waste. "Adaptive reuse" is the transformation of discarded or useless objects into new ones that may be utilized for a new function. Therefore, nothing but only the item's use changes from time to time. With the expansion of urban density and tall and compact buildings, the need to build new buildings in large cities is saturated. But as large cities are constantly evolving culturally due to population growth, the need for public spaces and collective cultural venues is also growing. Since cities have a large number of abandoned historic buildings, adding a new use to these buildings can not only save a lot of costs (energy, time, construction, monetary costs, etc.) but also provide many other benefits, such as preventing the devastating damages to the city, caused by abandoned buildings. The heritage value of the structure and its surroundings should not be adversely affected by the adaptive reuse of a historic property. Developers must first figure out why the structure is designated as historical and then look for ways to repurpose it to respect the structure. Adaptive reuse is self-defeating if the building's heritage values are not preserved (Commonwealth of Australia, 2004).

The best adaptive reuse designs are for buildings with a rich history recognize and preserve, that significance while also adding a modern layer. Adaptive reuse is occasionally the only choice when it comes to adequately preserving, disclosing, or interpreting a building's fabric while maximizing its utility. When a building's original purpose is no longer viable, it may be necessary to modify it for a new purpose to preserve its historical significance. When examining the development of heritage places, some state bodies are developing strategies to manage change, including adaptation. Standard criteria are included in such regulations to help ensure that an adaptive reuse project has the least amount of influence on a building's heritage values, such as (Commonwealth of Australia, 2004):

- Following "façadism:" the theory or practice conserving magnificent architectural designs on building fronts.
- The new construction must be recognizably Integrated with the building, rather than a bad copy of the building's original historical style.

- Assign a new application for the structure compatible with its previous purpose.

Long-term development of communities requires Building adaptive reuse. As a result of the advent of landscape urbanization, post-industrial sites can now be recovered in creative and long-term ways. There are various benefits in different aspects for Adaptively Reusing Heritage Buildings and Post-Industrial Sites Regeneration as follow (Commonwealth of Australia, 2004):

- ***Environmental***

Since historic buildings make such a significant contribution to the landscape, identity, and amenity of the communities in which they are located, the environmental advantages of their reuse are amplified.

Embodied energy is One of the significant environmental advantages of reusing structures.

- ***Social***

Communities that cherish historic structures benefit in the long run from their preservation and use. Adaptive reuse can help maintaining and restoring a building's historic significance.

The reuse of heritage buildings in established communities can create new recreational, cultural, and commercial property options. Repurposing historic structures in existing neighborhoods can produce new opportunities for commercial, cultural, and recreational real estate.

- ***Economic***

The adaptive reuse of historic structures has a number of financial advantages and returns due to the embodied energy savings from delaying demolition.

2.4.1. Case examples of landscape urbanism, adaptively reusing heritage buildings and post-industrial sites regeneration

Many sites were abandoned after post-industrialization, resulting in so-called void zones in the center of cities. As a result of the advent of landscape urbanism, post-industrial areas can now be recovered in creative and long-term ways.

The bellow presented case examples are good instances of how these blank spaces can be turned into a public recreational center, which are essential in any city to bring itself

to life. These might serve as an example for numerous post-industrial locations that are left unoccupied, with the risk of dangerous pollution, which is why these places remain empty.

Kelvin Grove Urban Village, Australia

In June 2000, the Queensland Government acquired the former Gona Barracks location from the Department of Defense. The Department of Housing, working with Queensland University, transformed the barracks and adjacent property into the Kelvin Grove Urban Village. It will host QUT services like a physical exercise and health center and an Institute for Health and Biomedical Innovation in addition to public and private housing, commercial, retail, and mixed-use developments. The Creative Industries Precinct was the first area of the neighborhood to be developed and inhabited (Figure 2.13). Thanks to inventive adaptive reuse, a sizable inner-city Brisbane block that once housed abandoned army barracks is now the location of a cutting-edge urban renewal project.

The Queensland University of Technology (QUT) and the Queensland State Government renovated the area into a Creative Industries Precinct today, with new activities including creative arts, design, journalism, fashion, drama, and film devoted to the buildings (Figure 2.14) (Carroli, 2012).



Figure 2.13: Master Plan of Kelvin Grove Urban Village (Carroll et al: Hassells Pty Ltd).



Figure 2.14: Comparative images of Kelvin Grove Urban Village before and after regeneration (KGUV Innovation Implementation Report, Garred, 2007).

Sümerbank Kundura Beykoz Factory, Turkey

In 1804, on Selim III's order, a paper mill was first erected in the mill pit at Beykoz Hünkar Port. In 1810, a tannery was established next to the paper mill. Following Mahmut II's purchase of the tannery in 1812, the business began producing military shoes, boots, and harnesses. After the Republic was declared, this industrial space operated as Sümerbank Leather and Shoe Factory.

In 1955, the factory's yearly capacity reached 860 thousand pairs. In 1968, 2 million pairs were produced, followed by 2,5 million pairs in 1977. Following the decision to privatize, Beykoz Kundura was integrated into Yldrm Holding in 2004. Since then, it continued to serve the creative industry, remaining true to its long-standing cultural value. With multiple shooting offers, Beykoz Kundura has transformed into a movie set serving the series and film business since 2005.

Today, Beykoz Kundura is a professional venue rental organization that provides cultural events in line with today's dynamics in a stunning location across the Bosphorus, being among Turkey's most important cultural and historical values with a history spanning over two centuries. This industrial sector, which was in continuous operation from the Ottoman period to the Republic, is undeniably a rich cultural resource because it contributed significantly to the Turkish economy (Figure 2.15) (Url-8).

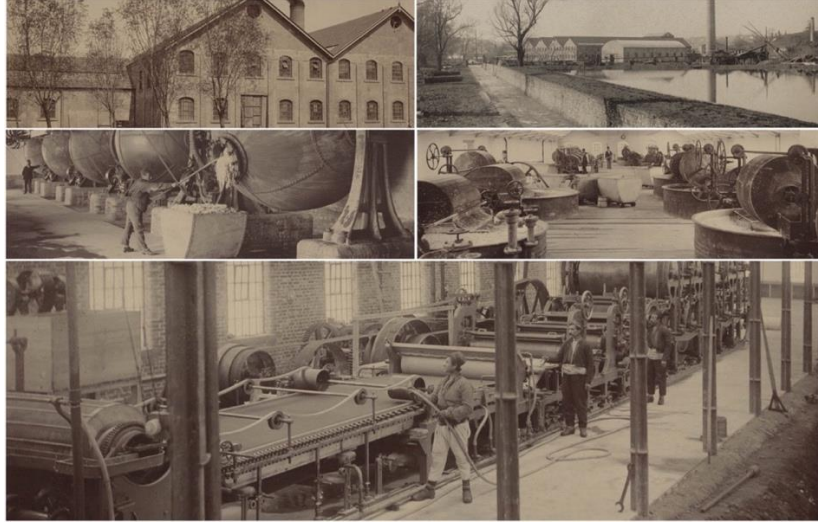


Figure 2.15: Old images of Sümerbank Kundura Beykoz Factory (Url-8).

Beykoz Kundura acts as a movie set for tv series and movies, with loads of projects being carried out via its green box and modern fiber infrastructure, in addition to extensive scenery, with the influence of the historic ambiance leftover from a closed factory. In Beykoz Kundura, there are a variety of locations for film and photoshoots. The majority of these places are certified and grade II listed historical buildings carefully preserved by the executives at Beykoz Kundura. These rooms hold corporate events such as premiere nights, launching assemblies, meetings for various brands and firms, and acting as a set for TV series, film, and catalog shoots (Figure 2.16) (Url-8).



Figure 2.16: Sümerbank Kundura Beykoz Factory cultural texture (Url-8).

With the responsibility of preserving this heritage, the Beykoz Kundura team presents a variety of events in the former industrial space of 183 declares that are both inspired by the past and up to date with today's standards. Beykoz Kundura is currently active

as a gathering place for creative ideas. It continues to thrive along the Bosphorus, adding to the cultural values it has accumulated in the past (Figure 2.17) (Url-8).



Figure 2.17: Sumerbank Kundura Beykoz Factory exhibits (Url-8).

Landschaftspark Duisburg Nord, Germany

Landschaftspark Duisburg Nord (North Duisburg Landscape Park), located in one of the highly populated Ruhr Districts in Germany, makes a marked break with this history. It represents a unique approach to the urban cultural environment, accepting its industrial legacy and significantly altered natural circumstances. It is a landmark in landscape design. Latz + Partners have built a location of remarkable beauty that will serve as a memorial to the industrial facilities for future generations on the location of a former industrial blast furnace. From 1989 to 2002, the 230-hectare project was developed over thirteen years in different stages. It comprises numerous layers of design elements that work together to produce a feeling of orientation that allows an exceedingly complex site to be interpreted on a human scale (Figure 2.18). A railroad park, consisting of raised ribbons of old rail-beds and other structures of a formerly artificial topography (Figure 2.19). Among the significant aspects, a new footbridge, low-level water park, and vegetation woodlands can be mentioned. Within this physical framework are intertwined Secret Gardens hidden in old storage bunker buildings, a central Blast Furnace Park with high observation platforms, climbing walls, rock gardens, and public spaces. The park's principal event and gathering venue are the Piazza Metallica, located in the park's symbolic heart. The park has grown popular

with local inhabitants due to its unusual design and distinctive new recreational activities (Stilgenbauer, 2005).



Figure 2.18: Landschaftspark Duisburg Nord, Tourismus NRW e.V. (Lisa Menke) (Url-9).



Figure 2.19: Landschaftspark Duisburg Nord (Url-10).

Gas Works Park: Seattle's strangest park, United States of America

Since it was designated as a public park in 1975, Gas Works Park has attracted curious residents of Seattle as well as visitors to its unusual location. One of Seattle's most well-known and divisive city parks is Gas Works Park. There formerly stood a Native American fishing town there. Then there was the location where trash from Seattle was burned. It eventually changed into a facility that produces gas (Figure 2.20). The city of Seattle bought what had been a coal gas plant from 1906 to 1956 in the 1960s

with the idea of establishing a park on Lake Union's northern shores. Richard Haag's park design is forward-thinking in using bio-phytoremediation to treat soil that previous industrial processes on-site had contaminated. The most toxic soil was piled up and covered with clay. After changing the application, the soil got detoxicated. The settlement is currently use for a public park called the gas work park or Seattle's strangest park (Figure 2.21) (Radmer, 2014).



Figure 2.20: Gas Works Park: Seattle's strangest park (Url-6).



Figure 2.21: Gas Works Park: Seattle's strangest park (Url-11).

The above studied case examples are evaluated according to the landscape urbanism and adaptive reuse principles and benefits in the following Table 2.4:

Table 2.4: Case examples evaluation according to landscape urbanism and adaptive reuse principles and benefits.

	Kelvin Grove Urban Village	Kundura Beykoz	Landschaftspark	Gas Works Park
				
Abandoned post-industrial area	✗	✓	✓	✓
Following Façadism	✓	✓	✓	✓
Integrated construction style	✓	✓	✓	✓
Environmental benefits	✓	✗	✓	✓
Social benefits	✓	✓	✓	✓
Economic benefits	✓	✓	✓	✓

2.5. Wild Urban Woodland

Woodlands are transition zones between different ecosystems, such as grasslands or actual forests. However, woodlands are lighter and less dense, with more open spaces than forests. Various types of woodlands include (FitzGerald et al., 2021; e.g. Roovers et al., 2002):

- **Urban Woodlands**

Urban woodlands are solitary forest islands surrounded by developed urban areas that are located in close proximity to urban centers (FitzGerald et al., 2021).

- *Peri-urban Woodlands*

Peri-urban woodlands are found in the outer city fringes and are integral to the peri-urban cultural landscape. Agriculture or village life shaped the majority of these peri-urban cultural landscapes historically (FitzGerald et al., 2021).

- *Non-urban Woodlands*

Non-urban woodlands, on the other hand, are found outside of the urban effect zone and are often intertwined with traditional cultural landscape components (FitzGerald et al., 2021).

In the 14th century, after a large-scale population reduction happened due to the plague, broad stretches of lands across Europe had emptied, and forests returned to those places no longer maintained land use. The same occurred 300 years after the Thirty Year's War, and again after World War II, in many ruined European cities, little forests sprouted up on the fields of wreckage. Urban woodlands can be entirely encircled by urban regions, creating forest islands within the city. However, they mostly grow out fringe of cities, direct interaction with urbanized areas on the one side and open spaces on the other. Increasing woodland's proximity to cities caused the accessibility for urban residents to them, and the woodlands opportunity to grow and react to the social functions (Ellenberg, 1988; e.g. Roovers et al., 2002; Dettmar, 2005; Grapow and Blasi, 2003; Alt, 2009; Kowarik, 2005).

Another type of self-growing woodlands occurred during industrialization called 'urban-industrial woodlands. Industrial cities were restructured due to economic, social, and technological changes Since industrialization in the 19th century. Organizational changes co-occurred as socio-cultural changes, when cities grew peripherally, bringing businesses and residents away from the city core. The Industrial City's demise led to spontaneous nature in areas where frequent use was no longer possible. Natural interaction provides ecological infill in previously occupied places as a result of suburbanization and deindustrialization. As fresh nature interweaves itself into holes in the urban fabric, overlap occurs (Ellenberg, 1988; e.g. Roovers et al., 2002; Dettmar, 2005). The city's working landscape becomes spontaneous and wild, indicating the constant fight between economics, nature, and culture; When buildings are ripped apart, forest margins and tree walls form new edges of spaces. As a new urban landscape typology, the 'Wild Urban Woodland' is a self-growing wild

green texture and infiltrates the shattered environment of the abandoned industrials in the metropolis. The natural, ecological, or forest succession process arises due to regional cultural and environmental differences. While parks and other intensively maintained green spaces are acknowledged as a controlled type of urban nature, wild and spontaneous urban nature, owing to contradictory social conceptions, is not fully integrated into the urban culture. Urban-industrial woodlands result both from cultural and natural processes shown in Table 2.5 (Ellenberg, 1988; e.g. Roovers et al., 2002; Dettmar, 2005; Grapow and Blasi, 2003; Alt, 2009; Kowarik, 2005).

Table 2.5: Cultural and natural processes effects on urban-industrial woodlands result (Kowarik, 2005).

Cultural Processes	Natural Processes
- Previous uses have significantly altered soil substrates or created entirely new soils	- Building corrosion or erosion
- Older structural remains may be preserved in their entirety or in part	- Vegetation and site dynamics adaptation to present applications
- It's possible that remnants of prior garden plantings are still intact	- Following the deposit of substrates, physical-chemical processes and soil formation take place (decalcification, enrichment of organic matter, etc.)
- It's possible that previous occupants unintentionally produced non-native plant or animal species.	- Plant species that were previously cultivated are multiplying and establishing themselves
- Non-native plants have a significant role as ornamentals in urban areas and are a source for the colonization of abandoned sites.	- Pristine vegetation and animal species are colonized by animal species, typically native species with long-distance dispersal
- After previous uses have been abandoned, social activities may alter flora and site dynamics, resulting in new cultural patterns	- Population growth and decline during succession, as well as natural stand dynamics

While being in proximity with the city's core, the successive emergent forests provide immense ecological, experiential, educational, and communal growth possibilities. As our planet undergoes dramatic climatic and energy shifts, the best future for cities is a biophilic one that incorporates nature into urban design and planning on a holistic level.

Below are some worldwide examples of abandoned places covered in greenness (Figure 2.22), to have a better understanding of what the wild urban woodland is:



Figure 2.22: Examples of Wild Urban Woodland, Generated by Author.

Newry Mill, South Carolina, United States

The gigantic Newry Mill, whose official but the less well-known name is Courtenay Manufacturing Company, is still towering over the abandoned textile industry surrounded by plants. The mill was established in 1893 and became operational in 1894. Newry became the first textile village in Oconee County on June 14th. The old mill and historic town still stand along the Little River, at the base of Duke Power Company's dike that encircles Lake Keowee today (Figure 2.23) (Url-13).



