CONSERVATION STRATEGIES AGAINST CLIMATE CHANGE EFFECTS ON COASTAL HISTORIC SETTLEMENTS: THE CASE OF KUŞADASI CITADEL

A Thesis Submitted to
The Graduate School of Engineering and Sciences of
Izmir Institute of Technology
in Partial Fulfillment of the Requirements for the Degree of

MASTER OF SCIENCE

in Conservation and Restoration of Cultural Heritage

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July 2023
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To Kuşadası Cultural Heritage
and
To the Paşolar House

ACKNOWLEDGMENTS

This thesis would not have been accomplished without the support of many people.

I would like to thank my supervisor, Prof. Dr. Hülya Yüceer, and my co-supervisor, Prof. Dr. Alper Baba. I am incredibly grateful to my thesis advisor for bringing this timely topic to my attention and inspiring my choice.

I would also like to express my sincere appreciation to the members of the examination committee, Prof. Dr. Başak İpekoğlu, Prof. Dr. Mine Turan, and Assoc. Prof. Dr. İrem Gençer and guests; Dr. A. Ege Yıldırım, Dr. Keziban Çelik, Res. Asist. Nihan Bulut and Bilge Bektaş. Their valuable comments and insights have contributed significantly to the quality of this work.

I would like to express my sincere gratitude to Prof. Dr. Hasan Böke, Prof. Dr. Başak İpekoğlu, Prof. Dr. Mine Turan, Assoc. Prof. Dr. Elif Uğurlu Sağın, Assoc. Prof. Dr. Nurşen Kul, Dr. Önder Marmasan, and all the academics from the Department of Conservation and Restoration of Cultural Heritage. Their invaluable expertise and guidance throughout my graduate program have contributed significantly to my knowledge and skills in the field.

I would like to my appreciation to the Department Secretary, Çiçek Aktuna, for her incredibly helpful with administrative tasks and document-related matters throughout my graduate education.

I would like to express my deep gratitude to all the professors from IZTECH who have contributed to my education in architecture, planning, and architectural conservation. Their knowledge, expertise, and guidance have been instrumental in shaping my understanding of the field.

I would also like to extend my thanks to the Faculty of Architecture at İzmir Institute of Technology (IZTECH) for providing a conducive learning environment and valuable resources throughout my academic journey.

I would like to thank Merve Nur Selvi, Rabia Nur Bilekli, Fatih Aydoğan, Sena Nur Yazgan, Zeynep Koştu, and Selen Güler, my dear classmates with whom I endured difficult times during the online courses, for their support and solidarity.

I would like to thank my office mates Bilge Bektaş and Mert Kaya who, despite their busy schedules, supported me during times when I felt like the work would never get done.

To my dear friends Bilgesu Şamiloğlu, Hakan Karaman and Fatma Köksal from Kuşadası, who listened to me while I worked on the dissertation, I thank them for their tireless support.

To my dear friend Gülce Karagöz, who never hesitated to support me when I had difficulties writing in English, and to the highly esteemed Hilal Talay, who carefully examined my work, I thank you for your tireless support.

I thank all those who listened to me, gave me advice on my papers, and honoured me with their contributions throughout this process.

To my dear friends Fatma Defne Çalık, Muzaffer Arda Yüksel and to my all-undergraduate friends, who have been there for me since my university years and listened to me through all the difficult times, I thank them for their tireless support.

I am deeply grateful to my aunt Feryal Çıkıkçı, who has always listened to me, guided me, and supported me regardless of time or place.

Finally, I would like to express my heartfelt appreciation to my beloved family whose understanding and endless support stood by me through all difficulties and challenges.

ABSTRACT

CONSERVATION STRATEGIES AGAINST CLIMATE CHANGE EFFECTS ON COASTAL HISTORIC SETTLEMENTS: THE CASE OF KUŞADASI CITADEL

Climate change is currently one of the most essential and fastest-growing threats to people and their heritage around the world. Heritage assets and sites are vulnerable to the impacts of climate change due to their age and being in constant interaction with the environment and weathering processes. In particular, historic coastal settlements are highly vulnerable to climate change effects due to their proximity to the sea, which may lead to coastal erosion, changing sea levels, abrupt changes in air temperatures, storms and floods that may damage or even lead to the disappearance of these areas. Thus, developing resilience through tailor-made conservation strategies for historic coastal settlements is crucial to transfer them to future generations.

In this context, this study discusses the effects of climate change through the example of Kuşadası Citadel, a historical coastal settlement located in the Mediterranean Basin, which is expected to be highly vulnerable to climate change. The study identified the potential conservation problems that may arise from the effects of climate change on the listed and 'façade to be conserved' immovable cultural assets of the Kuşadası Citadel. Accordingly, the study has developed its method. Area-specific climate change impacts were determined, vulnerability and risk analyses were performed, and administrative, site and building-scale conservation strategies were developed.

In conclusion, strategies have been developed for the Kuşadası Citadel, which is highly vulnerable to the effects of climate change, to protect it from these effects at different scales. It is an example of coastal settlement research in the context of climate change adaptation and gives guidance for local-scale conservation efforts.

Key Words: Climate Change, Cultural Heritage, Coastal Historic Settlement, Conservation Strategy, Kuşadası

ÖZET

İKLİM DEĞİŞİKLİĞİNİN TARİHİ KIYI YERLEŞİMLERİNDEKİ ETKİLERİNE KARŞI KORUMA STRATEJİLERİ: KUŞADASI KALEİÇİ ÖRNEĞİ

İklim değişikliği, günümüzde insanlığın ve onun mirasına yönelik en önemli ve en hızlı büyüyen tehditlerden biridir. Miras varlıkları ve sit alanları, yaşları ve çevre ve ayrışma süreçleriyle sürekli etkileşim içinde olmaları nedeniyle iklim değişikliğinin etkilerine karşı savunmasızdır. Özellikle tarihi kıyı yerleşimleri, denize yakınlıkları nedeniyle iklim değişikliğinin etkilerine karşı oldukça savunmasızdır, özellikle, kıyı erozyonundan, deniz seviyesinin yükselmesinden, hava sıcaklıklarındaki ani değişikliklerden, fırtınalardan, taşkınlardan kaynaklı alana zarar verebilecek ya da kayıplara neden olabilecek etmenlere karşı. Bu nedenle, tarihi kıyı yerleşimleri için alan özgü koruma stratejileri geliştirmek onları gelecek nesillere aktarmak için çok önemlidir.

Bu bağlamda bu çalışma, iklim değişikliğine karşı oldukça savunmasız olması beklenen Akdeniz Havzasında yer alan tarihi bir kıyı yerleşimi olan Kuşadası Kaleiçi örneği üzerinden iklim değişikliğinin etkilerini değerlendirmektedir. Çalışma, iklim değişikliğinin Kuşadası Kaleiçi'ndeki tescilli ve 'cephe koruması' olan taşınmaz kültür varlıkları üzerindeki etkilerinden kaynaklanabilecek potansiyel koruma sorunlarını tespit etmiş. Buna bağlı olarak çalışma kendi yöntemini geliştirmiştir. Alana özgü iklim değişikliği etkileri belirlenmiş bu kapsamda hassasiyet ve risk analizleri yapılarak yönetimsel, alan ve yapı ölçeğinde koruma stratejileri geliştirilmiştir.

Sonuç olarak, iklim değişikliği etkilerine hassasiyeti yüksek olan Kuşadası Kaleiçi bölgesine yönelik farklı ölçeklerde bu etkilerden korunması için stratejiler geliştirilmiştir. Çalışma değişen iklim koşullarına uyum sürecinde benzer kıyı yerleşimlerine örnek bir araştırma ve yerel ölçekte yapılacak koruma çalışmalarına rehber niteliği taşımaktadır.

Anahtar Kelimeler: Kültürel miras, iklim değişikliği, koruma stratejisi, tarihi kıyı yerleşimi, Kuşadası

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Conservation Plan:	Kuşadası Conservation Aimed Development Plan (1994) *(Kuşadası Koruma Amaçlı İmar Planı)*
Conservation Council:	Aydın Regional Conservation Council of Cultural Assets *(Aydın Kültür Varlıklarını Koruma Bölge Kurulu)*
EKODOSD:	Ecosystem Protection and Natural Lovers Association *(Ekosistemi Koruma ve Doğa Sevenler Derneği)*
ICOMOS:	International Council on Monuments and Sites *(Uluslararası Anıtlar ve Sitler Konseyi*)
IPCC:	Intergovernmental Panel on Climate Change *(Hükümetlerarası İklim Değişikliği Paneli)*
KUAKMER:	Kuşadası F. Özel Arabul Cultural Centre *(Kuşadası F. Özel Arabul Kültür Merkezi)*
KUDEB:	The Unit of Conservation, Implementation and Control *(Koruma, Uygulama ve Denetleme Birimi)*
Municipality:	Kuşadası Municipality (*Kuşadası Belediyesi*)
UNESCO:	United Nations Educational, Scientific and Cultural Organization *(Birleşmiş Milletler Eğitim, Bilim ve Kültür Kurumu)*
UNFCCC:	United Nations Framework Convention on Climate Change *(Birleşmiş Milletler İklim Değişikliği Çerçeve Sözleşmesi)*

CHAPTER 1

INTRODUCTION

Climate change is currently one of the most important and fastest-growing threats to people and their cultural heritage around the world (ICOMOS 19G/A 2017). Historic coastal settlements, in particular, are more vulnerable to the effects of climate change. In this regard, historic coastal settlements should be resilient to the impacts of climate change because they have a major impact on the world's environment in different ways and to different degrees. However, there is a new focus on examining the intersection of climate change and cultural heritage in heritage conservation (ICOMOS 2019).

In this context, this study aims to contribute to the current debate on the impact of climate change on historic coastal settlements and offer conversation strategies. Studies that address how to improve the intersection of climate change and cultural heritage and how to develop preservation strategies for historic coastal settlements were reviewed. Some of them are presented below.

Global climate change is affecting the world's environment in various ways and to varying degrees, and its effects are expected to accelerate. Global surface temperature has already increased by about 1.07°C and is projected to exceed 1.5°C, due to increasing human activities since the beginning of the Industrial Revolution in the 1880s. Greenhouse gas emissions are considered the main cause of global climate change, along with other factors such as the increase in the Earth's surface temperature and the presence of certain chemicals. Increasing greenhouse gas emissions may also contribute to various natural disasters (IPCC 2021).

These sites have evolved throughout history and serve as important resources to help current and future generations understand the evolution of humanity, culture, and nature. In addition, cultural heritage sites are in constant interaction with the environment and are subject to weathering processes that make them continuously vulnerable to environmental factors (UNESCO 2007).

Heritage sites are areas that require protection due to their vulnerability to various natural and human-induced impacts, as well as current conservation problems and the effects of climate change. These sites are particularly vulnerable to problems such as coastal erosion and salinization due to sea level rise, losses due to seawater acidification, abrupt changes in air temperature, coastal erosion, storms, floods, landslides, and more, all of which can cause damage or even lead to the disappearance of these areas (ICOMOS 2019).

Studies of the effects of climate change on cultural heritage sites began in the early 1990s and initially focused on archaeological sites in Australia (Rowland 1992; Sesana et al. 2021). The topic of climate change and its impact on archaeological sites was discussed at the annual conference of the Australian Archaeological Association in 1990 and further explored in a workshop organised by the Department of Arts, Sports, the Environment, and Territories (DASET) in Canberra in 1991. Rowland's contribution to the literature focused on the potential impact of the greenhouse effect, particularly sea level rise, on Aboriginal coastal sites and presented scenarios to consider (Rowland 1992).

In later studies, Rowland emphasized the importance of adaptation responses to the greenhouse effect (interchangeable with climate change) for cultural heritage. He criticized the limited knowledge of scientific data, the potential impacts of climate change, and the need for adaptation and action measures. He emphasized the importance of developing cultural heritage strategies for climate change and increasing efforts to survey coastal sites within the watershed system (Rowland 1999).

The study of the impact of climate change on cultural heritage continued with the work of Viles (2002). Her article highlighted the importance of the impact of climate change on the built environment, focusing specifically on the deterioration of building blocks and the associated risks and processes in the United Kingdom.

The early studies related to the impact of climate change on cultural heritage in the international conservation authorities can be traced back to the International Scientific Committee meeting of the International Council on Monuments and Sites (ICOMOS) in 2004 (Gençer 2017), The recognition that climate change poses a significant threat to cultural heritage was acknowledged at the 29th General Assembly of the UNESCO World Heritage Committee in 2005. This was the first official recognition of the impact of climate change on cultural heritage by international authorities in this field (UNESCO 2007; Gençer 2018). Subsequently, experts conducted studies to assess the impacts of climate change on World Heritage sites and develop appropriate management strategies.

In May 2007, ICOMOS organized the 'International Workshop on the Impact of Climate Change on Cultural Heritage' in New Delhi. This workshop proposed the development of macro-level and micro-level strategies, emphasized the importance of scientific, technical, and academic research, and called for increased efforts by the National Institute of Disaster Management. UNESCO identified several potential threats to cultural heritage due to climate change, including changes in temperature, precipitation, humidity, wind intensity, sea level rise, desertification, and interactions between climatic changes and air pollution (UNESCO 2007).

The IPCC mentioned climate change impacts on cultural heritage in the AR5 Report in 2014, which was the first mention of this topic in IPCC reports (IPCC 2014).

In line with these developments, in 2016, the Climate Action Working Group was established by ICOMOS with representatives from different countries and offices. The aim was to prepare a new charter on global climate change and cultural heritage and develop a commitment program for climate change. With the support of the working group, the 2017 ICOMOS General Assembly endorsed the increase in climate change-related efforts within the international cultural heritage community and took steps to enhance the implementation of the Paris Climate Agreement (ICOMOS 2017). The most significant outcome of the working group was the report titled "Our Common Dignity: Enabling the Potential of Cultural Heritage for Climate Action," prepared in 2019. This report took a multidisciplinary approach to addressing cultural heritage and climate change and was intended for area managers, scientists, researchers, climate activists and decision-makers. The report guided the integration of cultural heritage into climate actions and highlighted its effective potential in this regard (Gençer 2022).

In the 2020 ICOMOS General Assembly, a Climate and Ecological Emergency was declared, calling for urgent and collective action to protect cultural and natural heritage against climate change. As a result of this call, a Three-Year Scientific Plan for 2021-2024 was prepared, focusing ICOMOS's efforts on climate change. (ICOMOS, 2022)

1.1 Problem Definition

The IPCC (International Panel Climate Change), is the United Nations body that assesses scientific evidence on climate change, If the overall temperature in the Mediterranean Region increases by 1 or 2 degrees in the coming periods, this will lead to widespread droughts, an increase in the frequency of heat waves, and an increase in the number of extremely hot days (IPCC 2018). The Mediterranean Region is considered one of the most vulnerable to climate change (Karaca and Nicholls 2008; Nicholls and Hoozemans 1996) (Figure 1). In addition, coastal areas are at increased risk from climate change impacts such as storm-related flooding and sea level rise (Karaca and Nicholls 2008). These climate change impacts increase the vulnerability of Mediterranean coastal areas, including their cultural heritage and pose a significant threat to these regions.

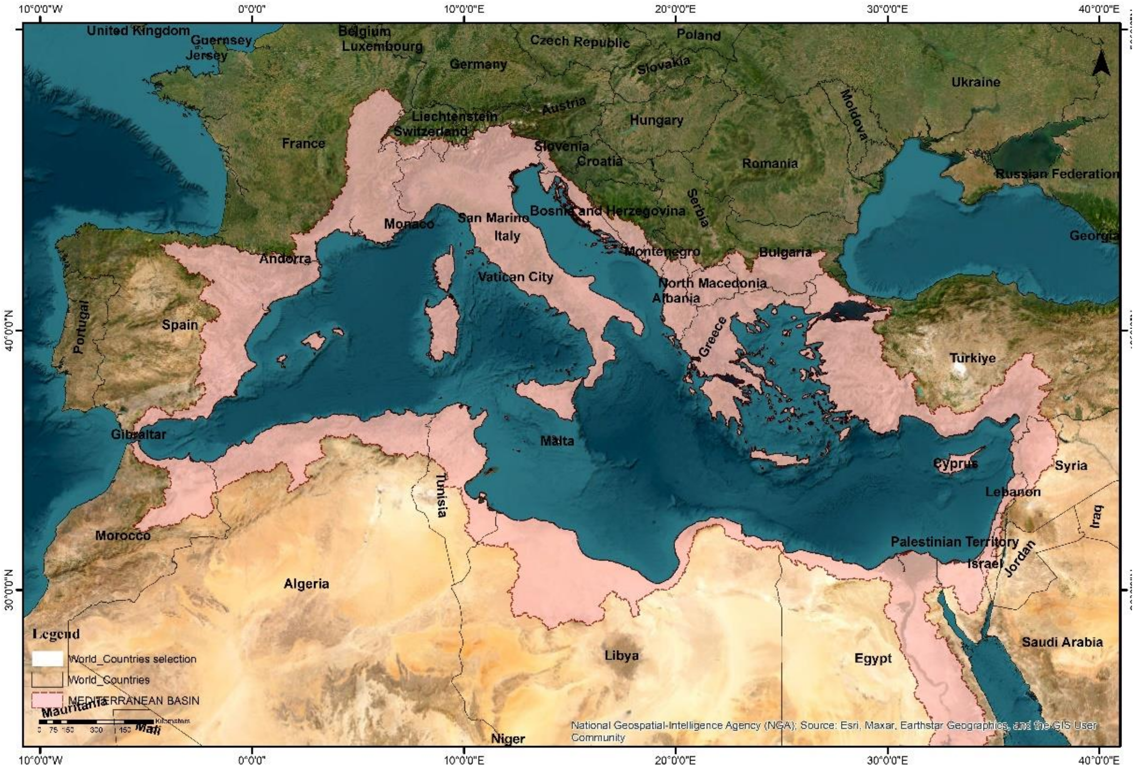


Figure 1: Mediterranean Basin and its Border
(Source: National Geospatial-Intelligence Agency, 2023)

The Mediterranean region is rich in cultural heritage sites whose history dates back thousands of years. Many of the UNESCO World Heritage sites in this region, especially those in low-lying coastal areas, are at risk of flooding and coastal erosion (Reimann et al. 2018). Consequently, many UNESCO World Heritage sites and cultural heritage sites in the Mediterranean region are under severe threat to their conservation and integrity.

Türkiye is located in the southern part of the Mediterranean basin and on the coast of the Aegean Sea. Like other heritage sites in the Mediterranean, Türkiye and its heritage sites will be affected by climate change, especially those located on the Aegean Coast.

The Aegean Region is of great importance due to its numerous cultural heritage sites (Figure 2). World Heritage-listed Turkish sites such as Ephesus, Pergamon and its multi-layered cultural landscape and Aphrodisias are all located in the Aegean Region. These World Heritage sites and other cultural heritage sites along the Aegean Coast are highly vulnerable to the effects of climate change and natural hazards.

Figure 2: UNESCO World Heritage Sites around the Aegean Sea
(Source: UNESCO, 2023)

Among the various historical sites, this study focuses on Kuşadası, a historical coastal settlement in the Aegean Sea near twelve Ionian cities, including Ephesus, a World Heritage Site. The historic settlement of Kuşadası is likely to be affected by climate change.

The authentic architecture and layout of the historic coastal settlement of Kuşadası developed in response to the surrounding flat and sloping terrain. The Citadel of Kuşadası was selected as a case study due to its historical significance and potential vulnerability to climate change. Currently, there is little research in Kuşadası that addresses the interaction between built heritage and climate change and the local government does not have an action plan that addresses the impacts of climate change on cultural heritage (Figure 3).

There are 310 dissertations related to Kuşadası in the CoHE Thesis Centre. Of these, 125 theses (about 39%) deal with tourism or tourism management, while 12% (40 theses) are related to architecture, archaeology, art history, and urban planning (Figure 3). Within the latter category, 10 theses deal specifically with built urban heritage, and their publication dates range from 1992 to 2019, with one dissertation dealing with climate change scenarios for the modification of the coastline in the southern Aegean region. Surprisingly, none of the dissertations addresses the intersection of climate change and built heritage in the context of Kuşadası. Therefore, this study aims to contribute to developing conservation strategies for architectural monuments, including vulnerability assessment and risk mapping impacts.

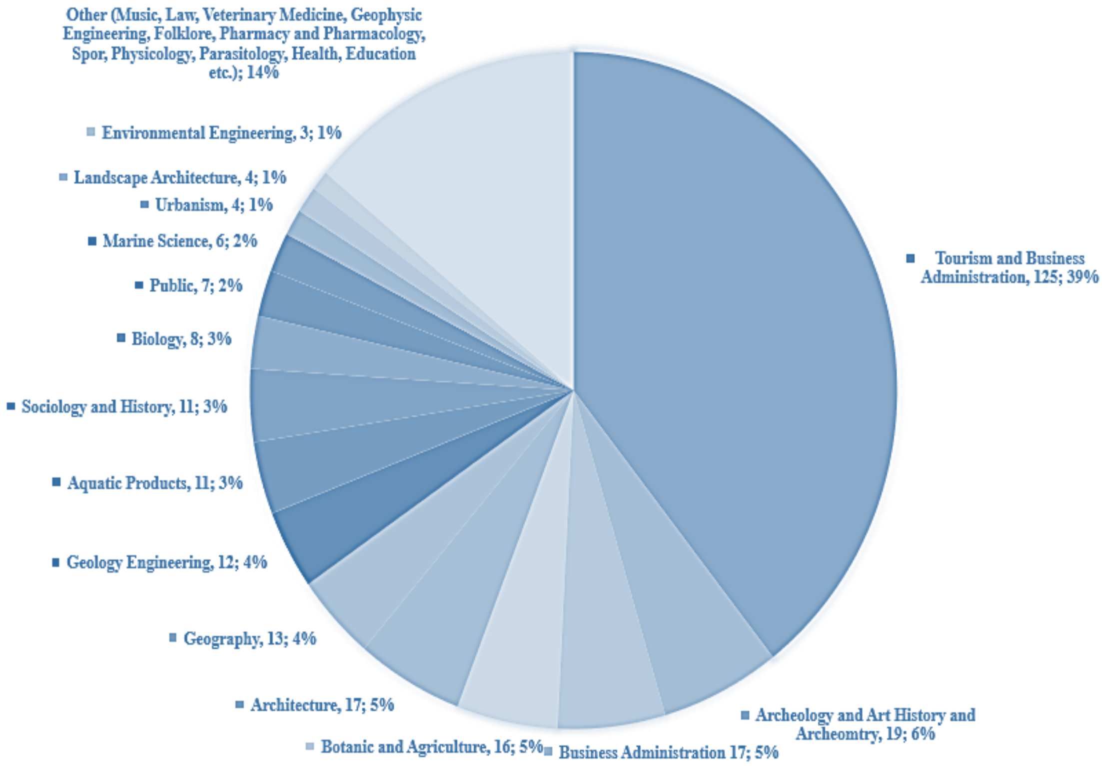


Figure 3: The Chart of Thesis Topics
(Source: CoHE, 2022)

With this background, the research questions are developed as follows.

- What are the impacts of climate change on the historic coastal settlement of Kuşadası?
- What should be the adaptation strategies for climate-resilient built heritage in Kuşadası Citadel?

1.2 Aim and Objectives

Historical coastal settlements, particularly those in the Mediterranean Basin, are expected to be impacted by changing climate conditions, as stated in the problem definition. Kuşadası Citadel is one of the historical coastal settlements within this background, this study aims to determine the probable effects of climate change on Kuşadası Citadel and develop conservation and adaptation strategies. The objectives of the study are to assess the conservation condition of 71 immovable cultural assets in Kuşadası Citadel and estimate the potential impacts of climate change. In addition, it is aimed to contribute to the conservation plans of climate change, which is one of the most current events that pose a problem to historic sites, and to serve as an example for future studies on climate change in historical coastal settlements. As a result, the project intends to accomplish a comprehensive adaptation of the 71 immovable cultural assets as well as the entire area to the rapid onset and slow onset consequences of climate change.

1.3 Scope and Limits

In the framework of the objectives of this study, the scope is determined to develop protection strategies for the impact of climate change on the Kuşadası Citadel. In line with this objective, the scope of the study was determined by examining the "Outline of Climate Change and Cultural Heritage Report" prepared by the International Council on Monuments and Sites (ICOMOS) in 2019. The report provides a systematic framework for understanding the intersection of cultural heritage and climate change. The first part of the report, which consists of two sections, summarises a positive, policy-based vision for cultural heritage in the context of climate action. This vision analyses climate action in four key categories/sectors: high ambition, greenhouse gas mitigation, adaptation and loss, and damage. These four sectors were formed based on the Paris

Agreement (ICOMOS 2019). However, this study focuses on two categories: Adaptation and Damage and Losses. Because this is a dissertation focused on historic coastal settlements, the built environment, and conservation strategies, it excludes the high ambition categories, which include funding, technology, and capacity building, and the mitigation categories, which include greenhouse gas mitigation, sinks, and reservoirs. The study developed conservation strategies to adapt to the effects of climate change and to cope with loss and damage. The research methodology was discussed in detail in Chapter 3 Methodology within this framework.

The study focused on the Kuşadası Citadel, as stated in the problem definition, specifically in the context of the Kuşadası Citadel. The historic settlement of Kuşadası encompasses a larger area, which includes the citadel area (Figure 4). The historic coastal settlement of Kuşadası, including the Citadel, was designated as a Kuşadası Urban Site by the Historic Preservation Council in 1978 (Yönetken 2018). This historic settlement has developed inside the city and outside the fortress walls (Figure 4). However, for this study, the case study was limited to the citadel area surrounded by fortress walls, a portion of which has survived to the present day. This limitation was made because the citadel of Kuşadası is located both on slopes and plains, which provides the opportunity to study different impacts of climate change in these different topographic environments.

The study area was limited to the Kuşadası Citadel 48 listed immovable cultural properties and 23 defined as "facades to be preserved" listed in the 1994 Kuşadası Master Plan. The 48 listed immovable cultural properties include fortress walls and their units, a caravanserai, a mosque, a hammam, public buildings, and residential buildings. The 23 buildings with facade protection are residential buildings. Therefore, this study was limited to the 71 immovable cultural properties located in Kuşadası Citadel (Figure 5).

Figure 4: Kuşadası Urban Site Boundary

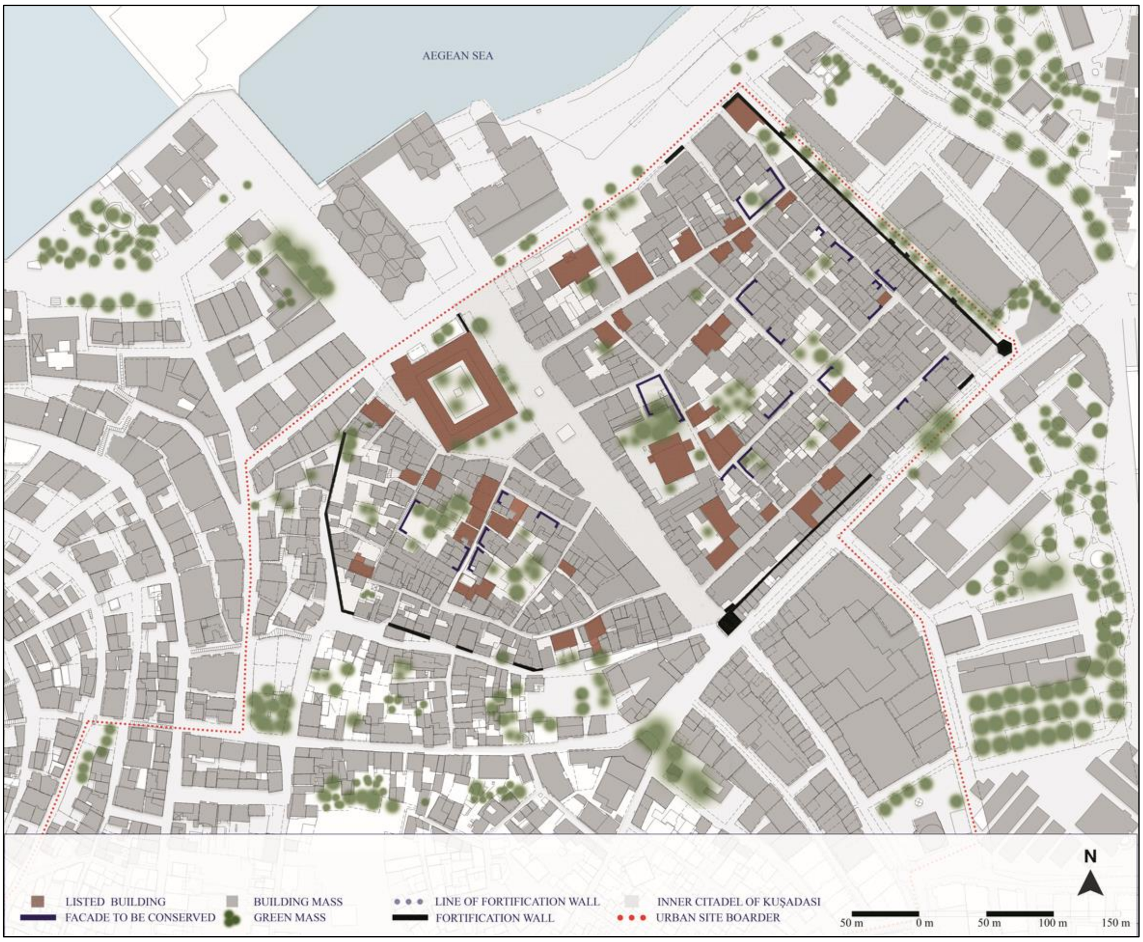


Figure 5: The Case Study Area

CHAPTER 2

THEORETICAL FRAMEWORK

This chapter addresses climate change and its impact on cultural heritage through a review of relevant literature.

The literature review methodology consists of five parts: Climate Change Background, Environmental Change, International and National Documents on Cultural Heritage and Historic Coastal Settlements, and Climate Change. Climate change is examined through the IPCC report, international and national protocols, and historical agreements. The last part consists of the international report of UNESCO, ICOMOS, IPCC and the articles of the systematic review.

2.1 Climate Change Studies: Background

According to the United Nations, “Long-term changes in temperature and weather patterns are referred to as climate change. These movements could be due to natural causes, for instance, oscillations in the solar cycle. However, human activities have been the primary cause of climate change since the 1800s, owing to the combustion of fossil fuels such as coal, oil, and gas” (United Nations website 2023). The combustion of fossil fuels produces greenhouse gas emissions, which are the most powerful cause of climate change. The IPCC's First Assessment Report (IPCC 1990) issued a global warning:

> “Emissions from human activities are significantly increasing greenhouse gas concentrations in the atmosphere. These increases will amplify the greenhouse effect, further warming the Earth's surface on average. For a decade or more, a clear description of the increased greenhouse effect from measurements is unlikely."

The Intergovernmental Panel on Climate Change (IPCC) is a United Nations agency that evaluates climate change science. The IPCC was founded in 1988 to give periodical scientific assessments of climate change, its implications, and risks to policymakers, as well as to propose adaptation and mitigation solutions.

Although the IPCC was established in 1988, it was stated that fossil fuels burned almost a century ago could cause global warming. After the 1850s, the greenhouse gas effect was recognized (Christie 1990, Grove 1990, Rowland 1992). Svante Arrhenius, a Swedish scientist, identified the importance of burning fossil fuels for global warming in 1896 (Rowland 1999). Global warming studies rapidly increased between the mid-1970s and early 1980s (Rowland 1992).

The Rio Conventions were an important step taken in the international arena against the effects of global warming caused by human-induced activities on the climate at the Earth Summit in Rio de Janeiro in 1992. These Conventions are the United Nations Framework Convention on Climate Change, the Convention on Biological Diversity, and the United Nations Convention to Combat Desertification. The three Rio Conventions overlap in climate, desertification, and biodiversity loss, are heavily interlinked, and pose existential to humanity. The Conventions work closely and develop solutions to climate, desertification and biodiversity (United Nations 1992).

