

**A CRITICAL INQUIRY INTO ECOLOGICALLY
RESPONSIVE ARCHITECTURE:
A CASE STUDY OF THE ISIMANGALISO WETLAND
PARK (KWAZULU-NATAL)**

Submitted in fulfilment of the requirements of the
degree Masters of the Built Environment (Architecture) at
the Durban University of Technology

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AUGUST 2025

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Declaration

I **Tasheel Subkaran**, declare that:

- (i) The research reported in this dissertation, except where otherwise indicated, is my original work.
- (ii) This dissertation has not been submitted for any degree or examination at any other university.
- (iii) This dissertation does not contain other persons' data, pictures, images or other information, unless specifically acknowledged as being sourced from other persons.
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Date: 12 March 2026

Dedication

I dedicate this dissertation to:

To all students, conservationists, designers, architects, and built environment professionals.

Acknowledgements

This study is a culmination of three years of hard work yet rewarding theoretical learning which commenced during the Global Covid-19 Pandemic. This study would not have been concluded without the guidance and motivation of some individuals close to me.

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Abstract

This dissertation explored the severe strain on South Africa's natural resource base, leading to ecosystem degradation. The expanding built environment poses a threat to the sustainability of the natural ecosystem, resulting in imbalances between the resource base and socio-economic development. In support of Sustainable Development Goal 11 (2023:1), *“Take an active interest in the governance and management of your city. Advocate for the kind of city you believe you need,”* preserving and conserving the environment was deemed crucial, prompting an urgent shift towards ecologised architecture¹.

The research aimed to critically examine ecologically responsive architecture in the sensitive environment of iSimangaliso Wetland Park, Kwa-Zulu Natal, South Africa, using a case study approach incorporating a qualitative analysis of primary data, secondary data and visual observation. The focus was on analysing theories, concepts, and principles related to the relationship between the built environment, natural environment and humanity, as well as ecological architecture, conservation, traditional buildings, and precedents crucial for successful conservation initiatives. The study sought to understand the factors leading to the "world heritage site" designation, emphasise the importance of conserving the natural ecosystem in iSimangaliso Wetland Park, analyse the implementation of sustainable pro- ecological development for a new green economy, and explore how traditional methods in the built environment can be combined with modern sustainable technologies for an alternative ecological response to built form.

The study found the historical significance of traditional shelters in the human-environment relationship, underscoring their vital role in achieving sustainability. The preservation of South African heritage sites, particularly iSimangaliso Wetland Park, was highlighted.

The research delved into the multifaceted concept of conservation within iSimangaliso Wetland Park, defining conservation as the wise management of natural resources. It aligned the park's vision with the concept of conservation, aiming for a renowned World Heritage Park with sustainable practices. Recognition as a UNESCO World Heritage site underscored its exceptional value, meeting three criteria and emphasising the need to

¹ Ecologised architecture refers to an architectural approach that integrates ecological principles into the design and construction of buildings, aiming to create structures that harmonize with natural systems and minimize environmental impact. uGreen.io. (2023)

preserve the environment in the context of the built environment.

The dissertation highlighted the significance of ecological architecture, addressing the gap in integrating traditional techniques with modern technologies. Yahya and Hassanpour (2022:3) proposed a Hybrid Model that combined these elements, specifically for iSimangaliso Wetland Park, to bridge this gap and enhance conservation efforts within heritage sites. Precedent studies showcased diverse approaches but revealed a lack of synergy, particularly in the park's existing architectural structures.

Focusing on the park's cultural richness, the research advocated extracting principles from indigenous communities like the Thonga and Zulu. The case study revealed a diverse architectural language, lacking consistency and cultural identity. The park's buildings suggested that traditional cultures could influence design principles, emphasising the use of locally sourced materials and encouraging sustainability.

The study identified the relevance of a shift towards a new green economy, proposing the implementation of a design approach in iSimangaliso Wetland Park based on the Hybrid Model by Yahya and Hassanpour (2022). This model combines traditional architecture with ecological principles to address gaps, raise awareness, and contribute to ecosystem conservation.

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Chapter 1 Introduction

1.1. Introduction to the study

“If conservation of natural resources goes wrong, nothing else will go right”.

M. S. Swaminathan

These words by Swaminathan as quoted by Singh (2019) briefly capture the challenges posed by the built environment, particularly the ongoing challenge to preserve and conserve natural resources. The increasing impact of today’s rapidly expanding built environment threatens the sustainability of the natural ecosystem.

The depletion of the natural ecosystem, including the destruction of green ecology and natural resources, has become an ongoing problem. This is largely caused by the impact of local industries, lifestyles, and buildings, making it crucial for humanity to shift towards ecologised architecture to conserve the natural ecology within the built environment.

The research critically examines ecologically responsive architecture for the iSimangaliso Wetland Park in South Africa's KwaZulu Natal (refer to Figure 1.1). The enquiry aims to explore and recognise the role of local communities in this world heritage site, which is essential for the success of conservation initiatives. It integrates and critically analyses the relationship between the built form, indigenous architecture, human well-being and ecological conservation.