Figure 2.23: Newry Mill, South Carolina, United States (Url-13).

Houtouwan, Shengshan Island, China

Houtouwan, a small fishing village about 87 miles southeast of Shanghai, once home to approximately 2,000 fishermen and their families has been deserted for decades. Instead of being buried in dust and rubble, these structures are nearly entirely covered in ivy and luxuriant flora, creating a rich green environment.

While most of the village's original occupants relocated to the mainland in the early 1990s, a few individuals remain on the island, selling water to interested tourists and photographers (Figure 2.24) (Taylor, 2015).



Figure 2.24: Houtouwan, Shengshan Island, China (Url-14).

SS Ayrfield Shipwreck, Sydney, Australia

During the early twentieth century, the area of Homebush Bay was an industrial junction of Sydney, with ships bringing coal and oil. Unfortunately, the waters quickly became contaminated and toxic (due to all of the coal and oil), a problem that was only rectified during the commercial boom that followed the 2000 Olympic Games. Although the region is now a fully working residential suburb, you can still see remnants of Homebush Bay's industrial past covered in green texture.

The powers of nature, notably the triumphant wild development of a mangrove forest with flora bursting over the steel hull, have countered the inevitable degradation of The SS Ayrfield over time. (Figure 2.25) (Taylor, 2015).



Figure 2.25: SS Ayrfield Shipwreck, Sydney, Australia (Url-14).

Valley of Mills, Sorrento, Italy

The valley includes a collection of stone flour mills, a sawmill, and a washhouse erected in a rock fissure as early as the 13th century. The mills were decommissioned and abandoned in the 1940s after the flour milling industry went out. The old structures have been totally overrun by greenery when viewed from above the canyon, creating a stunning image (Figure 2.26) (Url-13).



Figure 2.26: Valley of Mills, Sorrento, Italy (Url-6).

2.6. Biophilic Design Concept and Principles

The word Biophilia consists of two components, 'Bio' and 'Philia.' The word bio is used at the beginning of nouns to have adjectives and adverbs related to living things or human life, and philia has Greek roots meaning to love nature and peoples positive

feeling for habits and activities and all that is in nature. Erich Fromm first used the term 'Biophilia' in 1964 to describe human's inherent dependence on other living things and the instinctive link between humans and other systems of life. The biophilia theory was also proposed by scientist Edward O. Wilson, who defined it as "the intrinsic inclination to focus on life-like activities" as well as "the impulse to join with other forms of life." He understood that humans are biologically, psychologically, physically, and spiritually related to nature, with a tendency to associate with natural systems beneficial to their health and productivity. In his book "Biophilia," he further highlighted this profound reliance on life as a sophisticated and challenging method to promote mental health and well-being development. Unfortunately, the dominant pattern in the design of modern structures is that the building becomes a consumer of resources and energy. It has become unstable that this type of architecture expands air and water pollution, pervades climate change, destroys the rights of future generations, creates unhealthy indoor conditions, and increases alienation from nature (Oxford Dictionary, 2010; Kellert & Wilson, 1995; Wilson, 1984; Stewart-Pollack, 2006; Minke, 2001).

Biophilic design is a construction according to the nature of our minds. Of course, the biophilic design does not only mean greenery of the city and buildings using plants. The biophilic design, as was already mentioned, tries to bridge the gap between modern architecture and people's desire to engage with nature. Overall, biophilic design is a cutting-edge strategy. to creating the places where we live, study, and work, to reduce the built environment's environmental effect and strengthen our connection to the natural world. It can be used at many scales, from city planning to building design and interior design. Biophilic design, it appears, aims to instill healthy and productive habits in modern beings. Stephen R. Kellert, a renowned social ecologist and Yale University professor, published several influential papers that laid the groundwork for biophilic design. In 1993, he co-wrote *The Biophilia Hypothesis* with Edward O. Wilson, who popularized the term biophilia (Browning, Ryan and Clancy 2014).

The book attempted to "refine the idea of biophilia" by incorporating the perspectives of a number of famous scientists and intellectuals of the period. Kellert categorized the biophilic design into six main elements in direct and indirect expression: Environmental characteristics, natural shapes and forms, natural patterns and

processes, light and space, relationships based on place, and the evolution of human-nature relationships. The basics of biophilic design also include two main approaches. The first approach is a direct use of nature; Which means that we can enter nature and the natural environment into human space as much as possible. For example, use plants, natural light, and natural ventilation in architectural spaces. The second approach is an indirect use of nature; The second approach is to take advantage of the features and properties of nature in design. "Biophilic Design Patterns" explore the relationship between nature, biology of human, and environmental design so that the biophilic human benefits are experienced in design applications. These 14 patterns are divided into three main categories (Browning, Ryan and Clancy 2014):

- ***Nature in the Space***

- (1) Visually connecting with nature
- (2) Non- visually connecting with nature
- (3) Non-rhythmic sensory stimulations
- (4) Thermic variability and airstream
- (5) Water presence
- (6) Dynamics and transpiration of light
- (7) Natural system communication

- ***Natural Analogues***

- (8) Biomorphic forms and patterns
- (9) Linking materials with nature
- (10) Complexity at the same time

- ***Nature of the Space***

- (11) vision
- (12) Refuge
- (13) Mystery
- (14) Risk/Peril

2.6.1. Biophilic city

As mentioned earlier, with the rapid growth of cities and the entry into industrial life, nature in human life has diminished, and cities have distanced themselves from their natural context due to physical compaction and population growth. Interfering with the natural system caused damage to ecological order, human health, and the production of many pollutants in the living environment, which resulted in a decrease in quality of life, increased energy consumption, and dissatisfaction of urban residents, most importantly, urban instability (Figure 2.27).

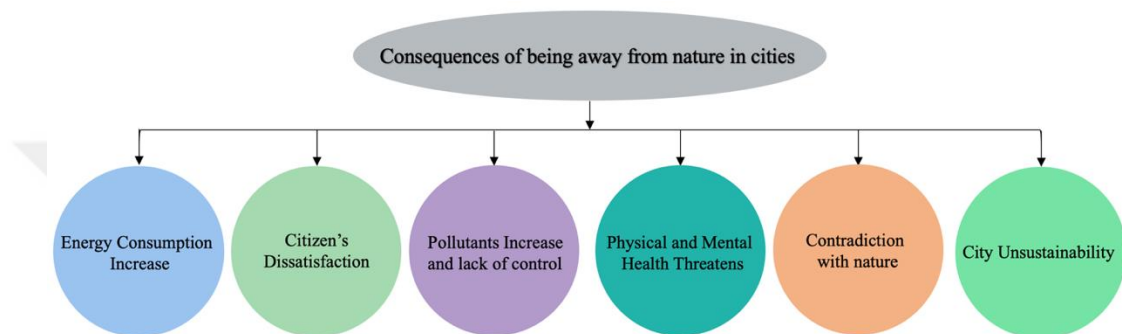


Figure 2.27: Consequences of being away from nature in cities (Pourahmad & Kachui, 2021).

Modeling the experience of countries using the biophilic urban planning method can be an excellent solution to deal with the problem of distancing from nature and its negative consequences. Biophilic cities are cities where abundant wildlife is available to a large number of urban dwellers, and accessing green spaces and the natural environment does not require hours of driving and traveling to the fringe or out of cities. Biophilic cities have biodiversity, and they are rich multi-sensory environments in which the sounds of nature are as valuable as the visual experiences. These cities are an essential arena for nature educations. Biophilic cities provide many opportunities to learn and enjoy nature and bring urbanites closer to nature through social and physical infrastructure (Wilson, 1993; Kellert et al, 2011).

This purpose can happen through museums, wildlife centers, parks, and recreational programs and projects. Generally, the biophilic city is a city that first places nature's conception, organization, and management. Green belts are one of the most common tools in creating such cities. However, a biophilic city does not mean a green city, and the existence of nature on a large scale is necessary, but the condition is not enough (Wilson, 1993; Kellert et al, 2011).

Biophilia can apply to cities on different scales, at the building and urban furniture level (Micro scale), neighborhood and city units (Macro scale), with natural design features, or biophilic elements in the urban environment. The biophilic components and elements, were collected and categorized more detailed in Table 2.6.

Table 2.6: Biophilic components and elements based on application levels and scale (Beatley et al., 2009).

	Components	Special Benefits	General Benefits
Building	House plants	-Improving air quality -Reducing disease	-Promotion of tourism -Increase the value of real estate -Revitalization of cities
	Roof gardens	-Space efficiency -Food production	
	Green walls	-Vertical urban agriculture -Wall and roof's life span increasing	
Neighborhood	Green borders	-Reducing energy consumption -Water management	-Reconnect with nature
	Green islands	-Increasing social solidarity -Encourage walking and cycling	-Entertainment
City	Green corridors	-Connection of biophilic components -Easier access to areas inside or outside the city	-Promote mental health and reduce stress -Creating harmony with nature
	Urban farms	-Food production	-Improve water management cycle
	Urban Designs Sensitive to Water	-Groundwater protection -Water management	-Increase biodiversity -Reduce the destructive effects of greenhouse gases -Improving air quality -Reducing the effect of urban thermal islands -Revitalization of urban environments

2.6.2. Biophilic partner cities

"City inhabitants should not have to rely entirely on travels to faraway parks and rural settings to experience nature's healing power because they have everyday access to rich nature." That is the underlying idea driving UVA Architecture professor Tim Beatley's expanding Biophilic Cities movement. After releasing his book, 'Biophilic Cities,' in 2010, the initiative was developed by Dr. Beatley, who teaches urban and environmental planning. The book and the movement it inspired to emphasize the significance of regular contact with the environment as an essential component of living a fulfilling urban life and city's ethical obligations to protect nature as shared ecosystems for human and non-human life.

According to recent studies, the global population living in urbanized areas is rapidly increasing and is expected to reach 70 percent by the year 2050. The biophilic cities movement began with several geographically diverse 'partner cities,' and made up of cities from all over the world dedicated to strengthening inhabitant's relationships with urban nature, and their contribution to the biophilic design principles (Table 2.5), including Singapore, Fremantle city in Australia, and Edmonton, Canada (Biophilic cities: Url-5).

SINGAPORE (Biophilic Cities Partner City Since 2013)

Singapore, is a 700 square kilometers island city-state on the southern point of the Malay Peninsula with a population of 5.4 million people. The city began to combining human with nature in the 1960s with the motto of "Singapore - Garden City."

In addition to the well-developed green walkways, the city has worked hard to incorporate natural elements into its vertical spaces. Several high-rise buildings have installed green roofs for the urban heat reduction. Singapore is one of the few dense cities that genuinely is a city in a garden.

The biophilic examples presented that Singapore is pursuing biophilic urbanism by increasing and improving natural systems on building facades. Singapore is considered best practices worldwide (National Parks Board, 2012; Ministry of the Environment and Water Resources, 2002; SG Press Centre, 2012). The followings include examples of biophilic designs in Singapore:

- ***Gardens by the Bay***

The most recent environmental initiative of Singapore to become a garden city is garden by the Bay.

The green landscape matrix of streetscape greenery, parks and gardens, and nature reserves will be strengthened by more than 200 kilometers a network of park connectors connecting them throughout the whole island. Skyrise greenery will improve this further, a project that will see a lush green layer draped over the urban infrastructure (Figure 2.28) (Kenneth et al., 2010).



Figure 2.28: Gardens by the Bay, by Tristan Tan Canva, (Left: [Url-6](#), Right: [Url-7](#)).

- ***Jewel Changi Airport***

The world's most awarded airport, 'Jewel Changi,' is an iconic landmark in Singapore where visitors can walk through the lush greenery of one of the most extensive climate-controlled indoor gardens in Singapore. On different levels, Jewel Changi airport includes (Figure 2.29; Figure 2.30):

Forest Valley

The awe-inspiring Forest Valley is a climate-controlled indoor garden that is one of Singapore's largest. Forest Valley, dappled with sunshine from Jewel's glass ceiling, is home to hundreds of trees, bushes, and floral plants. Visitors can go to Canopy Park and explore the garden quickly, thanks to the walking trails (Jewel Changi Airport Official Website: [Url-30](#)).

Rain Vortex

The majestic 40-meter-high Rain Vortex – the world's highest indoor waterfall – will be the centerpiece of Jewel. When night falls, the radiance of the descending streams of water creates a stunning light and sound extravaganza (Jewel Changi Airport Official Website: [Url-30](#)).

Canopy Park

The 14,000sqm Canopy Park on the top level, which is sunlit by day and offers a view of the sky at night, features a variety of attractions (Jewel Changi Airport Official Website: Url-30).



Figure 2.29: different levels of Jewel Changi airport (Section) (Url-4).



Figure 2.30: Jewel Changi airport, Photos by: Paula Pintos (Url-4).

EDMONTON, CANADA (Biophilic Cities Partner City Since 2013)

Edmonton is a city with a wide variety of wildlife and stands out among the cities pioneering in creating a more integrated network of green texture and habitats. Edmonton was born from the nature. A river valley park system connects the city's mature forests and make them accessible to residents so they could enjoy nature on a daily basis.

Achieving this goal is provided by designing and installing wildlife pass ways. The project began taking place in the River Valley Parks, and linking urban parks along the North Saskatchewan River. It is the largest municipally-owned park in Canada with a size of 18,000 acres. Through a number of complementary planning initiatives aimed at preserving and advancing the city's urban ecosystem, the city has carried on this legacy (Figure 2.31).



Figure 2.31: Views of Edmonton as a biophilic city (Url-5).

FREMANTLE, AUSTRALIA (Biophilic Cities Partner City Since 2018)

Fremantle provides an opportunity for citizens to create a stronger bond with their surroundings by recognizing the value of nature in urban settings and urban biodiversity. Located at the mouth of the Swan River in Western Australia, Fremantle is one of Australia's most iconic cities. Despite its dense urbanization, Fremantle has a lot of biophilic traits.

The various flora and wildlife, and waterfront position, provide several possibilities for people. The street and reserve tree policy and verge garden policy in Fremantle continue to enhance the city's natural setting. These initiatives encourage households to develop native verge gardens by providing free mulch and discounted native plants. In addition, an Annual Street Tree Planting Program aims to plant at least 1000 new trees each year.




Greening Fremantle: Strategy 2020 aims to inform, direct, and implement an eco-friendlier city. Other historical and current acts contributing to Fremantle's reputation as a biophilic city include support for Friends Groups, community planting days, and revegetation-related activities. Support for Friends Groups, neighborhood planting days, and revegetation-related activities are a few further historical and contemporary actions that have helped Fremantle develop its reputation as a biophilic city (Figure 2.32).



Figure 2.32: Biophilic city development plans of Fremantle, Australia (Url-5).

Comparing the above studied case examples evaluating according to the biophilic design patterns and principles is shown in the following Table 2.7:

Table 2.7: Biophilic partner cities evaluation according to biophilic design patterns.

	SINGAPORE	CANADA	AUSTRALIA
			
Nature in the Space	<ul style="list-style-type: none"> ✓ Visually connecting with nature ✓ Non- visually connecting with nature ✓ Thermic variability and airstream ✓ Water presence ✓ Dynamics and light emission ✓ Communication with natural systems 	<ul style="list-style-type: none"> ✓ Visually connecting with nature ✓ Water presence ✓ Communication with natural systems 	<ul style="list-style-type: none"> ✓ Visually connecting with nature ✓ Non- visually connecting with nature ✓ Water presence ✓ Communication with natural systems
Natural Analogues	<ul style="list-style-type: none"> ✓Biomorphic forms and patterns ✓Linking materials with nature ✓Complexity at the same time 	<ul style="list-style-type: none"> ✓Linking materials with nature 	<ul style="list-style-type: none"> ✓Linking materials with nature
Nature of the Space	<ul style="list-style-type: none"> ✓Vision ✓Refuge ✓Mystery 	<ul style="list-style-type: none"> ✓Vision ✓Refuge ✓Risk/Peril 	<ul style="list-style-type: none"> ✓Vision

2.7. Evaluation of the Chapter

During the early evolution of human dwellings, the balance between humans and nature was determined by nature. In the early phases of urbanization, humans did not have the required technology to intervene in nature and disturb its balance. The rapid growth of technology and, as a result, the increase in urbanization in the 19th century upset this balance. Today's cities are far from natural features, and they are no longer suitable living spaces, neither for human beings nor any other species. The high density of buildings and the increasing number of abandoned and unused buildings in cities are other occurrences of rapid urbanization. Before being the most advanced species among other living beings due to science and technology, humans were a part of nature, and their instinct originated from nature. This human-nature bond was hurt in recent years through increased urbanism and industrialization. The urban ecosystem is an interconnected collection of buildings, plants and green spaces, urban wildlife, and humans that need to be balanced in order to survive in this cycle.