The first step of the United Nations Framework Climate Change Convention was taken in the Rio Conventions, 196 countries are parties, and their primary goal is to address climate change by stabilizing greenhouse gas concentrations in the atmosphere at levels that preclude harmful human interaction with the climate system (UNFCCC). The treaty recognizes countries' common but diverse responsibilities in mitigating climate change, taking into consideration their various national conditions and capabilities. It fosters worldwide collaboration in decreasing greenhouse gas emissions, adjusting to the effects of climate change, and assisting developing nations with financial and technological assistance. The UNFCCC has played an important role in developing global collaboration and laying the groundwork for subsequent climate change agreements, such as the Paris Agreement (Student et al. 2021)

The Kyoto Protocol is an international agreement adopted in 1997 under the United Nations Framework Convention on Climate Change (UNFCCC). It suggests new obligations for industrialized areas to reduce their greenhouse gas emissions to mitigate climate change. The Kyoto Protocol established precise emission reduction objectives for Annex I (developed countries) for the period 2008-2012, aiming for a 5% decrease below 1990 levels. It established three flexible instruments to ensure compliance with these targets: emissions trading, the Clean Development Mechanism, and Joint Implementation. The significant role of the Kyoto Protocol is raising global awareness about the requirements for the reduction of emissions and serving as a foundation for subsequent climate change negotiations (United Nations 1998)

The Paris Agreement is an international treaty adopted in 2015 under the United Nations Framework Convention on Climate Change (UNFCCC) to address climate change and limit global warming to well below 2 degrees Celsius above pre-industrial levels (UNFCCC 2015). The agreement explains a framework for countries on how to take action to mitigate greenhouse gas emissions and adapt to the climate change effects. The agreement highlights the notion of shared but differentiated responsibilities, acknowledging that wealthier countries should take the lead in decreasing emissions while also offering financial and technological help to underdeveloped countries (UNFCCC 2015).

The United Nations Sustainable Development Goals (SDGs) are a series of global targets agreed upon by UN member states to address a variety of social, economic, and environmental concerns, including climate change. Goal 11 of the Sustainable Development Goals focuses on making cities and human settlements more inclusive, safe, resilient, and sustainable. This aim emphasizes the significance of cultural heritage preservation and the promotion of sustainable urban development techniques to create liveable and resilient cities. It underlines the need to preserve cultural heritage places, incorporating heritage conservation into urban planning and design, and providing equal access to cultural resources and history for all (ICOMOS 2021).

2.2 Environmental Changes

Climate change has numerous effects at various levels, one of which is its environmental impacts. Global warming, caused primarily by human activities and the emission of greenhouse gases, results in a long-term increase in Earth's average surface temperature (IPCC 2014). This phenomenon leads to significant changes in ecosystems, urban life, and natural resources. These changes manifest in alterations to temperature, precipitation patterns, rising sea levels, and the frequency and intensity of extreme weather events. Such shifts have a direct impact on biodiversity, potential species distribution, migration patterns, and ecological interactions. To address these environmental changes, proactive measures are necessary to mitigate climate change and safeguard the resilience and integrity of ecosystems.

2.2.1 Extreme Weather Events

Cultural heritage sites can be vulnerable to climate weathering processes. Despite the changing climate and its effects, cultural heritage sites are being preserved by international, national, and local authorities on a different scale. Climate change is associated with an increase in the frequency and intensity of extreme weather events, which pose significant risks to human societies and natural ecosystems. These events include heatwaves, heavy rainfall, hurricanes, cyclones, droughts, and storms. As global temperatures rise, the atmosphere holds more moisture, leading to more intense rainfall and increased flood risks (Daly et al. 2022).

2.2.1.1 Heat Waves

Heat waves are the main extreme water event in the climate change process According to the World Meteorological Organization, heat waves are prolonged periods of unusually high temperatures that exceed historical averages in a region or during a specific time of year. The definition of a heat wave considers specific threshold temperatures, location, and climate characteristics. Heat waves trap hot air under high-pressure systems, preventing its dissipation and leading to stagnant and prolonged heat accumulation (National Oceanic and Atmospheric Administration - NOAA). The Intergovernmental Panel on Climate Change (IPCC) stated in its 6th Report that there is a connection between climate change, increasing temperatures, and the occurrence and intensity of heat waves (IPCC 2019).

2.2.1.2 Droughts

Droughts are one of the most serious consequences of climate change, causing substantial challenges to ecosystems, agriculture, water supplies, and human livelihoods. Drought is characterized as "a complex, slow-onset phenomenon that occurs when rainfall is significantly below normal levels, causing serious water shortages" (United Nations 2018). Drought conditions are exacerbated by climate change, which alters precipitation patterns and increases evaporation rates. Rising temperatures accelerate soil moisture evaporation, resulting in lower soil moisture content and increased water stress on vegetation. Droughts can have wide-ranging implications, such as decreased crop yields, increased frequency of wildfires, depletion of water supplies, and economic losses in impacted areas. Mitigation and adaptation strategies are critical for dealing with the effects of drought and increasing resilience in the face of climate change (United Nations 2015).

2.2.1.3 Wildfires

A significant impact of climate change is the increase in wildfires, which pose substantial risks to communities, ecosystems, and public health. Longer droughts, higher temperatures, and altered precipitation patterns are all made worse by climate change, which also increases the frequency and intensity of wildfires. The Intergovernmental Panel on Climate Change (IPCC) asserts that "observational and modelling studies consistently indicate that climate change has increased the frequency and severity of fire weather in many regions since the 1980s" (IPCC 2021). Conditions that are warmer and dryer are excellent for wildfires to start, spread quickly, and become harder to contain.

2.2.1.4 Floods

Floods are one of the most serious effects of climate change, having far-reaching ramifications for populations, infrastructure, and ecosystems (Angelakis et al. 2023). Climate change increases the frequency and intensity of floods by increasing rainfall, raising sea levels, and changing precipitation patterns. The Intergovernmental Panel on Climate Change (IPCC) reports that "the frequency and intensity of heavy precipitation events have increased since the 1950s over most land area” (IPCC 2014). As a result, regions are experiencing more frequent and intense rainfall, leading to higher river flows and an elevated risk of flash floods. Coastal areas are particularly vulnerable to flooding due to rising sea levels, which amplify storm surge impacts during extreme weather events.

2.2.1.5 Storms

Storm frequency, severity and patterns are changing because of climate change. The amount of moisture in the atmosphere rises because of increasing water evaporation brought on by rising global temperatures. The development of more dangerous storms, such as tropical cyclones, hurricanes, and severe thunderstorms, may be aided by this higher humidity. The distribution of precipitation and storm tracks may both shift as a result of changes in atmospheric circulation patterns brought on by climate change. Extreme weather events like flooding, windstorms, and storm surges could become more frequent as a result of these changes, posing serious threats to coastal regions and vulnerable communities (IPCC 2018).

2.3 International Studies on Cultural Heritage and Climate Change

International cultural heritage authorities began to perform climate change and cultural heritage studies early 2000s with the increasing effects of climate change. These studies highlight the significance of safeguarding and managing cultural heritage against climate-related risks. They emphasize the importance of cultural heritage in fostering sustainable development and enhancing the well-being of local communities. In the following headings, these international authorities and documents are presented.

2.3.1 UNESCO World Heritage Centre

UNESCO World Heritage Centre was established in 1992 and it is the focal point and coordinator within UNESCO for all matters related to World Heritage. The Center coordinates both the reporting on the state of the sites and the emergency action taken when a site is threatened. It also organizes the annual meetings of the World Heritage Committee and its Bureau, offers assistance to States Parties in the preparation of site nominations, and organizes international assistance from the World Heritage Fund upon request. The Center also develops teaching resources to educate young people about the importance of heritage preservation and keeps the public informed about World Heritage issues. It also organizes technical seminars and workshops and updates the World Heritage List and database (UNESCO 2023).

World Heritage sites play an important role as climate change observatories, actively collecting and sharing data on monitoring, mitigation, and adaptation approaches. As many sites are currently and will continue to be impacted by climate change, it is critical to understand how these changes affect their Outstanding Universal Value and respond effectively to ensure their preservation. Furthermore, the global network of World Heritage sites not only helps to raise public awareness of the effects of climate change on human societies, cultural variety, biodiversity, and ecosystem services, but it also emphasizes the importance of protecting natural and cultural assets around the world (UNESCO 2023).

2.3.2 Sendai Framework for Disaster Risk Reduction 2015-2030

The "Sendai Framework for Disaster Risk Reduction 2015-2030" recognizes the importance of cultural heritage in disaster risk reduction and encourages its incorporation into risk assessment, preparedness, and recovery efforts. It is a global agreement adopted by United Nations Member States to reduce disaster risk and improve disaster resilience. Its primary goal is to significantly reduce disaster mortality, the number of people affected by disasters, economic losses, and damage to important infrastructure and essential services. The framework highlights the significance of preventing new disaster risks, mitigating current risks, and strengthening communities' and nations' resilience to endure and recover from disasters. (United Nations 2015).

2.3.3 Climate Heritage Network

The Climate Heritage Network (CHN) is a voluntary, mutual support network that brings together government agencies, non-governmental organizations (NGOs), universities, corporations, and other groups dedicated to collaborating and sharing knowledge on climate change adaptation and mitigation for cultural heritage and meeting the Paris Agreement's goals. The Network mobilized in 2018 during the Global Climate Action Summit and launched in 2019. It works to develop climate policy, planning and action at all levels to account for dimensions of culture from arts to heritage (Climate Heritage Network 2023).

2.3.4 Outline of Climate Change and Cultural Heritage

The "Outline of Climate Change and Cultural Heritage" was prepared by the International Council on Monuments and Sites (ICOMOS). This outline guides on assessing the vulnerability of cultural heritage to climate change impacts, developing adaptation strategies, and integrating climate considerations into heritage management (ICOMOS 2018).

The Outline of Climate Change and Cultural Heritage is a framework developed by ICOMOS (International Council on Monuments and Sites) that explores the relationship between climate change and cultural heritage. It provides a comprehensive overview of the potential impacts of climate change on heritage sites, including risks such as rising sea levels, extreme weather events, and changing environmental conditions. The outline emphasizes the need for proactive measures to protect and adapt cultural heritage in the face of climate change. It highlights the importance of conducting research, assessing vulnerability, and developing strategies to mitigate the impacts. The outline also emphasizes the role of local communities and indigenous knowledge in managing climate risks and preserving cultural heritage for future generations (ICOMOS 2019).

2.3.5 European Cultural Heritage Green Paper

The European Cultural Heritage Green Paper, produced in collaboration with Europa Nostra, ICOMOS, and the Climate Heritage Network, highlights the significance of cultural heritage in achieving the ambitious goals of the European Green Deal, aiming to make Europe carbon-free by 2050 (European Cultural Heritage Green Paper 2021).

The Paper highlights the contribution of cultural heritage to various areas of the European Green Deal, such as Clean Energy, Circular Economy, the Renovation Wave, Smart Mobility, Farm to Fork, Green Finance and a Just Transition, Research and Innovation, Education and Training, and Green Deal Diplomacy, and provides concrete recommendations for policymakers and stakeholders in the heritage sector. It also addresses potential problems between heritage preservation and ecological projects, offering solutions. The text's significance extends to other EU policy efforts, such as the New European Bauhaus program, in which Europa Nostra is an official partner (European Cultural Heritage Green Paper 2021)

2.4 National Framework on Cultural Heritage and Climate Change

As everywhere in the world, climate change studies have been conducted in Türkiye. Although national-level actions for climate change and its impacts in Türkiye are not directly included in the Seventh Five-Year Development Plan, which was prepared by the 1992 Conventions, decisions have been evaluated in the context of international studies. However, with the explicit inclusion in the Eighth Five-Year Plan and the strategy developed thereafter, the related documents began to be addressed at the national level (Alp Arısoy, Ahmet Onur Altun and Ceyda Yılmazdoğan Aydın 2023). Since the beginning, many different studies on cultural heritage and climate change have been conducted at the national level. Various studies such as symposiums, workshops and discussion groups have been conducted to share the available data, raise awareness and find common solutions.

In Türkiye, the first meeting on climate change and cultural heritage took the form of a workshop, Climate Change in Türkiye and Conservation of Cultural Heritage Workshop (TÜDAV 2012). The impact of increasing pollution of the seas and underwater heritage, as well as increasing acidification due to climate change, which is a cultural heritage, was the focus of this workshop.

2.4.1 Ministry of Environment, Urbanization and Climate Change Studies

Since the emergence of climate change as an agenda, Türkiye has made efforts to address this issue by establishing the Climate Change Coordination Board (IDKK) in 2001. The purpose of this board is to monitor policies in the field of climate change and determine relevant strategies. As a result, Türkiye became a signatory to the UNFCCC treaty on May 24, 2004. As part of this research, the IDKK was reformed, and a board consisting of various ministries and chambers was established under the Ministry of Environment and Urbanization. Within the scope of all these studies, the name of the ministry was changed to the Ministry of Environment, Urbanism and Climate Change by Presidential Decree No. 85 published in the Official Gazette No. 31643 dated October 29, 2021 (Ministry of Environment, Urbanism and Climate Change, 2023).

2.4.2 Provincial Disaster Risk Mitigation Plan

A 'Provincial Disaster Mitigation Plan' has been developed to assess the potential impacts of disasters at the provincial level, minimize the losses and damages caused by these impacts, and define the processes, responsibilities, and parties involved before, during, and after a disaster. These plans have been formulated with the participation of all provincial institutions. The Sendai Disaster Risk Reduction Framework serves as the foundation for these plans in the international arena. In Türkiye, the Provincial Disaster Mitigation Plan (IRAP) is developed based on Presidential Decree No. 4 dated 15/07/2018, No. 30479, and it follows the 'Disaster Management Section' of the 11th Development Plan during its preparation (T.C. İçişleri Bakanlığı Afet ve Acil Durum Yönetimi Başkanlığı 2021).

The Provincial Disaster Risk Mitigation Plan is a comprehensive strategy developed to reduce the vulnerability of provinces in Türkiye to various types of disasters. The plan aims to improve disaster preparedness, response, and recovery capabilities to reduce the effects of disasters on the population, infrastructure, and environment. It is concerned with recognizing and assessing the risks associated with natural and human-induced hazards such as earthquakes, floods, wildfires, and technological accidents.

2.5 Historic Coastal Settlements and Climate Change

Coastal areas are the most affected by climate change. Therefore, historic coastal settlements are more vulnerable to climate change impacts. In these areas, the most expected effects are coastal floods and coastal erosion due to sea level rises. However, extreme weather events such as storms, floods, and fires can also be counted as indirect effects. These effects damage the cultural heritage, together with damaging and affecting local livelihoods, and social and cultural life.

2.5.1 Sea-level Rise (SLR)

Sea-level rise poses a severe threat to coastal cultural heritage sites around the world. As rising of global temperatures, glaciers and ice sheets melt, leading to sea-level rise. Low-lying coastal areas, including ancient cities, archaeological sites, and cultural landscapes, are threatened by this change. The IPCC warns that "rising sea levels can result in the loss, damage, or displacement of cultural heritage sites" (IPCC 2019). According to IPCC, global sea level rise was found to be 0,19 m between 1901-2010 (IPCC 2014). A future scenario for SLR is that it will be 0,28-0, 98 m by 2100 (IPCC 2014; A. Ege Yıldırım; C. İrem Gençer 2021).

2.5.2 Coastal Erosion and Coastal Flooding

Climate-induced processes leading to increased coastal erosion and flooding possess irrefutable challenges for upholding our rich cultural legacy located in vulnerable coastal areas (Figure 6). These processes entail the risk of land loss along shorelines combined with consequent destabilization threatening culturally significant structures with life-altering outcomes such as damage or destruction. The Intergovernmental Panel on Climate Change (IPCC) highlights that "Cultural heritage and cultural landscapes are at risk of being eliminated due to the ravages of coastal erosion and flooding" (IPCC 2019).

Figure 6: A coastal erosion in Norfolk is the seaside village of Hemsby in March 2018, by Daisy Dunne, Carbon Brief (Source: Eco-Business, 2023)

2.5.3 Extreme Rainfall

Extreme rainfall events, which are a result of climate change, are a serious threat to cultural heritage since they deteriorate and ruin old buildings and artefacts. The integrity and preservation of cultural assets are at risk due to the increased intensity and frequency of severe precipitation, which can result in flash floods, landslides, and erosion. According to the Intergovernmental Panel on Climate Change (IPCC), "extreme rainfall events can result in physical damage to cultural heritage structures and landscapes, as well as the loss or displacement of artefacts" (IPCC 2019).

2.5.4 Floods

Cultural heritage sites at locations susceptible to climate change-induced floods face a grave risk with potentially far-reaching consequences. These extreme events can wreak havoc on structures and landscapes with priceless cultural relevance leading to irreparable losses both for local communities as well as for humanity at large (Figure 7). The rising number of such devastating occurrences is mainly driven by increased precipitation patterns marked by rapid heavy rainfall episodes that overpower structures designed to protect them. The Intergovernmental Panel on Climate Change (IPCC) has brought attention to this pressing concern stating that ruinous impacts ranging from destroyed artefacts to damaged physical sites confront us all (IPCC 2014).

Flood waters can penetrate buildings, leading to structural damage, erosion of foundations, and the deterioration of architectural elements. In addition, the force of floodwaters can wash away or displace artefacts, documents, and other cultural objects, resulting in an irreversible loss. The restoration and recovery of flood-affected cultural heritage sites require extensive efforts, including documentation, stabilization, and rehabilitation of damaged structures, as well as salvage and preservation of affected artefacts.

Figure 7: Flooding in and around Tewkesbury in 2007 by Historic England
(Source: Historic England, 2023)

2.5.5 Storm Surges

Storm surges, exacerbated by climate change, pose severe hazards to coastal cultural heritage sites (Figure 8). Extreme weather events, defined by a rapid rise in sea level during storms, can cause severe flooding and erosion, resulting in the destruction and damage of cultural heritage. The International Council on Monuments and Sites (ICOMOS) states that "rising sea levels and storm surges threaten coastal heritage, resulting in inundation, erosion, and physical damage to vulnerable structures" (ICOMOS 2019).

Figure 8: A storm surge affected cultural heritage.
(Source: BeSafeNet, 2023)

2.5.6 Fire

The increasing incidence and severity of fires, driven by climate change, pose a significant threat to cultural heritage, causing irreparable damage to historic sites, buildings, and artefacts (Figure 9). Wildfires can engulf cultural heritage sites, leading to the destruction of invaluable cultural and historical assets. The Intergovernmental Panel on Climate Change (IPCC) emphasizes that "wildfires can cause irreversible loss of cultural heritage and historical records" (IPCC 2014).

Figure 9: A fire from Athena, Greece on 6 August 2021 by Morios Lolos, Xinhua (Source: National Geographic, 2021)

CHAPTER 3

METHODOLOGY

Since this thesis is a current debate in architectural heritage management, the methodology was mainly determined by the literature review. In this context, this section discusses the description of the methods used for the analysis of the case study and evaluation sections.

3.1 Overall Methodology and Models Driven from Literature

To provide answers to the research questions, the literature on the concept of climate change and its effects, historic coastal settlement, risk assessment, climate resilience and conservation strategies are reviewed from national and international resources. Conservation and restoration of cultural heritage disciplines focus on the concept of the intersection between climate change and cultural heritage. The theoretical framework shows the vulnerability of cultural heritage sites to climate change and the requirement for risk assessment, risk adaptation and mitigation strategies. Following the comprehensive theoretical framework, the methodology of the thesis was developed by the report titled 'The Future of Our Past: Engaging Cultural Heritage in Climate Action', which the ICOMOS Working Group on Climate Change and Cultural Heritage outlined in 2018 and published in 2019 (ICOMOS 2018; 2019). The report presents a comprehensive framework for comprehending the relationship between cultural heritage and climate change. The first of two parts of the report highlights a constructive, policy-based vision for cultural heritage in climate action. This vision divides climate action into four major categories/sectors: high ambition, greenhouse gas mitigation, adaptation, and loss and damage. The Paris Agreement serves as the foundation for these four divisions (ICOMOS 2019) (**Table 1**).

The division of high ambition is more related to finance, technology, and capacity-building support framework. On the other hand, mitigation is more related to energy efficiency and reducing greenhouse gas emissions. The thesis is developed from an architectural restoration perspective. Therefore, the study focuses on two divisions;

adaptation and 'loss and damage' and according to the Outline of Climate Change and Cultural Heritage, in terms of managing change, the divisions of 'adaptation' and 'loss and damage' are intersected, and 'adaptation' is no longer an option (ICOMOS 2019). In this framework, the thesis methodology is developed by adaptation and loss and damage base.

Table 1: Outline of Climate Change and Cultural Heritage Sectoral Outline Divisions (ICOMOS 2019)

Outline of the Climate Change and Cultural Heritage Sectoral Outline Division	Paris Agreement Concordance
High Ambition	Financial, technological, and capacity-building assistance (Articles 9, 10, and 11 of the Paris Agreement): A technical framework has been formed, and capacity-building initiatives will be improved through increased international cooperation on the development and transfer of climate-safe technologies as well as capacity building in the developing world. Enhancements must be made to climate change education, training, public awareness, public involvement, and public information access (Article 12).
Mitigation	Reaffirms the long-term objective of keeping global temperature rise to far below 2 degrees Celsius while pursuing measures to keep it below 1.5 degrees Celsius (Article 2). To create a balance between anthropogenic emissions by sources and removals of GHGs by sinks in the second half of the century, Parties strive to reach global peaking of greenhouse gases (GHGs) as soon as is practical. While poorer nations should keep stepping up their mitigation efforts, developed nations should set absolute reduction targets for their whole economies. Encourages Parties to maintain and improve, where necessary, sinks and reservoirs of GHGs, including forests (Article 5).
Adaptation	In the context of the Agreement's temperature objective, Article 7 establishes a global goal on adaptation that aims to increase adaptive capacity, build resilience, and decrease susceptibility to climate change. Through assistance and international collaboration, it seeks to considerably strengthen national adaptation efforts.
Loss and Damage	Loss and damage (Article 8): Understand the significance of preventing, limiting, and dealing with loss and damage brought on by the negative consequences of climate change, including extreme weather events and slow-onset events, as well as the contribution of sustainable development to lowering the risk of loss and damage. Parties are expected to improve cooperation, response, and understanding of loss and damage.

3.2 Methodological Framework

The methodological framework was formed by the divisions of "Adaptation" and "Loss and Damage" identified by the ICOMOS Climate Change Working Group and the conservation strategies developed according to these divisions. Climate change will affect cultural heritage, so adaptation strategies are needed for the conservation of cultural heritage. The implementation of adaptation measures will require cultural significance assessment and risk assessment, feasibility assessment (ICOMOS 2019). In this line, for adaptation strategies, methodological toolkits were used that were suggested by ICOMOS. These are heritage inventory and risk assessment.

In this context, heritage inventories were prepared by UNI EN 16096:2012(E): Conservation of cultural property - Condition survey and report of built cultural heritage. This report was formed by European Committee for Standardization members in 2012. Before the implementation of inventory, 71 immovable cultural assets in the case study, the Kuşadası Citadel, were identified. The heritage inventory includes building information, the conservation status of cultural assets, building components and their conditions and risk qualifications. For each title, the analysis maps were created. As a result, each immovable cultural asset and its condition were identified.

Identification of immovable cultural assets and their conditions, studies were carried out to projections of climate change effects. In this context, Aydın Provincial Disaster Risk Mitigation Plan (2021), A Framework for Resilient Cities to Climate Change: Green Revision Guidebook, Izmir Region (2019) and Climate Projections and Climate Change with New Scenarios of Türkiye (2015) were used for analyses of possible climate change impacts that may affect Kuşadası Citadel. The four most effective climate change effects have been selected for climate change risk assessment according to these literature reviews. These are floods, storms, heat waves and sea level rise.

As a result, the conservation strategies for adaptation, loss and damage developed by focusing on overlapping heritage inventories and climate change effects analysis (Figure 10).

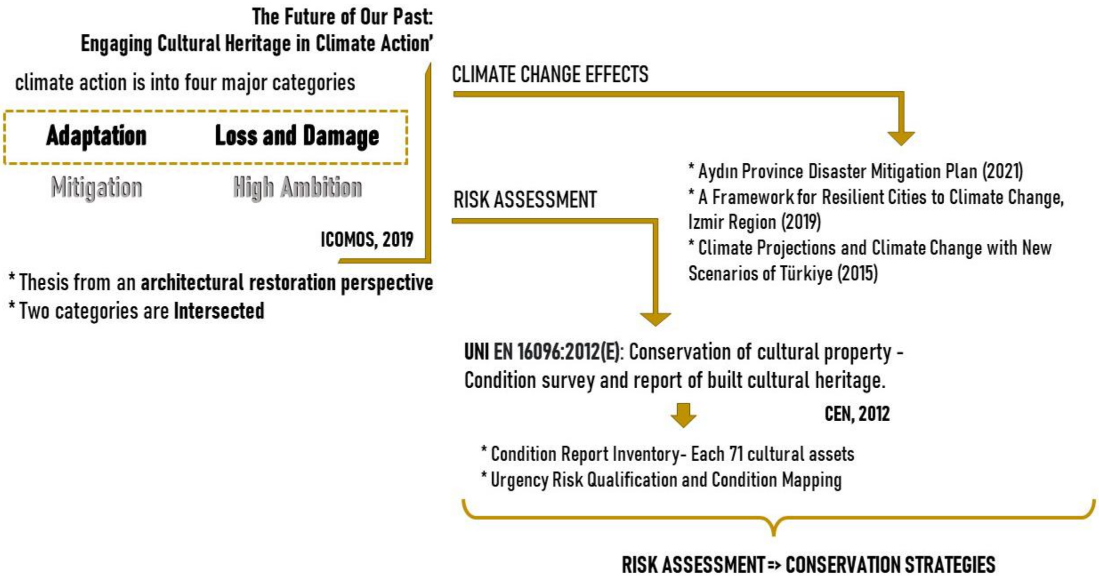


Figure 10: Methodological Framework

3.3 Method

The study method was developed by scanning the national and international literature. Within the scope of all the research, it was decided to carry out the necessary analysis titles, determination of risks related to climate change, classification, and sensitivity analysis for heritage significance. Field studies were carried out in line with the determined objectives of determining the effects of climate change and conducting a risk assessment. The site investigation consisted of three steps.

Analyses were conducted for urgency risk classification analysis, climate change risk classification and heritage significance classification. These analyses were used as a basis for vulnerability classification and the vulnerability analysis was developed accordingly.

The classification method is adapted to the climate change risk classification and heritage significance as used in the UNI EN 16096:2012(E) method used in the hedging analysis. In this framework, a quadratic rating system was used.

3.3.1 Site Investigation

The site investigation was conducted in three steps. The first step included the preliminary work for the cultural heritage inventory, which included mapping and organizing the condition survey on the Internet using Google Forms. The second step consisted of a site visit to the Kuşadası Citadel, during which photographs were taken and an online form was completed (Figure 11).

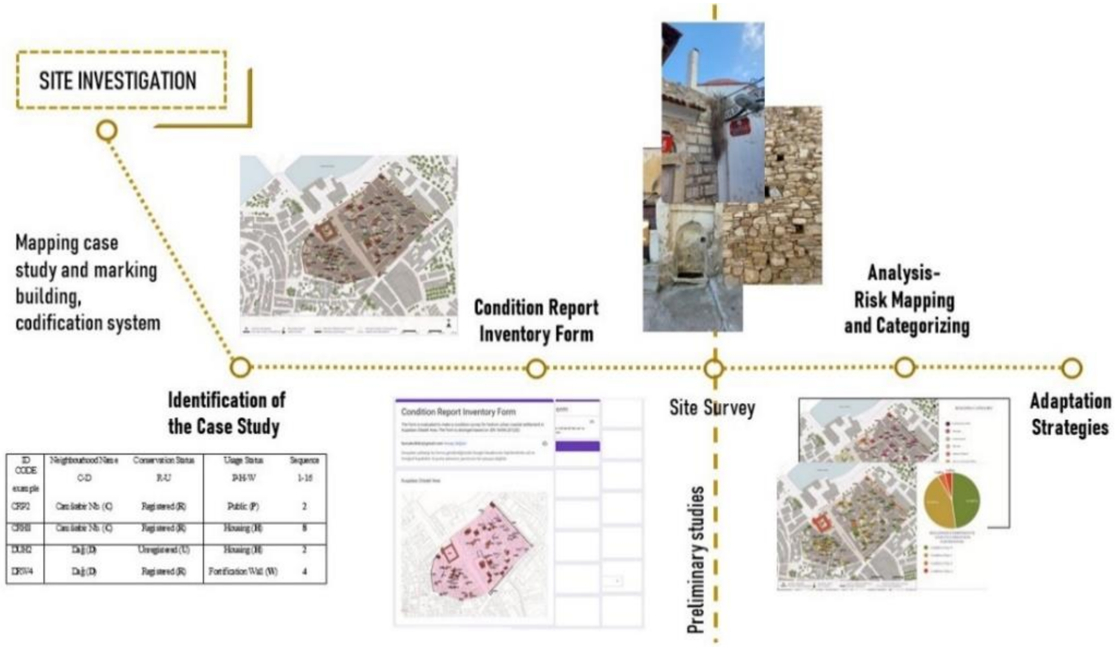


Figure 11: Site Survey Flow

3.3.1.1 Description of the Immovable Cultural Assets in the Case Study

The first step was to create a map marking the seventy-one immovable cultural properties within the study boundaries. The identification of these properties was based on the listed and preservation-oriented development plan (Figure 12).

Figure 12: The Case Study

The study evaluated a quartet codification system focused on the neighbourhood in which the buildings are located, use status, and protection status (**Table 2**). The case study area consists of two different neighbourhoods: Dağ and Camikebir Neighbourhood. In the codification system, these two neighbourhoods were included due to different topographic characteristics. Another expression is the use of the building. A distinction was made between public use, private use and castle walls. The last classification is expressed as registered and non-registered and provides information about the protection status of the structure. The classification was created based on the streets running from north to south.

Table 2: The Codification System

ID CODE example	Neighbourhood Name C-D	Conservation Status R-U	Usage Status P-H-W	Number 1-16
CRP2	Camikebir Nb. (**C**)	Registered (**R**)	Public (**P**)	**2**
CRH8	Camikebir Nb. (**C**)	Registered (**R**)	Housing (**H**)	**8**
DUH2	Dağ (**D**)	Unregistered (**U**)	Housing (**H**)	**2**
DRW4	Dağ (**D**)	Registered (**R**)	Fortification Wall (**W**)	**4**

3.3.1.2 Condition Report Inventory Form

For the inventory of the historic urban coastal settlement in the citadel of Kuşadası, the Cultural Heritage Inventory Form was evaluated (Figure 13). The form was designed based on UNI EN 16096:2012(E). The form was organized in Google Forms Digital with five parts. The questions were divided into multiple-choice and short-answer questions. The five parts are identification of a property, protection information, building information, building components and their condition, and risk rating.