The research begins by exploring the significance of the designation “World Heritage Site”. It then examines the context and ecosystem of iSimangaliso Wetland Park, Followed by an analysis of its contribution to economic infrastructure and indigenous architecture within the iSimangaliso Wetland Park region. This research also investigates the possibilities of moving towards a new human ecology, where the built form can co-exist with nature by preserving the ecosystems together with cultural landscapes. In the “significance of the study” section discussed below, the anticipated outcomes of the research are outlined. This chapter discusses how the study may contribute to raising awareness about the importance of preserving natural resources within the built environment, and concludes with the study’s broadly defined aims and objectives.

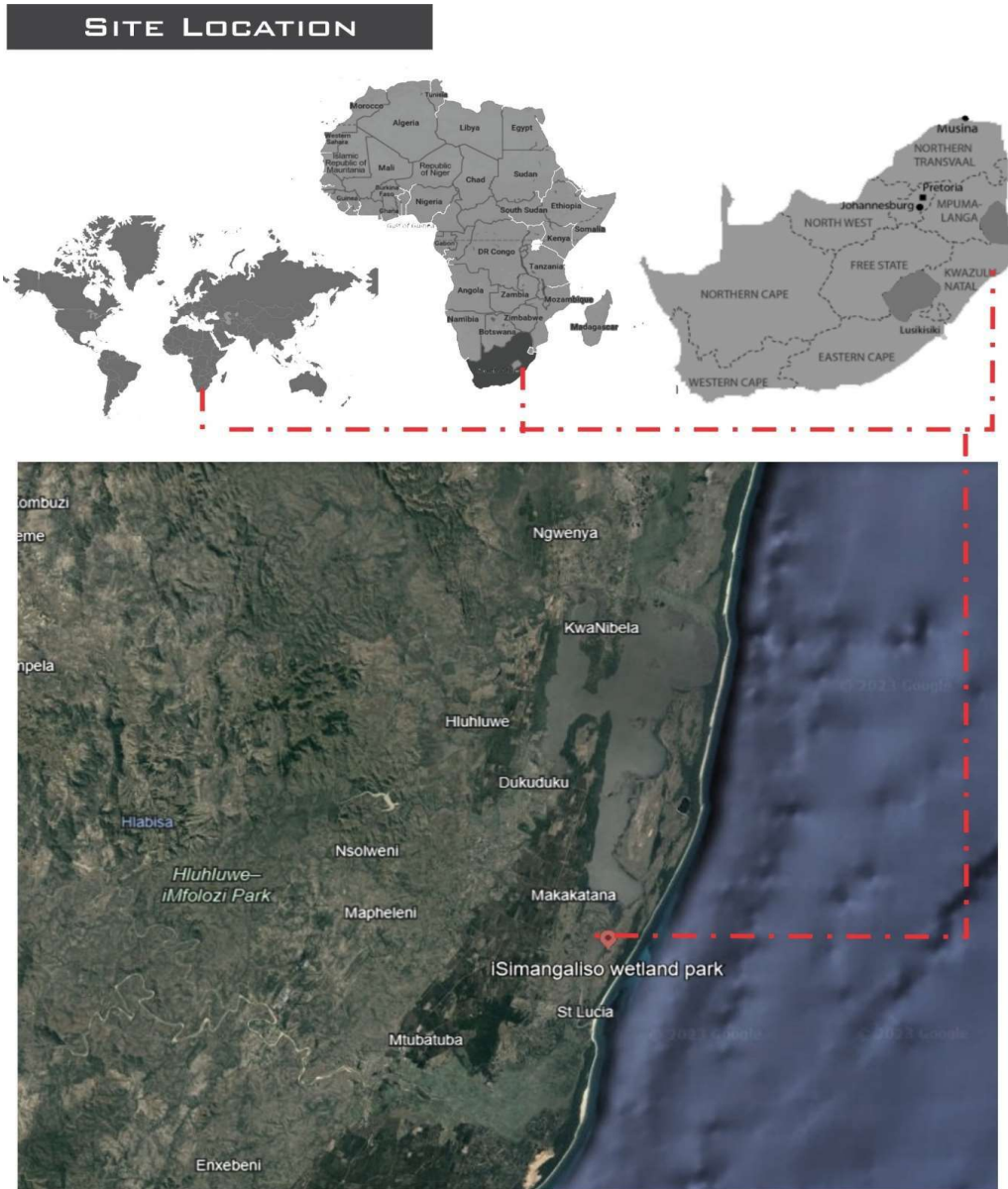


Figure 1.1: Locality Plan showing the location of iSimangaliso Wetland Park in relation to South Africa and Globally

Source: Google Earth (2023)

1.2. Detailed background to the problem

According to Times of Crisis (2023:19), there is a deterioration in ecosystems, human well-being, planetary resilience, and sustainability. A more promising future requires proactive efforts and comprehensive security strategies. Social security, water, food, energy, climate, the environment, and geopolitics are just a few of the interrelated aspects of security that need to be addressed. While preserving harmony with the environment, transformational change strategies should adhere to the values of equality, solidarity, and well-being.