Human culture and how cities are structured directly impact the lives of other living organisms in urban settings. In addition to meeting the needs of the present society, we need to develop our cities and our ways of living to prevent diminishing the ability of future generations to meet its needs. The pattern of sustainable development guarantees the survival, stability, and sustainability of things that must remain constant during the evolution of phenomena and ensure the survival of future generations. Therefore, sustainability theories have recently become an essential aspect of architectural and urban studies and should be considered in all types of urban studies. Almost all of today's environmental problems are caused by severe social issues, and modern human needs to be taught ways to reconnect with nature. This education can be done through different ecosystems we live in, but the most effective one is the macrosystem which influences the developing human and the microsystems and mesosystems embedded in those cultures. To make changes to city structures, we need to change the culture of citizens, and culture is always dependent on history and nature. To make these changes, cities have to include public spaces with different and modern approaches to educating their citizens, an area with all the components of sustainability, and are in direct contact with nature.

Museums are the best places for collective learning in cities. In museums, people can participate in group activities, socialize and learn. But in today's world, with the increasing advancement of technology, it is not enough to create a connection between the city, humans, and nature, but these changes must be in line with this modern development. This study aims to revive the interplay between the city of nature and human culture the technologist. It is possible to take a step towards sustainably reconnecting the city with nature by considering a useless historical monument related to the urban context and nature and allocating the use of a cultural space like a museum with a green approach. Table 2.8 is adjusted according to the scope of this research and studies have shown that most studied approaches and concepts are related to the interconnection of the components of culture, nature, and history as much as the method and the design tools used for applying these concepts to the aim. This connection has recently faded in some urban and human abstractions which can come to life through this study's aim.

Table 2.8: Culture, nature, and history interactions with urbanism concepts.

	Title	History	Culture	Nature
Aim	Adaptive reusing a post-industrial area	✓	✓	✓
Approach	Landscape urbanism	✓	✓	✓
	Biophilic design	✓	✓	✓
	Sustainability	✓	✓	✓
	Eco-social design	✓	✓	✓
Application	Green Museum	✓	✓	✓
Methodology	Smart City	✗	✓	✓
And Design Tools	VR model	✗	✓	✓



3. EVALUATION OF THE STUDY AREA AND THE CASE STUDY: BEYKOZ, ISTANBUL

Turkey formally referred to as the Republic of Turkey, is a country that lies on the border between Europe and Asia. Greece and Bulgaria border it on the northwest, the Black Sea on the north, Georgia on the northeast, Armenia, Azerbaijan, and Iran on the east, Iraq on the southeast, Syria and the Mediterranean Sea on the south, and on the west side, there's the Aegean Sea. Istanbul, the country's largest city, serves as the financial hub. Istanbul, the capital of two illustrious dynasties, has a 2700-year-old history. Beykoz district was known as the remote countryside north of Istanbul on the Bosphorus during the Ottoman period. With an area of 239.22 km², the district grew as an essential location of industrialization after establishing the Sumerbank Factory in the early nineteenth century.

Industrial structures have been removed to a large extent recently due to a rule requiring the removal of industrial usage from the Bosphorus. The industrial complexes of Beykoz, like the ancient residential fabric, have retained their significant characteristics. Furthermore, they have considerable power and the ability to strengthen strengthening the open relationship of Beykoz with the city center (Mihcioglu and Tumer, 2009; Akkaş et al., 2020).

Below are some other features to get a more complete understanding of the Beykoz district:

- ***Appellation***

The old name of Beykoz was "Amikhos," which was the name of a Thracian ruler who arrived in Beykoz by sea around 700 B.C. The word "Beykoz" has been subjected to two separate etymological studies. The first is based on the definition of "Koz," which is walnut, while the second is based on the definition of "kos," which is a village. The Walnut tree is one of the most common tree species in Beykoz in the first half of the 14th century, especially in 'Osman Gazi' and 'Akçakoca Bey' areas and the name of the district caused by the majority of walnut trees in this area (Gokcen,1988; Oral, 1973).

- ***Location, Transportation and Access to the Study Area***

Beykoz is Istanbul's greatest district, located on the Asian side's north coastlines. Despite its proximity to Asian city centers, Beykoz is a somewhat remote location.

The central regions of the district are the parts of the Üsküdar District that are adjacent to the FSM Bridge. Beykoz's coastal line begins in the center of the Bosphorus and extends along a stretch of the Black Sea. Beykoz is strategically located on Istanbul's mainland routes. The TEM Motorway (E-80), Istanbul's ring road connecting Europe by the FSM Bridge, runs in Kavacik-Beykoz (Figure 3.1).

Despite the proximity to major highways, traffic congestion is an issue due to the capillary nature of the old coastal circulation network. The district is reachable by public transportation from Mecidiyeköy, Kadıköy, and Üsküdar. It is insufficient, though. The district's bus and minibus (Dolmuş) routes are erratic and ill-organized. Although there are several marine route connection points along the Bosphorus (ferries, sea buses, and motorboats), they are not enough to build a robust network and meet the needs of the district.

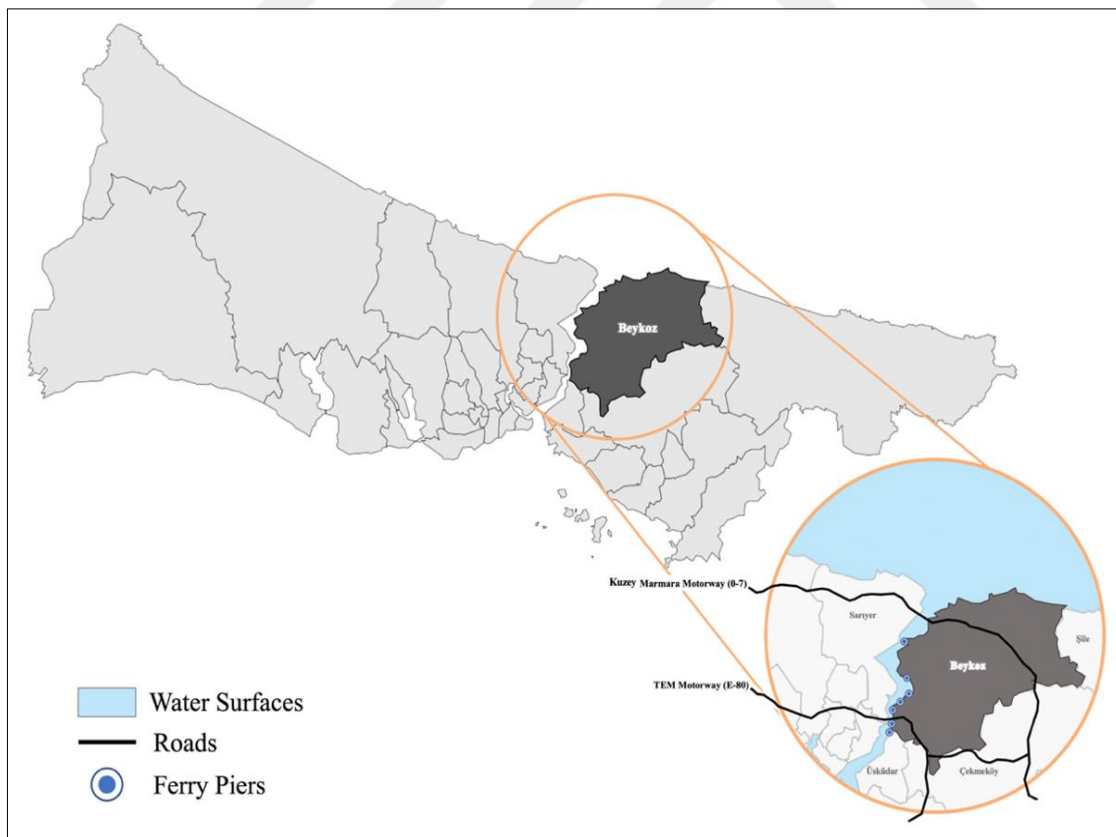


Figure 3.1: Beykoz, Istanbul; accesses, proximities and roads map, Generated on base map (2020).

- **Population**

According to the age groups population of the Beykoz district in Figure 3.2, it can be understood that about 70% of the population of this region is young adults and middle-aged people (mostly young adults) and after that the population of children (under 18 years old) has the highest percentage (Url-17).

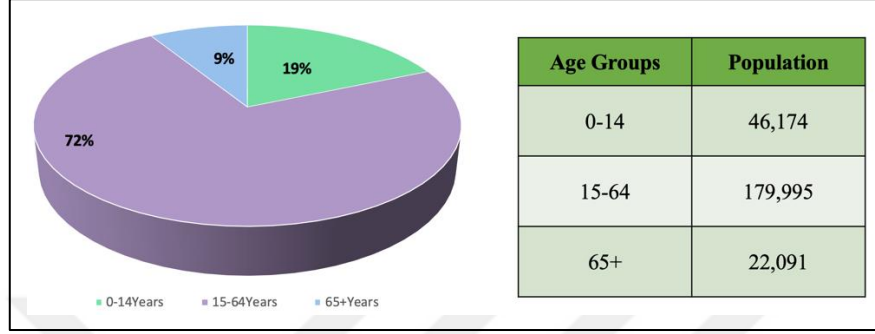


Figure 3.2: Age Groups Division Graph of the Population of Beykoz in the Year 2019, (Url-17).

- **Urban Wildlife**

The Ministry of Forestry and Water Affairs started the Biological Diversity Monitoring Project in 2015 in Istanbul. Type determinations are made within the scope of Flora and Fauna in the city. the project identified 4770 species so far which one thousand 937 of the identified species, belong to the fauna. There are Animals such as, fox, wild boar, racoons, Red deer, foxes, Squirrel, cats, dogs and wide varieties of bird species live in the forests that make up 44 percent of the city (Url-18). Beykoz District has important wildlife and rich fauna, with its natural areas. Birds are a significant part of this animal diversity. The district is on the world's important bird migration routes and hosts thousands of birds during their migration period. Large and small streams flow through the valleys of Beykoz, which has a very rough terrain in the altitude range that can reach up to 300 meters from sea level. The district, which has a transition-type climate, hosts the broadleaf, mixed and coniferous forests of the Black Sea climate and the scrub woods and shrubs of the Mediterranean climate. Some of the nature parks of Beykoz are Polonezköy Nature Park, Beykoz Gökarnalık Nature Reserve, Mihrabat Nature Park, Goztepe Nature Park, Elmasburnu Nature Park, Beykoz forests, etc. (Figure 3.3). In these forest areas, pine, oak, chestnut, hornbeam, hazelnut, ash, linden trees, and in scrub areas, arbutus, mullein, rosehip, wild rose, blackberry, firethorn, and broom bush are common. Beykoz's forested areas, expansive meadows and

grasslands, coastline and bays, rocky slopes, and freshwaters are rich in fish, rich vegetation, birds, mammals (fox, deer, hog, etc.), reptiles (different frog species), butterflies, and insect species; In other words, it is home to a wide variety of wildlife (Akkaş et al., 2020).



Figure 3.3: Beykoz district’s natural parks and forests (Greenland map)
Generated based on Google Maps.

- **Landmarks**

Beykoz Leather Shoe industry (kundura factory), Beykoz Mosque, Beykoz Mansion, “Ishak Agha” historical Fountain, and “Ahmet Mithat Efendi” old Mansion, are significant monumental buildings and areas in the studied area (Figure 3.4). There are several historic mansions mostly along the coastline which make a historical corridor. These mansions had long defined the boundary between Bosphorus and the rear middle-class communities (Gokcen, 1988).

Governors of Egypt erected the Beykoz Mansion (Mecidiye Kasrı) on the summit of the south hill of Hunkar Iskelesi in 1855. After Topkapi Palace, the first palace built on the Bosphorus is Beykoz Mansion. Also, Ishak Pasha erected the Ishak Agha

Fountain in 1746 to replace another fountain designed by Architect Sinan (Figure 3.4) (Oral, 2007; Yesilbas, 2005; Gokcen, 1988).



Figure 3.4: Beykoz district's landmarks and historical places, Generated based on Google Maps.

- **Land Use and Ownership**

The study area is dominated by a few fundamental uses: residential, evacuated industrial areas, and green contexts. A large area is covered by the old Sumerbank Leather Shoe Factory buildings located in the north side of Yalılıkoy, surrounded by the forest. Beykoz Field, a nearby historical site, connects the ocean and the woodland on the backside. Similarly, vast green areas, such as Beykoz Forests, can be found on the study area's west and south borders (Beykoz Ormanı ve Korusu). The built-up region is mainly residential in between the green spaces. Five primaries and two high schools are distributed around the residential area for educational purposes, while nine mosques and one Armenian church are used for religious purposes (Mihcioglu and Tumer, 2009).

Beykoz Leather and Shoe Factory, which had a closer link with the center than in the past. The factories shaped factory workers' education and social lives until their evacuation in the early 2000s. Oyak Concrete, Osel Drug Industry, Beykoz Kundura leather and shoe factory, and AYPEN factory are all prominent factories in Beykoz. Traditional economic activities included glass making, known as "Beykoz Style" since the reign of Selim III, and granite production at a quarry near Sahinkaya Avenue. "Şişecam bottle and glass factory Group of Paşabahçe" is one of the most iconic values in the Beykoz industrial area (Figure 3.6) (Gokcen, 1988; Oral, 1973; Alpman, 2009).

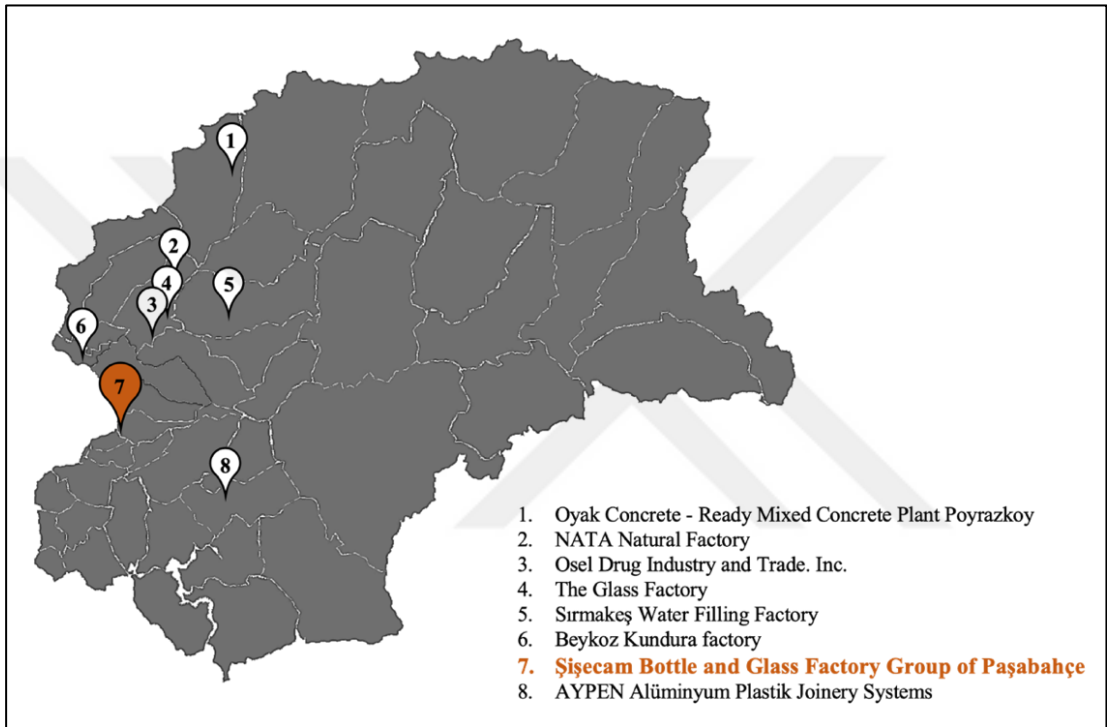


Figure 3.6: Beykoz district's industrials, generated based on Google Maps.