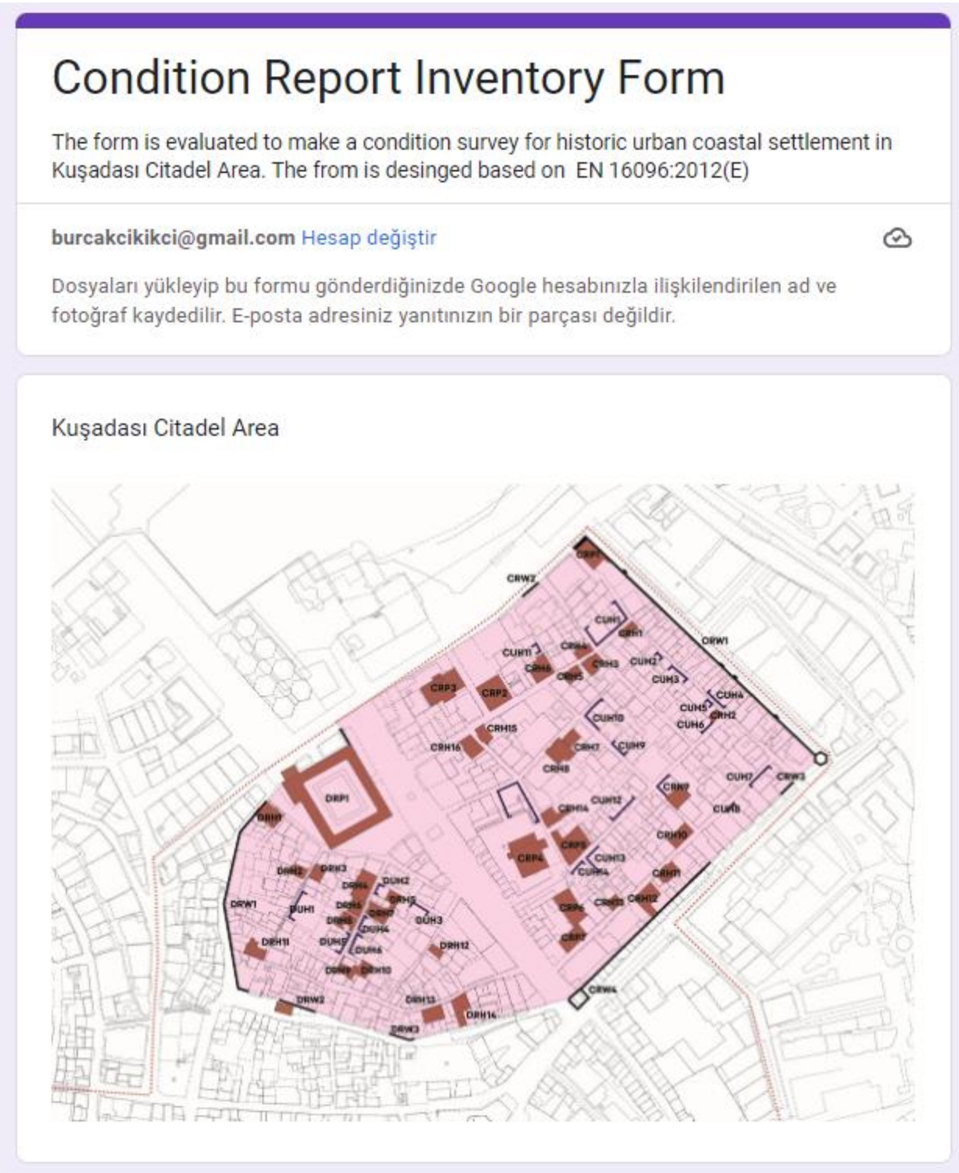


Figure 13: “Condition Report Inventory Form” Google Form View

The first part is used to identify historic buildings (Figure 14). It includes photos of the building, ID number (code), name of the building if it has a block and lot number, geographic information (coordinates), address, building category (residential, mosque, caravanserai, hammam, fortress wall, commercial building, historic school building, library), date of construction (1600-1700, 1700-1800, 1800-1900, 1900-2000, 2000-...), original function (residential building, public building, commercial building, fortress wall), current function (residential building, public building, commercial building, fortress wall, used by nuns).

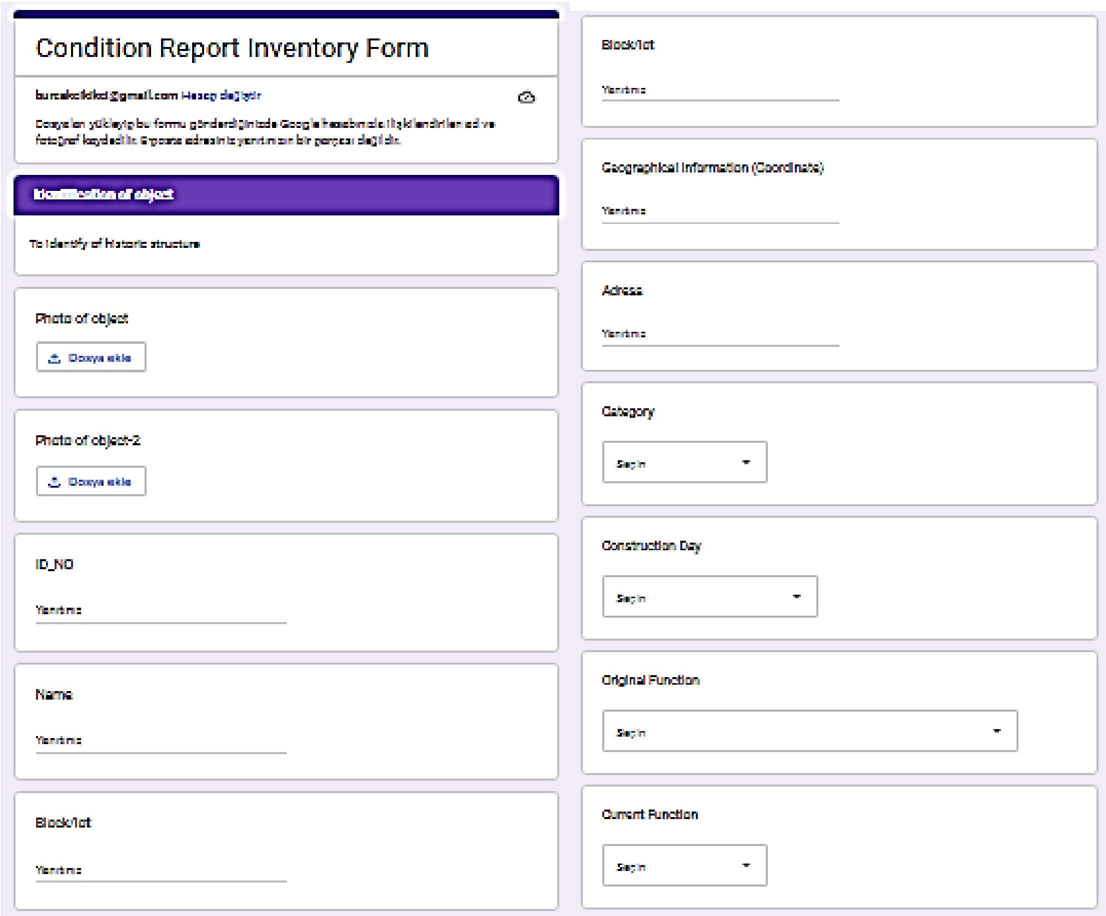


Figure 14: Part I “Identification of Object”

The second part is for defining the protection status of historic buildings (Figure 15). This part has three questions: protected object (area, building, façade, fortification wall), protection act (registered, façade protection) and statement of significance.

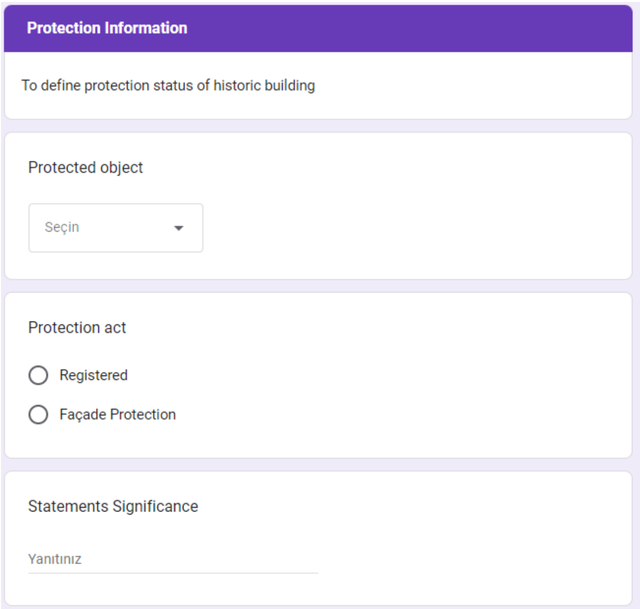


Figure 15: Part II "Protection Information"

The third part is for information about historical buildings and their structure (Figure 16). The four questions concern the number of floors (with/without basement), the area, the construction method (masonry, wooden frame, steel frame, reinforced concrete, etc.) and the building material (stone, brick, brick and stone, brick and wood, steel, concrete, etc.).

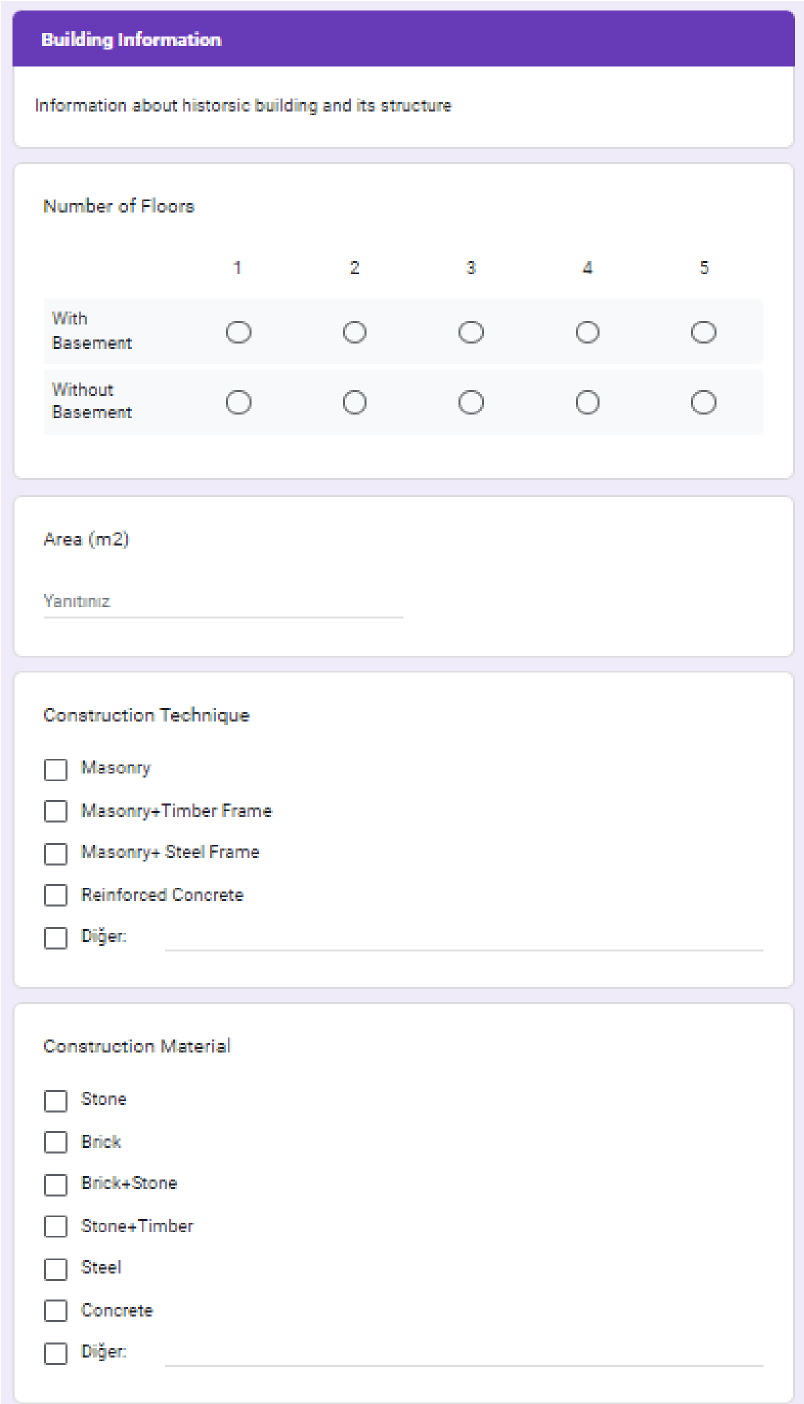


Figure 16: Part III “Building Information”

The fourth part is for recording the condition of the historic building and its components (Figure 17). In this part condition classes were described. Building components are examined into two parts: structure and ancillary components. Building components that are related to structure, are the foundation, vertical structure, horizontal structure, roof and roof coverings, and envelopes (solid areas, wall). Ancillary components are envelopes (openings), divisions, and wall coverings.

Condition classes were defined for every building component. The descriptions of condition class were defined as a symptom; minor, moderately strong, major and no symptoms in UNI EN 16096:2012(E): Conservation of cultural property - Condition survey and report of built cultural heritage.

a) Condition Class 1 (CC1): Condition class 1 is defined as minor symptoms. For instance, Paint is worn, moss on roof tiles and a few broken roof tiles.

b) Condition Class 2 (CC2): Condition class 2 is defined as Moderately strong symptoms. For instance, Localized damage caused by minor wet rot infestation in panel boards requires improvement and partial replacement.

c) Condition Class 3 (CC3): Condition class 3 is defined as major symptoms. For instance, a leaking roof with consequent damage and major damage caused by fungal or rot infestation.

d) Condition Class 0 (CC0): Condition class 0 is defined as no symptoms.

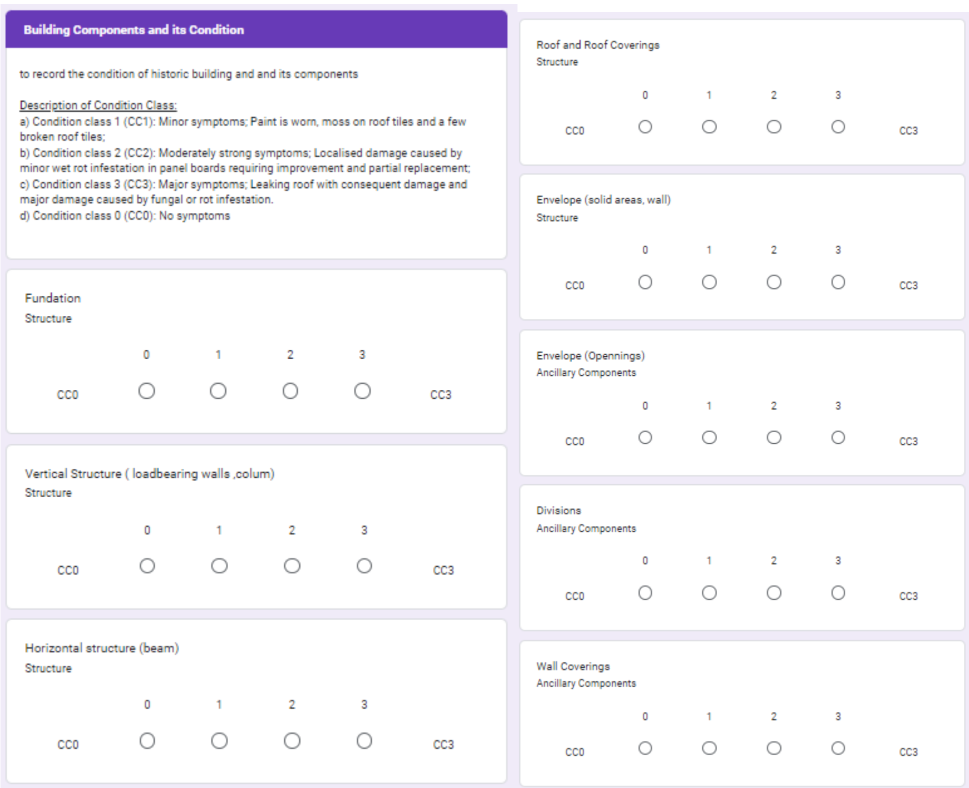
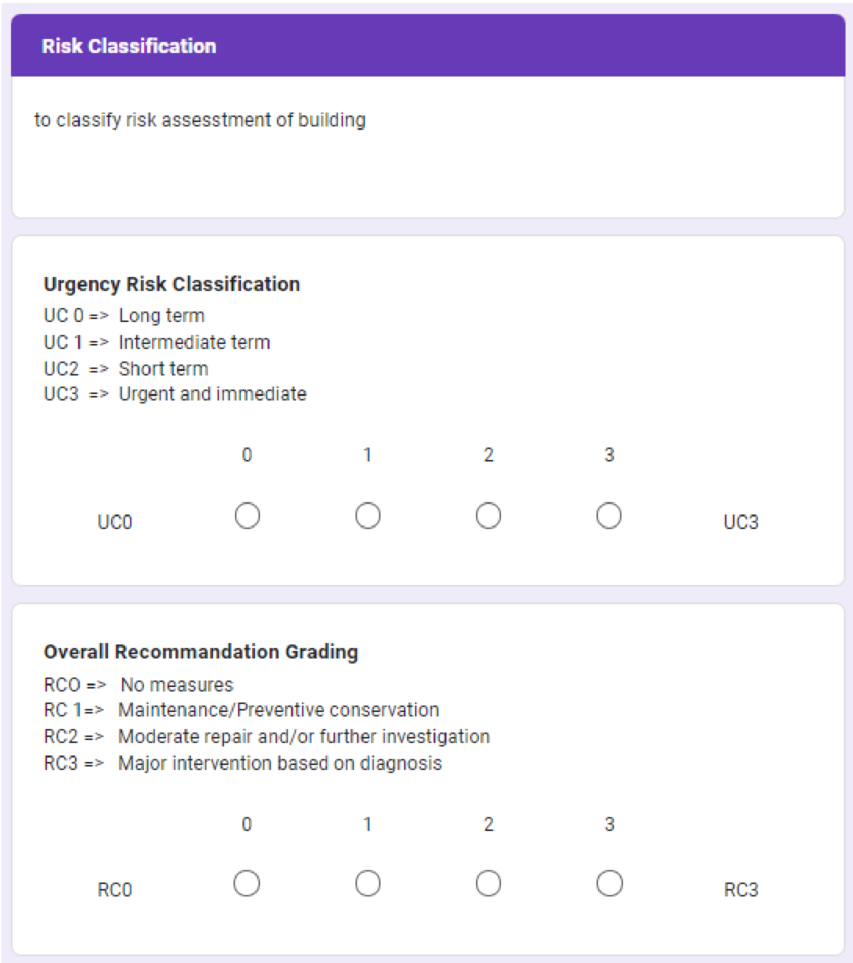


Figure 17: Part IV "Building Components and its Conditions".

The last part is for classifying the general risk assessment of the building. This classification was organized from EN 16096:2012(E): Conservation of cultural property -Condition survey and report of built cultural heritage. The classification includes “Urgency Risk Classification” and “Overall Recommendation Grading”. “Urgency Risk Classification” (Figure 18) was defined in four terms as; long, intermediate, short urgent and immediate. “Overall Recommendation Grading” is for the degrees of intervention to be carried out considering the risk situation. The interventions are defined in four grades; no measures, maintenance/preventive conservation, moderate repair and/or further investigation, and major intervention based on a diagnosis.



Risk Classification

to classify risk assesstment of building

Urgency Risk Classification

UC 0 => Long term
UC 1 => Intermediate term
UC2 => Short term
UC3 => Urgent and immediate

	0	1	2	3	
UC0	○	○	○	○	UC3

Overall Recommandation Grading

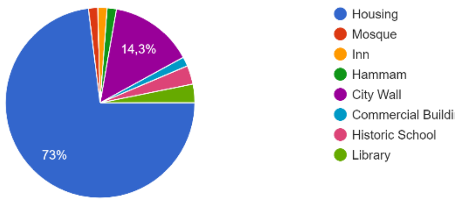
RCO => No measures
RC 1=> Maintenance/Preventive conservation
RC2 => Moderate repair and/or further investigation
RC3 => Major intervention based on diagnosis

	0	1	2	3	
RC0	○	○	○	○	RC3

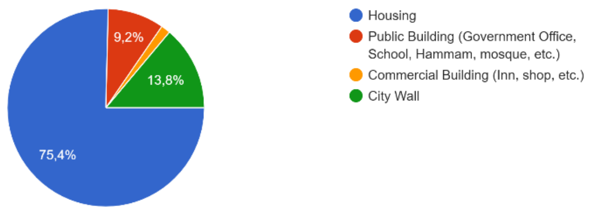
Figure 18: Part V “Risk Classification”

3.3.1.3 Site Survey

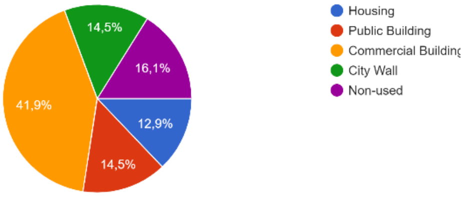
The online form was filled in for each historic building. The Google Forms application can convert answers to graphics. Every graphic show general information about historic buildings that are in Kuşadası Citadel (Figure 19). The graphics are explained in Chapter 4. They used to show production of The Google Forms.



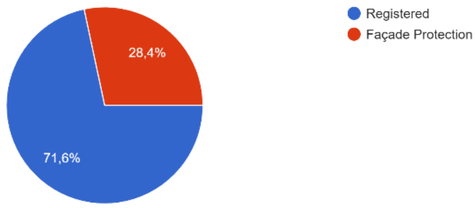
Graphic of Building Category



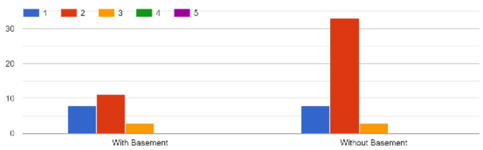
Graphic of Original Function



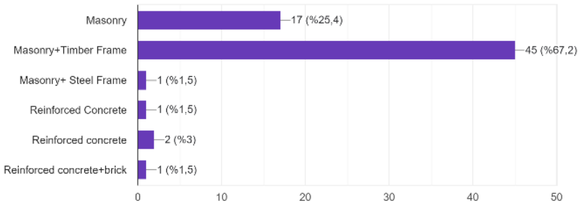
Graphic of Current Function



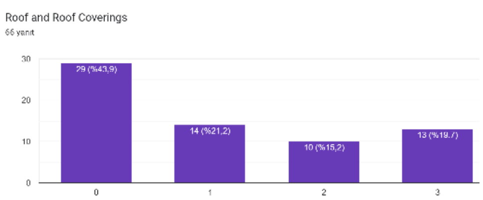
Graphic of Protection Act



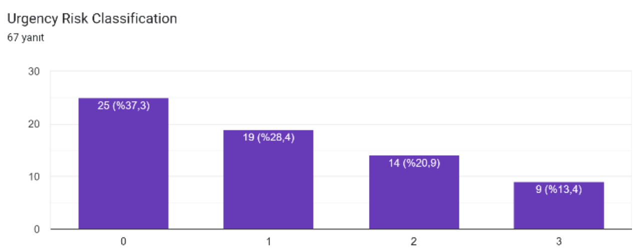
Graphic of Number of Floors



Graphic of Construction Technique



Graphic of Roof and Roof Coverings Condition Class



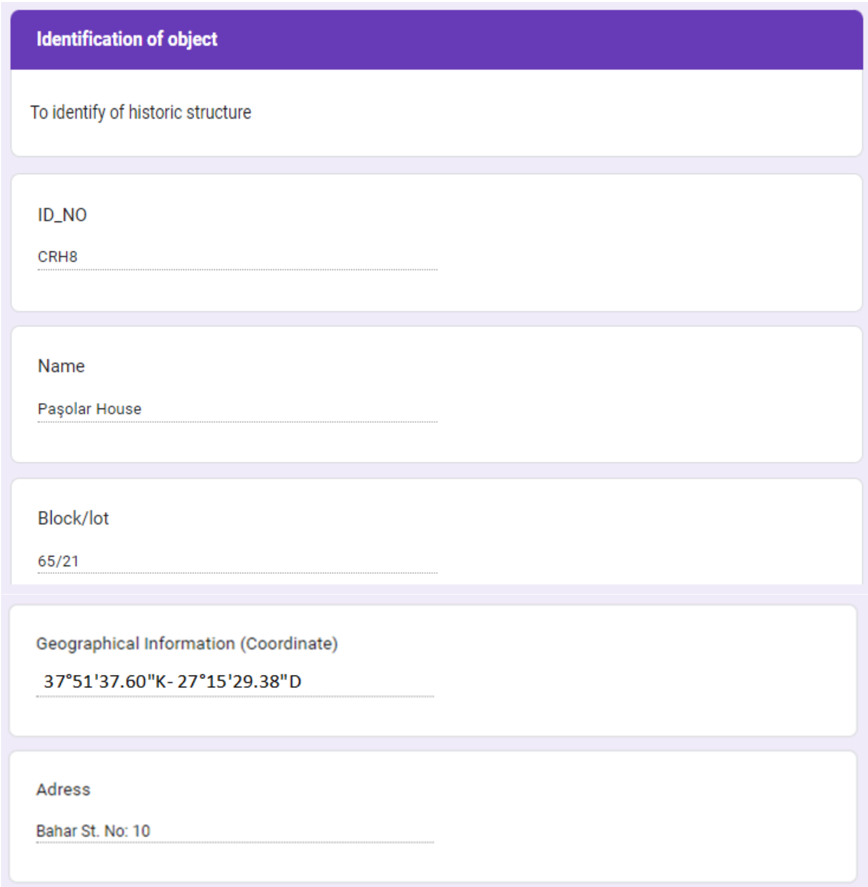
Graphic of Urgency Risk Classification

Figure 19: Examples of Site Survey Graphics

An example shows how the form was applied that filled in for a historic building (CRH8), was shown below (Figure 20).

Figure 20: The Paşolar House Photos (taken during the site survey on the 18th of December)

Part I- Identification of Object of CRH8 (Figure 21-22): ‘The Paşolar House’ was coded with CRH8 (Figure 15). Because it is in Camikebir Neighbourhood (**C**), registered building (**R**) and was used as housing (**H**). The Paşolar House on 65 blocks, 21 lot is located on Bahar Street Number 10. It was constructed in the 19th century as a house and was used till the late 1980s as a house. Now, it is used for commercial activities.


Identification of object

To identify of historic structure

ID_NO

CRH8

Name

Paşolar House

Block/lot

65/21

Geographical Information (Coordinate)

37°51'37.60"K- 27°15'29.38"D

Adress

Bahar St. No: 10

Figure 21: Part I “Identification of Object- CRH8”

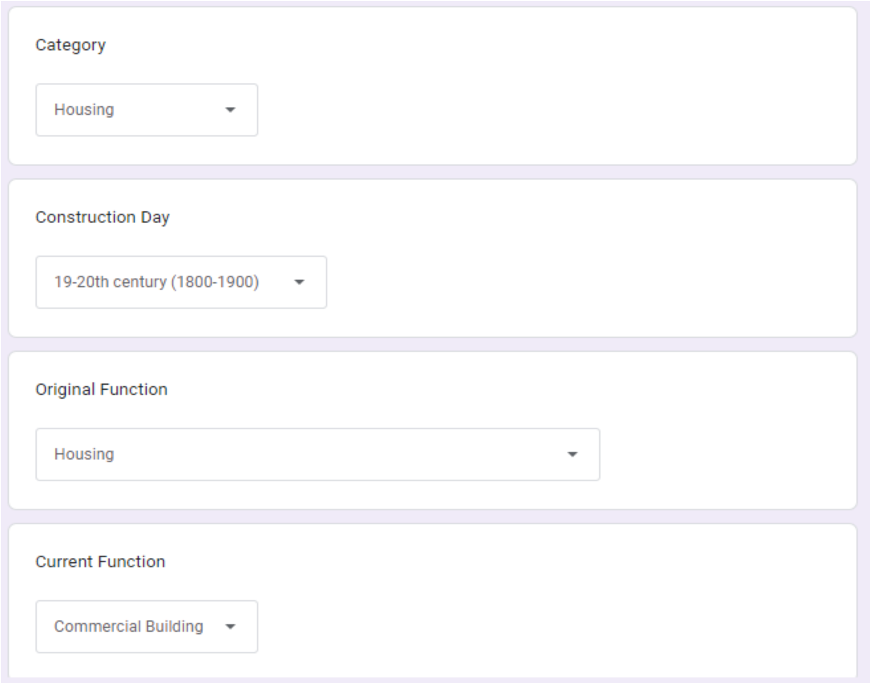


Figure 22: Part I "Identification of Object- CRH8"-2

Part II- Protection Information of CRH8 (Figure 23): The Paşolar House is protected as a whole building. It was listed in 1978 (Conservation Council), and this decision was sustained in the succeeding years (1978, 1986, 1994). It is at least a 200-year-old historic building. It has wall paintings on walls and ceilings, and wooden details.

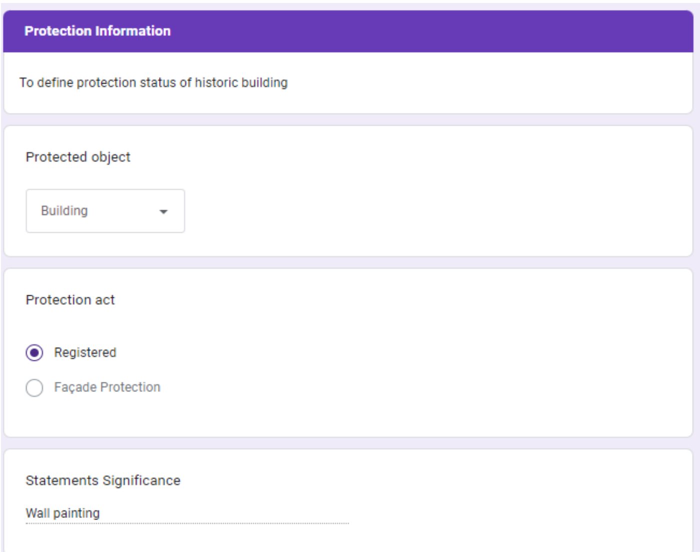
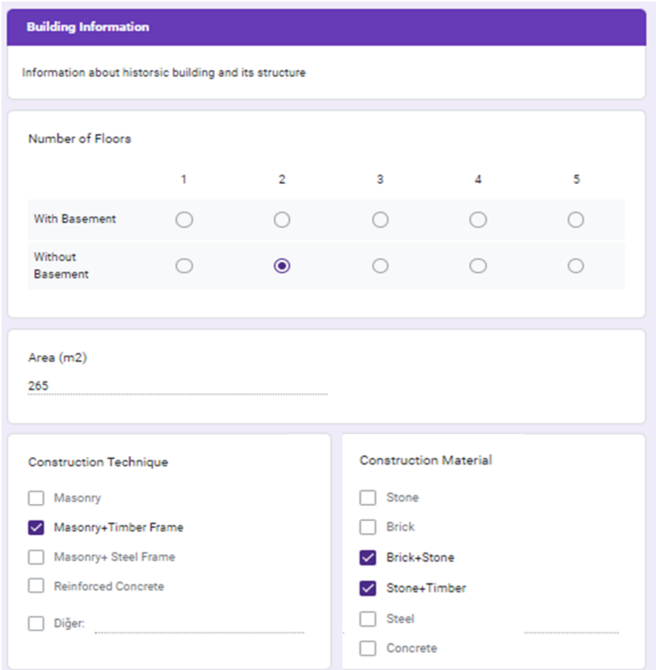


Figure 23: Part II "Protection Information- CRH8"

Part III-Building Information of CRH8 (Figure 24): The Paşolar House is a two-storey building without a basement. It has 265 square meters. Its construction technique is masonry and timber frame. Brick, stone, and timber were used as construction materials.


Building Information

Information about historsic building and its structure

Number of Floors

	1	2	3	4	5
With Basement	○	○	○	○	○
Without Basement	○	◉	○	○	○

Area (m2)

265

Construction Technique

- [ ] Masonry
- [x] Masonry+Timber Frame
- [ ] Masonry+ Steel Frame
- [ ] Reinforced Concrete
- [ ] Diğer:

Construction Material

- [ ] Stone
- [ ] Brick
- [x] Brick+Stone
- [x] Stone+Timber
- [ ] Steel
- [ ] Concrete

Figure 24: Part III “Building Information- CRH8”.

Part IV - Building components and their conditions (Figure 25): The Paşolar House had a structural problem with the load-bearing wall after the 2020 Samos Earthquake. Therefore, it is supported with a temporary wooden pier. Its foundation rarely has moisture problems. This problem is defined as a minor symptom. The vertical structure (bearing walls, column) has a serious problem because the wall on the southeast side is 10-15 cm crooked and stones on the wall have been lost. The vertical structure (beams) was rarely attacked by organisms (biodeterioration), so the symptom is investigated as minor. The roof and roofing have minor symptoms such as moss on the roof tiles and some broken roof tiles. The building envelope (solid surfaces, non-load bearing walls) is in condition class 2, as some of the walls show localised damage from minor wet rot and paint loss. The envelopes (openings) of the ancillary building components show no symptoms. The compartments are in condition class 1 because they have many paintings and rarely material. The wall coverings are in condition class 1 as they show discolouration and wear to the paint.

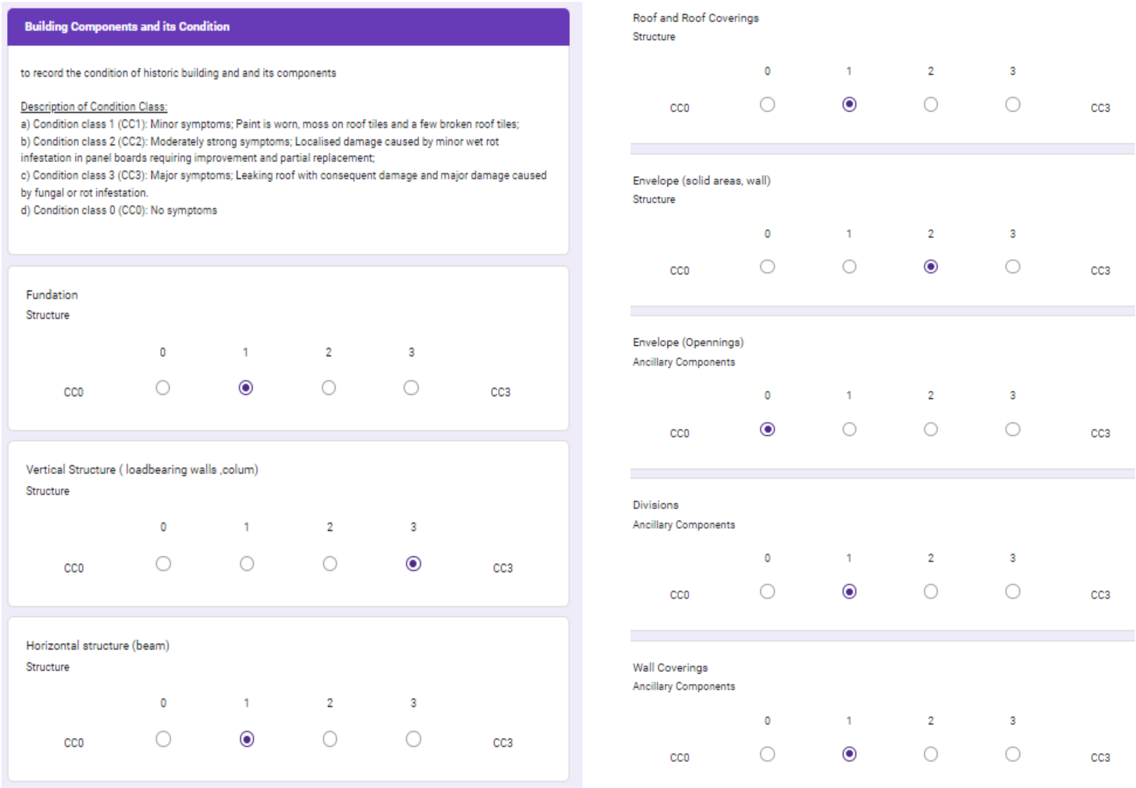


Figure 25: Part IV “Building Components and its Conditions- CRH8”.

Part V- Risk Classification of CRH8 (Figure 26): For the classification of risk assessment of Paşolar house, urgency risk classification is examined as ‘urgent and immediate’ because of out of plumbing on the wall and material loss. For overall recommendation, grading is examined third grade as a major intervention based on a diagnosis.

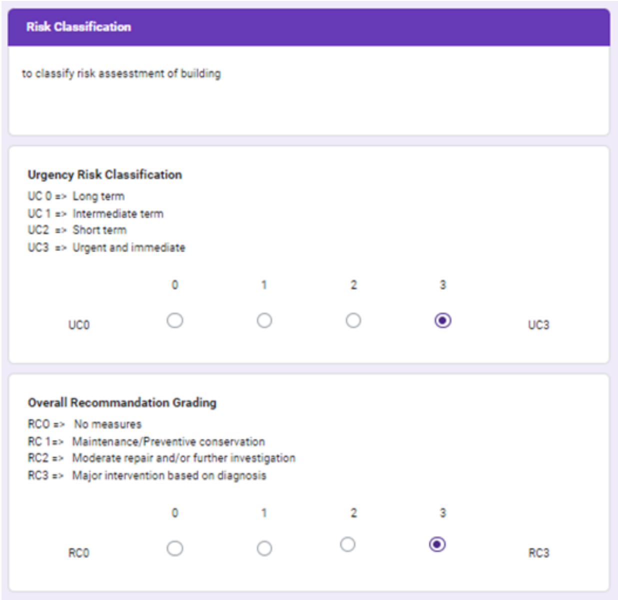


Figure 26: Part V “Risk Classification- CRH8”

3.3.2 Possible Climate Change Effects Projections

The identification of immovable cultural properties, as well as their condition, was studied to predict the effects of climate change. For the analysis of the potential impact of climate change on Kuşadası Citadel, Aydın Provincial Disaster Mitigation Plan (2021), A Framework for Resilient Cities to Climate Change: Green Revision Guidebook, Izmir Region (2019), and Climate Projections and Climate Change with New Scenarios of Türkiye (2015) were used. In A Framework for Resilient Cities to Climate Change: Green Revision Guidebook, Izmir Region, CMIP5 (Coupled Model Intercomparison Project Phase 5) was used. CMIP5 as a climate projection in the study concerning the Izmir area was prepared to cover the period December 2050-2100. The same climate scenarios were used in three studies, namely RCP 4.5 and RCP 8.5 scenarios of HadGEM2- ES Global Communication Model (GCM), which are also used in the CMIP5 project included in the evaluation report. For this model review, the reference period from 1971 to 2000 was provided by 14 meteorological stations. One of these stations is Kuşadası station number 17232, located at latitude 37.8597, longitude 27.2652, and elevation 25. These climate change projections data were adopted from the study of Berberoğlu, Çilek, and Ünlükaplan (2019).

3.3.2.1 The Climate Change Risk Classification

In the literature review, historical coastal settlements have experienced climate change impacts such as rising sea levels, coastal erosion, floods, heat waves, and storms. The most effective climate change impacts expected in the Kuşadası Citadel are heatwaves, floods, rising sea levels, and storms, based on the specific climate change projections for Kuşadası and its surroundings, and considering the limitations of the study. For each risk scenario, site-specific criteria have been established, considering things like the location of the structure and the materials used, which have a significant impact on the vulnerability.

An analysis framework with clear categories and a classification system for vulnerability categorization analysis has been used in climate change impact assessments. Floods were identified as the area's most significant influence in this context, acting as the foundation for rating. The effectiveness and length of the impact are considered by the classification system for each impact. Floods, for example, happen suddenly, while sea level rise happens gradually. As a result, each impact is classified differently.

A risk classification has been developed for each risk. This classification is based on a four-grade system as in the condition class classification. In addition, the heritage value, which affects the vulnerability of the building, is considered a criterion in climate change impacts and the heritage value classification is made and classified in the climate change risk classification. Thus, flood risk, storm surge risk, heat island risk, sea level rise risk and heritage value classification were used for holistic risk classification in buildings. In the classification, 0, 1, 2, and 3 grades of the four-grade system were used as points and the building with the highest degree was evaluated as the most risky. By overlapping with the classification of the protection status, assessments were made for climate change risks.

3.1.1.1.1. Flood Risk Class

Flooding is one of the most likely climate change risks to affect the area. The distance of the buildings to the Damlacık Creek and the altitude at which they are located are considered as criteria for flood risk classification.

a) Flood Risk Class 0 (FRC0): This risk class represents the lowest risk class due to its location and altitude. It defines the risk class of structures with the highest altitude.

b) Flood Risk Class 1 (FRC1): This risk class represents the low-risk class due to location and altitude. It defines the risk class of structures with an altitude of 5 meters and above.

c) Flood Risk Class 2 (FRC2): This risk class represents a medium risk class due to its location and altitude. It defines the risk class of structures located at least 200 meters from the streamline and at an altitude of 2-3 meters.

d) Flood Risk Class 3 (FRC3): This risk class represents the highest risk class due to its location and altitude. It defines the risk class of structures located at least 80-200 meters from the streamline and at an altitude of 0-2 meters.

3.3.2.1.1 Heat Island Risk Class

Heat island is one of the most likely climate change risks to affect the area. The proximity of the buildings to the green area, their location in the prevailing wind direction, the width of the street where they are located and their proximity to the surrounding buildings are considered criteria for heat island risk classification.

a) Heat Island risk class 0 (HRC0): This risk class represents the lowest risk class when the specified criteria are evaluated. It defines the risk class of buildings that are in the direction of the prevailing wind, close to the green area, located on a sloping area or in a split layout.

b) Heat Island Risk Class 1 (HRC1): This risk class represents the lowest risk class when the specified criteria are evaluated. It defines the risk class of buildings that are in the direction of the prevailing wind, close to the green area, and adjacent to each other.

c) Heat Island Risk Class 2 (HRC2): This risk class represents the medium risk class when the specified criteria are evaluated due to its location and altitude. It defines the risk class of buildings that are in the direction of the prevailing wind, far from the green area and adjacent to the buildings.

d) Heat Island Risk Class 3 (HRC3): This risk class represents the highest risk class when the specified criteria are evaluated. It defines the risk class of the buildings that are opposite to the prevailing wind direction, far from the green area, adjacent and on narrow streets.

3.3.2.1.2 Storm Surge Risk Class

Storms are one of the most likely climate change risks to affect the area. Proximity to the sea, facing the sea, and being in the direction of the prevailing wind are considered criteria for risk classification. Two degrees were used in this classification.

a) Storm Surge Risk Class 1 (SRC1): This risk class represents the lowest risk class when the specified criteria are evaluated. It defines the risk class of structures located 200 meters or more from the sea and at low altitudes.

b) Storm Surge Risk Class 2 (SRC2): This risk class represents the highest risk class when the specified criteria are evaluated. It defines the risk class of structures that are closest to the sea or have an altitude of 5 meters or more and face the sea.

3.3.2.1.3 Sea Level Rise Risk Class

Sea level rise is one of the most likely climate change risks to affect the area. The proximity of the buildings to the sea and their altitude are considered as criteria for risk classification.

a) Sea Level Rise Risk Class 0 (SLRC0): This risk class represents the lowest risk class when the specified criteria are evaluated. It defines the risk class of the buildings that are farthest from the sea and have an altitude of 5 meters.

b) Sea Level Rise Risk Class 1 (SLRC1): This risk class represents the low-risk class when the specified criteria are evaluated. It defines the risk class of structures that are farthest from the sea and have an altitude of 2 -3 meters.

c) Sea Level Rise Risk Class 2 (SLRC2): This risk class represents the medium risk class when the specified criteria are evaluated due to its location and altitude. It defines the risk class of structures that are 300 meters from the sea and 1-2 meters in altitude.

d) Sea Level Rise Risk Class 3 (SLRC3): This risk class represents the highest risk class when the specified criteria are evaluated. It defines the risk class of structures closest to the sea and with an altitude of 0-1 meters.

3.3.2.2 Heritage Significance Class

Heritage value is a condition that increases the vulnerability of the structure affected by climate change, although it is not a climate change effect. Historical and age value, uniqueness value, authenticity value and social value are considered as criteria for value classification.

a) Heritage Significance Class 0 (HSC0): This value class represents the lowest value class when the specified criteria are evaluated. It defines the value class of reconstructed residential buildings or residential buildings that have lost their original values.

b) Heritage Significance Class 1 (HSC1): This value class represents the lowest value class when the specified criteria are assessed. It defines the value class of residential buildings that have original material details but have lost their function.

c) Heritage Significance Class 2 (HSC2): This value class represents a medium value class when the specified criteria are evaluated. It defines the value class of residential buildings with original timber and façade decorations.

d) Heritage Significance lass 3 (HSC3): This value class represents a high-value class when the specified criteria are assessed. It describes the value class for city walls, public buildings, residential buildings with social value and residential buildings with uniqueness value.

As a result, four climate change risks were addressed within the scope of the developed method and a risk map was created by making risk classifications. Vulnerability analyses were also created by overlapping the conservation status analyses and the classifications made for heritage value (Table 3). All these analyses guided the development of conservation strategies.

Table 3: An example of Climate Change Risk Classification

	FRC	HRC	SRC	SLRC	CCRC	HSC	UC	VC
CRP1	3	0	2	3	2	3	0	2
DRP1	3	1	2	3	2	3	1	2
CRW4	1	1	1	0	1	3	0	1
CRH8	2	2	1	2	2	3	3	2
DRH6	0	0	2	0	0	2	0	0

CHAPTER 4

CASE STUDY

Within the context of the theoretical framework and methodology presented throughout the research, this chapter examines the case study and its relations with geography, history and culture. At the same time, this chapter attempts to map the condition class of historical buildings and their components. Therefore, this chapter includes location, landscape, history, cultural heritage, environmental dynamics, climate, and climate change threats.

4.1 Location

Kuşadası is a district of Aydın in the western part of Türkiye. It is surrounded by Selçuk to the north, Söke to the east and the Aegean Sea to the west. Kuşadası is located within the Küçük Menderes Basin and functions as a sub-basin (T.C. İçişleri Bakanlığı Afet ve Acil Durum Yönetimi Başkanlığı 2021; "Aydin-2040 1/25.000 Ölçekli Nazım İmar Planı Açıklama Raporu" 2018) (Figure 27).

Figure 27: Location of Kuşadası

The case study, Kuşadası Citadel, is in the city centre and is bounded by the Aegean Sea to the northwest, Mount Kese to the west, and the Damlacık Creek to the east and northeast. Considered as a whole, the landscape of Kuşadası includes various coastal elements, including the Aegean Sea and the Gulf of Kuşadası. The study area, the citadel of Kuşadası, is located east of Mount Kese, close to the ancient settlement area and other coastal landscape elements, such as the Yılancıburnu-Tombolo. The citadel of Kuşadası is more protected compared to the Yılancıburnu settlement area and is also protected by the Güvercinada Fortress situated in the gulf (Figure 28).

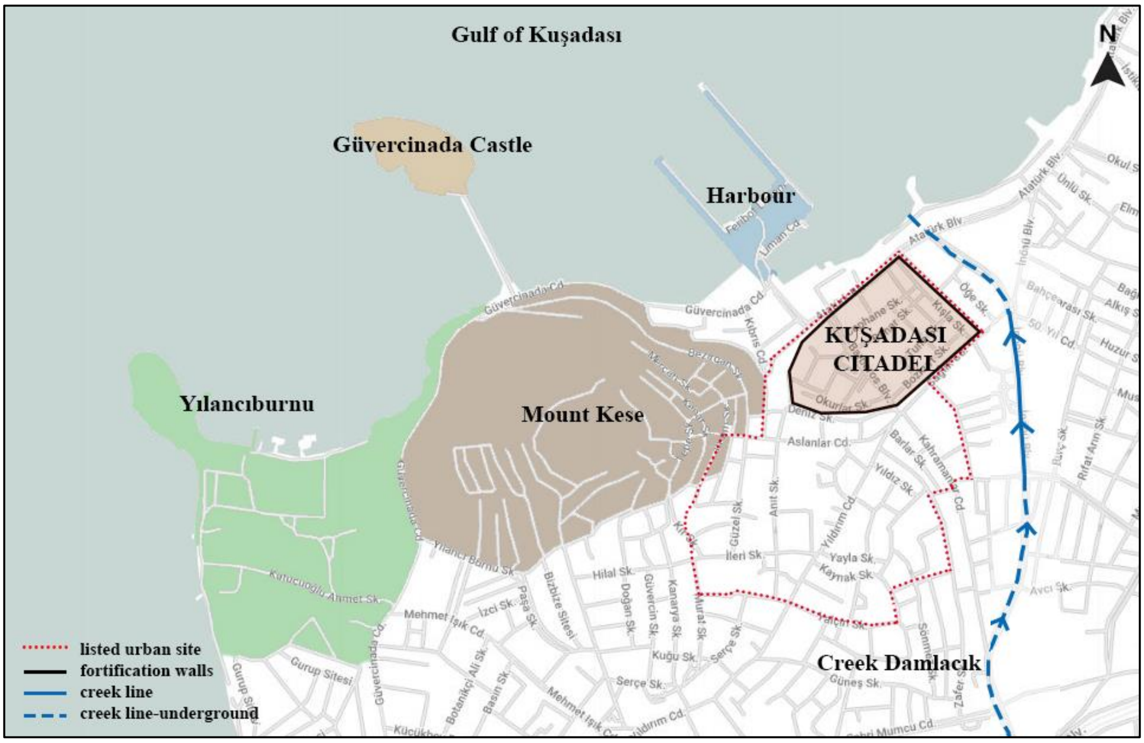


Figure 28: Location of Kuşadası Citadel

4.2 History of Kuşadası Citadel

Kuşadası has a 5000-year-old history and was a strategically and economically important port city in the Aegean Sea. Throughout its history, Kuşadası was dominated by various civilizations, including the Hittites, Carians, Lelegs, Ionians, Macedonians, Roman Empire, Byzantine Empire, Venetians, Genoeseans, and Ottomans (Yıldırım 2011; Yönetken 2018). According to G. Müller Wiener, the early settlement around the

Kuşadası citadel began in the 14th century (Baykara 2000). The Güvercinada inner castle with an arsenal was built in 1534 to protect the jetty from attacks by Barbaros Hayrettin Pasha, and the fortress walls were built by İlyas Ağa in 1826. The citadel of Kuşadası was built by Öküz Mehmet Pasha in the early 17th century and included a caravanserai, mosque, hammam, school, mill, houses and shops, and fortress walls surrounding the city (Yıldırım 2011; Yönetken 2018).

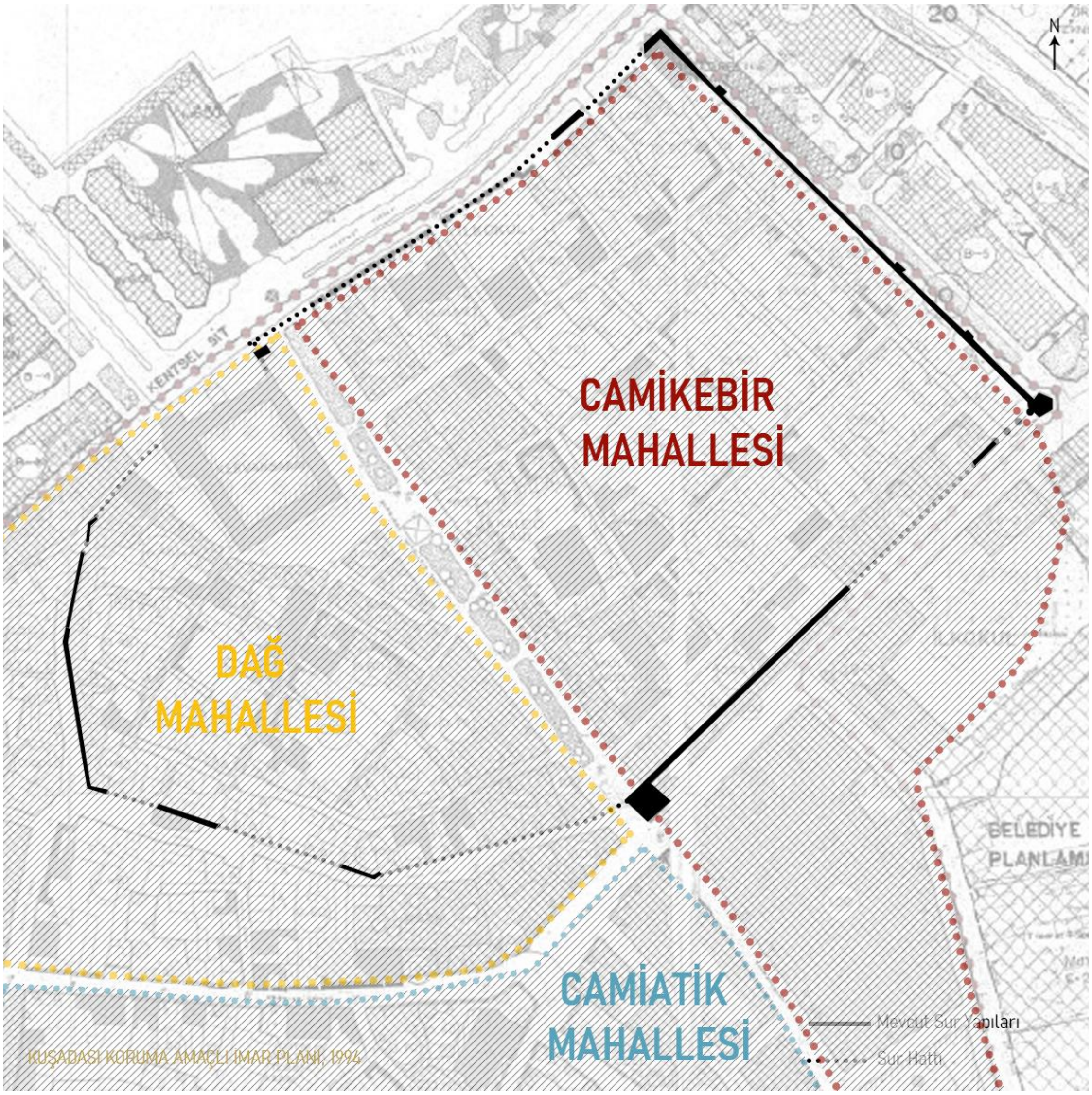


Figure 29: Neighbourhood Boundaries

Therefore, the inner part of the city consisted of the Dağ and Camikebir neighbourhoods, which were the first settlement areas in the historical area (Figure 29).

In the 18th century, with the development of the city, new settlements and neighbourhoods emerged outside the city walls, where Turks, Greeks (Rums), Jews and Armenians lived (Figure 30-31). The citadel of Kuşadası has experienced various developments and disasters throughout history, so that a mosque, a caravanserai, and a bathhouse have been preserved to this day. In addition, many new buildings were added while older ones were renovated. Therefore, it can be said that the residential units and historic public buildings are mainly from the 19th century (Nezahat Belen 2011).

Figure 30: Scalanova
(Source: APIKAM Archive)

The Kuşadası Citadel and its urban fabric were affected by developments and restoration works between 1929 and 1965. Many historic buildings and stores were demolished during the construction of Barbaros Hayrettin Boulevard and the restoration of the Öküz Mehmet Pasha Caravanserai. As urbanisation and tourism increased, the land use of the Kuşadası citadel changed. In particular, the Camikebir neighbourhood changed from a residential area to a business district.

Figure 31: French Map of Kuşadası before 1916
(Source: Kuşadası Yerel Tarih Dergisi Archive)

4.3 Governmental and Non-Governmental Initiatives for the Conservation of Kuşadası Citadel

This case study examines initiatives launched by governmental and non-governmental groups to conserve Kuşadası Citadel and combat climate change. In 1978, the Conservation Council classified the historic coastal settlement of Kuşadası including the Citadel, as a Kuşadası Urban Site (Yönetken, 2018). Through the Kuşadası Conservation Aimed Development Plan (1994), the initial planning for the area's conservation was completed in 1994. Over time, numerous conservation initiatives have been undertaken, including listed buildings, street rehabilitation projects and restoration works (Yıldırım, 2011; Yönetken, 2018). The case study area is monitored by the Aydın Regional Conservation Council of Cultural Assets, Aydın Regional Directorate of Pious Foundation, the Aydın Metropolitan Municipality's Unit of Conservation, Implementation and Control (KUDEB) and Kuşadası Municipality’s Unit of Conservation of Cultural Assets. Kuşadası Municipality has also carried out various activities related to cultural heritage, such as the symposiums "Past to Future Kuşadası Symposium I" (2000) and "Past to Future Kuşadası Symposium II" (2008) and the publication of the book "Kuşadası Inventory" (2010). However, this inventory has limited and outdated information. There is no digital inventory record from which the updated approach can be adapted.

Regarding climate change studies, there have been limited initiatives. The Ministry of Environment, Urbanization, and Climate Change has begun work on the Aydın province's Local Climate Change Action Plan (YİDEP) (AİÇŞİDM, 2021). In addition, the Ministry of Interior's Directorate General of Disaster and Emergency Management created the Aydın Provincial Disaster Risk Mitigation Plan. However, no formal government study on the convergence of climate change and cultural assets has yet been done. In addition, studies on the monitoring of cultural heritage, which has an important work in the effects of climate change, are very insufficient.

Cultural heritage conservation necessitates the involvement of both public institutions and local non-governmental organizations. EKODOSD (Ecosystem Protection and Natural Lovers Association), KUAKMER (Kuşadası F. Özel Arabul Cultural Centre), Kuşadası Local History Research Group, Kuşadası Cultural and Historical Heritage Conservation Association, and Kuşadası Thessaloniki Exchanged and Rumelia Migrants Association are some of the non-governmental organizations working in the field of cultural heritage in Kuşadası. EKODOSD is the most active in tackling environmental issues among these. Climate change and environmental events are organized by KUAKMER and the Exchange Association. However, research in the field of civil society efforts that expressly address the interaction of climate change and cultural assets remains scarce.

4.4 Demographic, Physical and Climatological Background

Demographic, climatological, geological, tectonic, hydrogeological, and historical urban landscape features of the study area are discussed under this heading.

4.4.1 Demographic Features

The total population of Kuşadası is 130,835 and the annual population growth rate is reported to be 39.1%. The population is composed of 65,097 (49.76%) men and 65,738 (50.24%) women (TURKSTAT, Address-based population registration system, 2022). Kuşadası Citadel includes part of Dağ and part of Camikebir Neighbourhood, and the total population of the two districts is 1,311.

4.4.2 Climatological Features

Kuşadası is located in the Mediterranean region where the Mediterranean climate prevails, summers are hot and dry and winters are warm and rainy. When examining the current meteorological parameters, it can be observed that the average temperature during the summer months ranges from 23.6°C to 25.9°C. Throughout the year, the average temperature in July and August is approximately 25.55°C, while the maximum temperatures during the same months reach as high as 31.1°C to 36.6°C. Almost all of the precipitation in Kuşadası is in the form of rain, and the distribution of precipitation according to the seasons is 154.4 mm in spring, 29.6 mm in summer, 144.9 mm in autumn and 336 mm in winter. The average number of rainy days is 79.9 and the average annual precipitation is 664.9 mm. According to these determinations, Kuşadası receives the most rainfall in winter months (December, January, February), and the least rainfall in summer months (June, July, August). 51% of the precipitation is in winter, 45% is in spring and autumn, and 4% is in summer (General Directorate of Meteorology, 2023) (Figure 32).

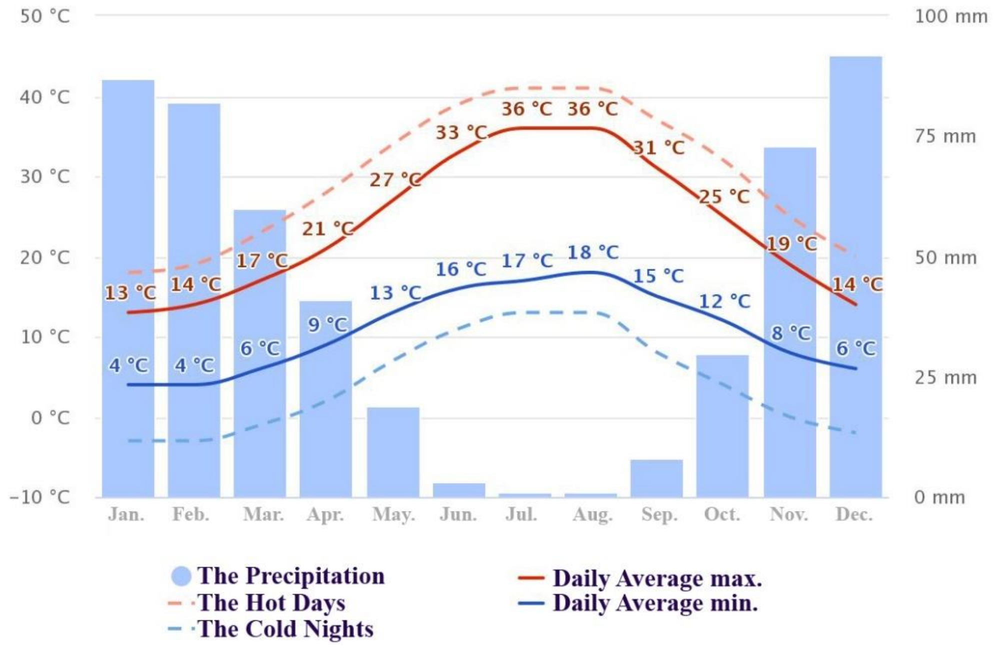


Figure 32: Annual Precipitation and Temperature Graph
(Source: General Directorate of Meteorology, 2023)

In the region, the predominant wind direction is from the southeast (SE). The total annual average frequency of wind from this direction is 5,396 times, with an average wind speed of 2.0 m/s. The second, third, and fourth predominant wind directions are respectively east-southeast (ESE), north-northwest (NNW), and west-northwest (WNW). The highest recorded wind speed in Kuşadası to date was 35.7 m/s, blowing from the south (S) direction ("Aydin-2040 1/25.000 Ölçekli Nazım İmar Planı Açıklama Raporu" 2018).

4.4.3 Geological and Tectonic Features

The geologic formations in the case study area and its immediate vicinity consist of Paleozoic (P) schist and recrystallized marble, Mesozoic (M) dolomitic limestones and marbles, Neogene (N) sedimentary units, and Quaternary (Qal) alluvium ranging from old to young. The predominant geological formation in the Kuşadası Citadel and its surroundings is the Neogene sedimentary rocks (Figure 33). The thickness of the alluvium in the centre of Kuşadası and Kuşadası Citadel ranges from 5.00 to 15.00 metres and depending on the topographic elevations that occur around the area, the thickness of the alluvium increases or decreases depending on the Neogene age units observed at the base. In general, the alluvial unit has a silty clayey silt component and may be contained in marine sediments with a silty sand component at nearshore locations. The alluvial unit observed in the offshore areas of the Kuşadası citadel consists of sediments with gravelly silty clay components formed by streams flowing into the sea, and units with mudstone marl intertwined at the base of this unit form the basic structure. This unit is a rock suitable for decomposition with low strength and is defined as a decomposed rock (Kapucu 2017).