3.1. Introduction and History of Şişecam bottle and Glass Factory Group of Paşabahçe as a Case Study

Being one of the Republic's most important industrial centers, the historic Paşabahçe Factory in Beykoz, which employed 873 people, ceased manufacturing in 2002. At its 68-year-old factory in Beykoz, şişecam said goodbye to glass manufacture. For 15 days, the company halted production and placed all 873 employees on unpaid leave. The decision was made owing to a loss of 71.5 million dollars at the facility over four years, from 1998 to 2001, according to Şişecam. This effort is said to protect a total of 5,350 employees (Mizrak, 2002; Url-20). Important historical events related to Şişecam factory can be seen in Figure 3.7.

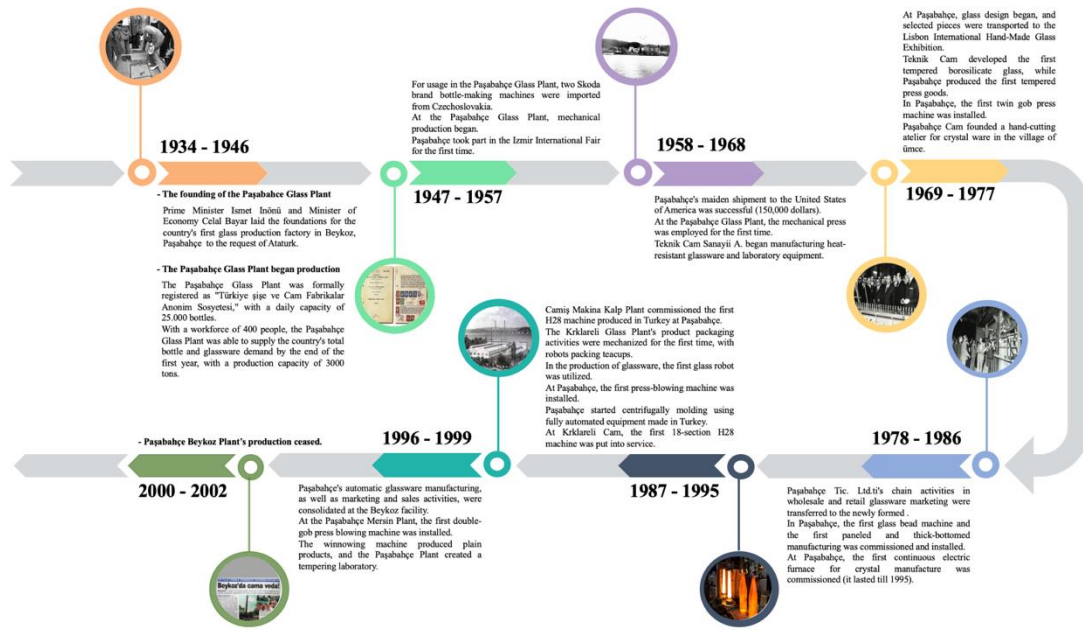


Figure 3.7: Historical Timeline of Şişecam bottle and glass factory Group of Paşabahçe (Url-22).

Rüştü Bozkurt, Şişecam General Secretary, emphasized that: "This is a very large, but a scattered area. It will be reevaluated by becoming a museum or a hotel,". Bozkurt said that the factory might not continue production as a glass factory, but it will not be left empty, and its history will be kept alive (Mızrak, 2002; Url-20). Şişecam bottle and glass factory Group of Paşabahçe on Çukur Çayır street comprising İncirköy Quarter, is located on the south side of sultaniye park, and the Paşabahçe Stadium is bordering the factory from the north-east side of it. It is also nearby the historical Beykoz Field (Beykoz Cayırı) from the north side. The factory is defined by Beykoz Woods (Beykoz Korusu) on the north, Polonezköy Nature Park (POLONEZKÖY TABİAT PARKI) on the east, Göztepe Nature Park (Göztepe Tabiat Parkı) both by the Bosphorus on the west and the south-east. The study region has significant land linkages via the TEM Motorway and Yeni Riva Avenue. The three regions of the factory are surrounded mainly by commercial and residential usage. There's a small green area (Sultana park) and a stadium (Paşabahçe Stadium) located on the north and northeast side of the factory (Figure 3.8). The neighborhood mostly includes residential and commercial buildings while there are some sport fields, small parks, green lands, religious and educational facilities and the huge industrial area of the Şişecam bottle and glass factory (Figure 3.9). It can be understood from the study

area's land use map shown in Figure 3.9 that there are no cultural facilities in the neighborhood.

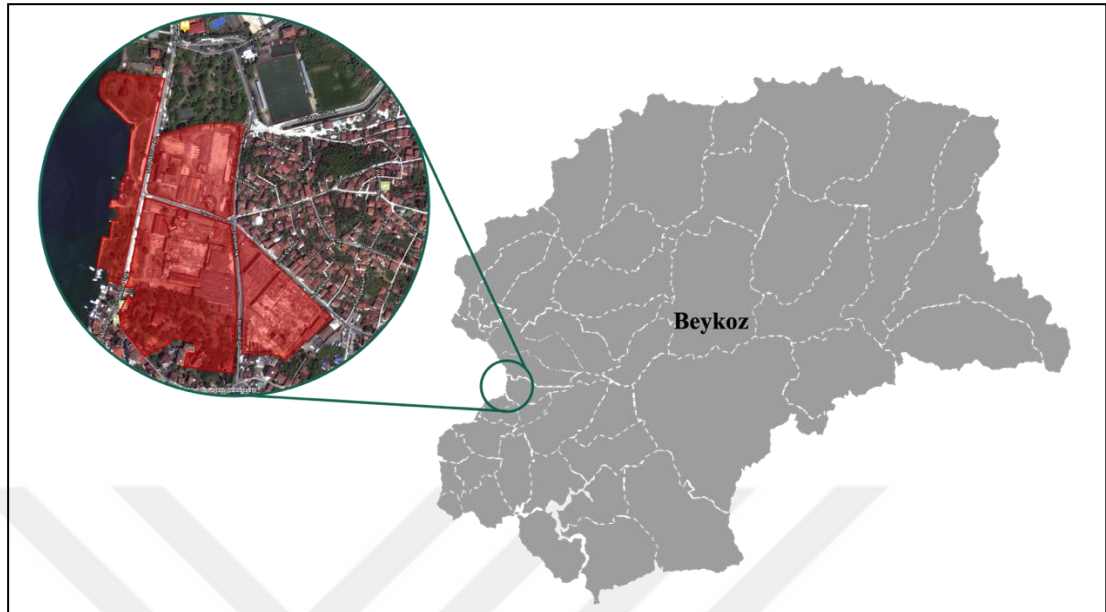


Figure 3.8: Study area's location, generated based on Google Maps.

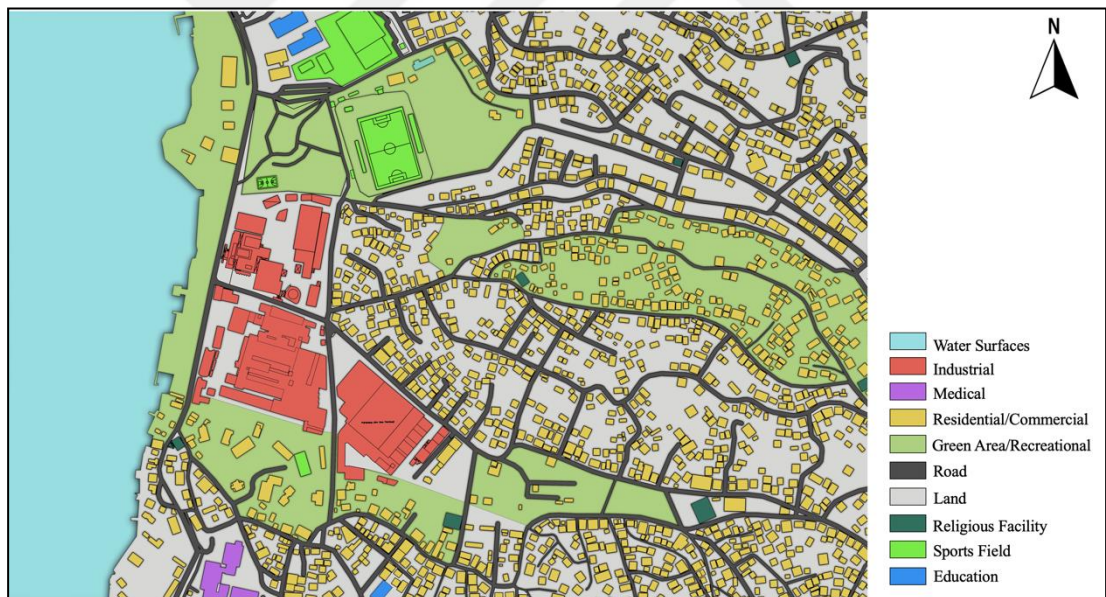


Figure 3.9: Study area's land use map, Generated on base map (2015)

3.2. Outcomes of the Analyses and Problem Statement of the Study Area

The following contains four paradigms of opportunities, threats, strengths, and weaknesses, of the Beykoz District and the study area were defined by a comprehensive phase of analyses (Figure 3.10; Figure 3.11):

- Following the above analyses, the study area's 'strong' features were identified as follows:

A coastline stretching along the Strait, proximity to center of the city, large green areas including the Beykoz Forests, unique historic residential urban fabric, monuments (Beykoz Mansion), and industrial heritage including the Sumerbank Factory and pasabahce, all of which contribute to the district's identity.

Many viewpoints of the city, the Bosphorus, and the surrounding flora provide stunning scenery.

The Fatih Sultan Mehmet Bridge and the TEM (Trans European Motorway) provide transportation and access, with single houses or low-rise buildings comprising the basic architectural typology. The environment is serene, and residents constitute the majority.

- The 'weaknesses' of the area are:

Limited possibilities of transportation, The main internal transit axis is a narrow, crowded seaside road, Lack of historical heritage conservation (severely damaged historic structures, historic urban fabric integrity, and historic green spaces), widespread issues with historical heritage restoration, illegal and unlicensed building areas, primarily destroying the historic green spaces, and a lack of social, cultural, and recreational opportunities (The opposing social sides of the Beykoz district are mentioned as inadequate social, and cultural facilities in the area, lack of theatres or art galleries, and a deficient number of libraries and cultural centers.), inconvenient routes for pedestrians, a disorder of shoreline uses due to fishing boats, arbitrary parking spots and open spaces used indefinitely, unused large spaces and ruined buildings of industrial heritage that have destroyed the integrity of green spaces, and buildings with no specified use and no defined access due to a lack of planning.

- The identified aspects as 'opportunities' in the study area are specified as:

Potentials of maritime Transportation, valuable historic residential urban fabric and monuments (Beykoz Mansions), and industrial heritage (pasabahce Factory and Sumerbank Factory) to be revitalized and preserved.

- The 'threats' for the study area were specified as:

Several unqualified façades, noise pollution owing to traffic lines, lack of security in

green spaces, lack of safety following several abandoned industrial textures and the broken window theory, and pollution due to industrial waste.

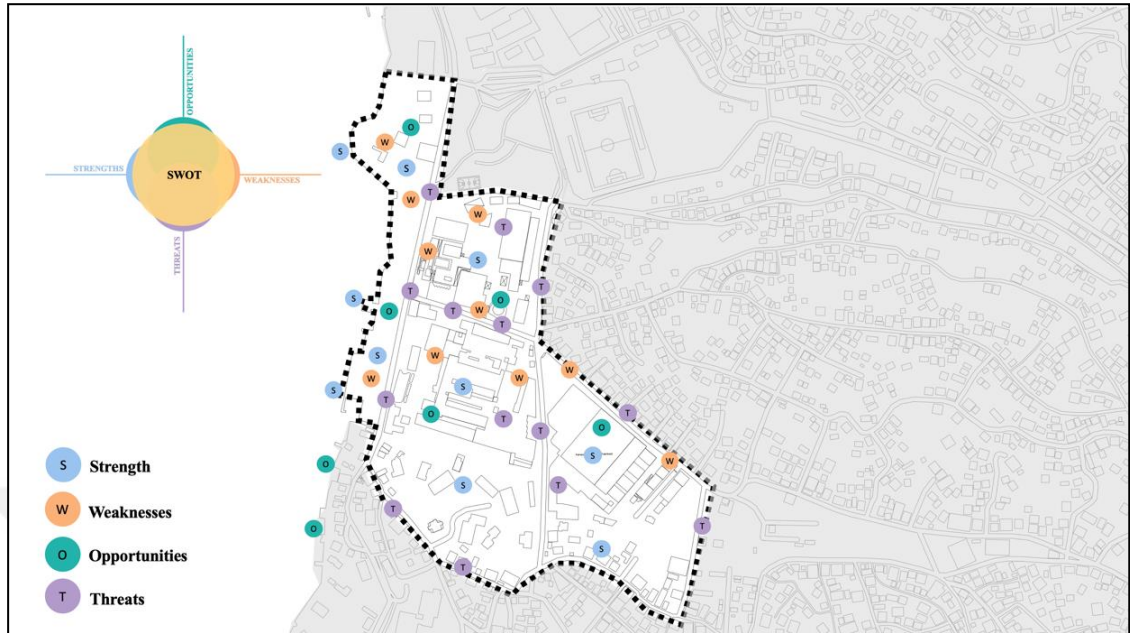


Figure 3.10: Swot Analysis of the Study Area.

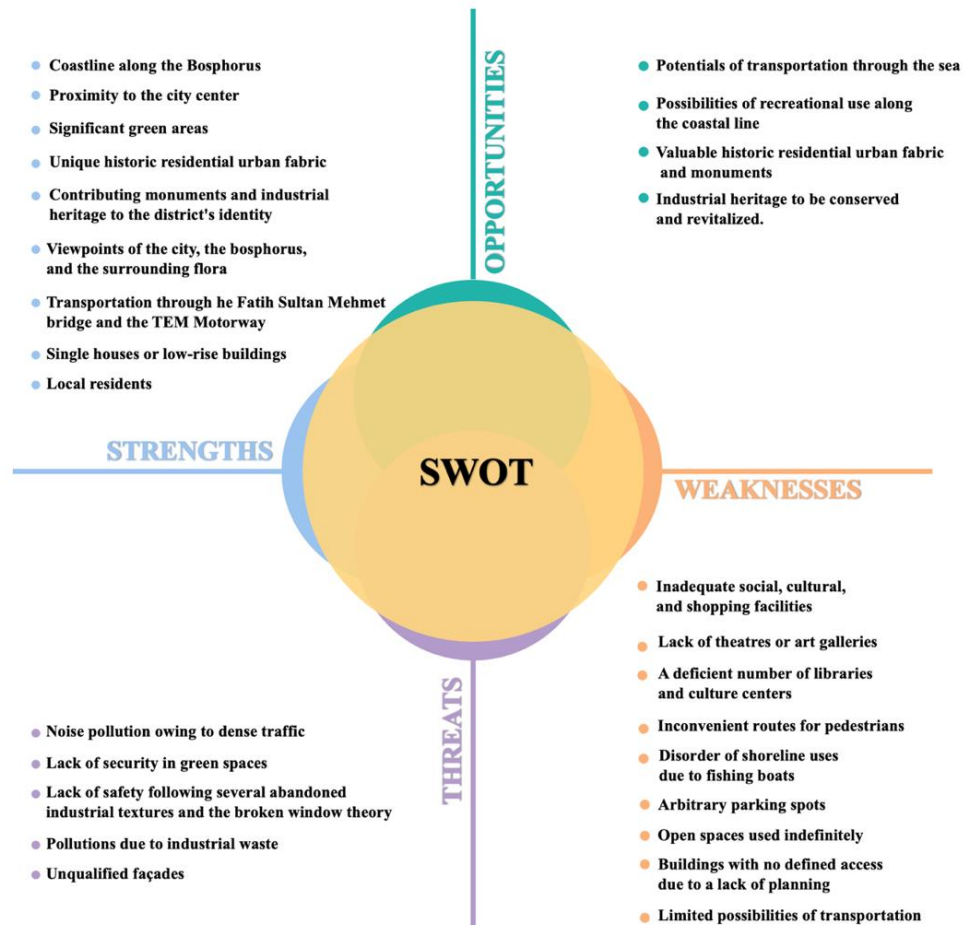


Figure 3.11: Swot Schematic of the Study Area.