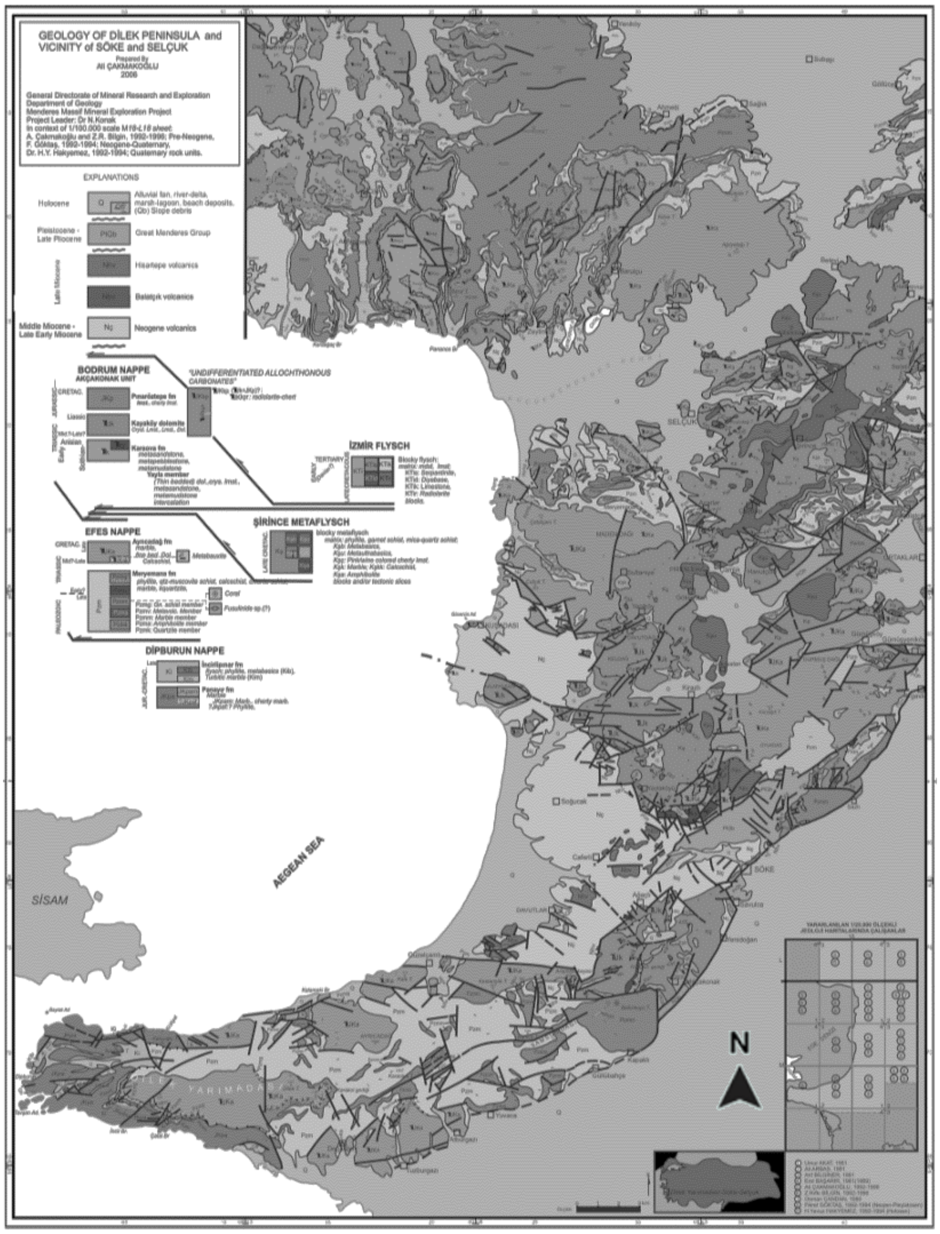


Figure 33: Geological map of the region around Dilek Peninsula, Söke and Selçuk (Source: Çakmakoğlu 2007)

Kuşadası is in a high-risk earthquake zone. The case study area is within the limits of the greatest ground acceleration “0.506 g hazard” in the Earthquake Hazard Map of Türkiye (10% probability of exceeding 50 years -the recurrence December is 475 years).

Figure 34: Active Fault Zone
(Source: MTA, 2023)

4.4.4 Hydrological Features

The underground water sources in Kuşadası and its immediate surroundings are karst springs, buried marble and limestone reservoirs, groundwater in coarse-grained rock fragments between Tertiary sediments, and surface deposits in very young alluvial deposits. However, the groundwater table is 3-6 meters. Depending on the proximity of the sea level and the seasonal precipitation regime, increases and decreases can be observed at this level (Karamanderesi and Helvacı 1992)

The current flowing waters in and around Kuşadası are seasonal in the form of streams that hold rain only in winter. Damlacık Creek, which is located in the east of

Kuşadası citadel, is a seasonal stream and only its flows are active (Karamanderesi and Helvacı 1992).

Damlacık Creek is located to the east of the Kuşadası Citadel. The area in the northeast is currently going underground and it is located about 80 meters from the fortification wall walls. the part remaining in the southeast is 70 meters away from the castle bastion, which is the closest point, and continues moving away (Figure 35).

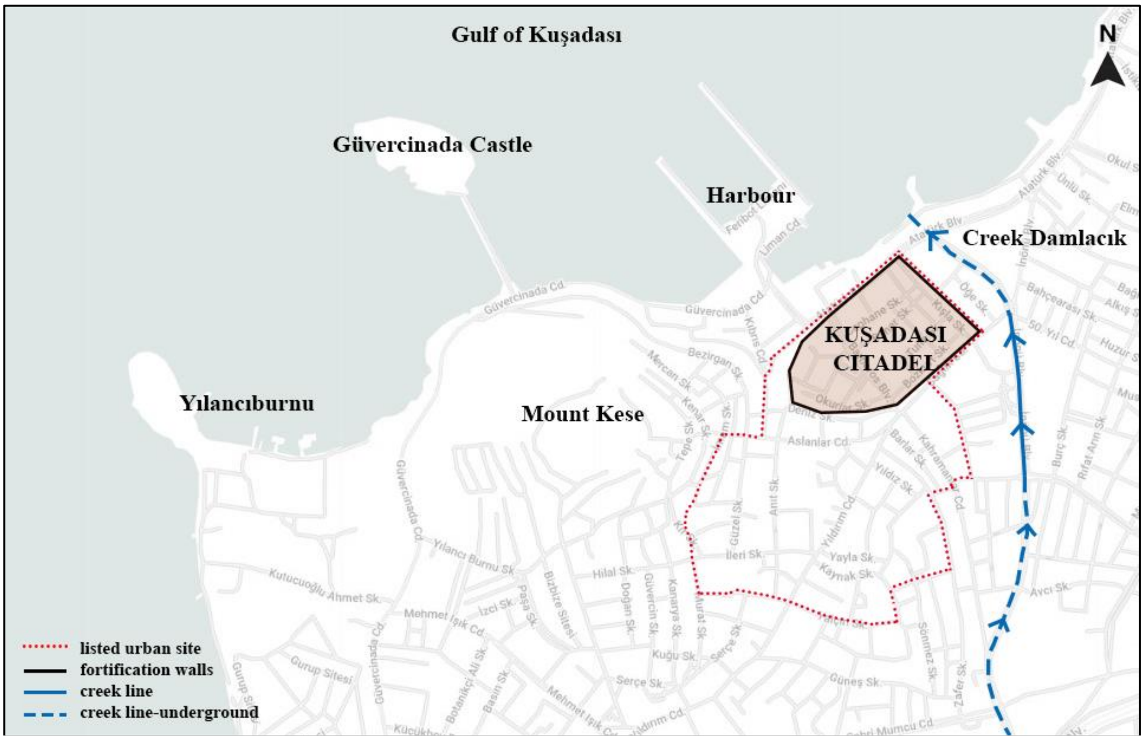


Figure 35: Relations between the Kuşadası Citadel and Damlacık Creek

4.4.5 Historic Urban Landscape

The citadel of Kuşadası was designed according to the topography and natural boundaries. The eastern side of the city walls was on a flat plain that ran parallel to the seashore, while the western side rested on a steep hill. The Kuşadası citadel was bounded by the seashore to the northwest of the settlement, the Damlacık Creek, and its possible floodplain to the southeast and northeast of the settlement, and the abruptly sloping topography to the east and south of the settlement. Thus, the boundaries of the city were drawn according to the natural landscape elements (Figure 36-37).

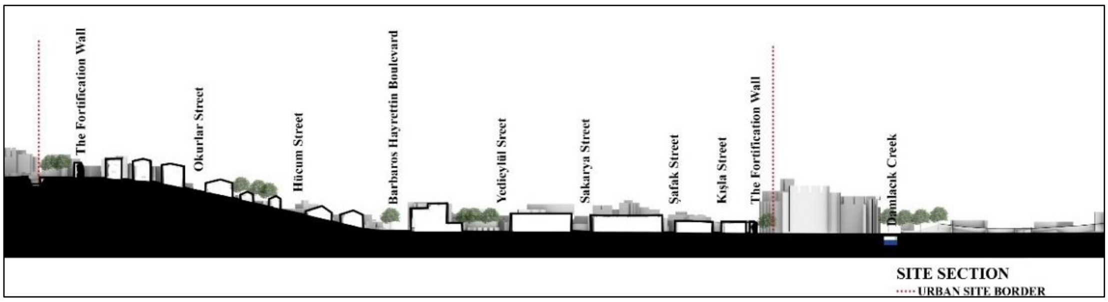


Figure 36: Site Section of Kuşadası Citadel

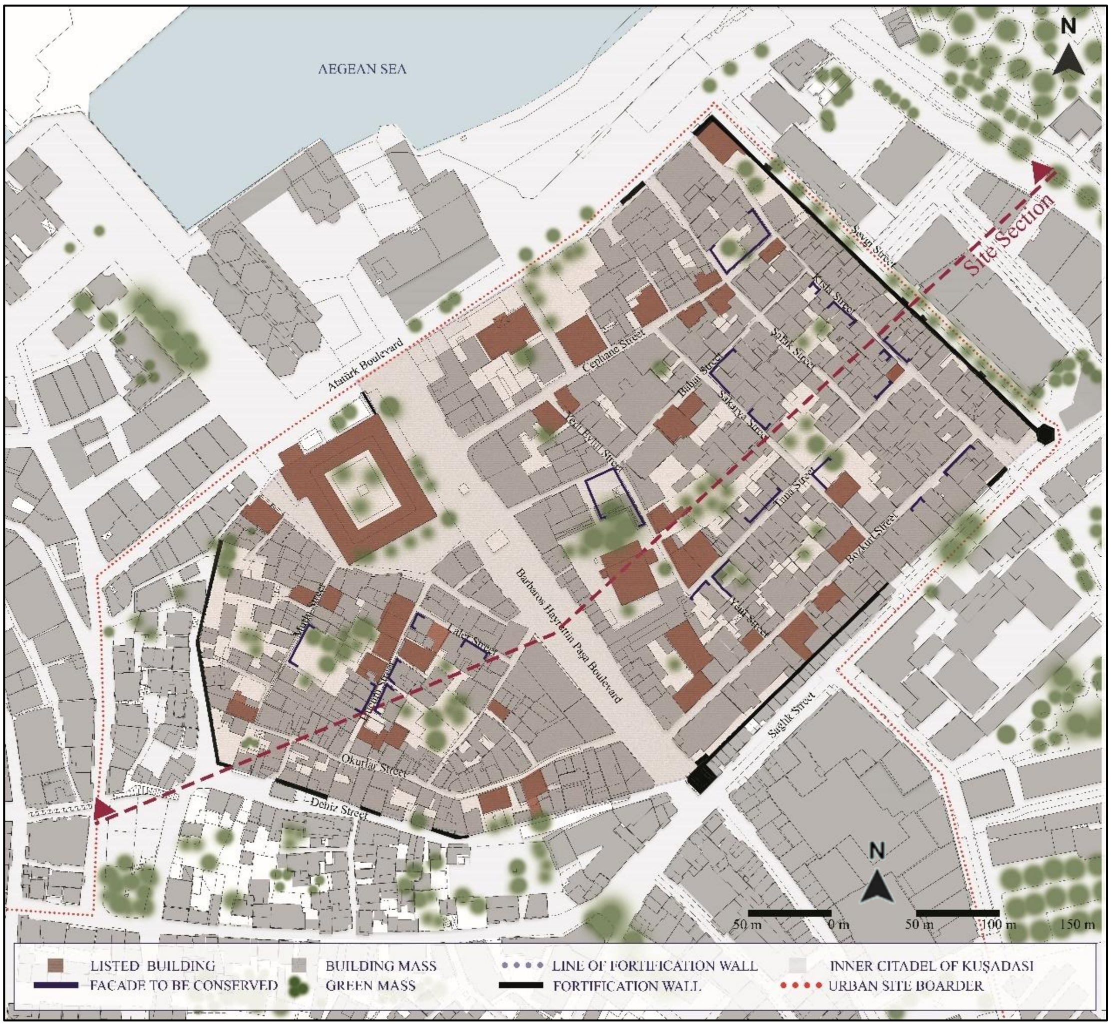


Figure 37: Site Plan of Kuşadası Citadel and Its Surrounding

The Kuşadası citadel is divided by Barbaros Hayrettin Boulevard in the northwest-southeast direction, and the boulevard connects the Camikebir and Dağ districts. In this direction, there were two city gates in the northwest and southeast. The northwestern city wall and gate were not reached today. The settlement fabric of the Citadel district has a grid-iron layout. The streets are orthotomic in the Camikebir Neighbourhood in a flat area, and the streets reach the seashore or Barbaros Hayrettin Boulevard. Okurlar Street runs parallel to the city wall in the south and is the main street in Dağ Quarter. Other streets with stairs cross Okurlar Street at the end at right angles (Bektaş 1987; Levi 2008). Most of the houses are located along the streets, with gardens in between. Thus, both the garden and the house are on a stepped terrace, with both sharing a considerable portion of the scene in front of them (Bektaş 1987). Many buildings had been built as residences or public buildings. In particular, the houses in the Camikebir neighbourhood and the buildings on Barbaros Hayrettin Boulevard are now used as stores or tourist restaurants. In the Dağ Neighbourhood, the use of residential buildings is continuous. Contemporary buildings were constructed mainly on Barbaros-Hayrettin Boulevard due to changes in function and commercial and public demands (Figure 36).

The settlement layout of the Kuşadası Citadel was generally maintained. Therefore, when Barbaros-Hayrettin Boulevard was constructed, the stores in this area and the city gate and walls were destroyed. Increasing tourism and the demands of urbanisation have also led to changes in the historical landscape elements based on the structure.

4.5 Possible Climate Change Effects on Kuşadası Citadel

Climate change can have significant effects on the Kuşadası Citadel. Analyses of potential climate change impacts that may affect the area were conducted using the Aydın Provincial Disaster Risk Mitigation Plan (2021), A Framework for Resilient Cities to Climate Change: Green Revision Guidebook, Izmir Region (2019), Climate Projections, and Climate Change with New Scenarios of Türkiye (2015). The climate projection utilized in the study, which focused on the Izmir environment, was based on CMIP5 (Coupled Model Intercomparison Project Phase 5) and covered the period from December 2050 to 2100. The Evaluation Report incorporated the IPCC 5th Assessment Report, which utilized the RCP 4.5 and RCP 8.5 scenarios from the HadGEM2-ES Global Communication Model (GCM) also employed in the CMIP5 project. Model verification was conducted using data from 14 meteorological stations, including the Kuşadası Station (number 17232) located at latitude 37.8597, longitude, and altitude 25. These data were utilized in the study (Berberoğlu, Çilek, and Ünlükaplan 2019).

4.5.1 Climatological Changes

Climate change predictions are made based on measurements made so far and different scenarios. The predictions in the study area were created by the data of Kuşadası Meteorological Station No. 17232 and its altitude is 25 m. (General Directorate of Meteorology 2023) (Figure 38).

Figure 38: Kuşadası Meteorological Station (17232) Location
(Source: Google Earth, 2023)

4.5.1.1 Average Temperature

The average temperature of Kuşadası has shown an increase in recent years. According to data from the General Directorate of Meteorology, there has been a 1.05 °C increase between the seasonal average temperatures from 1990-2005 and the annual average temperatures from 2005-2020 (Figure 39).

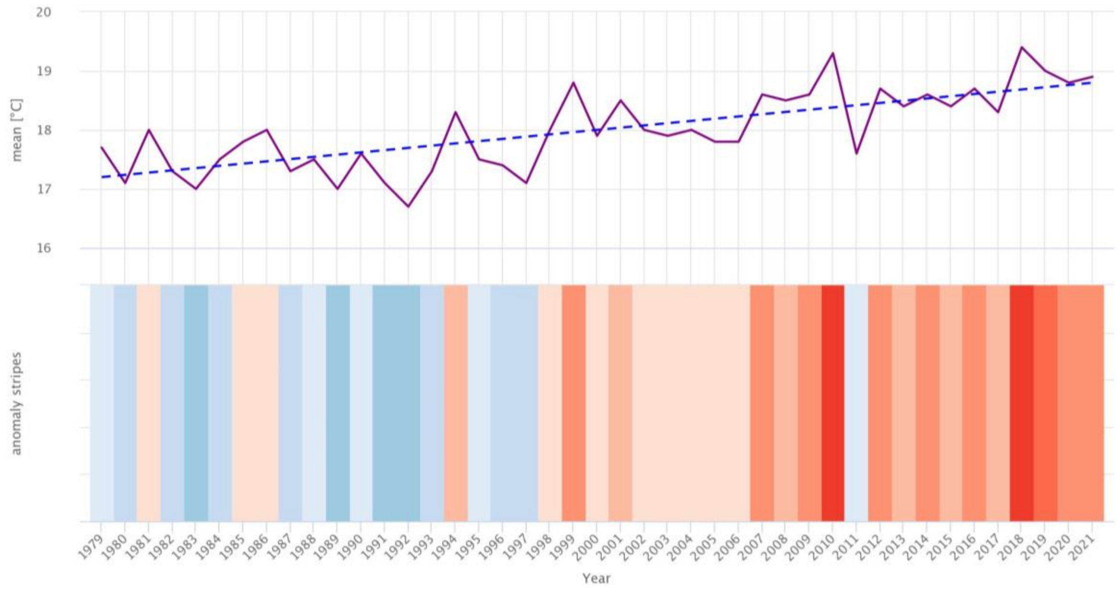


Figure 39: Mean Yearly Temperature and Anomaly stripes between 1979-2023 (Source: meteroblue.com)

Monthly average temperatures between 1971 and 2000 and the future 2050-2100 are examined. Two different scenarios were used to show changes in temperature according to the IPCC Report shows temperatures changing. According to both scenarios, an increase of 0.5 °C in average annual temperatures is predicted. In the maintenance of monthly values, the temperature changes were different. In winter months (January-February), the temperature change is close to 1.3 °C on average. In April and May, the temperature is expected to have the highest increases (Table 4).

Table 4: Change of monthly average temperature of current (1971-2000) and future (2050-2100) climate station in Kuşadası (Source: Berberoğlu, Çilek, and Ünlükaplan 2019)

	Kuşadası/ Aydın		
	Present	RCP 4.5	RCP 8.5
	(°C)	Increase (°C)	
January	9.03	0.72	1.87
February	9.23	0.41	1.81
March	11.08	-1.74	-4.81
April	15.02	3.69	1.89
May	18.73	2.89	2.63
June	23.15	-1.19	-0.39
July	25.44	0.64	0.46
August	24.81	-0.72	-0.67
September	21.84	-0.98	0.10
October	17.97	2.17	1.03
November	13.58	-0.49	0.53
December	10.71	-0.01	-0.03
Mean	16.71	0.45	0.37

4.5.1.2 Total Precipitation

Variations of monthly total precipitation data of current (1971-2000) and future (2050-2100) were examined. Two different scenarios were used to show changes in temperature according to the IPCC Report shows temperatures changing (Figure 40). According to the RCP 4.5 scenario, there is generally a drop in the March and April months, although there is an increase in the other months. In the RCP 8.5 scenario, a decrease in average annual precipitation is predicted, especially, in February, March, April and May (Table 5).

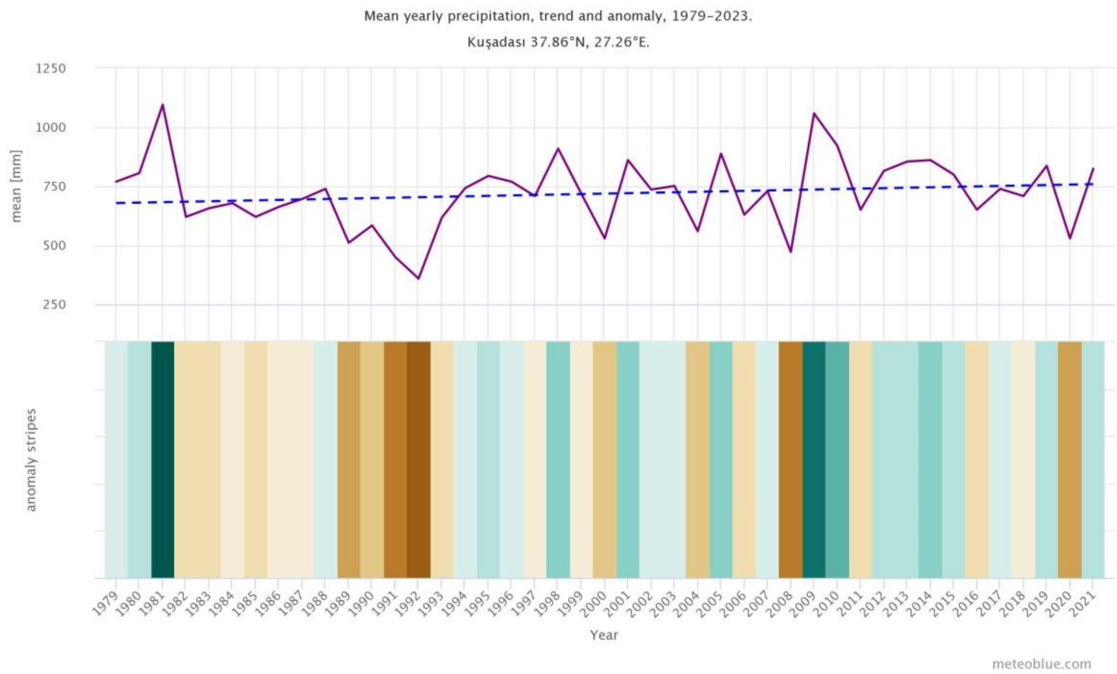


Figure 40: Mean Yearly Precipitation, Trend and Anomaly stripes between 1979-2023 (Source: meteroblue.com)

Table 5: Variation of monthly total precipitation data of current (1971-2000) and future (2050-2100) climatic station in Kuşadası (Source: Berberoğlu, Çilek, and Ünlükaplan 2019)

	Kuşadası/ Aydın		
	Present	**RCP 4.5**	**RCP 8.5**
	(mm)	**Increase (mm)**	
January	**101.78**	**40.44**	**25.96**
February	**83.61**	**56.10**	**-49.46**
March	**77.27**	**-48.56**	**-75.70**
April	**45.70**	**-45.15**	**-45.70**
May	**20.87**	**25.68**	**-20.87**
June	**5.00**	**40.43**	**16.45**
July	**0.13**	**0.30**	**0.33**
August	**0.19**	**0.23**	**0.43**
September	**13.52**	**20.34**	**14.38**
October	**33.73**	**51.31**	**36.89**
November	**88.98**	**12.60**	**96.69**
December	**117.36**	**64.05**	**09.52**
Mean	**49.01**	**43.15**	**9.08**

The surface water flow directions are shaped in the direction of slope. In the Camikebir Neighbourhood, where the slope is low, the flow direction is in the north-western direction, while in the Dağ Neighbourhood, which is in a sloping area, the flow is in the northeast direction, which is the slope direction (Figure 41).

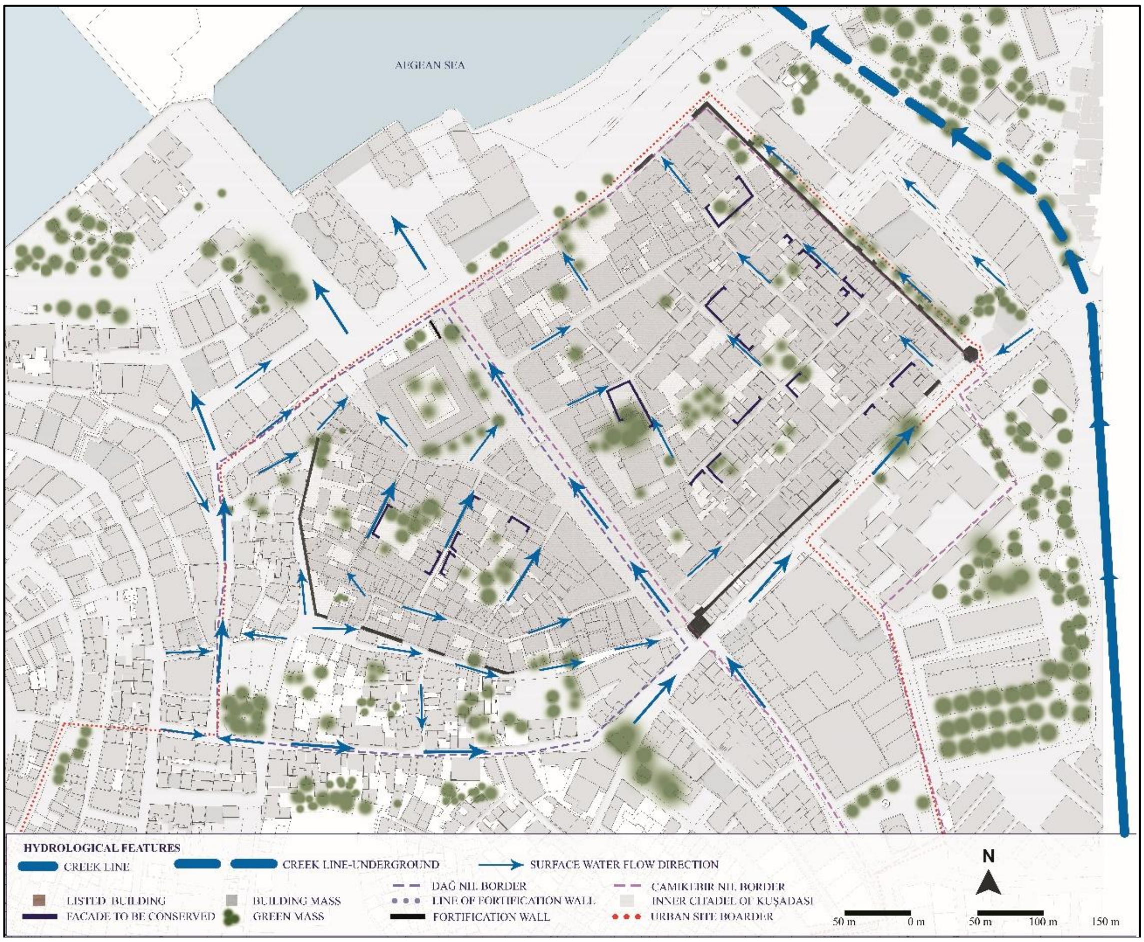


Figure 41: Surface Water Flow Direction

4.5.1.3 Average Wind Speed

Monthly average wind speed data change for the current (1971-2000) and future periods (2050-2100) are examined. A decrease in wind speed is predicted for both scenarios and these decreases are close (Table 6).

Table 6: Monthly average wind speed data change for the current (1971-2000) and future period (2050-2100) in Kuşadası (Source: Berberoğlu, Çilek, and Ünlükaplan 2019)

	Kuşadası/ Aydın		
	Present	RCP 4.5	RCP 8.5
	(m/sn)	Increase (m/sn)	
January	**2.71**	**-2.62**	**-2.62**
February	**2.70**	**-2.58**	**-2.58**
March	**2.35**	**-0.41**	**-0.41**
April	**2.18**	**0.00**	**0.00**
May	**1.96**	**0.00**	**0.00**
June	**1.94**	**-1.85**	**-1.85**
July	**1.96**	**-0.64**	**-1.91**
August	**1.85**	**-1.00**	**-0.10**
September	**1.95**	**-1.95**	**0.00**
October	**2.00**	**1.04**	**0.00**
November	**2.26**	**-2.19**	**-2.19**
December	**2.48**	**0.00**	**0.00**
Mean	**2.20**	**-1.02**	**-0.97**

4.5.1.4 Soil Moisture

Changes in monthly average soil moisture data of current (1971-2000) and future (2050-2100) periods are examined. According to the RCP 4.5 scenario, a significant decrease is observed in March-April while the RCP 8.5 scenario. According to the RCP 8.5 scenario, an increase in average soil moisture is observed (Tablo 7).

Table 7: Change of monthly average soil moisture data of current (1971-2000) and future (2050-2100) period of climate station in Kuşadası (Source: Berberoğlu, Çilek, and Ünlükaplan 2019)

	Kuşadası/ Aydın		
	Present	RCP 4.5	RCP 8.5
	(%)	Increase (%)	
January	**28.67**	**3.62**	**-1.93**
February	**28.02**	**1.20**	**15.70**
March	**26.74**	**-23.90**	**26.87**
April	**23.86**	**-23.45**	**9.30**
May	**21.23**	**33.63**	**-12.96**
June	**19.00**	**24.89**	**5.74**
July	**15.82**	**-0.18**	**1.16**
August	**13.92**	**-5.04**	**0.93**
September	**13.96**	**-5.79**	**-0.59**
October	**17.05**	**-6.07**	**1.21**
November	**21.08**	**-5.40**	**-2.57**
December	**26.74**	**-3.25**	**-1.53**
Mean	**21.37**	**-0.81**	**3.24**

4.5.1.5 Sea-Level Change

When considering global sea level rise, it is predicted to continue throughout the 21st century. The projected rises vary according to the different scenarios of the Representative Concentration Pathway (RCP). According to the scenarios derived from the CMIP5 modelling results, sea level rise is projected as follows:

For RCP 4.5, the range is 0.32 to 0.63 meters.

For RCP 8.5, the range is 0.45 to 0.82 meters.

It should be noted that sea level rises will not exhibit a uniform distribution across all regions. (Akçakaya et al. 2015).

4.5.1.6 Flooding

Flooding can be seen in three different ways: rapid-onset floods, which can happen after heavy rains, floods caused by the adjacent Damlack Creek overflowing, and coastal floods, which can happen after natural disasters like earthquakes and storms. According to the hydraulic modelling results of Damlacık Creek in Kuşadası District, floods with return periods of 500, 100, and 50 years pose a risk in the district of Kuşadası (T.C. İçişleri Bakanlığı Afet ve Acil Durum Yönetimi Başkanlığı 2021).

Damlacık Creek is close to the Kuşadası Citadel and is at risk of flooding because of climate change. Climate change affects water supplies and river regimes via increasing temperatures, heavy rainfall events, and shifting precipitation patterns. Damlack Creek flood danger relates to the occurrence of significant rainfall events and the quick rise of water levels.

Figure 42: The Flooding in 2002
(Source: Murat Saraç Archive, 2002)

After the flood disaster that occurred in 2002, the Kuşadası Citadel was also affected and exposed to floods and the historical buildings located in the Kuşadası Citadel have been flooded the structures. According to the news ‘During the flood that occurred at that time, about 400 business places were flooded in the city centre, vehicles parked on the streets were on top of each other. traffic was closed in the city for 5 hours, commercial life in the city could return to normal only after 1 month.’ (Öncü Şehir News 2022) (Figure 42).

Waterholes have formed in the Caravanserai and its surroundings because it has remained at a low altitude after the sudden and extreme rainfall of April 2023. After such extreme rainfall, the same situation is observed in Caravanserai (Figure 43).

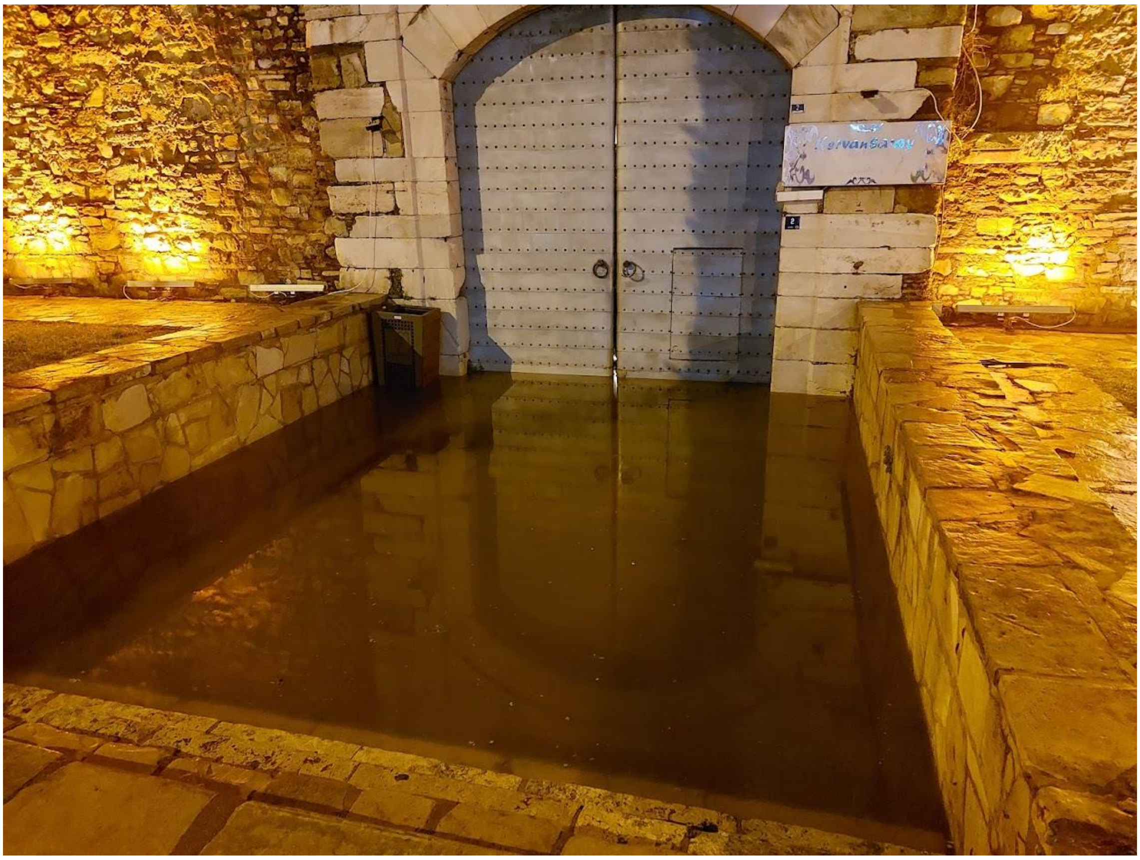


Figure 43: After Extreme Rainfall in April 2023
(Source: S. Burçak Çıkıkçı Archive, 2023)

4.6 Analysis of Kuşadası Citadel

In the scope of the case study, analyses have been conducted at two different levels: site scale and building level. These analyses have served as the fundamental of conservation strategies.

4.6.1 Site Level

At the site scale, studies have been conducted focusing on urban development and tourism, green areas, and stormwater pipeline systems to develop strategies for the area.

4.6.1.1 Urban Development and Tourism

The historical settlement area of Kuşadası Citadel, which emerged in the early 17th century, underwent a series of dynamic changes and developments over time, including processes of urban expansion, war-related damages, and urbanization, which resulted in the configuration depicted in the 1957 aerial photograph (Figure 43). Originally acting as a trade, shelter, and repair hub, the port underwent substantial alterations beginning in the 1960s, owing mostly to an increase in tourism and the accompanying growth of its facilities (Kuto 2011, Güney Somuncu 2018). A causeway was built before 1964 to connect the small island where the Güvercinada Castle stands to the mainland, and the space between the causeway and the port was filled in to accommodate port services. Furthermore, the southern castle wall was removed, and trees along Barbaros Hayrettin Boulevard were cut down to improve vehicle accessibility. The city had expanded eastward and northward as can be seen from an aerial photo of 1977 (Figure 43), with the development of the marina to the north of the city, and coastal arrangements were established around the marina. The 1982 Tourism Incentive Law resulted in the construction of several hotels, which contributed to population growth and necessitated the establishment of new settlement areas and tourist establishments, resulting in further urban expansion (Güney Somuncu 2018). These changes, as well as the installation of a second causeway to the port, are depicted in a 1993 aerial photo. Furthermore, Damlacık Creek, located in the city centre, was covered and channelled underground as the settlement area increased, but after the 2002 flood disaster, a portion of it was exposed and rehabilitated. As seen in the 2021 aerial view, the 1957 region, which included the old port and was surrounded by old population areas and agricultural plains, has now been turned into a dense urban area. It is still part of the urban fabric; however, its functions and structures have altered. Further analysis at the building scale will provide clearer insights into these changes (Figure 44).

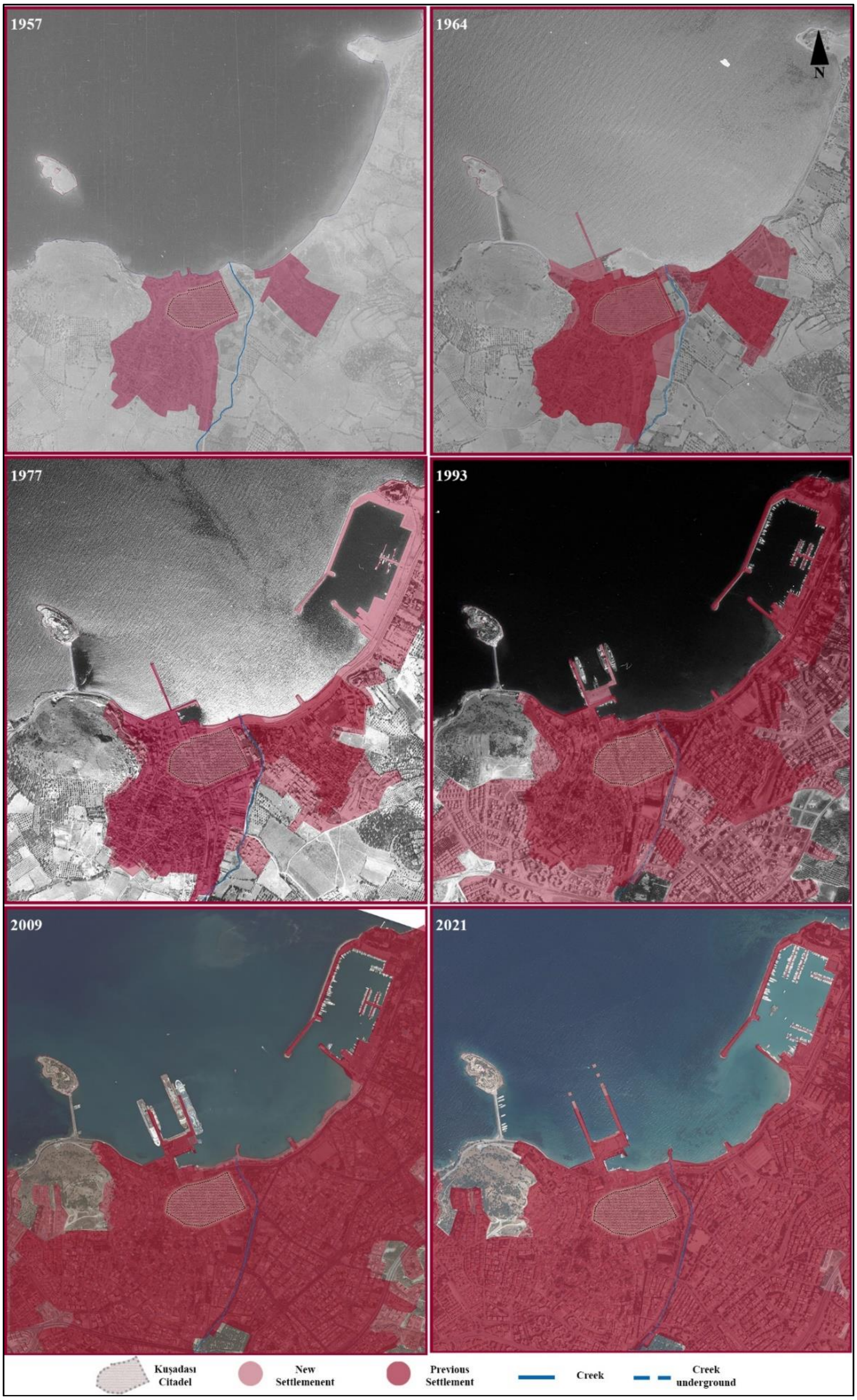


Figure 44: The Development of the Kuşadası Citadel from 1957 to 2021
(Source: General Directorate of Mapping Archive)

4.6.1.2 Green Areas

Kuşadası Citadel is a peculiar urban fabric that is intersected by perpendicular streets and characterized by courtyard residences with street facades (Bektaş 1987). The residential function of the Kuşadası Citadel was prominent in 1957 and 1964 (Figure 45), and the greenery within the courtyards was seen. However, as the port expanded and the tourism business grew in the 1960s, urban construction activities surged. Part of the southern castle wall was dismantled to allow active usage of Barbarous Hayrettin Boulevard, which necessitated the removal of trees along this thoroughfare. By 2009, several properties in Kuşadası Citadel had undergone substantial functional modifications, and numerous courtyard dwellings had been transformed for commercial purposes, resulting in courtyard enclosures or tree removal.

Landscape patterns that encouraged the establishment of green areas were seen in the region surrounding the significant restoration of Caravanserai. Furthermore, in the 1990s, Barbaro Hayrettin Boulevard was restricted to vehicular traffic, allowing flora to grow. However, it is clear from the 2021 aerial photo (Figure 45-46) that recent street reorganization in 2020 resulted in a loss of green spaces along the boulevard, and the vine-covered walls that contributed to a cooling effect around the Caravanserai were removed. The loss of flora in the area has exacerbated the urban heat island effect (Figure 47).

Figure 45: The Changing of Green Areas in Barbarous Hayrettin Boulevard from the 1950s to 2021 (Source: Selami Çetin (a), Mustafa Saraç (b), S. Burçak Çıkıkçı (c) Archive)

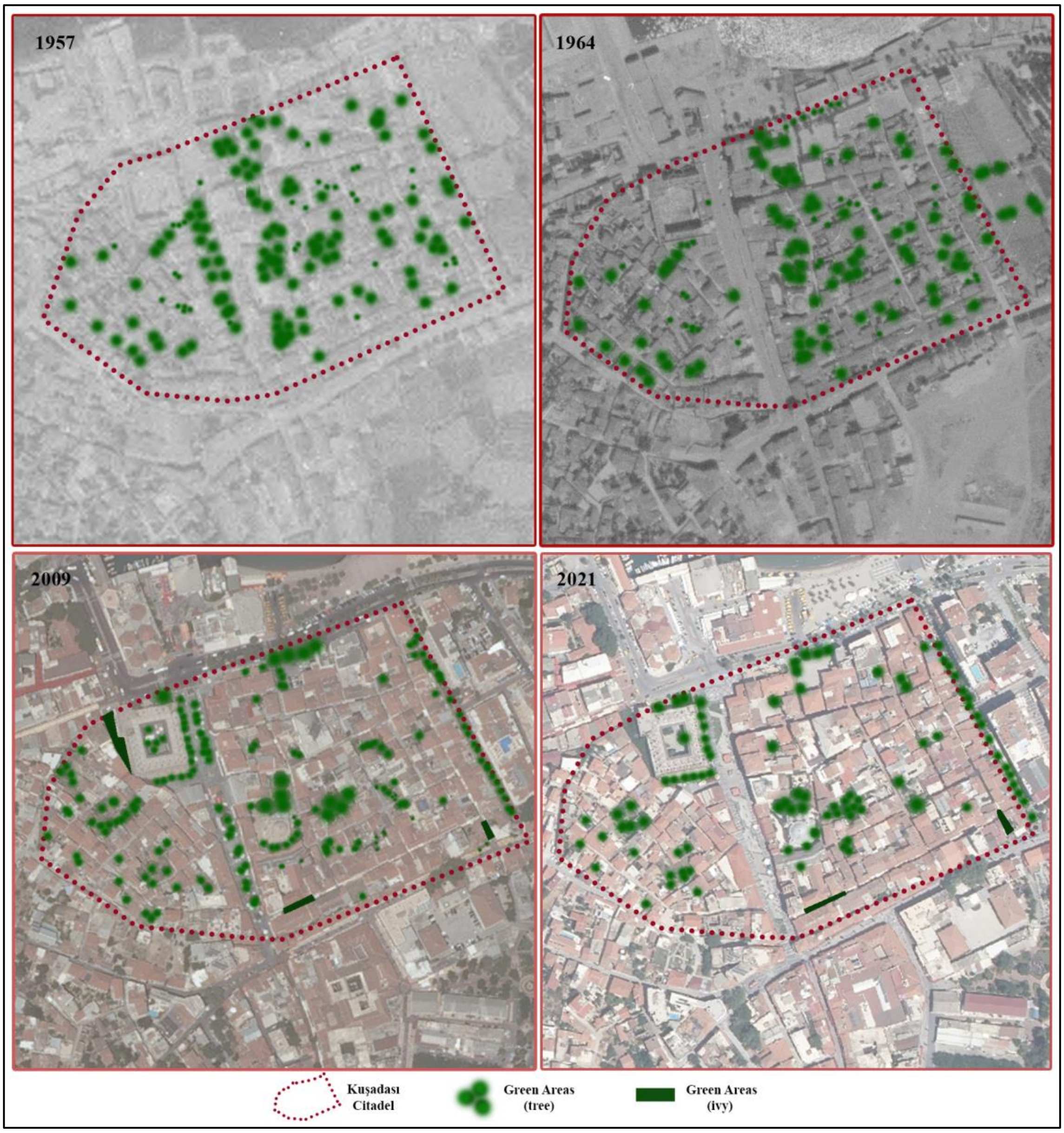


Figure 46: The Changing of Green Areas in Kuşadası Citadel from 1957 to 2021
(Source: General Directorate of Mapping Archive)

Figure 47: The Ivy used for shading the streets in Kuşadası Citadel
(Source: S. Burçak Çıkıkçı (right) Archive, 2023)

4.6.1.3 Rainwater Pipelines Network

There is a contemporary rainwater collection network in the Kuşadası Citadel that helps with the draining and removal of rainwater from the area after rainfall. The major rainfall sewer line belonging to Aydın Metropolitan Municipality was retrieved from the Kuşadası (Aydn) Sewage Network Management Plan. However, pipes in the Kuşadası Citadel, which is managed by Kuşadası Municipality, were located and mapped using rainwater collection manholes. The flat sections of Kuşadası Citadel have a well-organized rainwater collection line, according to this study (Figure 48). There are no rainwater collection lines in sloped regions; nevertheless, once the slope ends, the rainfall manholes are expanded to accommodate rainwater from higher places. Nevertheless, in other areas, these manholes are not adequately sized, and they may get clogged due to materials that can cause blockages (Figure 49).

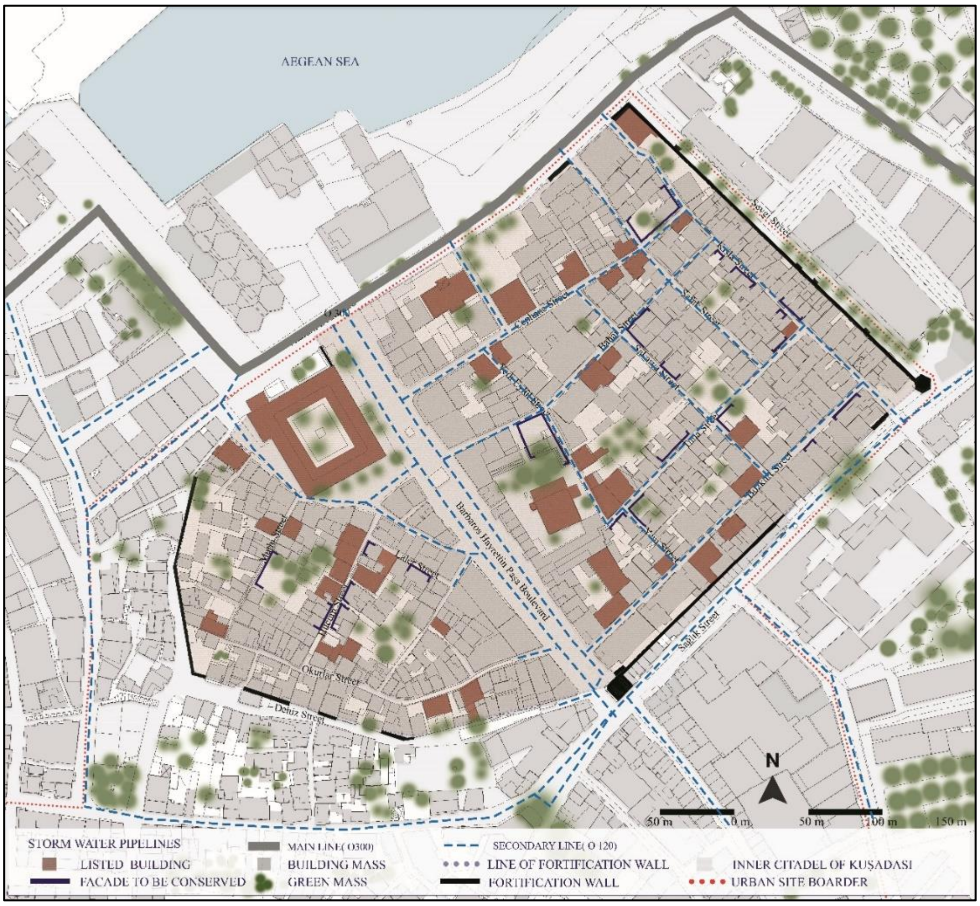


Figure 48: The Rainwater Pipelines Network
(Source: Kuşadası (Aydın) Sewage Network Management Plan 2013)

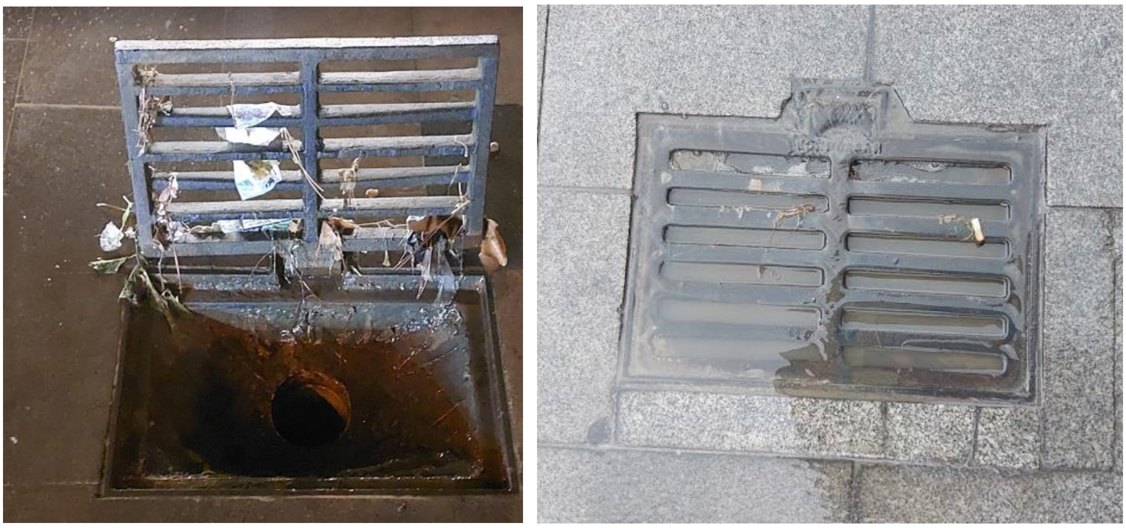


Figure 49: The Rainwater Manholes from Kuşadası Citadel
(Source: S. Burçak Çıkıkçı Archive 2023)

4.6.2 Building Level

The case study area, Kuşadası Citadel, consists of seventy-one immovable cultural assets that were analysed within the scope of a 2-day field study.

4.6.2.1 The Building Category

The building category was formed using a building. The seventy-one immovable cultural properties are dwellings, caravanserais, mosques, hammams, historic schools, the government office, library buildings, and fortress walls. The forty-nine immovable cultural properties were built for residential purposes. Kuşadası Citadel has a mosque, a caravanserai, a hammam, a government office, two historical schools and two library buildings. The area of the citadel was surrounded by nine fortress walls and their units - city gate, walls and bastion (Figure 50-51).

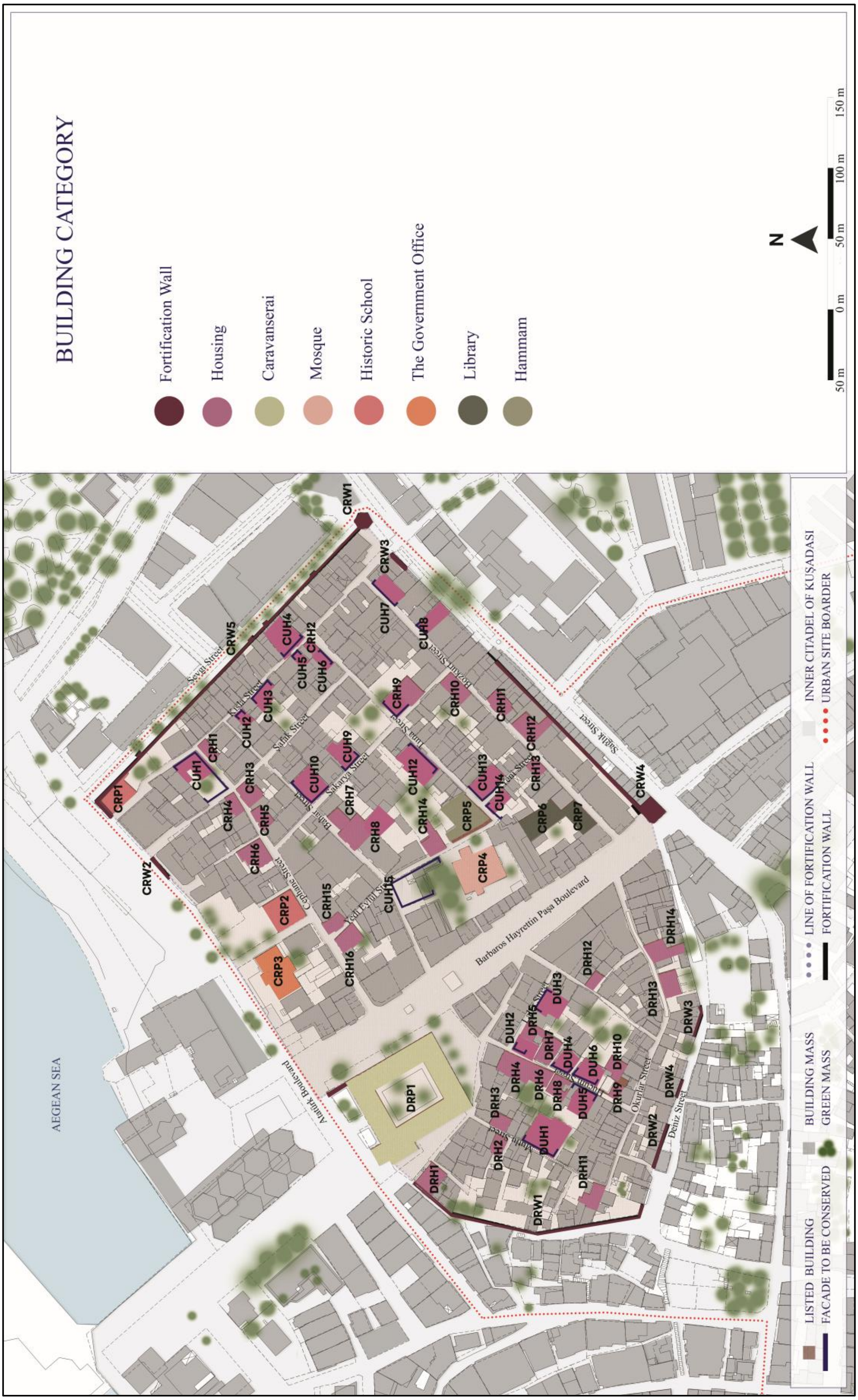


Figure 50: Building Category

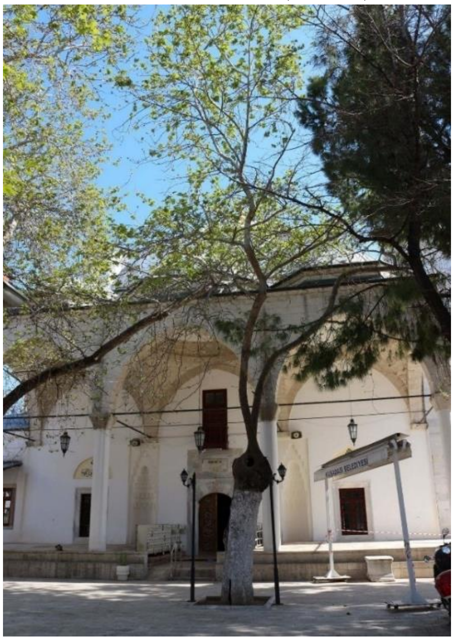

Caravanserai (DRP1)


Historic School (CRP2)


The Governance Office (CRP3)


Fortification Wall (CRW5)

Hammam (CRP5)


Mosque (CRP4)


Housing Building (CRH16)


Library (CRP7)

Figure 51: Building Category Examples from the case study.
(Source: S. Burçak Çıkıkçı Archive, 2023)

4.6.2.2 The Construction Date

The construction dates of all of the immovable cultural assets are not known exactly. Twenty-five immovable cultural assets' construction dates were known. The monumental buildings; a mosque, a caravanserai, a hammam and the fortification walls and their units were dated around 1618, the early seventeenth century (Baykara 2000). The housing units are generally dated to the nineteenth and twentieth centuries (Levi 2008). Six of them were reconstructed or built with reinforced concrete in the last thirty years.

4.6.2.3 The Original Function

The functions of the immovable cultural assets are examined as housing, public buildings, and commercial and fortification walls. The majority function was housing. 54 immovable cultural assets were used as housing. Public buildings consist of a mosque, a hammam, historic schools, a government office and library buildings. These buildings were 7. The commercial building was for a caravanserai. The last 9 immovable cultural assets were fortification walls (Figure 52-53).

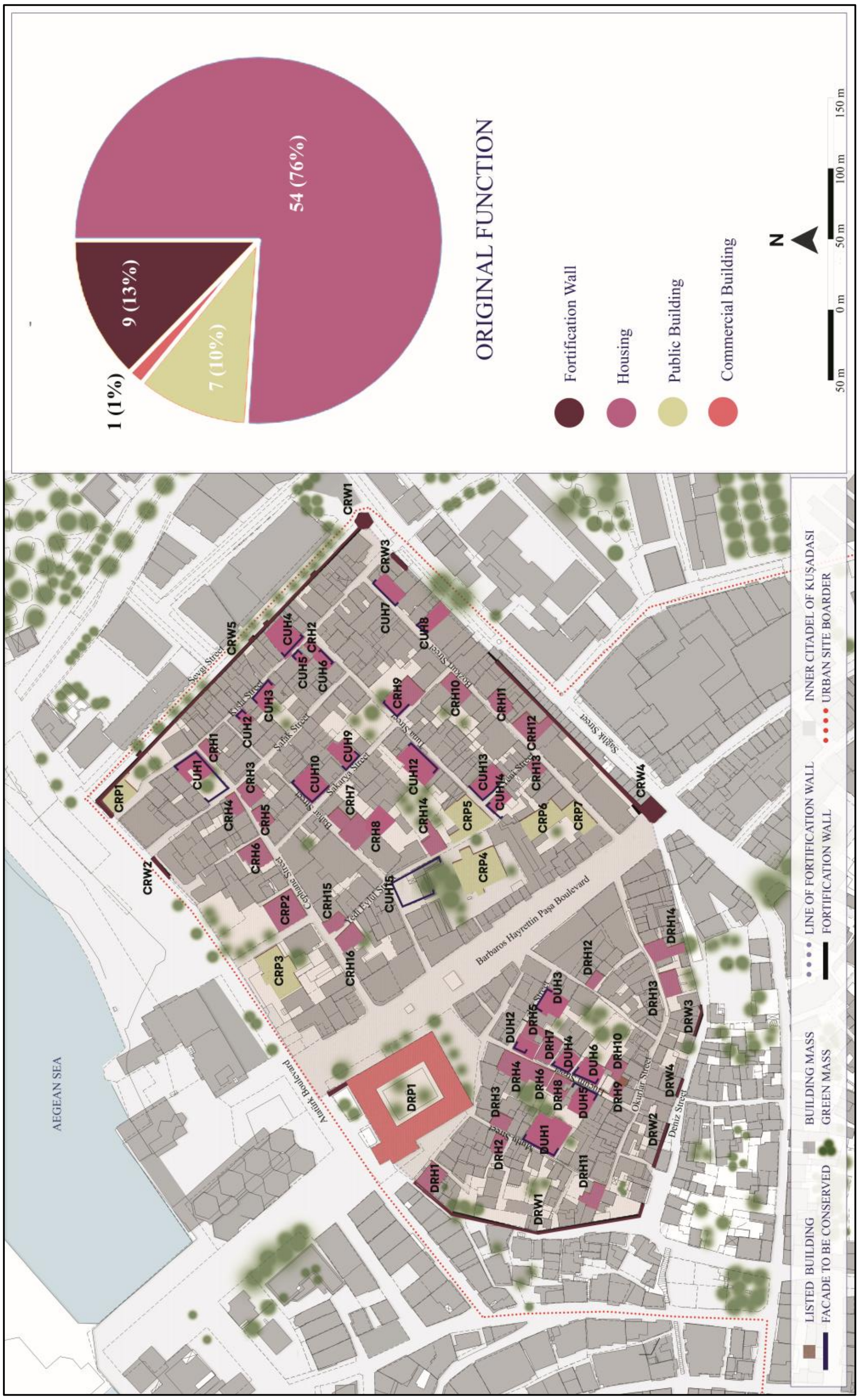


Figure 52: Original Function

Fortification Wall (DRW1)

Housing (CRH12)

Public Buildings: Historic School (CRP1)

Commercial Building: Caravanserai (DRP1)

Figure 53: Original Function Examples from the case study
(Source: S. Burçak Çıkıkçı Archive, 2023)

4.6.2.4 The Current Function

The current functions of immovable cultural assets are examined as housing, public building, commercial, fortification walls and non-used. The majority usage of immovable cultural assets was changed from housing to commercial buildings. 30 historical buildings are used for commercial buildings like shops, restaurants, bars etc. 13 of them are used for public usage, like schools, art galleries, NGO buildings, mosques, libraries government offices, etc. 10 of the immovable cultural assets are non-used (Figure 54).