3.3. Reasons and Purposes for the Choice of Şişecam Bottle and Glass Factory Group of Paşabahçe as a Case Study

Due to environmental and cultural aspects of this study, two main reasons for this selection are as follows:

- ***Social Structure***

The population of Beykoz, like most of Istanbul's districts, is on the rise. Nonetheless, the general inhabitant is dominated by Beykoz local residents who lived in this district for more than 30 years. Since it was a fishing village, the territory has attracted immigrants from the Black Sea region. The majority of Beykoz's population is implicated in Greeks, Armenians, and Jews before the 20th century (Alpman, 2009). Although limited social, cultural, and shopping facilities in the area neighborhood are the primary sources of frustration while there is also a small number of theaters or art galleries in the area, and the number of libraries and cultural centers is restricted (One movie hall and two multi-functional halls comprise the Beykoz Municipality Culture Centre), local residents are satisfied of the tranquility and natural environment and mostly cite the district's beautiful views as a reason for their satisfaction (Mihcioglu and Tumer, 2009).

- ***Natural and Manmade Structures***

The study area is dominated by a few fundamental uses: residential, evacuated industrial, and greenery. Beykoz Field (Beykoz Cayiri), a nearby historical site, connects the ocean and the woodland on the backside. Similarly, significant green spaces, such as Beykoz Woods (Beykoz Korusu) and parks, can be found on the study area's north, east, and south borders. The introduction of industrial use spurred tremendous urbanization and population increase in Beykoz in the nineteenth and twentieth centuries. The district's social character had shifted from a tiny town in the countryside to a laborers' community. However, after the factories closed, Social life and the character of the population have slightly changed. An introverted character of Beykoz, is characterized by the working systems of all enterprises in the area, but especially Beykoz Leather and Shoe Factory (Kundura factory), which had a closer link with the center than in the past (Gokcen, 1988). Following the analyses as mentioned earlier, the study area's strong features were identified as an important coastline along the Bosphorus, proximity to the city center, critical green areas,

including Beykoz Woods and parks (Sultana park, Atatürk park, Mihrabat Nature Park, Polonezköy Nature Park, Kanuni Sultan Süleyman, etc.); monuments (Beykoz Mansion, Beykoz Field, etc.), and industrial heritage (Şişecam factory, Kundura factory, etc.) forming urban identity; and numerous viewpoints towards the city, Bosphorus, and greenery (Bilir, 2008; Gokcen, 1988; Yesilbas, 2005; Alpman, 2009).

The Fatih Sultan Mehmet Bridge, the TEM (Trans European Motorway), and the coastline road provide convenient mobility; Flat houses, villas, or low-rise buildings make up the basic architectural typology; the environment remains quiet. Generally, lack of cultural, social, recreational, and shopping services, big vacant spaces, and wrecked industrial historical structures are the main reasons to choose this location to provide a socio-cultural texture as well as strengthen the greenery of the area. Şişecam bottle and glass factory located in the Incirkoy neighborhood of beykoz district is a suitable choice for creating this public space. The factory occupies an extensive area of 117 square meters and is abandoned in an awkward position. Although all three factory regions are guarded 24 hours a day, no practical use has been suggested for this building, and it remains abandoned. As seen in and Figure 3.12, the facilities of the buildings and worn-out facades have disturbed the city's visual beauty and caused damage to its surroundings.

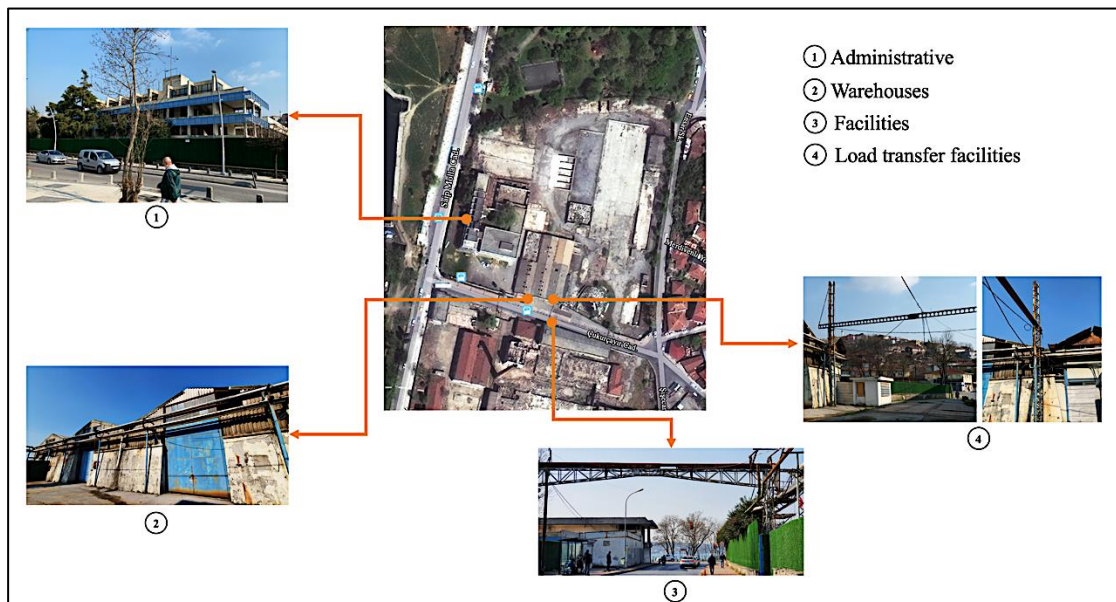


Figure 3.12: Block (1) - Photography of Şişecam bottle and glass factory.

The existence of high walls in the crusts of the streets creates a sense of limitation and blocks the sea views and urban fabric access along the coastline. Broken windows, damaged and cracked walls and irregularly growing wild plants create an undesirable

image in the area and develop a sense of insecurity due to the broken window theory effect, as shown in Figures 3.13 and 3.14.

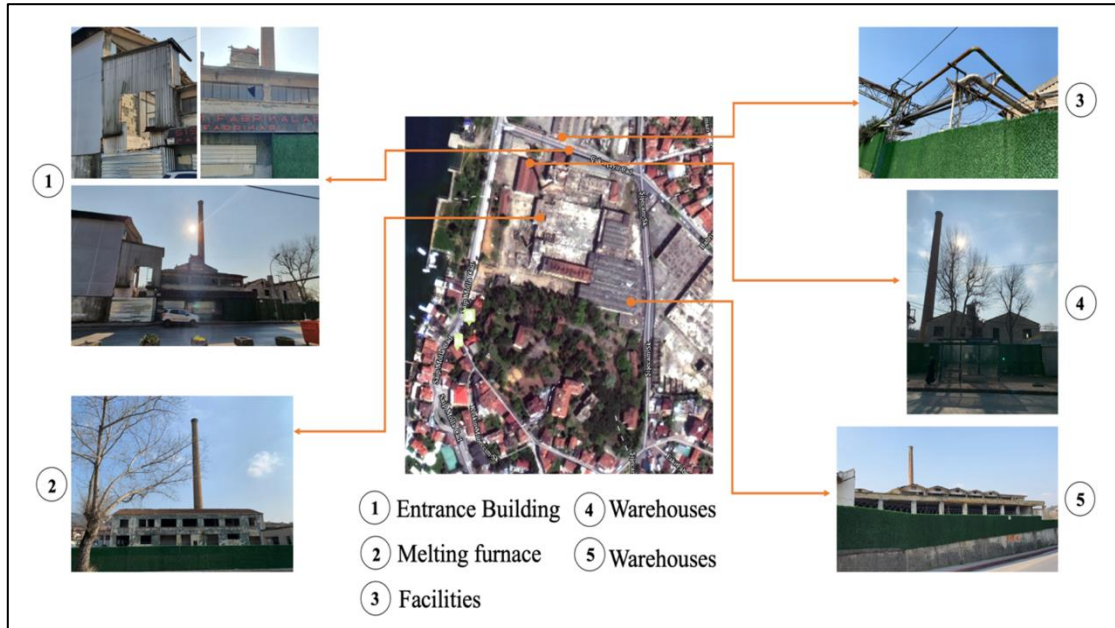


Figure 3.13: Block (2) - Photography of Şişecam bottle and glass factory.

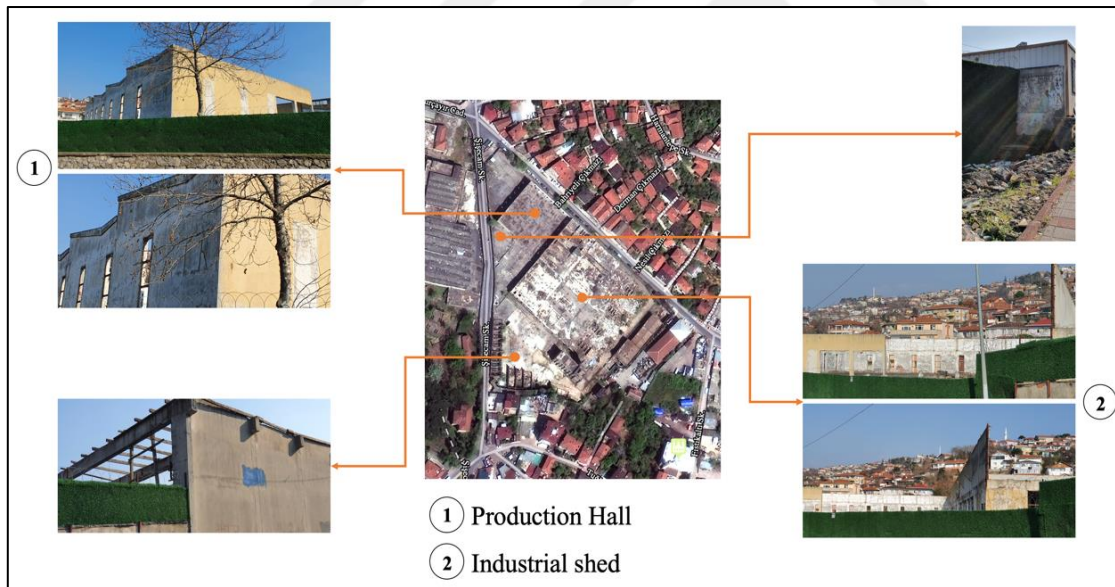


Figure 3.14: Block (3) - Photography of Şişecam bottle and glass factory.

Also, with its large unused area, the unusable Şişecam factory’s area has blocked the interactions between green textures of the Beykoz region and the green context of the hills above the factory, as well as cutting off the connection of the urban context and vegetation with the coastal area (Figure 3.15).

Choosing the Şişecam bottle and glass factory group of Paşabahçe as a case study in order to create a green cultural corridor as an urban public space to make up for the

lack of socio-cultural spaces in the selected area as well as reconnect urban texture with beykoz's rich nature, is convenient according to its enough space, its location in the area, proximity to the shoreline, and rich historical background.

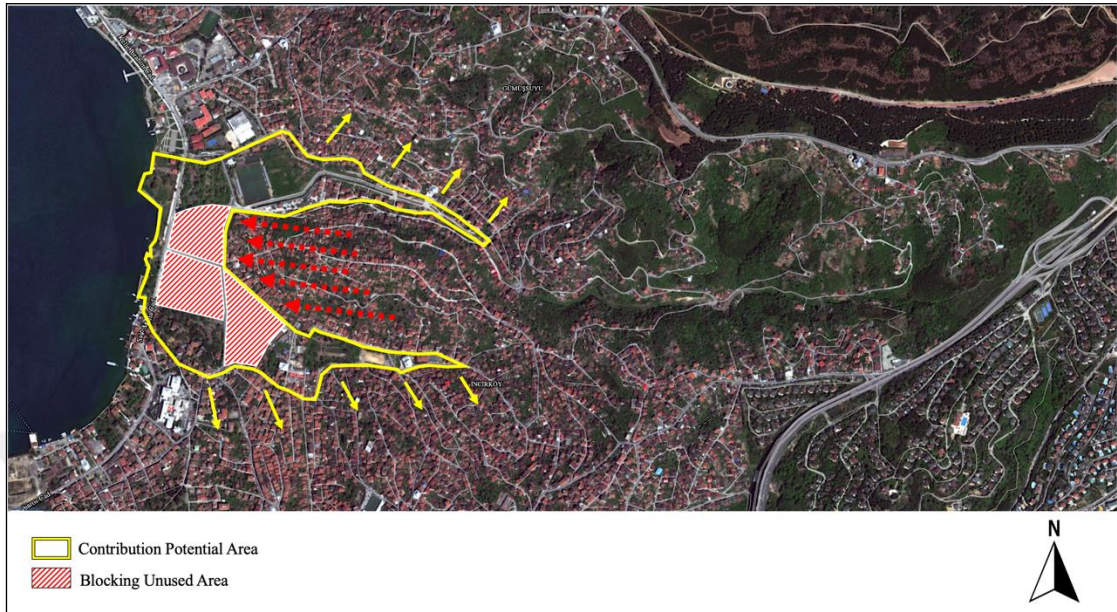


Figure 3.15: Unusable factory buildings blocking the interaction with green texture and coastline, generated based on Google Earth Map.

3.4. Evaluation of the Chapter

The Beykoz area is situated in one of Istanbul's most advantageous geographical locations. The region of Beykoz is dominated by a few fundamental uses: residential, evacuated industrial, and greenery and is remarkable for its proximity to the Bosphorus, the existence of small and large green areas, and its diverse industrial structure, including the Kundura factory and şişecam bottle and glass manufacturing, historical texture, and convenient access to the city center.

This area contains a rich plant cover and nature parks including Polonezköy Nature Park which transition-type climate, and hosts the broadleaf, mixed and coniferous forests of the Black Sea climate and the scrub woods and shrubs of the Mediterranean climate. Despite the age range of this region, which is mainly composed of children and young people (Figure 3.2), there are few cultural and art centers in the Beykoz district. Having a history of more than eighty years, the şişecam factory is one of the first factories established in this region, and it is located in one of the important locations in the area. The activity of this factory was stopped in the year 2002 and has

been left inactive until today (Figure 3.7). The abandoned factory area causes lots of urban and social problems such as:

- lack of safety
- city life quality decrease in the region
- severely damaged historic buildings
- inadequate social, and cultural facilities
- lack of theatres and galleries,
- Inconvenient pedestrians' routes,
- Disorder of shoreline uses caused by fishing boats
- unqualified façades
- lack of green spaces security
- lack of safety following several abandoned industrial textures and the broken window theory

The 117 square meters of the abandoned factory site, divided into three blocks, including the construction and production buildings, and an additional section stretching along the coastline, block the integrated green structure of the region and cuts off the neighborhood's visual connection with the coastal area.

By selecting this large abandoned building as a case study, eliminating the weaknesses and threats of this factory, and allocating new use and adaptive reuse with a biophilic approach and sustainable design components, an effective cultural atmosphere can be created in the region.

4. EVALUATION AND DISCUSSIONS ON THE RESULTS OF THE STUDY AND THE PROPOSALS FOR ADAPTIVE REUSE OF ŞİŞECAM BOTTLE AND GLASS FACTORY GROUP OF PAŞABAĞÇI

According to Lefebvre, the process of industrialization is the dynamic of the social transformations that took place during the last century in many parts of the world (Lefebvre, 1999). Lynch defines "place identity" as providing individuality and distinguishing it from other places (Relph, 2007). Revitalizing a historic post-industrial texture is a coherent purpose of preserving the cultural heritage of a region and maintaining the environmental balance in the area and the urban context.