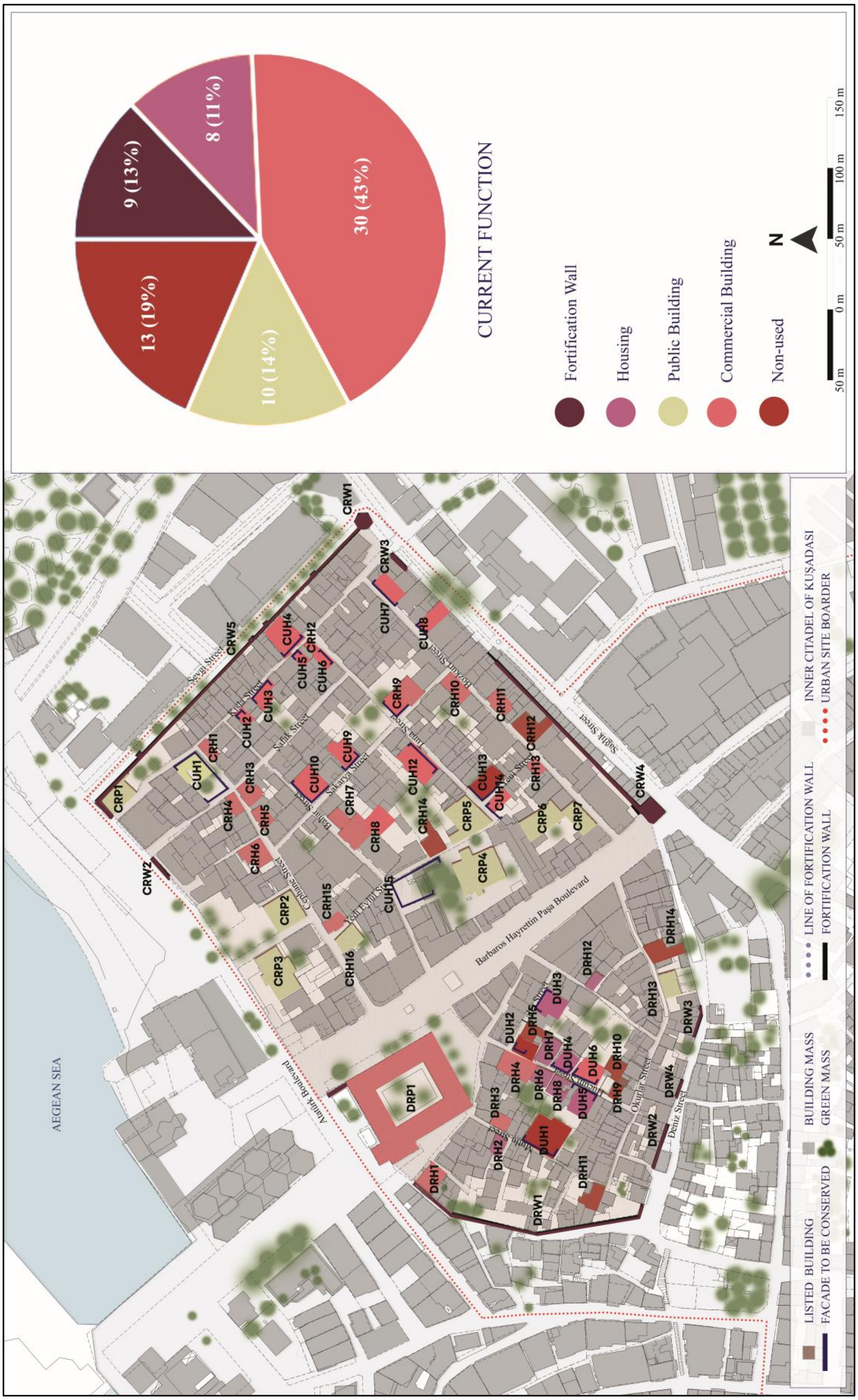


Figure 54: Current Function

4.6.2.5 The Protection Act

The Urban Site of Kuşadası including the Citadel Area was listed in 1978 with the Immovable Old Antiquities and Monuments Supreme Council (Conservation Council, 1978) The first Conservation Aimed Development was approved in 1994 by İzmir Numbered II Conservation Council of Cultural and Natural Assets (Conservation Council, 1994). 48 (67.6%) of them made by the 1994 Conservation Aimed Development Plan were listed. 23 (32.4%) buildings were recommended for façade to be conserved (Figure 55).

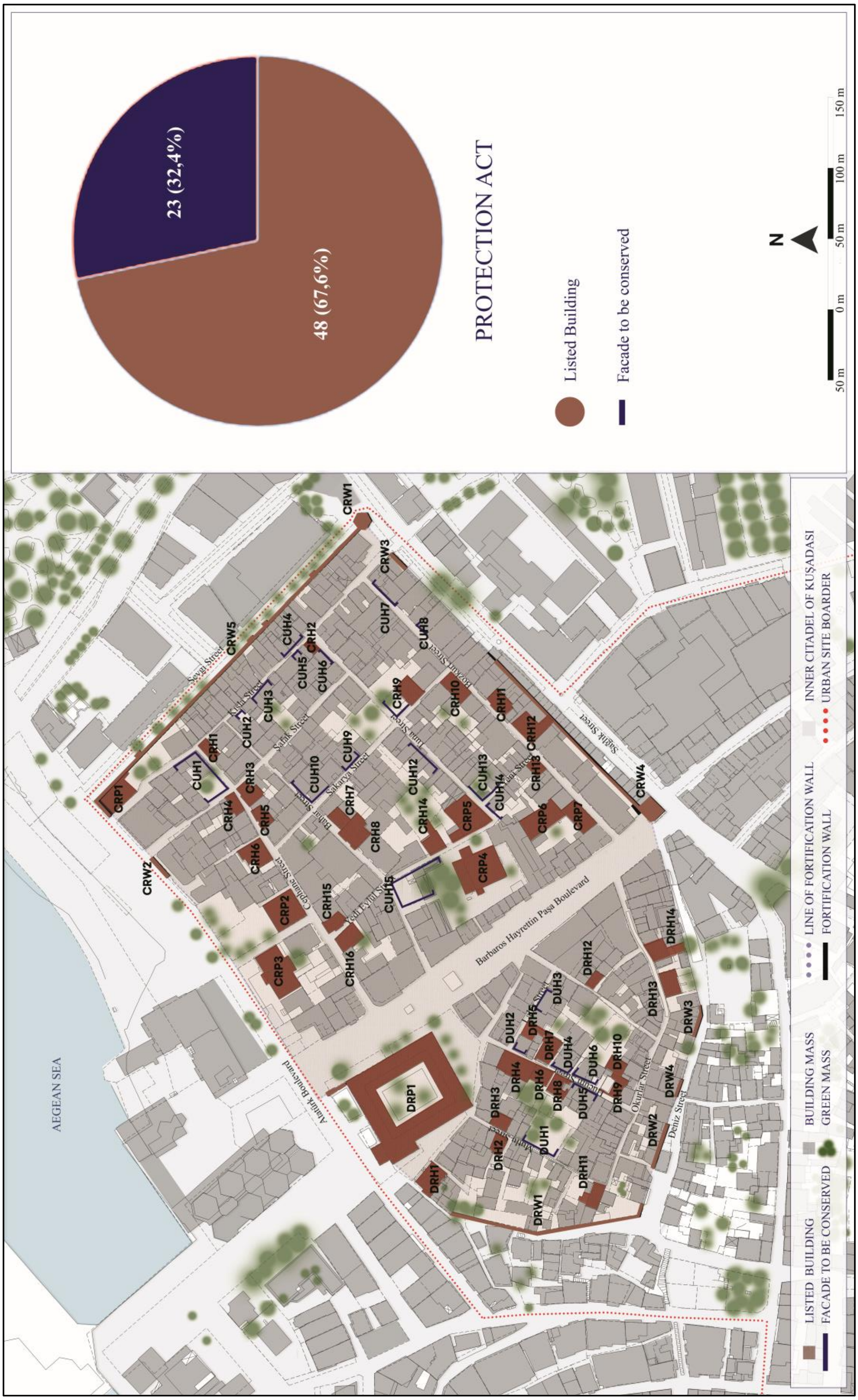


Figure 55: Protection Act

4.6.2.6 Construction Technique

In the Kuşadası citadel, the immovable cultural assets were built using various construction techniques. These are Kuşadası Citadel masonry (stone, brick and alternate), masonry and wooden frame, masonry and steel frame and reinforced concrete are the main construction techniques of the immovable cultural properties. 40 of the immovable cultural properties were built in masonry with wooden frames. The caravanserai, the fortress walls and their units, the hammam and some residential units were built in masonry. Five buildings were constructed in reinforced concrete. The historic school was reconstructed with masonry and steel frames (Figure 56-57).

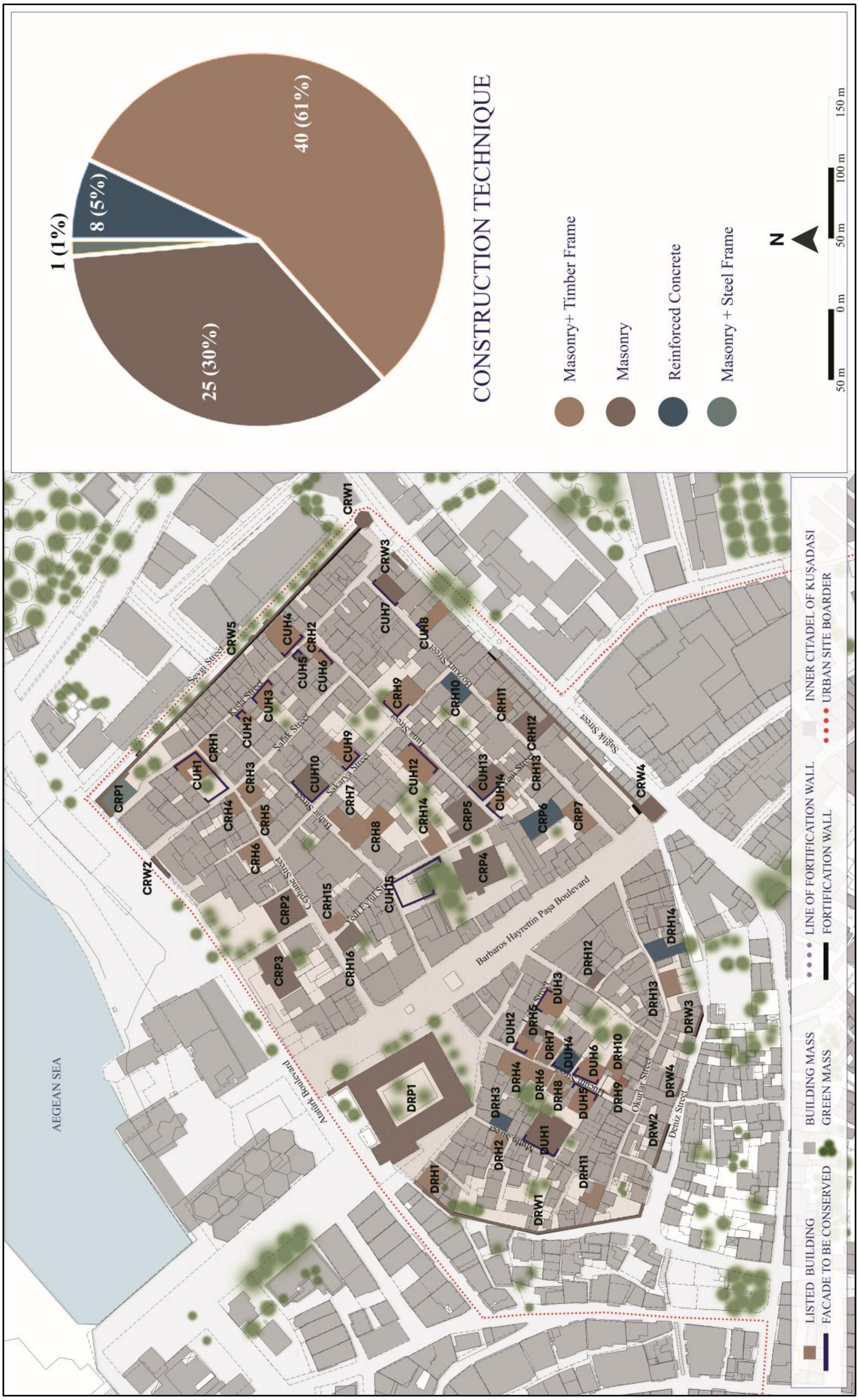


Figure 56: Construction Technique

Masonry + Timber Frame: Housing (CUH1)

Masonry: Fortification Wall (DRW1)

Reinforced Concrete: Housing (CRH10)

Masonry + Steel Frame: Historic School (CRP1)

Figure 57: Construction Technique Examples from the case study
(Source: S. Burçak Çıkıkçı Archive, 2023)

4.6.2.7 The Condition Class and Risk Classification Maps

Risk classification and condition class analysis are some of the basic tools for risk assessment. Various risk classification methods or tools have been used for risk assessment. In this study, a report approved by the European Committee for Standardization was used (CEN 2012). This report is UNI EN 16096:2012(E): Conservation of cultural property - Condition survey and report of built cultural heritage. Four condition classes are described in this report. The condition class descriptions have been defined as symptomatic, minor, moderately severe, severe, and no symptoms. In addition, the risk classification maps are prepared according to these condition classes. In these analyses, each building and its components were evaluated according to these condition classes, and an urgency risk classification map was created. The foundation, vertical structure, horizontal structure, roof and roofing were evaluated as structural components of the building and condition class maps were created.

a) Condition class 1 (CC1): Condition class 1 is defined as minor symptoms. For instance; Paint is worn, moss on roof tiles and a few broken roof tiles;

b) Condition class 2 (CC2): Condition class 2 is defined as Moderately strong symptoms. For instance; Localized damage caused by minor wet rot infestation in panel boards requiring improvement and partial replacement;

c) Condition class 3 (CC3): Condition class 3 is defined as major symptoms. For instance, a leaking roof with consequent damage and major damage caused by fungal or rot infestation.

d) Condition class 0 (CC0): Condition class 0 is defined as no symptoms.

4.6.2.7.1 Building Component and Its Condition: Foundation

The foundation is a structural component of the building. Therefore, its condition is important for the stability of the building. The evaluation of the foundation's condition class was based on its proximity to the sea, the level of the building and existing moisture problems. For the immovable cultural properties that are located near the sea and have low levels, the foundation condition class was rated as low.

In the case study area, the foundations of 33 (46%) historic buildings are in condition class 0. Three (4%) historic buildings are in condition class 3 There are 3. DRP1, CRW3, and CRW5 are the lowest condition classes in the case study area. Therefore, they have a moisture problem (Figure 58-59).

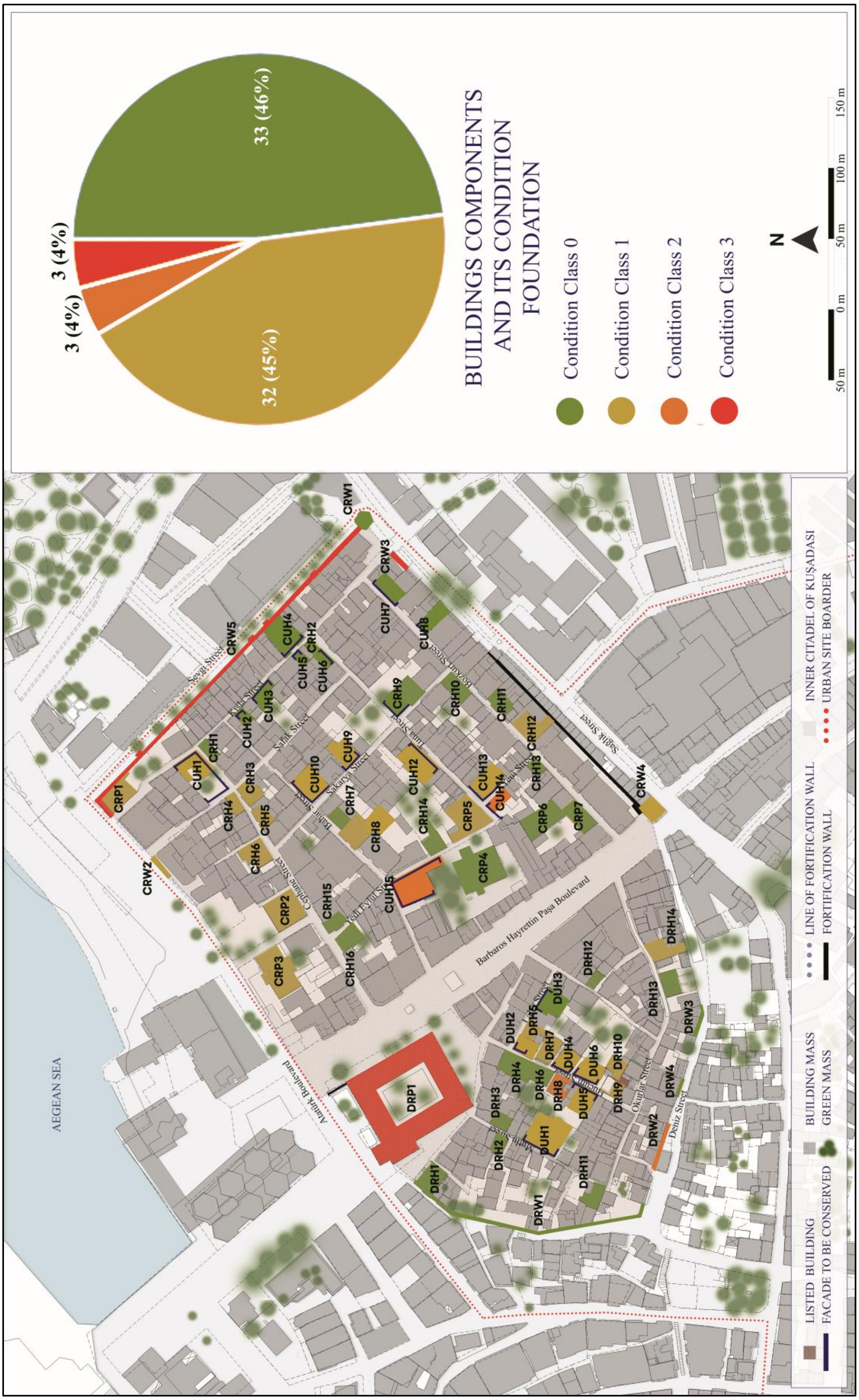


Figure 58: Building Component and Its Condition: Foundation

Condition Class 3: Caravanserai (DRP1)

Condition Class 2: Fortification Wall (CRW5)

Condition Class 1: Housing (CUH13)

Condition Class 0: Housing (DRH2)

Figure 59: Building Component and Its Condition: Foundation Examples from the case study. (Source: S. Burçak Çıkıkçı Archive, 2023)

4.6.2.7.2 Building Component and Its Condition: Vertical Structure

The vertical structure is a structural component of the building. Therefore, its condition is important for the stability of the building. The vertical structure is load-bearing walls and columns. The condition assessment of the vertical structure was based on material loss and integrity of the building, as well as plumb and moisture problems.

In the case study area, the condition of the vertical structure of 39 (55%) historic buildings is in condition class 0. Six (8%) historic buildings are in condition class 3. DRW1, DUH1, CRH8, CRH14, and CRW5 are the lowest condition classes in the case study area. DRW1, CRW5, DUH1, and CRH14 have a loss of material and integrity of the building. CRH8 has issues with plumb and loss of material at the bearing wall (Figure 60-61).

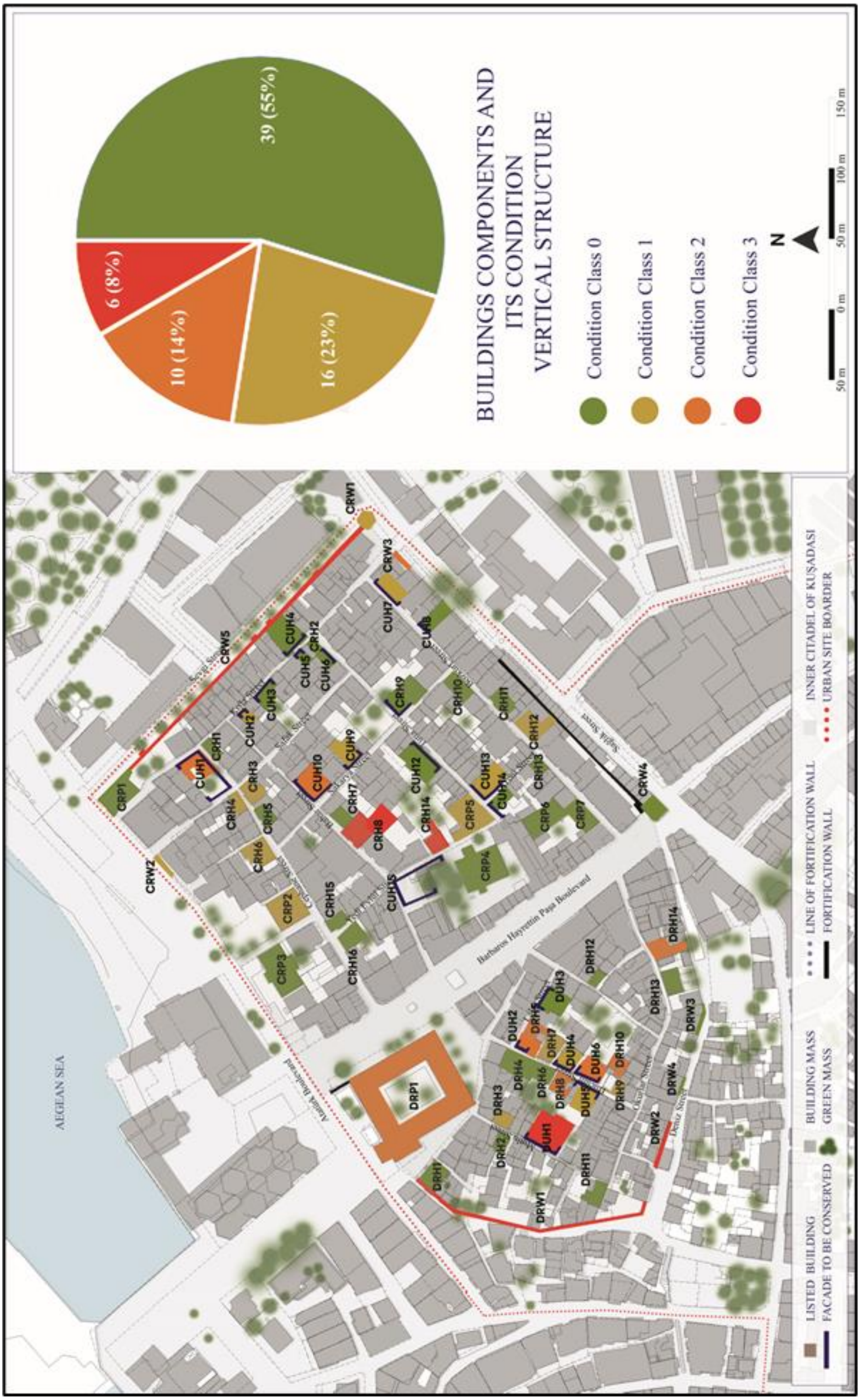


Figure 60: Building Component and Its Condition: Vertical Structure

Condition Class 3: Fortification Wall (DRW2)

Condition Class 2: Housing (DRH14)

Condition Class 1: Housing (CUH2)

Condition Class 0: Housing (CRH9)

Figure 61: Building Component and Its Condition: Vertical Structure Examples from the case study (Source: S. Burçak Çıkıkçı Archive, 2023)

4.6.2.7.3. Building Component and Its Condition: Roof and Roof Covering

The roof and roof covering are structural components of the building. Therefore, its condition is important to the preservation of the building. The condition class evaluation for the vertical structure was made according to the loss of material and integrity of the roof.

In the case study, the roof and roof coverings condition of 34 (47%) historic buildings are in condition class 0. 13 (8%) historic buildings are in condition class 3. DRW1, DRH5, DUH6, DRH10, DRH14, CRH12, CUH10, CRH14, CRW1 and CRW5 are the lowest condition classes in the case study area. DRW1 and CRW5 do have not any capping material on the wall. The roofs of DUH1, DRH14, CRW1, CUH10 and CRH14 had collapsed, so they do not have any roof covering. DUH6, DRH10 and CRH12 have a loss of material on the roof and partially collapsed (Figure 62-63).

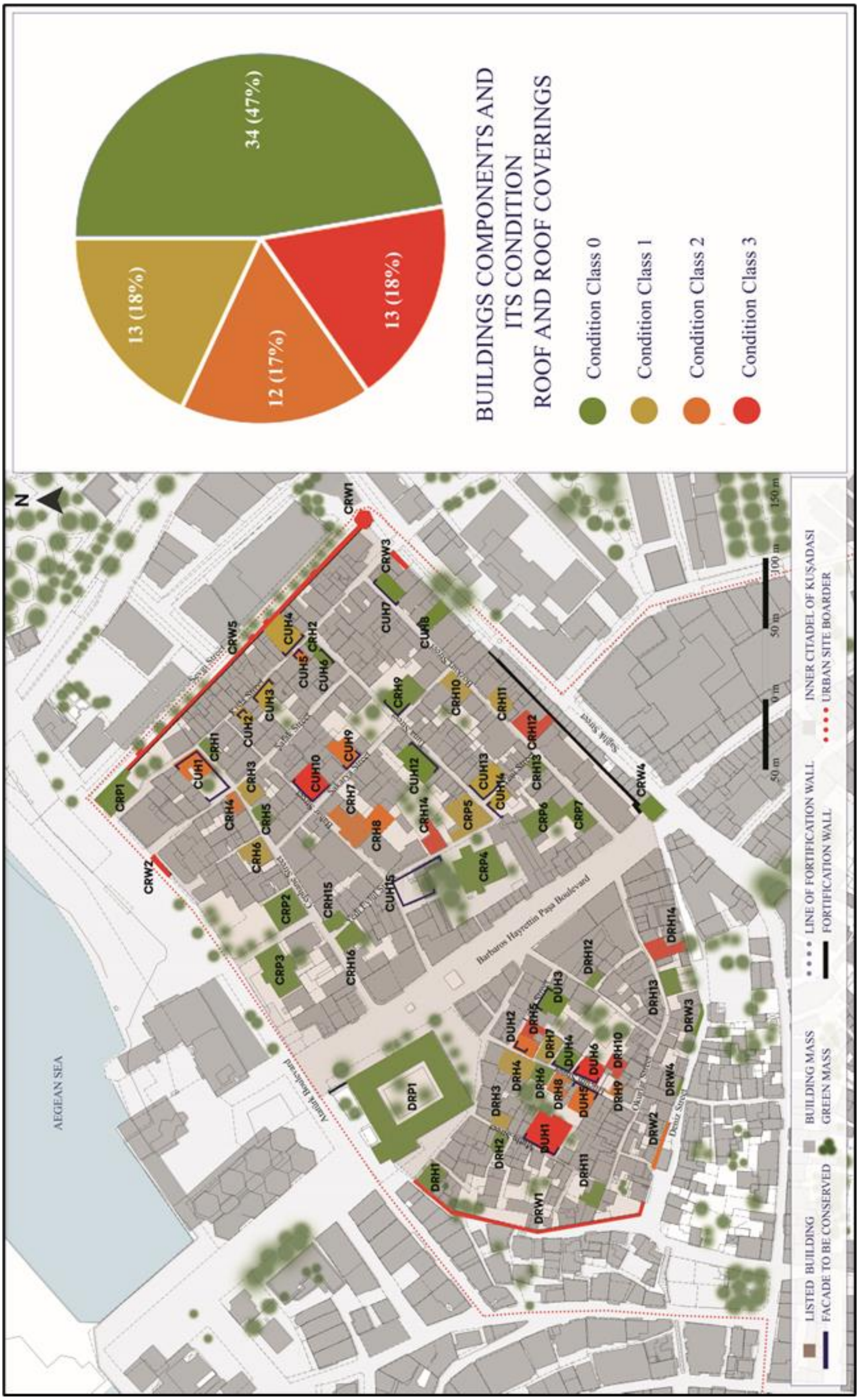


Figure 62: Building Component and Its Condition: Roof and Roof Covering

Condition Class 3: Housing (DRH5)

Condition Class 2: Housing (CRH4)

Condition Class 1: Housing (CUH14)

Condition Class 0: Housing (DRH1)

Figure 63: Building Component and Its Condition: Roof and Roof Coverings Examples from the case study. (Source: S. Burçak Çıkıkçı Archive, 2023)

4.6.2.7.4. Building Component and Its Condition: Envelope (Solid Area, Wall)

The envelope is an ancillary component of the building. The envelope involved walls. The condition class evaluation for the envelope was made according to loss of material and integrity of the building, out-of-the-plumb and moisture problems.

In the case study, the envelope condition of 31 (44%) historic buildings is in condition class 0. 3 (4%) historic buildings are in condition class 3. DUH1, DUH2 and CRH14 are the lowest condition classes in the case study area. DUH1 and CRH14 have a loss of material and integrity of the building. DUH2 has out-of-the-plumb on the solid area (Figure 64-65).

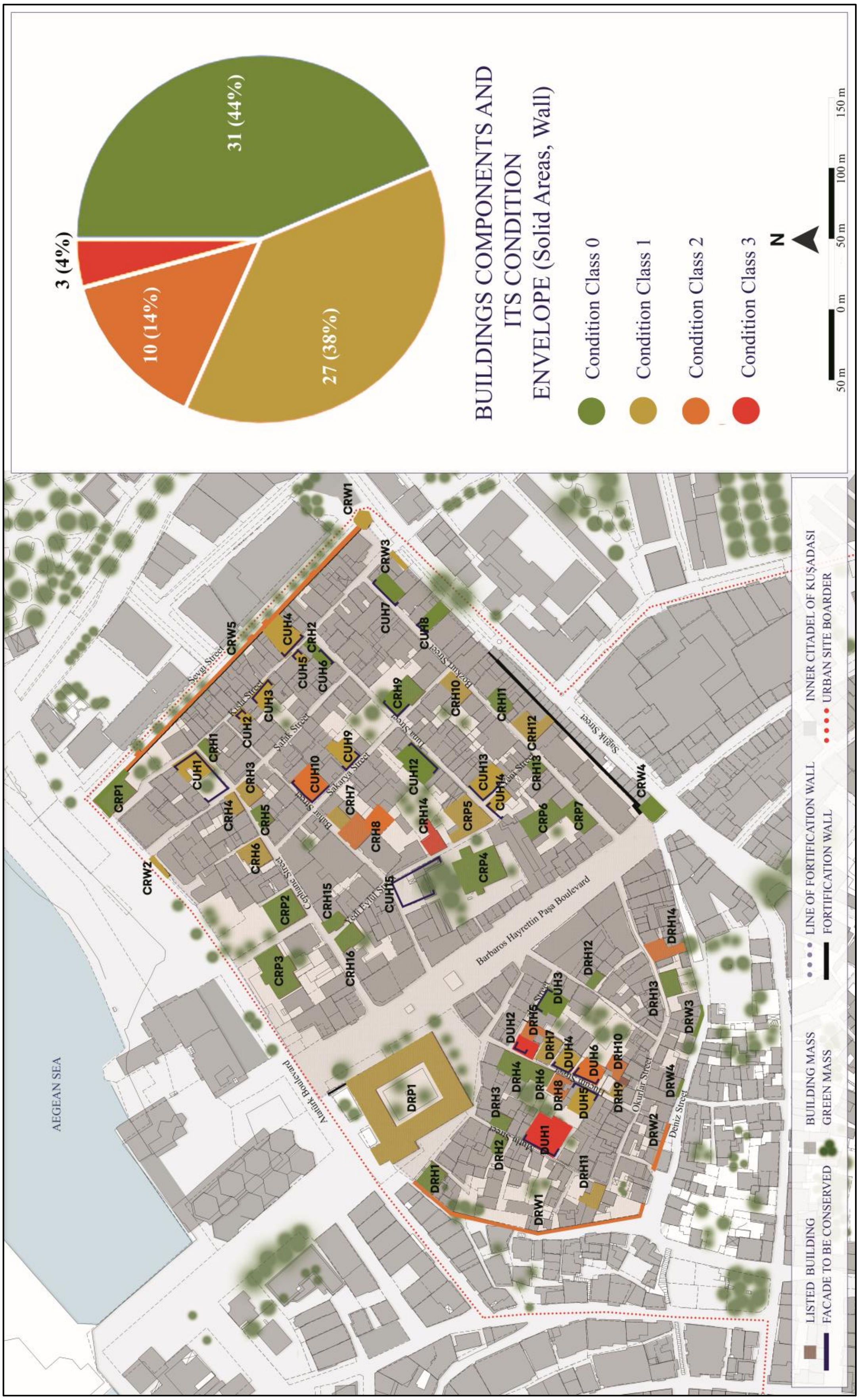


Figure 64: Building Component and Its Condition: Envelope (Solid Area, Wall)

Condition Class 3: Housing (DUH2)

Condition Class 2: Housing (CUH10)

Condition Class 1: Housing (CUH14)

Condition Class 0: Housing (CRH5)

Figure 65: Building Component and Its Condition: Envelope Examples from the case study. (Source: S. Burçak Çıkıkçı Archive, 2023)

4.6.2.7.5 Urgency Risk Classification

The risk assessment was formed by urgency risk qualification. Besides, the risks identified by the risk analysis were categorized according to their grade of urgency. The categories were expressed as long-term, intermediate-term, short-term urgent and immediate. According to risk assessments, nine immovable cultural assets have the urgent and immediate urgency categories. Loss of integrity of a building and structural problems are the main risks to the general condition of the building.