4.1. Impact of Green Post-Industrial Zones on the Study Area's Development

Industrial green spaces are an essential type of greenery planted in the industrial complex in an ordered manner to accompany industrial structures. They served a variety of tasks, including protection, decoration, recreation, representation, psychology, and disguising. A green area can take many different shapes depending on its intended use: clumps, single plants, and different shaped layouts. The selection of an appropriate species adapted to both the terrain conditions and the specialization of production was just as important as the type of greenery. During the construction of an industrial site, terrain configuration is altered, water relations and climate are changed, and plant groups are destroyed, resulting in the loss of landscape value. Green spaces help control water flow, prevent erosion, lessen negative impacts on surrounding areas, and enhance the climate. Green industrial zones are green landscapes that surround industrial sites and have a high vegetation coverage ratio (forests, shrubs), often connecting wildlife areas like wildlife corridors. Green places that are part of the urban tissue, as well as neighboring locations such as reserved areas, are frequently found (Latusek, 2016).

Unfortunately, industrial regions are vanishing from the environment, along with open spaces, and are being replaced by hotels, housing estates, and shopping malls. Large areas of greenery, which are so crucial in ever-increasing population centers, are also lost as a result of this process. More and more "concrete deserts" are being built, where

aspects such as plant influence on building a healthy residential and work environment and animal and plant migration routes are absent. Greenery is decreasing, built-up areas are expanding due to pressure on urbanization and the growth of cities brought on by the increase in people relocating to cities. In addition to the growing need for living and working space, there are also growing demands for areas for work, industry, and the city's general infrastructure, or what is known as the "gray zones" of the city. Greenery is vanishing as a result, while urban areas are expanding. The greening of industrial buildings enables sustainable economic growth and promotes sustainable economies (United Nations Industrial Development Organization, UNIDO). Going green has numerous good social and economic implications in addition to having a favorable impact on the environment, as shown by the economic and social advantages of doing so. Green industrial zones offer a variety of benefits for businesses, including improved working conditions for staff, resource preservation for future growth, the avoidance of high switching costs to immediate cost reductions through resource-efficient production, and the exploitation of new competitive environmental products advantages and technologies (Altenburg & Assmann, 2017). In this study, the objective is to attempt to retain the self-growing texture of plants in the Şişecam factory's post-industrial region in addition to disseminating this greenery over the entire site context.

4.2. Green Museum: Şişecam Bottle and Glass Factory's Revitalization as a Biophilic Urban Corridor

Beykoz, being one of the 19th century's industrialized seashore areas, requires a redefinition of its urban organization. Analysis and assessments were carried out as part of the above-mentioned process in an effort to aid in the reshaping and improvement of the area's social structure. The objectives of this study include developing tourist destinations, converting undefined or underutilized green spaces into usable recreation areas, extending coastline usage opportunities, strengthening ties between the urban fabric and the environment, enhancing the sustainability of natural resources like green spaces, promoting the Bosphorus as one of the region's greatest assets, and reintegrating historical sites. In the following, proposals for the revitalization of the Şişecam factory, an early industrial settlement, as a cultural biophilic corridor entitled green museum, have been discussed and developed at

different scales through the contemporary problems of this area that discussed in Chapter 3.

4.3. Design Strategies

Irregular migration and rising natural population growth have faced many challenges in today's cities, including urbanization and urban sprawl. As a result, the development of cities and towns, resulting in destructive effects and catastrophic events such as excessive energy consumption, deforestation, and the extinction of plants and animal species on the planet's natural habitats, so that cities as the central place of human action have become increasingly important. Traditional methods and management no longer fulfill the issues and needs of today's societies in this way. Therefore, new solutions must be considered and adopted to solve the problems of current cities. Regarding, smart city concept, resource management, and waste energy have grown in popularity in order to meet citizens' needs and provide comfort, protect natural and cultural resources, increase proximity to nature, solve traffic problems, and improve transportation infrastructure. The term of "smart city" encompasses a wide range of concepts and names that constitute a significant portion of a smart city's fundamental ideals and objectives (Neirotti et al., 2014; Winters, 2011).

Digital city, virtual city, and Intelligent city are all other expressions for the smart city. "Smart City" was developed to expand and promote sustainable development strategies in response to the escalating urbanization-related problems. This framework fundamentally consists of an intelligent network of interconnected machines and things that communicate with one another via wireless technology and cloud computing. Information and communication technology, smart transportation, smart building systems, and improved control structures are all used in smart cities. The fundamental objective of implementing smart cities is to improve the quality of people's lives, and the concept is typically associated with urbanization, city growth, and its related challenges. Different dimensions have been established as six main indicators in order for the smart city to provide a suitable function in a variety of scenarios by the European Union: Smart Economy, Smart Mobility, Smart Environment, Smart People, and Smart Living. (Capdevila and Zarlenga, 2015; Neirotti et al., 2014; Winters, 2011; Ramezani et al., 2021; Lee et al. 2013; Galati 2018). Many methods have been created for the digital modeling of urban systems,

including Computer-Aided Design (CAD), Building Information Modeling (BIM) for buildings, and Geographic Information Systems (GIS) for urban infrastructures. Different urban systems such as infrastructures, Buildings, and cities require various tools to share data among urban information systems. 3D city models and Virtual Reality modeling are some other tools developed for smart city performance (Buchholz, 2014; El-Hawary, 2014; Momoh, 2012; Tuballa, 2016).

The 3D model of the city also called the Virtual 3D model of the city, is a digital urban model, including a 3D digital modeling of usual urban systems like districts, buildings, landscapes, streets, and any relevant object in the urban environment. A more advanced 3D model visualization and digital urban modeling tool have recently emerged, called 'Virtual Reality.' VR is becoming increasingly common in smart cities. These virtual replicas are tremendously helpful in human-environment interactions, space perception, conducting control, and assisting in city development. In this thesis, the Green Museum design elements, which emanate from the design principles such as smart city, ensuring nature conservation, green architecture and sustainability, cultural, safe, and smart living spaces, eco-social responsibility, and biophilic design approaches, were explained briefly. Afterward, the virtual museum was presented via Lumion panoramic renders for user interactions and a more realistic experience. The Virtual Reality (VR) designed potentials, 3D modeling, and virtual visualization of a detailed model are presented and its advantages and disadvantages are discussed due to its responsiveness. The ability to develop, build, and visualize incredibly intricate smart city concepts is made possible by the potential of a VR environment. The 3D model experimental VR tour of the Green Museum is available on a website-based model, and it can be accessed through the link in [Url-36](#).

At this stage, the goal is to apply changes to the abandoned Şişecam Bottle and Glass Factory area in line with concepts according to the studies conducted on the approaches and concepts studied earlier in Chapter 2. It is vital to cite that these changes are trial alternatives, and the purpose is not to present an urban project but a proposed design concept sequoia of the approaches studied in Chapter 2 and surveying their application in a real existing urban region. The proto-design successfully neutralizes or undoes the majority of the environmental harm that the factory's infrastructure causes. Some of these changes are shown through before-after visuals. As regards the Figure 4.1 the trial proto-design model is presented in respect of all

studied urban concepts and approaches in the Chapter 2, and the new dedicated uses to the buildings and lands are marked in the Figure 4.1.



Figure 4.1: The Proto-design trial model's top view.

According to the Table 2.4, biophilic features and elements applied to this trial proto-design, can be mentioned as: Roof gardens, green walls, green borders, green islands, green corridors, and urban farms (hobby farm), which are beneficial for air quality improvement, vertical urban agriculture, increasing of wall and roof's life span, increasing social solidarity, encouraging of walking and cycling, promotion of tourism and visitors, increase the value of real estate, reconnection with nature, entertainment, promotion of mental health and reduce stress, and creating harmony with nature. Applied changes can be categorized into different scales and four groups. The modifications applied to each part of the study area are described as follows:

The Coastline Area

The waterfront area of the factory is located along Saip Molla street in Incirköy, Beykoz. The coastline is recently renewed by the municipality and currently use as a waterfront public park. This shore provides a magnificent view of the Bosphorus. The connection of the factory area and its surrounding urban environment to the seaside area is a potential as much as the lack of this connection in the existing situation is a considerable weakness. According to the design strategies, making a connection between the factory area and the seaside, as well as transforming the green texture of the beykoz district into the coastline, are some of the focused points of the proposed

trial model in this study. As an alternative proffer, a pedestrian overpass as a wild-green belt can be extended from the factory blocks into the seaside and beyond that towards the sea (Figure 4.2). The width of the bridge at its narrowest is 6 meters and at its widest is 12 meters, and the height above the water and the street is 5 meters. The floating bridge design is made using suspended system, and prestressed concrete. The prestressed concrete is utilized in large-scale structures where it must support significant loads, more than 240 tons or about 4 thousand people at a time, applied at various angles which allows the structure to withstand. It is suitable for longer distances, and because the concrete is both reinforced and prestressed, lengthier foundations may be built without the risk of breakage (Url-34).

The observation platform along the entire length of the pedestrian overpass is fenced from a high-strength glass “triplex” with a height of 1.5 meters. The bridge offers panoramic views of the Bosphorus, the factory area, the urban context, and the green hills.

Due to the accomplished swot analysis in Chapter 3 and reviewed potentials and weaknesses of the coastal area, and biophilic design approaches that explain the relationship between nature, human biology, and environmental design, which was mentioned earlier in Chapter 2, and as it can be observed in the Figure 4.2 and Figure 4.3, this bridge provides responsiveness to all of the three biophilic design application’s main categories. The subcategories are as follows:

Nature in the Space

- Visually connecting with nature: a view of all green textures along the district and the redesigned factory area, and the wildlife around the coastline and park.
- Thermal variability and airflow: experiencing different airflows and temperatures. The presence of water: proximity to the sea and perception via the sound of waves and the sea airflow.

Natural Analogues

- Biomorphic forms and patterns: natural curved pattern of the bridge is followed by topographical lines of the region.
- Linking materials with nature: using native plants and bushes on the bridge. Complexity at the same time: making a complex multi-branched pedestrian road on the bridge, which is a guided walkthrough at the same time.

Nature of the Space

- vision: an unobstructed vision over a long distance is provided for observation.
- Mystery: meandering movement and pause points on the bridge urge individuals to move forward the bridge and explore the surroundings more deeply.

Additional to the created biophilic approached walkthrough bridge, the tall trees in the waterfront park area are slightly blocking the disturbing vehicle sounds from Saip Molla street (Figure 4.4).



Figure 4.2: Pedestrian bridge as a wild-green belt.



Figure 4.3: The bridge's both sides view of the sea and the urban context.



Figure 4.4: The coastline area.

Large Scale: Biophilic Urban Corridor ‘Green Museum’

Adaptively reuse of the Şişecam factory (Figure 4.5), includes allocating new uses to existing buildings and open spaces with respect to their past assignments and with least interference in the existing condition, which can perceive in the Figure 3.12, Figure 3.13, and Figure 3.14. The factory’s whole area is going to turn into a green museum as an urban green corridor. According to the explanation of green museums in Chapter 2, a green museum contains green exhibits (Figure 2.12). It can be seen in Table 2.3 that some of characteristics for green exhibits are design for reuse and reused and recycled Materials. Therefore, some existing buildings of the factory will be used for exhibition and open space fair purposes.



Figure 4.5: Adaptive reuse map of the Şişecam bottle and glass factory: Green Museum.

In order to create a sense of integrity and connection between the two main blocks of the factory, the Çukur Çayır Street between block 1 and block 2, introduced earlier in Figure 3.12 and Figure 3.13, was eliminated. Due to Figure 4.5, existing buildings of the factory are getting utilized in the following, for applications such as:

- **The Cultural Center**

Due to the significant lack of cultural facilities in the area, mentioned in Figure 3.10 and Figure 3.11 as a weakness, the building formerly used as an administrative building is turning into a cultural center and a library. The building is situated in front of the seashore thrive along the Bosphorus, with a view of the strait and the sea. the

façade of the building is preserved. the building contains a public common area, a library and a roof garden with a 360-degree view of the surrounding environment (Figure 4.6).



Figure 4.6: The before (left)/ after (Right) visual of the cultural center (Url-38).

- **The Educational Center**

As mentioned earlier in the Chapter 2 museums are permanent nonprofit organizations committed to society's growth and available to the public. They conserve, communicate, exhibit, and conduct research in order to study, and educate people about the environment around them. Which means that museums are educational centers after all (Figure 2.12). Şişecam bottle and glass factory as a green museum can be also an educational center to educate visitors about environmental and social sustainability issues, history, cultural issues and even economic topics. in different age groups but mostly young generations since most of the Beykoz district's population are adults and young adults (Figure 3.2). According to Figure 4.5 and Figure 4.7, the former warehouse reused as an educational center is located close to the cultural center, forming a cultural-educational focused point.



Figure 4.7: The before (left)/ after (Right) visual of the educational center (Url-19).

- **The woodlands and Secret Botanical Gardens**

One of the biophilic approaches benefits is urban farms and woodlands. when Şişecam factory uses have been abandoned after previous activities, social activities may have

altered flora and site dynamics, resulting in new growth patterns. Vegetation and site woodlands adapt themselves to present applications and plant species that were previously cultivated are multiplied and established themselves (Figure 4.8). In addition to maintaining the intact remnants of prior garden plantings, self-growing wild green texture, and infiltrating the shattered environment of the abandoned glass industries, new woodlands and secret gardens or urban farms are applied to the factory’s site (Figure 4.8). Previous uses have significantly altered soil substrates and created entirely new soils, which is creating a rich substrate to plant a new green texture of native botanicas, trees and bushes. Some of the most common plants found in Beykoz district are English ivy, oleander, paper flower, common fig, common lantana, bay laurel, olive, pomegranate, tree of heaven, aloe Vera, purple dead-nettle, cherry plum, southern magnolia, Judas tree, rubber plant, and Indian laurel (Url-35).

As it can be seen in the Figure 4.5 the botanical garden marked as number 7, and the bridge, contain native trees and plants. Visitors can walk through these botanical parks and secret gardens, and interact with the native natural texture (Figure 4.9). These changes have the benefits of creating harmony with nature, increasing biodiversity, Reduce the destructive effects of greenhouse gases, improving air quality and make natural ventilation, promote mental health and reduce stress for the visitors and other native urban species, which all are the benefits of designing based of biophilic principles that mentioned earlier in the Table 2.4.



Figure 4.8: Existing wild woodlands and self-growing green texture on the buildings of Şişecam factory (Up) and adaptively expansion of wild green texture and ivy plants on green walls (Down).



Figure 4.9: The secret garden (Up), botanical garden and hobby farm (Down).

- **The History Museum of the Factory**

A previously industrial shed and warehouses building is granted new activity of history museum (Figure 4.10). The building continues a view along the Bosphorus and adds to the cultural values it has accumulated in the past, a former industrial blast furnace that will tell the tale of industrial facilities for future generations. The museum contains a lot of information about the factory's timeline, political and cultural backgrounds, Information about the past processing productions and displaying of the factory's machinery in the past. According to Figure 3.4 there are significant monumental buildings and historical heritages mostly along the coastline in Beykoz district and enliven the historical spirit in the factory's texture can be a turning point in this historical corridor.



Figure 4.10: The History museum of the adaptively reused Şişecam Bottle and Glass Factory of Paşabahçe.

- **The Recycle Glass Art Exhibition**

Green museums containing exhibitions are used as a sustainability transition, through their content and design type. A green design exhibit is a museum including an exhibition that is built and exposed using green design principles and the museum itself has become a subject of the exhibition. According to the green exhibit possible characteristics shown in the Table 2.3, green exhibits are generally design for reuse multiple purposes, reused and recycled materials, sustainable wood stands and a healthy indoor environment (Byers, 2008). The recycle glass art exhibition is a 3D mass media of visual artistic expressions and create a stimulating setting for social interaction, communicate and educated about the glass factory and the value of recycling (Figure 4.11).



Figure 4.11: The Recycle glass art exhibition of the adaptively reused Şişecam Bottle and Glass Factory of Paşabahçe.

- **The Recreational Buildings**

According to the Figure 3.11, the swot analysis of the study area in Chapter 3, lack of social, cultural, and recreational facilities in the opposing social sides of the Beykoz district are mentioned as inadequate weaknesses of the area. In addition to the recreational facilities such as walking, meditation, reading, etc., coffee shops and restaurants are recently popular among citizens. Allocating a cafe and restaurant use to a building to can be an answer to some of the issues that have been analyzed in this

study (Figure 4.12). For instance, allocating a cafe and restaurant use to a building can be an answer to some of the issues that have been analyzed in this study. For example, the comfortable hues, chill background music, and diverse, interesting people who spend hours using laptops, conversing with friends, and reading books create an intimate ambiance at the coffee shop, which is a response to the approach of social sustainability and human interactions. Coffee shops contribute to their environment by providing jobs and create a more diverse local economy. Additionally, restaurants are the backbone of regional food culture, preserving crops and recipes from generation to generation.



Figure 4.12: The recreational buildings: coffee shop (Left) and restaurant (Right) facilities.

- **The Open and Semi-Open Amphitheater**

Despite of the young population of the Beykoz district, the region is suffering a huge lack of cultural-artistic possibilities and green open spaces. Due to the adaptive reuse map of the Şişecam bottle and glass factory shown in Figure 4.5 and the industrial shed situated in the block 3 shown in the Figure 3.14, an open and semi open amphitheater is proposed (Figure 4.13)



Figure 4.13: The industrial shed and the proposed proto-designed amphitheater (Left), following facadism (Right).

Another biophilic design feature is green borders. An eco-social bridge calling the green belt transmits the wild urban woodlands and makes a walkable natural corridor

for the urban wildlife. This green belt that ends in a looped bridge on the coastline, transforms the green and wild woodland texture of the district to the site and the shore (Figure 4.14). Citizens and urban animals (dogs, cats, birds, Squirrels, etc.) can safely pass the wild themed corridor. In this walkable border and the over pass connected to it, visitors can directly interact with the nature, plants, and Natural elements such as water, soil and urban animal species. By responding the social ecological aspects humans are getting closer to their instinct of merging with the nature and it solves the hegemonic mentality issue discussed in Chapter 2. Also, creating green islands encourage walking through the area (Figure 4.15).

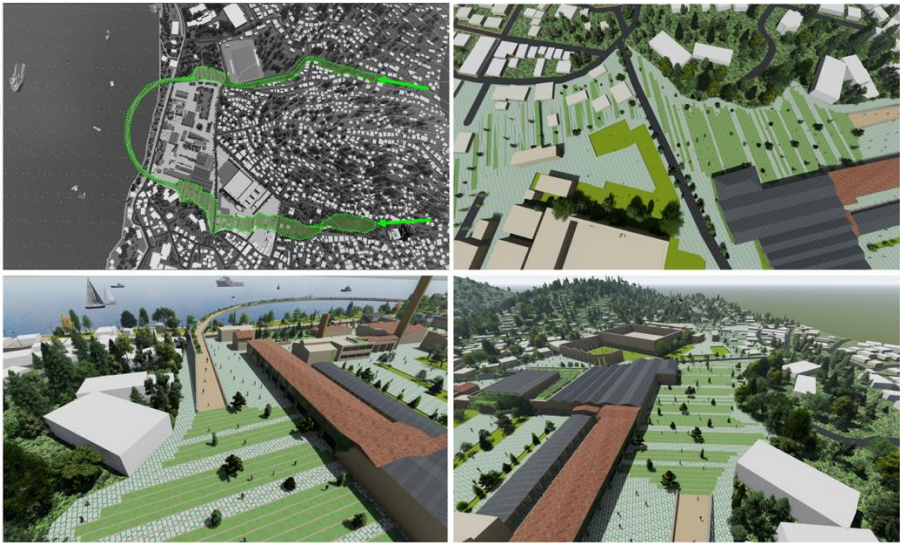


Figure 4.14: Walkable natural wildlife green belt and its visuals.



Figure 4.15: The green islands.

Since the Şişecam bottle and glass factory of Paşabahce is a historically valued area, the collection of these buildings, their adaptive reuse plans, and open and semi-open

space designs create an urban green corridor and it is named the ‘Green Museum’. This granted application is a tribute to the background of this historical place while maintaining the general manmade structure and wildlife.

Small Scale: Buildings and Facades

In this proto-design, most efforts have been made to maintain the current state of spaces and buildings, and turning threats and weaknesses into opportunities. Many social sustainability issues have solved through adaptively restoring of the buildings and their facades: (a) Preserving the identity and sense of place, (b) making safety and feeling of security by restoring all broken windows and rusty walls to solve the miss-effect of the broken glasses and removing the broken window theory effects on the safety of the area (Figure 4.16).



Figure 4.16: Existing situation of the buildings facades and broken windows (Up) and proposed proto-designed image of the buildings and facades (Down).

Also, as shown in the Figure 4.17, every high wall and barbed wire on the factory borders were eliminated and replaced with green borders in this trial proto-design to create a sense of inviting into the factory site.



Figure 4.17: Existing situation of border walls (Left) and proposed proto-designed visual of the green borders (Right) (Url-19).

Green walls, Green roofs, solar panels instead of unnecessary windows, use of solar energy system on roofs and urban mobilities, water collecting systems in buildings and on their roofs, open and semi-open facades are all proceedings to make this green museum responses to the features of biophilic design principles (Figure 4.18).

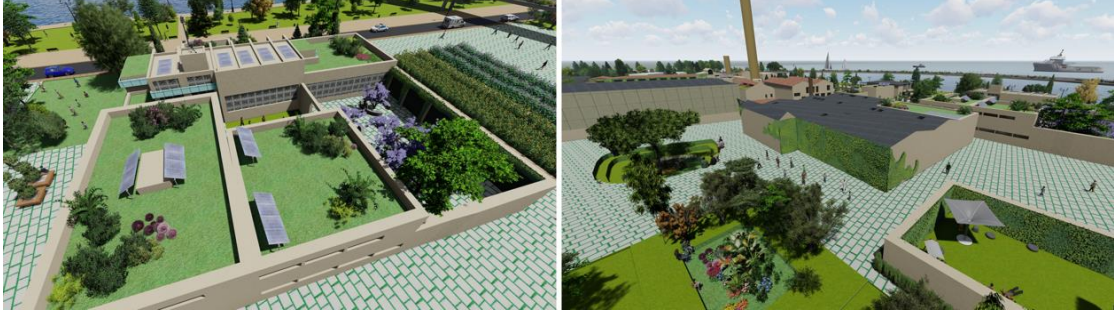


Figure 4.18: Roof gardens (Left) and green walls (right).

Micro Scale: Green Mobility, Green Furniture and facilities

Paying attention to the urban mobilities and furniture is a must for reaching a successful biophilic sustainable approached design such as: solar panels and lamps, nature points for social interactions and social sustainability issues, and interaction with nature, green benches, etc. (Figure 4.19).



Figure 4.19: The bridge visuals including solar lamps, nature points, and green furniture.

In addition, the design employs a coordinated bioremediation and on-site material recycling program to mitigate or even undo much of the environmental harm brought on by those facilities.

4.4. Examination of the Virtual Reality Model: The Responsiveness of the Trial Proto-Design to Sustainability and Smart City Principles

Numerous businesses have already begun to see the benefits of using virtual and augmented worlds to improve operations. In the modern world, AR and VR are used for everything from design and prototyping to marketing, offering customer service, providing training, and boosting productivity. Experts believe that individuals will increasingly use advances in virtual and mixed reality in their daily lives. This holds true, especially for smart cities, which regularly use the Internet of Things (IoT) technologies. “To improve the quality of life for city dwellers, connectivity and technology are the means for smart cities, not the end objective” says Jamie Cameron, director of digital solutions at building security company Johnson Controls. Virtual and Augmented Reality could help smart cities become much smarter. Smart cities could become considerably smarter and more sustainable with the help of virtual and Augmented Reality technologies (Url-33).

Entering into architecture and urban design fields, VR will allow designers to perceive the color and texture of given materials, proportions of the spatial layout, and aesthetic expression of structural elements by walking through the virtual space. As a result, Virtual Reality (VR) is becoming a valuable visual tool for architectural learning and education, however, it is currently in the research stages (Shui-Chan, 1997; Pimentel, 1995; Lingard, 1995; Durlach and Mavor, 1995; Ellis, 1991; Mazuryk & Gervautz, 1996; Cruz-Neira et al., 1992).

Virtual Reality (VR) is proposed as an experimental approach to examine sustainable behavior in the green museum by exploiting its properties that were previously investigated in Chapter 2. With the aid of Virtual Reality (VR) technology, this technique creates an immersive space that closely resembles the circumstances under which relationships between sustainable behavior are expected to materialize. A virtual environment on responsiveness to green demand will help us better understand the conditions and contexts in which a theory-driven method to explore this sustainable behavior is applicable (Jolink and Niesten, 2021).

Massive amounts of effort have been dedicated to developing smart city solutions, adapting to changing conditions, and directing this dynamic process. A multidisciplinary approach is required for the conceptual designs and planning of smart cities. The implementation of realistic smart city concepts should include

existing urban structures as well. Creating smart and sustainable cities requires an enormous amount of data collection and processing. Smart city design and development require multidisciplinary approaches that encompass many domains and disciplines. The requirements of large-scale city design involve professionals from a wide range of fields as well as users, policy-makers, community representatives, etc. The stakeholders need to be able to comprehend this vast amount of data types. VR will become more and more crucial in bridging the technological and physical worlds as technology develops. By removing visual constraints and enabling people to perceive projects on a bigger scale, VR can help individuals provide more thorough, in-depth input and designs. Interactive environments with direct human interaction can be made using VR technology (Url-24; Buyukdemircioglu and Kocaman, 2022).

As a result, their input is of higher quality, which helps them visualize, share, and assess new advances. The representation of geographic data and the ideas behind smart cities also can be studied using VR and AR technology. 3D city model visualization requires a specific approach when compared with other data visualization techniques. Visualizing massive amounts of data requires performance optimization of building geometries and textures. Virtual Reality for smart cities can be generated and visualized in real-time using VR technology and tools. (Figure 4.20) (Url-24; Buyukdemircioglu and Kocaman, 2022).



Figure 4.20: Integrating Virtual Reality capabilities with VR tools and technologies (Url-16; Url-39).

After reviews and analyses of the study area, the Şişecam bottle and glass factory, and offering an alternative proposal for the adaptive reuse of the factory, a 3D replica model is prepared in SketchUp software using the observation of the existing situation of the factory, maps and case study photography. SketchUp is a designing software that produce 3D modeling Computer-Aided Design (CAD) program for a broad range of drawing and design applications. This model is designed based on all the concepts

and approaches that discussed earlier in Chapter 2 and case study reviews in Chapter 3. The SketchUp model is formed based on perceived data and knowledge from the Physical establishment and the applied changes are all connected to the currently existing establishment such a way that visitors can experience the physical establishment and the 3D replica model at the same time and virtually observe the virtual model's changes. This is applicable in such a way that the SketchUp 3D model is getting imported in the Lumion software to provide a more detailed and realistic virtual model of the factory area and the trial proto-design.

The Lumion software provides an experimental observation tools for Virtual Reality such as realistic 3D masses, animated visuals, and panoramic VR through the model's hotspot links. These links present a simulation of the 3D model similar to the google street view for the redesigned Şişecam factory. The Virtual Reality tour is generated in Easy VR website using Lumion hotspot links in which exported simulation can administer via devices such as computers, tablets, smart phones and VR glasses. The designed VR environment of the proposed 3D model can also provide a timeless visit ability via a QR barcode. Two barcodes are generated via EasyVR website which is open access and VRdirect application (Url-36) (Figure 4.21).



Figure 4.21: Testing the 3D model presented in VR environment and visualized via VR glasses, Generated in EasyVR and VRdirect (Url-40; Url-41).

Examining the model at the street level as a part of the suggested smart city concept re-design of the factory is provided. In addition to the street-level perspective, a bird's view is available through animation and in the VR model to allow visitors and users to move around the place and observe elements on rooftops that are difficult to see from the ground in the physical world. Visual effects such as vegetation, vehicles, animals, and personage give a scene a more lively and realistic appearance. Also, a better understanding of a certain area can be achieved by simulating the site and adding noise levels. Figure 4.21 includes some VR views tested via smartphone orientation and VR glasses.

Virtual Reality gained popularity in management studies on sustainability in the 1990s, with research on tourism demonstrating how 3D representations of travel destinations may be able to reduce the carbon footprint of sensitive environments. Therefore, Virtual Reality technology offers a great chance to meet sustainability goals (Dewailly, 1999). Examination of the 3D virtual model's responsiveness, as a smart city tool, due to smart cities' main dimensions and indicators, is as follows in Table 4.1:

Table 4.1: The 3D VR model's responsiveness to smart cities main dimensions and indicators.

Dimensions	Responsiveness
Smart Economy	<ul style="list-style-type: none"> ✓Poverty reduction, housing and infrastructure improvement ✓Helping local economy ✗Resolution of monetary-banking system difficulties, and the creation of investment infrastructures
Smart Mobility	<ul style="list-style-type: none"> ✓Sustainable, creative, and safe urban mobilities
Smart Environment	<ul style="list-style-type: none"> ✓New technologies to protect the environment and means creating appropriate mechanisms to use energy optimally to reduce pollution of the environment
Smart People	<ul style="list-style-type: none"> ✓Education, stimulating innovation, and inviting public engagement in urban affairs ✓Virtual and integrated education spaces ✓Getting people involved in social activities like environmental conservation or other comparable causes can improve the smart city's image.
Smart Living	<ul style="list-style-type: none"> ✓Using technology to provide security, health, diverse culture, and tourist growth. ✓Facilitate people's way of life, environmental protection. ✓Increasing the life quality in terms of services and facilities

4.5. Evaluation of the Chapter

An intentional goal of preserving a region's cultural legacy, upholding the ecological balance in the area, and keeping the urban setting is revitalizing a historic post-industrial texture. In order to complement industrial structures, industrial green spaces are a sort of greenery that must be grown in the industrial complex in an organized manner. Buildings that lack elements like the impact of plants on creating a healthy living and working environment and animal and plant migratory paths are referred to as "concrete deserts" and are becoming more and more common.

The goal of this project is to spread this greenery throughout the full site context while also attempting to preserve the self-growing texture of plants in the post-industrial area of the Şişecam factory. The goal is not to offer an urban project but rather a recommended design concept sequoia of the earlier researched methodologies. These alterations are trial options. General applied changes are categorized into different scales and four groups (Figure 4.22):

- The Coastline Area,
- Large Scale: Biophilic Urban Corridor ‘Green Museum,’
- Small Scale: Buildings and Facades,
- Micro Scale: Green Mobility, Green Furniture, and facilities.



Figure 4.22: General view of the factory existing (Left) and after the implemented changes (Right).

The applied changes and their evaluation on the factory site are categorized in the following tables of Table 4.2, Table 4.3, Table 4.4, Table 4.5, Table 4.6 and Table 4.7.

Table 4.2: The evaluation and responsiveness of the proposed trial proto-design to the social ecology concept.

Features	Responsiveness
Human social and biological systems interactions	<ul style="list-style-type: none"> ✓The green bridge as a wild green belt, transferring vegetation from the forests to the city texture and the sea side. ✓Interactions of human and other species such as different native plants, and urban wildlife such as birds, cats, dogs or squirrels.
Communities and environments	<ul style="list-style-type: none"> ✓Green educational center for educating people about ✓Sustainability and environmental issues. sustainable green cultural center.
The environmental impact of human activities	<ul style="list-style-type: none"> ✓Sustainable education, recycling, sustainable facilities and recreational buildings. ✓The use of renewable energies, and water consumption systems.

Table 4.3: The evaluation and responsiveness of the proposed trial proto-design to the social sustainability concept.