In the case study, the urgency risk classification of 28 (39%) historic buildings are in condition class 0. 9 (13%) historic buildings are in condition class 3. DUH1, DUH2, DRH5, DRH10, CRH8, CRH12, CRH1, DRW2, CRW1 and CRW5 have urgent and immediate urgency.

DUH1, DRH5, DRH5 and CRH14 have urgent and immediate urgency because of the loss of integrity of the building. DUH2, DRH10, CRH8, CRH12, CRW1 and CRW5 have structural problem (Figure 66-67).

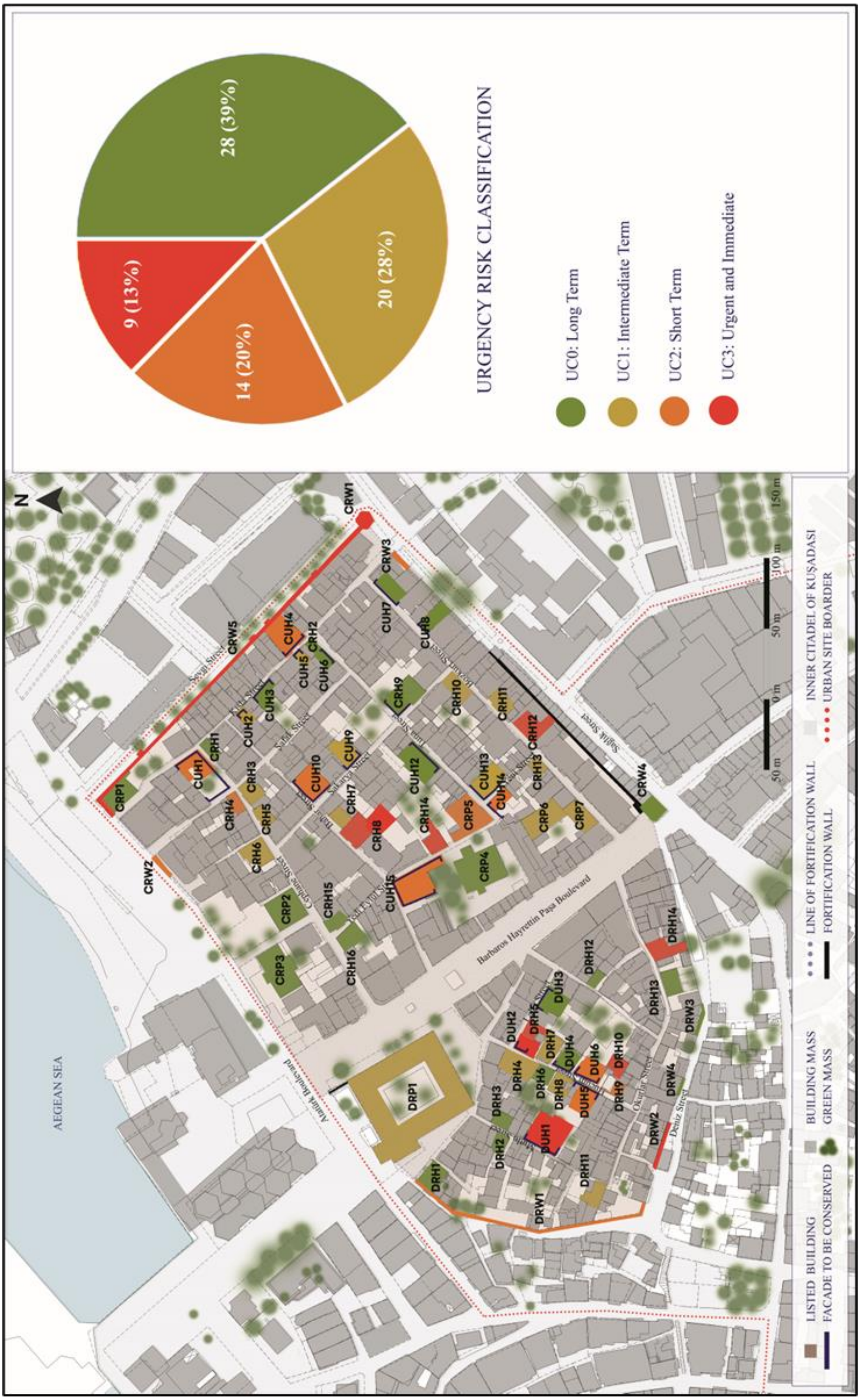
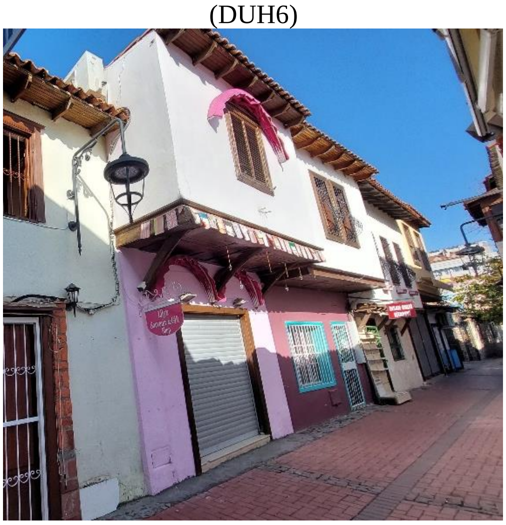


Figure 66: Urgency Risk Classification

Urgency Risk Classification 3: Housing (DUH1)

Urgency Risk Classification 2: Housing (DUH6)

Urgency Risk Classification 1: Housing (DRH11)



Urgency Risk Classification 0: Housing (CUH12)

Figure 67: Urgency Risk Classification Examples from the case study
(Source: S. Burçak Çıkıkçı Archive, 2023)

4.6.2.8 The Climate Change Risk Classification

Another risk classification in the study is the classification created for climate change impacts. This classification includes four priority climate change impacts. Floods, heat island effect, storm surges and sea level rise are the priority impacts that are likely to affect the citadel. In this context, the quadruple classification system was applied for each of the four risks as described in Chapter 3 and the climate change risk classification was developed by averaging them. In the climate change risk classification, the quadratic rating system was used, and risk classes were defined accordingly.

a) <u>Climate Change Risk Class 0 (CCRC0):</u> This risk class represents the lowest risk class when the specified criteria are evaluated. The four studied risks define the structures that will be least affected. These are structures that are higher than sea level and protected against wind and environmental loads.

b) Climate Change Risk Class 1 (CCRC1): This risk class represents the low-risk class when the specified criteria are evaluated. It defines the risk class of structures that are farthest from the sea and have an altitude of 2 -3 meters. The buildings that will be least affected by the four studied risks. These are buildings that are far from the seashore and likely to be affected by environmental loads.

c) Climate Change Risk Class 2 (CCRC2): This risk class represents the medium risk class when the specified criteria are evaluated due to its location and altitude. Moderately affected by the four studied risks. These are buildings that are close to the seashore and at sea level and are most likely to be affected by environmental loads.

d) Climate Change Risk Class 3 (CCRC3): This risk class represents the highest risk class when the specified criteria are evaluated. The buildings are most likely to be affected by the four studied risks. These are buildings that are close to the seashore or river and at sea level. These are the buildings that will be affected by environmental loads.

In the case study, 21(30%) of the historic buildings in the Kuşadası Citadel belong to climate change risk class 0 in terms of reasons such as the buildings' level and the wind direction. 4(6%) historic buildings are in climate change risk class 3. CRW2, CRW5, CRH8 and CRH14 are the riskiest buildings in the Kuşadası Citadel. 20 (29%) of the buildings in the area belong to climate change risk class 2. Of these, DRP1, DRH1, CUH1, CUH1, CRP1, CRP2, CRP, CRH1, CRH3, CRH4, CRH5 CRH6, CRH15 and CRH16 have a high probability of being affected by sea level rise, storm surges, and floods due to their proximity to the seashore, therefore they are in climate change risk class 2 (Figure 68).

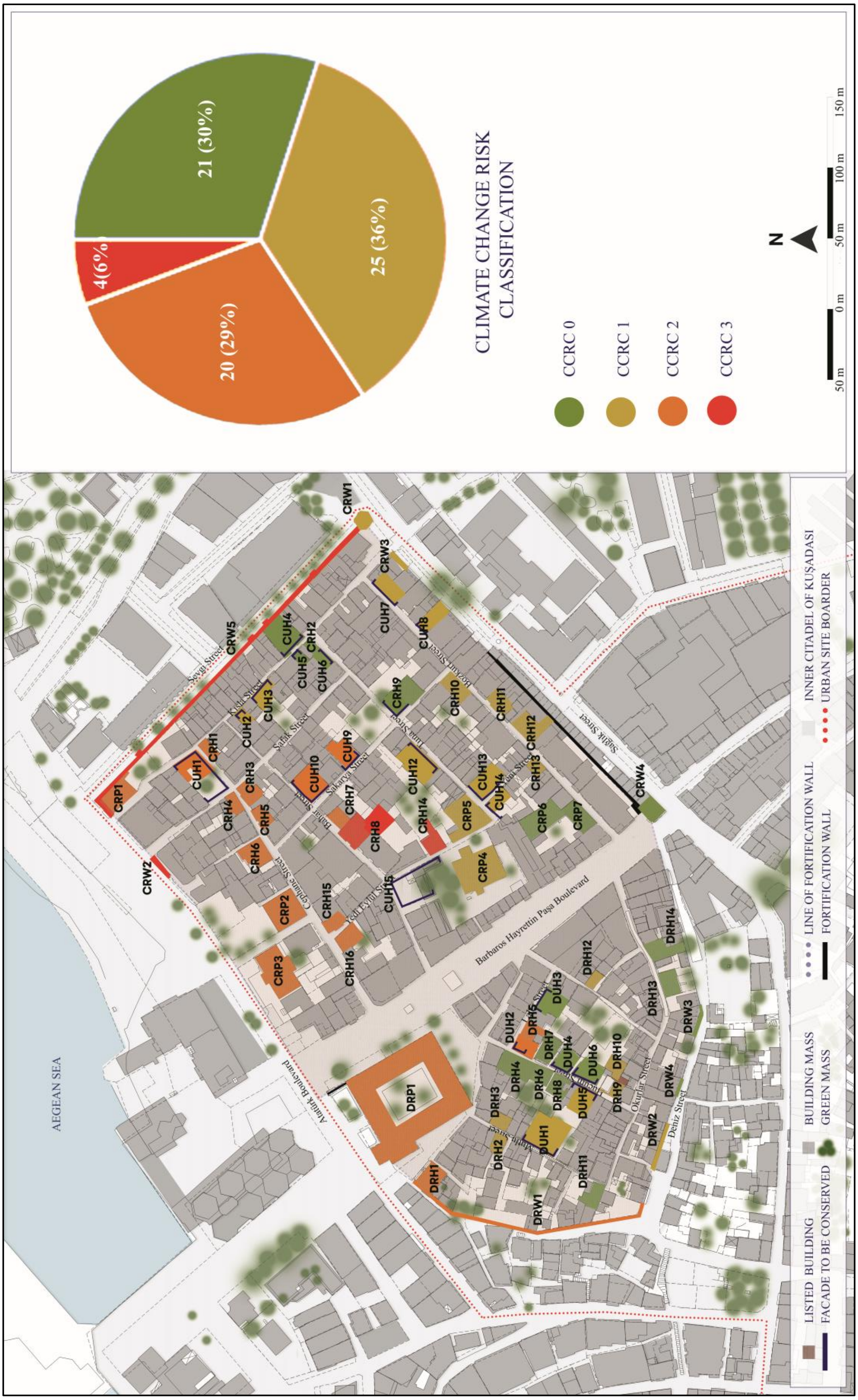


Figure 68: Climate Change Risk Classification

4.6.2.9 Vulnerability Classification

Another risk classification in the study is the classification formed for the vulnerability of the buildings. In this classification, the other classifications were evaluated. The climate change risks class, heritage values class, and urgency risk classification of the historic buildings were evaluated, and their vulnerability class was determined. The historic buildings with high climate change risks and urgency risk classifications and those with high heritage value were considered more vulnerable. A study of this was conducted in Chapter 3. As in other classifications, the vulnerability classification was based on a quadratic rating system and the vulnerability rating was determined by averaging these ratings.

a) Vulnerability Class 0 (VC0): The class represents buildings belonging to the lowest vulnerability class. Represents the vulnerability class of buildings with a good state of conservation, low climate change risk class and low heritage value.

b) Vulnerability Class 1 (VC1): The class represents the low vulnerability class. Represents structures with a good state of conservation, and heritage value but moderate climate change risk.

c) Vulnerability Class 2 (VC2): The class represents the medium vulnerability class. Represents structures in a good state of conservation and at high risk of climate change and with high heritage value.

d) Vulnerability Class 3 (VC3): The class represents a high degree of vulnerability. Represents buildings with a poor state of conservation and high degree of climate change risk and high heritage value.

In the case study, 38 (53%) of the historic buildings in the Kuşadası Citadel have a vulnerability class 1. The historic buildings with heritage value class 2 but likely to be affected by climate change or structures with low heritage value but with low heritage value and low risk of climate change are included in this group. 24 (33%) of the buildings have moderate vulnerability. 6 (8%) of the buildings belong to the low vulnerability class. These are buildings with low conservation status low risk of climate change and low heritage value. The four historic buildings have vulnerability class 3. These are CRW2, CRW5, CRH8 and CRH14. They have an urgency risk class 3 and climate change risk class 3 but also have heritage class 3 (Figure 69).

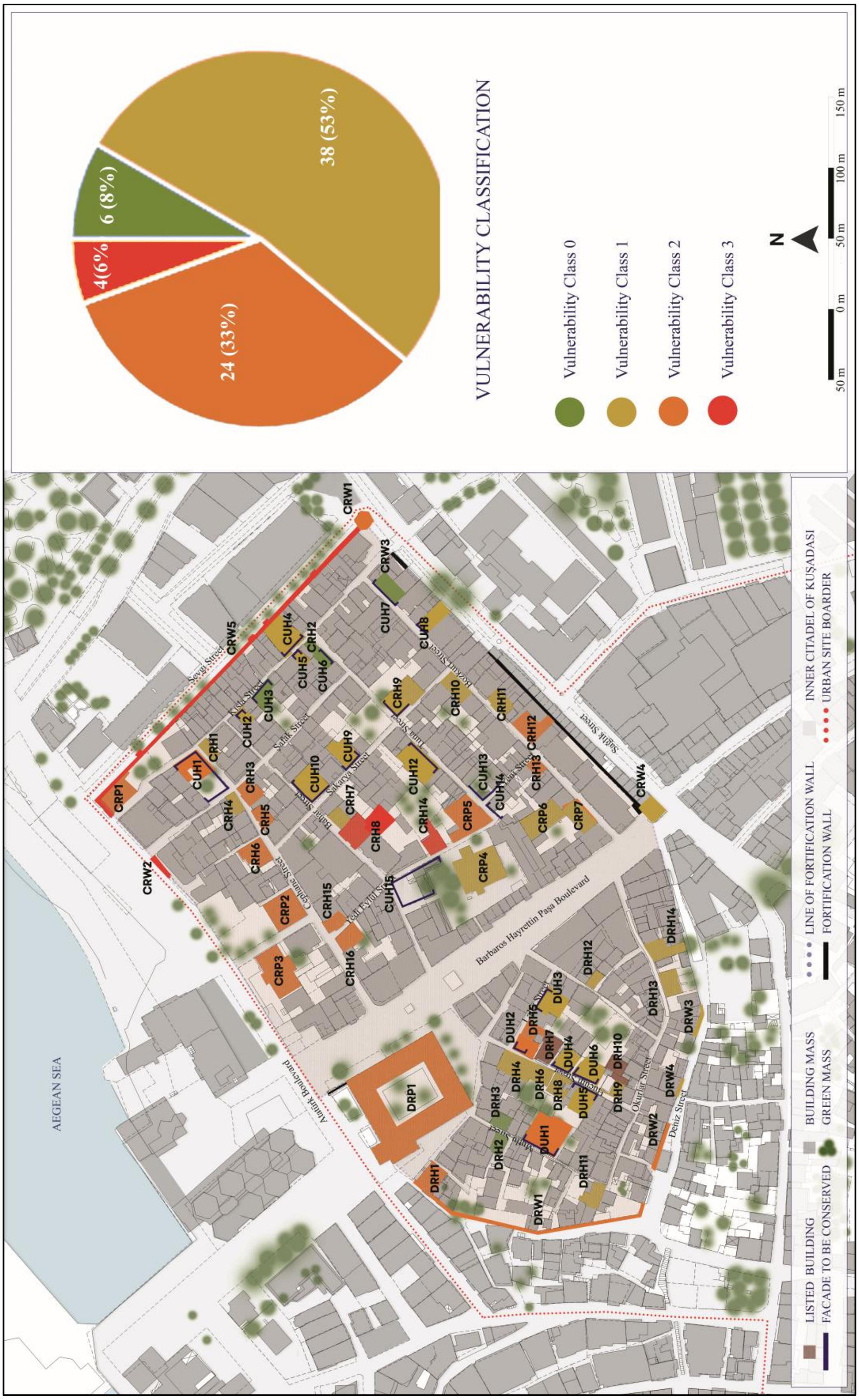


Figure 69: Climate Change Risk Classification

CHAPTER 5

CONSERVATION STRATEGIES

Developing strategies to preserve cultural heritage in the face of the unexpected impacts of climate change and to ensure that cultural heritage values are passed on to future generations is critical. This chapter presents a holistic conservation approach and climate change mitigation measures for the Kuşadası Citadel. It includes improving resilience and adaptability to climate change impacts and preparing for loss and damage.

5.1 Assessment of the Conservation of Kuşadası Citadel

- Conservation strategies are critical to adapting to the effects of climate change, which is one of the greatest threats to cultural heritage sites. The Kuşadası Citadel, located in a historic coastal settlement, is likely to be affected by these impacts. Previous and current studies on the Kuşadası Citadel that do not address its preservation are summarized below:
- Conservation and restoration work: Despite various conservation and restoration works carried out in Kuşadası Citadel since the 1960s, a comprehensive and integrative approach to the conservation and restoration of the area, taking into account its changing structure, function, infrastructure requirements, historical background and greenery, has not been realized.
- Inventory studies: Given the threats of climate change, mass tourism and urbanization, a comprehensive urban and structural inventory for the area is essential and a priority. Urgent inventory documentation of all heritage sites is critical, as an incomplete inventory poses a threat to the area.
- Climate Projection: Efforts have been made to develop climate projections for Aydın Province, but specific studies on climate change in the case study area are lacking. This lack of research further increases the area's vulnerability to the escalating impacts of climate change.
- Risk Assessment: The risk classification process identified nine immovable cultural properties in the area as posing an immediate risk, while fourteen others pose a

short-term risk. Conservation and restoration efforts for these historic buildings, including registered cultural properties, require urgent attention.

- Green Spaces and Urban Heat Island Effect: Evaluation of the green space-to-built-up area ratios in consideration of climate change effects has revealed a scarcity of greenery in Kuşadası Citadel.
- Infrastructure and Stormwater Management: The current infrastructure and stormwater collection and drainage tools in the Kuşadası Citadel are insufficient to handle potential flooding, especially in low-lying areas such as the Caravanserai and other immovable cultural assets.
- Sea Level Rise and Other Effects: The northern boundary of the Kuşadası Citadel measures 56 meters in proximity to the sea and 131 meters at its farthest point. The section most likely to be affected by flooding due to sea level rise is the northern part, including CRP1 and its immediate surroundings. Structures in the closest proximity in the northeast-southwest direction are susceptible to ground-related elevations and potential salinization.
- Wind Effect: Considering the prevailing wind direction, such as the southeast (SE) direction and the similar climate characteristics in the surrounding areas, structures, especially roofs and roofing materials, may be damaged by strong winds.

These assessments emphasize the need for developing conservation strategies to address the climate change effects on Kuşadası Citadel, which is a vulnerable cultural heritage site due to its location and historical coastal settlement characteristics.

5.2 Conservation Strategies Against Climate Change Effects

The evaluations carried out were conducted within the framework of the Guide on Climate Change and Cultural Heritage prepared by ICOMOS, which presents a systemic relationship between cultural heritage and climate change. In line with this, two relevant headings were identified, as well as three headings dealing with cultural heritage inventory, which is one of the most important tools for conservation.

- The first and urgent sub-strategy is the establishment of the Cultural Heritage Inventory for the Kuşadası Citadel, which encompasses the Kuşadası Citadel district. This work is a necessary documentation process to address the potential impacts of all pressures on the area. Creating an inventory form in line with climate change

- The second priority is to develop adaptation strategies to ensure the continuity of cultural heritage sites in the face of changing climate conditions and their effects, aiming to sustain it and pass it on to future generations.
- The final heading is focused on making the area more resilient against increasing and sudden events, by identifying losses and damages and developing strategies to minimize them.

5.2.1 Heritage Inventory

Heritage inventory, which is one of the most basic tools in the management and conservation of cultural heritage, is important in terms of documentation and monitoring in the process of conserving cultural heritage against climate change. The Registration Sheets (1976-2023), the Conservation Development Plan (1994) and the Kuşadası Inventory (2010) were the documentation studies carried out in the Kuşadası Citadel. However, to conserve and risk track this historical coastal settlement more effectively from the effects of climate change, the following inventory strategy is recommended:

5.2.2 Documentation and Digitization

- Revision and updating of inventory for 48 listed historic buildings.
- Preparing inventories for 23 buildings with 'facade to be conserved' recommendations.
- Digitization of existing documentation and archive data and recordings them in this heritage inventory.
- Documentation of the Kuşadası Citadel with 3-dimensional modelling.
- Preparation of heritage inventories including building identification, conservation status, material information, building components and their conditions.
- Assessment of the risk classification and evaluation, an indication of climate vulnerability and adaptation capacity within the scope of climate strategies.
- Managing an inclusive, participatory and transparent inventory and cultural mapping processes for the Kuşadası Citadel.
- For adaptation strategies, create a digital base for existing infrastructure systems (sewage system, electric, drainage of rainwater, etc.)

5.2.3 Adaptation

The Kuşadası Citadel is expected to be impacted by climate change, necessitating the development of adaptation strategies. These strategies have been specifically tailored for the Kuşadası Citadel, taking into account the data and values associated with the area as derived from the examination of heritage inventories. A governance approach that incorporates participation will serve as a guiding framework for the adaptation of the Kuşadası Citadel. Recommendations stemming from this context include:

5.2.3.1 Governance

- Conducting analyses on the social, cultural, and heritage values of the Kuşadası Citadel, in collaboration with local people and stakeholders, to develop protective methodologies.
- Organizing capacity-building activities for communities, practitioners, and local governments to enhance their ability to address climate change and its impacts, thereby supporting climate action.
- Establishing a coordinated team comprising local government, community representatives, and practitioners to devise conservation strategies that effectively counter climate change and its effects on the Kuşadası Citadel and its surroundings.
- Empower local governments and practitioners to formulate policies addressing the climate change impacts on cultural heritage.

5.2.3.2 Monitoring

- Implementing an active data collection system to facilitate an efficient adaptation process, with a focus on developing tracking and monitoring mechanisms integrated with geographical information systems.
- Establishing a dedicated 'Cultural Heritage and Climate Change Monitoring Unit' to ensure seamless data flow with existing meteorological stations. This unit should prioritize tasks related to the management, security, conservation, and presentation of acquired data.

- Developing geo-referenced methodologies for predicting, researching, and projecting climate change risks, and generating comprehensive reports that evaluate risks and vulnerabilities utilizing these developed methods.

5.2.3.3 Site Level

- Consequently, it is imperative that the existing infrastructure systems possess the capacity to effectively handle potential rainfall intensities and implement appropriate stormwater management strategies.
- Preservation measures should be implemented to protect these historical buildings from deterioration and damage.
- To mitigate the urban heat island effect, it is essential to augment the presence of green spaces and vegetation cover, aligning with the authentic character of the area.
- To develop and upgrade drainage systems to collect increased rainfall and stormwater. Extending the capacity of pipes and rainfall water collection, to minimize flood risks to historical settlements.
- Develop strategies that integrate climate change considerations into the preservation and management of green areas. This may involve adjusting land-use practices, protecting, or restoring natural features, and promoting sustainable tourism practices.

5.2.3.4 Building Level

- Implementation of barriers on the ground floors of DRP1, CRP1, CRP2, CRP3, CUH1, CRH1, CRH3, CRH4, CRH5, CRH6, CRH15, and CRH16 the historic buildings located near the sea to prevent water ingress during potential coastal flooding events.
- Strengthening of roofs in DRH5, DUH6, DRH10, DRH14, CRH12, CUH10, and CRH14 structures to mitigate the impacts of storms and extreme rainfall.
- Construction of protective roofs for DRW1, CRW1, CRW2, CRW3, and CRW5, which are city walls, to prevent material losses resulting from storms and rain.
- The roofs of DUH1, DRH14, CUH10 and CRH14 had totally collapsed. Protection for historic buildings, and construction of temporary protective roof coverings.

- DUH1, DUH2, DRH5, DRH10, CRH8, CRH12, CRH1, DRW2, CRW1 and CRW5 have urgent and immediate urgency.
- Overall recommendation grading for the Kuşadası Citadel, 23 (37.5%) of the immovable cultural assets were determined as maintenance-free. 19 (28.4%) of them were identified as needing maintenance and preventive protection studies. 14 (20.4%) of them were defined as Moderate repair and/or further investigation. 9 (13.4%) of them were determined to have major intervention based on diagnosis repair in accordance. These are DRW1, DRW2, CRW5, CRH8, CRH12, CRH14, DUH1, DRH5, DRH10 and DRH14 (Figure 70).

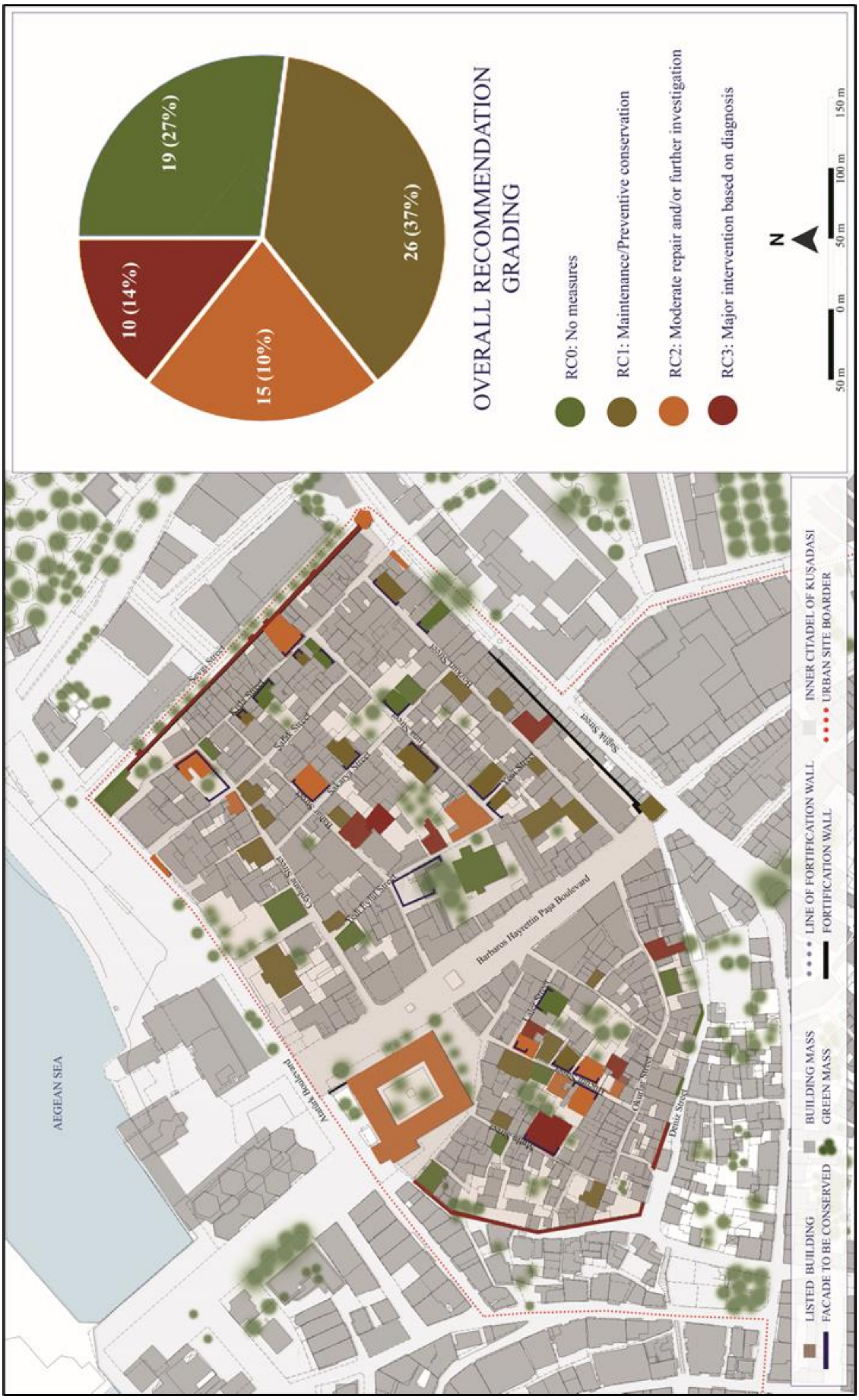


Figure 70: Overall Recommendation Grading

CHAPTER 6

CONCLUSION

As a historic coastal settlement, the Kuşadası Citadel is vulnerable and sensitive to the effects of climate change. The current conservation problems in the area, exacerbated by the influence of mass tourism, make it even more vulnerable to the effects of climate change, which could have a negative impact on the conservation of immovable cultural assets.

While the overall condition of listed immovable cultural properties and those designated as 'façade to be preserved' is generally good based on risk assessments, there are also properties that are classified in the category of urgent risk. When assessed in the context of climate change risks, there are immovable cultural properties that require immediate action.

A major deficiency of the Kuşadası Citadel is the lack of an up-to-date cultural heritage inventory. The lack of a cultural heritage inventory and the vulnerability of immovable cultural assets to climate change risks contribute to the increased vulnerability of the built heritage. Therefore, it was decided to prioritize the inventory of cultural heritage. In addition to the inventory, the implementation of the various conservation strategies developed to adapt to changing conditions is required.

The vulnerability of the area may lead to the loss of cultural heritage. Therefore, strategies and recommendations were developed in this study to prevent possible sudden loss and damage. The study serves as a guide for future work to address the impacts of climate change, focusing on building local social protection networks and raising awareness.

In conclusion, the study identifies the impacts of climate change on 71 immovable cultural assets. As a result of the condition assessment conducted for each immovable cultural asset, the risk qualifications of the buildings and their elements were identified and evaluated. Based on the evaluations, conservation recommendations were provided for immovable cultural assets and their elements that were in poor condition. In line with the evaluations, adaptation strategies of Kuşadası Citadel against the effects of climate change have been developed. Restoration of immovable cultural assets in poor risk condition was recommended. Comprehensive documentation studies to support the adaptation process have been proposed. The goal of this study is to guide future efforts in these conservation studies.

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