Features	Responsiveness
Social interactions/ Social networks	<p>Open and semi-open public spaces:</p> <ul style="list-style-type: none"> ▪ Amphitheater ▪ Secret gardens ▪ Nature points on the bridge ▪ Cultural an educational center ▪ Coffee shop and restaurant
Identity	<p>Adaptively reuse of the buildings with loyalty to their history and past uses</p> <p>Use of native materials and plants</p>
Sense of place	<p>Creating a feeling of inviting and attraction to the factory site</p> <p>Unique bridge design</p>
Safety and security	<p>Eliminating the broken windows and rusty walls and facades</p> <p>Eliminating high walls and barbed wires</p>
Participation in the community	<p>Nature gathering points on the factory site and the bridge</p> <p>Cultural and educational center</p> <p>Coffee shop</p>

The social advantages and economic of the green transformation show that, in addition to environmental and cultural advantages, a green industrial policy may also have several favorable social and economic outcomes (Table 4.2; Table 4.3).

The green architecture features include the responsiveness of the proposal to water systems, natural buildings components, passive solar panels, green materials, and living architecture, and also the features of biophilic design principles including the visual connection with nature effects, thermal variability, and airflow effects, the presence of water, following the biomorphic forms and patterns, linking materials with nature, complexity at the same time, vision and mystery are getting reviewed in detail in the following Table 4.4 and Table 4.5 are representing the evaluation of the proposed trial proto-design according to the sustainable architecture features and biophilic design approaches:

Table 4.4: The evaluation and responsiveness of the proposed trial proto-design to the green architecture/sustainable architecture features.

Features	Responsiveness
Water system	✓ Rain water collection system on the green roofs
Natural building	<ul style="list-style-type: none"> ✓ Green facades with ivy and other growing plants ✓ Use of open and semi-open buildings for natural ventilation ✓ Use of plants, bushes and trees to air detoxicate
Passive solar design	<ul style="list-style-type: none"> ✓ Solar panels instead of unnecessary windows ✓ Solar systems on the roofs ✓ Solar mobility and lamps
Green building material	✓ Recycle materials (reusing the broken window glasses)
Living architecture	✓ Use of English ivy in facade and walls instead of building materials

Table 4.5: The evaluation and responsiveness of the proposed trial proto-design to the biophilic design approaches.

Features	Responsiveness
Nature in the Space	<ul style="list-style-type: none"> ✓ Visual connection with nature: a view of all green textures along the district and the redesigned factory area, and the wildlife around the coastline and park. ✓ Thermal variability and airflow: experiencing different airflows and temperatures. ✓ The presence of water: proximity to the sea and perception via the sound of waves and the sea airflow.
Natural Analogues	<ul style="list-style-type: none"> ✓ Biomorphic forms and patterns: natural curved pattern of the bridge is followed by topographical lines of the region. ✓ Linking materials with nature: using native plants and bushes on the bridge. ✓ Complexity at the same time: making a complex multi-branched pedestrian road on the bridge, which is a guided walkthrough at the same time.
Nature of the Space	<ul style="list-style-type: none"> ✓ Vision: an unobstructed vision over a long distance is provided for observation. ✓ Mystery: meandrous movement and pause points on the bridge urge individuals to move forward the bridge and explore the surroundings more deeply.

Table 4.6: The evaluation and responsiveness of the proposed trial proto-design to the Landscape urbanism and adaptive reuse principles and benefits.

Features	Responsiveness
Abandoned post-industrial area	✓
Following Façadism	✓
Integrated construction style	✓
Environmental benefits	✓
Economic benefits	✓

In below Table 4.7 the checklist of the proposed design responsiveness to the green museum and exhibit approaches is provided:

Table 4.7: The evaluation and responsiveness of the proposed trial proto-design to the green museum and exhibit approaches.

Green Museum	Responsiveness
Energy Efficiency	✓
Recycling	✓
Reuse Materials	✓
Green Architecture and Technologies	✓
Historic Preservation	✓
Natural Lighting	
Water Efficiency	✓
Native Landscaping	✓
Green Roof and Walls	✓
Source Use Reduction	✓
Green Exhibit	Responsiveness
Design for Reuse	✓
Reused and Recycled Materials	✓
Energy Efficiency	✓
Multiple Purposes	✓
Healthy Indoor Environment	—
Sustainable Wood Stands	—



5. CONCLUSION

To demonstrate the development of the thesis, a summary of the investigations and findings will be given in this chapter. Additionally, some recommendations based on the findings were provided to aid in future studies. The main aims of this study are as follow:

First, review some concepts and approaches of architecture and urban planning and examine the relationships between them.

Second, every study or design needs effective tools and applications for implementation and evaluating the applied notions on the design or study. At this level the study aims to scrutiny the appropriate tools and applications.

Third, after overviewing the concepts and selecting effective applications, this study aims to search for a suitable case study for implementing the reviewed concepts and control their responsiveness via applications after applying changes to the case study. Şişecam bottle and glass factory Group of Paşabahçe was selected and changes were applied due to studied concepts and approaches. These applied changes are as follows:

- Preservation of the Urban-industrial Woodlands in the Şişecam factory area,
- Adaptively reuse some buildings to develop new application faithful to their past use,
- New application assignment to the existing buildings and areas, as well as preserving the historical heritage,
- Implementing green texture in the green belt and green corridor length,
- Reducing sea view blockings and making visual and physical access to the coastline through the factory area,
- Providing a cultural ambiance with the social sustainability approach,
- Coastline design using biophilic concepts.

Fourth, this research is not aimed to propose an urban design project, rather its aims to propose a trial alternative designed schema to picture the concepts and evaluate them visually.

Fifth, this research aims to choose a modern and distinct way to evaluate and visualize the proposal.

Finally, the aim is not to positively prove the responsiveness of all the studied and evaluated contents, but to discuss the pros and cons.

To achieve the above-mentioned aims, in this chapter the research questions are answered according to the earlier studies and results:

Main question:

Is the transformation of an unhealthy abandoned post-industrial area into a sustainable biophilic approached Socio-cultural public space in a city can affect that region's quality?

Answer:

In the case study chosen for this thesis, "Şişecam bottle and glass factory group of Paşabahçe", the mega abandoned factory area contributes to its surrounding environment and urban context in the worst way.

Non-safe pedestrian pass ways, lack of greenness, lack of nature friendly texture, visual damage to the frame of the area, economic miss-effects, regional access reduction especially to the coastline, and housing quality reduction are the impaired influences that the factory area applies in the region.

Adaptively change the factory's use and visual texture can make a magnificent difference on the region's quality.

As shown in the map revitalization of buildings and open spaces in Figure 5.1, and in the general views of the existing situation of the factory area and the proposed trial design in Figure 4.21, clearing out of broken windows, rusty facades, and huge concrete areas, improving the lack of accesses through the factory site and the coastline, and adding cultural and recreational uses as well as being loyal to the factory's history can positively affect the region's quality.



Figure 5.1: Adaptive reuse map of the Şişecam bottle and glass factory and the proto-design of buildings and open spaces revitalization.

Sub questions:

1. Can the concept of social ecology affect by the formation of public spheres with a biophilic approach?

Answer: Human instinct was always to interact with nature and be amused by it. Biophilic approaches to planning cities and designing buildings are an answer to this instinct. Eco-social designs with a biophilic approach provide an eco-friendly territory in which human beings and other species can interact safely. Therefore, public spheres with a biophilic approach are always attractive to human beings and also other species.

2. How are Green Museums contributing to the public and what green design techniques can be using in the development of green Museums?

Answer: People act in the natural world in specific ways based on their cultural and societal beliefs and values. One's background and experiences also influence a perspective on nature. Sustainable development favors higher educational accomplishment, which has also helped other social and environmental challenges, such as climate change, in the long run. The worth of humanity's natural and cultural legacies must be acknowledged for what it is: a culture of sustainability. Museums are public, nonprofit organizations that work to enhance society by conserving, sharing, exhibiting, and doing research in order to better understand and appreciate the world around them. A museum offers services for the transfer of knowledge. Visitors can

connect emotionally and intellectually while in museums, sharing thoughts or inspiring artifacts. Additionally, people can converse with others who have comparable ideas or interests. By integrating sustainability into their daily operations and programming, museums adopt a more proactive stance toward environmental issues which known as "Green Museums" (Brophy & Wylie, 2008). Organizations engaged in green businesses, environmentally friendly infrastructure, and long-term educational initiatives include green museums.

In addition to expanding their missions and interacting with local communities, green museums contribute to the solution to the degradation of the global environment. Going green can help museums save money, gain more support from the public, draw in more visitors, and positively influence the environment. Green Museums possible characteristics and development techniques are: Energy Efficiency, Recycling, Reuse Materials, Green Architecture and Technologies, Historic Preservation, Natural Lighting, Water Efficiency, Native Landscaping, Green Roof and Walls, Source Use Reduction (Byers, 2008).

3. Does the technique of smart city tools such as VR technology respond to the sustainability approaches?

Answer: In some levels the smart city, VR as a smart city tool can positively contributes to the sustainability approaches. Designing due to smart city principles results helping local economy, provides sustainable, creative, and safe urban mobilities, uses new technologies to protect the use energy optimally to reduce pollution of the environment, Education, stimulating innovation, and inviting public engagement in urban affairs, virtual and integrated education spaces, getting people involved in social activities like environmental conservation or other comparable causes can improve the smart city's image, Using technology to provide security, health, diverse culture, and tourist growth, facilitate people's way of life, environmental protection, and increase the life quality in terms of services and facilities. Using VR technology on the other hands reduces the number of physical establishment visits, decrease the carbon amount, and helps to manage the sustainable issues more easily through mirroring data and information of the physical object. Accordingly, smart city tools such as VR positively respond to the sustainability approaches.

4. Can a proposed plan be presented and reviewed only used a 3D model and in a VR environment, with minimal physical intervention?

Answer: A smart city is a city whose data is based on the combination of the physical world and the digital world and is created by concepts such as a digital city, the Internet of Things, and cloud computing. The virtual city is a new starting point for building contemporary smart cities.

Virtual Reality environments in smart cities offer several opportunities for economic change, Public smart services, and urban smart management to enable a more peaceful coexistence of man and nature. Smart cities' huge data issue creates both fresh opportunities and difficulties. To make a city smart, top-level design and general planning must be done in accordance with the unique characteristics of each city, and an operation brain and operation center must be established for smart cities. Smart city development can only be effectively carried out by performing well in the planning, proposed design, and subtraction development of physical cities, as well as by putting appropriate regulations into place. Every proposed design can visualize using VR tools to inform their future strategies. That extra function is not available in smart maps. In conclusion, it is still too soon to say that using Virtual Reality can be enough to present and review a design or city context. Although it will undoubtedly be essential to any city's long-term resilience plan. Like every innovation, there can be some possible drawbacks, but overall, the advantages outweigh them. The support for modernist planning philosophies, which are demonstrated to undermine the human aspects of cities, is also linked to the rise in data, which may work against creating inclusive cities.

As a result, despite the cities may perform better, the livability metrics may be to be declining due to only the use of virtual models instead of physical ones. Cities are at risk from this inversely proportional link, which needs to be fixed to maintain their unique identities and cultural legacies.

In this study, an attempt was made to provide a trial proto-designed proposal, with maximum response to the examined concepts. However, not all proposed plans can be considered completely efficient and 100% responsive, and all their pros and cons should be evaluated. In this study the overall answers to the study questions are based on the pros and cons Table 5.1 below:

Table 5.1: Pros and Cons of applied changes to the post-industrial area of Şişecam factory and the evaluating VR tool.

PROS	CONS
Use of renewable energy	Due to the lack of sustainable facilities at the city level, it may not be fully useful
Recycling system	—
No automobile road inside the area	The area is still situated between automobile roads and may get affected by the harmful gasses
Expansion of local plants	—
Creating safer crossings for the movement of urban animals	—
Production of less construction waste due to restoration of buildings	—
The consumption of the least construction energy, building materials and manpower and as a result the reduction of harmful gases considerably	—
Reducing the heating effect	—
Air conditioning of the place due to the high volume of plant tissue	—
Responding to the features of the smart city	It may not be fully effective due to lack of city smart planning and smart facilities
Using modern methods such as VR for the most accurate and closest presentation of the proposed design without the need for numerous physical presences at the site and reducing the resulting energy consumption	We still need the data from physical establishment to inform from the VR model and yet it is not possible to evaluate the design only using VR environment

Recommendations for the Further Studies

Utilizing VR technology, architects, engineers, and urban planners may study prototype models and attempt to understand the complex workings of smart cities. Because 68% of the world's population is forecast to live in urban areas by 2050, the combined carbon footprint of the world's cities is only anticipated to grow. Connected communities have an advantage since they may use IoT technology to appreciate the problem and subsequently contribute to its resolution. Smart cities are able to collect a significant amount of data by dispersing various sensors throughout the city. These sensors can check for water pipe leaks or assess air quality like the Air Quality Network does. Once the data has been gathered, the smart cities can decide what to do with it. Such a simulation is called a "Digital Twin." Digital Twins of cities can be made to simulate the effects that different policies might have on a place. It can also shed light on how far we've come in terms of sustainability goals. A Digital Twin is a connected model of a real machine that runs on a cloud platform and replicates health conditions using an integrated knowledge base that includes both data-driven analytical algorithms and other physical knowledge (Dumbell, 2022; Lee et al, 2013).

The amount and variety of new data sources have made data-driven city management more challenging. There is also a lot of pressure to speed up the response process, reduce the time spent analyzing data, and employ cutting-edge methods, like cognitive computing, to find patterns that might otherwise go undetected. A digital platform that supports Digital Twins has many potential advantages in this area. Most DT initiatives in the Smart City space are currently restricted to assets or buildings or are just concerned with utilities and transportation. This strategy is a terrific place to start, but to entirely realize the potential of these efforts, municipal management teams should link assets to processes and eventually connect entire ecosystems (Castro, 2019; Deuter and Florian, 2019; Kritzinger et al., 2018; Li and Shao, 2021; Segovia and Garcia-Alfaro, 2022).

Replica 3D models and VR environments in cities and their contribution to the DT implementation systems can give dynamics to digital urban planning in modern cities by creating the ability to expand urban spaces with wider scopes. This study's content contributes to future studies by the expansion of the DT model on the existing VR environment, to the information mirroring systems through tools such as GIS and concepts like IoT, and AI. Although today, only using the Digital Twin model without

physical attendance can have weaknesses, it is predicted that with the expansion of the scope of this science, access to more accurate capabilities will be possible. The DT model can predict and optimization for the system behavior by connecting to computational data, geospatial data, GIS information, IT datums, using models, any existing digital data, or even decision-making and techniques of machine learning. Soon, it is feasible to anticipate system behavior in the future and boost process productivity only using the VR environment and the systematic DT model, which means it will be possible for urban planners and supervisors to detect the gaps and problems in the structure, locate the exact occurrence and even solve the problem without any physical presence and in more sustainable bases. In that case, future planning can more contribute to smart city principles and sustainability approaches (Castro, 2019; Deuter and Florian, 2019; Kritzinger et al., 2018; Li and Shao, 2021; Segovia and Garcia-Alfaro, 2022).

The 3D model proposed in this study, "Şişecam bottle and glass factory Group of Paşabahçe," and its virtual version can be added with geographic information, land and satellite information, weather and atmospheric information, as well as connecting to urban smart control systems such as transportation, security and cleaning systems, tourism, accessibility, population, commutation of citizens, urban maintenance and repair systems should be transformed into a Digital Twin model that, in addition to the possibility of viewing, observation and virtual presence in the place by visitors and citizens, can also help the relevant authorities to remote control every system like plants irrigation control, rotation of solar panels and their necessary maintenance, and all the smart and digital systems used in the Green Museum project can be done completely directly and in real-time by the twin model.

Also, through its digital twin model, the virtual green museum project can play an important role in earning tourist income from a distance, virtual education in a tangible space, and connecting to existing tourism systems and applications for online viewing. which can be another contribution of this project in the category of sustainability and green design because of the less physical presence in public spaces and reduce the effect of carbon dioxide production.

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