The Sustainable Development Goals (SDGs) of the United Nations, also known as the Global Goals, offer a universal framework for tackling urgent global issues, including poverty, injustice, and environmental degradation. They aim to advance both social justice and economic prosperity simultaneously. The 17 interrelated Sustainable Development Goals (SDGs), which were adopted in 2015 as part of the 2030 Agenda for Sustainable Development, provide a comprehensive roadmap for building a sustainable and just future. They address a broad range of problems, such as inequality, hunger, poverty, and climate change, to create a future in which everyone thrives, and the environment is protected (*United Nations Department of Economic and Social Affairs Sustainable development 2024:1*).

Once democracy was established in 1994, South Africa broke with its past. Significant economic, political, and social changes have accelerated many trends originally driven by inequality and apartheid. Rather than experiencing economic decline, South Africa has a growing economy, supported by an increasing systematic expenditure plan to address poverty and redevelopment within the country (Department of Environmental Affairs 2008:12).

Economic growth has led to the assumption that growth requires increased utilisation of natural resources, ecosystems, and materials. Moreover, there is a prevailing belief that resources like energy, water, minerals, plants, and clean air will always be available to humanity, regardless of how they are used, produced, or managed.

The National Framework for Sustainable Development in South Africa (Department of Environmental Affairs 2008:7) states that certain aspects of the country's development path and the way South Africans live are unsustainable, making them neither feasible nor sustainable in the long run. In addition, a large number of South Africans live in impoverished conditions, and even though they have access to utilities like water, sewage, and electricity, challenges remain in ensuring their consistent provision. Moreover, the rapid depletion of natural resources and degradation of habitat at accelerated rates pose an imminent threat. This trend has undeniable consequences, with future development objectives and economic growth are at risk of being compromised.

According to the National Framework for Sustainable Development in South Africa

(Department of Environmental Affairs 2008:22), the South Africa's natural resources and ecosystems are highly degraded and under significant strain, disrupting the balance between the country's natural resource base and its socioeconomic development plans.

If this generation leaves behind degraded "natural resources, economic, social and environmental assets, this would result in an unsustainable future for the next generation" (Department of Environmental Affairs 2008:6).

The increasing impact of today's rapidly expanding built environment poses a threat to the sustainability of the natural ecosystem. This is a major concern that affects both the environmental stability and human well-being. Local industries, lifestyles and buildings significantly contribute to the depletion of natural ecosystems, leading to the destruction of the green ecology and natural resources to the extent that humankind must critically shift towards an ecologised architecture to conserve the natural ecology within the built environment. Industrialisation and urbanisation further contribute to the destruction of green ecology and natural resources (Rapoport 2006:436).

According to Attia (2018:1), the challenges in designing a sustainable built environment include, but not limited to, the following: carbon emission, human health, climate change, water related issues, scarcity of resources, biodiversity, population growth, depletion of fossil fuel and urbanisation.

These detrimental impacts highlight the urgent need to adopt more sustainable measures and environmentally conscious practices in the built environment to mitigate future damage to the environment.

He further states that promoting sustainable architecture will, in turn, contribute positively to the development of a sustainable society.

The National Framework for Sustainable Development in South Africa (Department of Environmental Affairs 2008:8) elaborates that the concept of sustainable development should incorporate collaborative governance, well-defined procedures, inclusive representation of diverse voices and accurate, decisive decision making towards promoting sustainable development. South Africa should strive to evolve into a more sustainable and economically self-reliant society that upholds its democratic values. This can be accomplished by addressing the basic human needs of its population, managing the planet's finite ecological resources responsibly for the benefit of present and future generations, and

fostering effective and efficient planning and governance through cooperation at regional, natural, and international levels.

According to the Constitution of the Republic of South Africa Section 24,

“Everyone has the right to an environment that is not harmful to their health or wellbeing; and to have the environment protected for the benefit of present and future generations through reasonable legislative and other measures that prevent pollution and ecological degradation promote conservation and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development” (Department of Environmental Affairs 2008:19).

The issues affecting South Africa's built environment, as indicated above, are particularly relevant to many of the Sustainable Development Goals (SDGs). Although this research does not go into great detail about all 17 SDGs, the following SDGs (*United Nations Department of Economic and Social Affairs Sustainable development 2024:1*) are particularly pertinent to South Africa's context:

- **Sustainable Development Goals (SDG) 1: No Poverty** - eliminating all types of poverty by guaranteeing fair access to opportunities and resources.
- **Sustainable Development Goals (SDG) 7: Affordable and Clean Energy** - enhancing electricity access while making the switch to renewable energy.
- **Sustainable Development Goals (SDG) 11: Sustainable cities and communities** - promoting environmentally friendly urban development.
- **Sustainable Development Goals (SDG) 15: Life on land** - preserving ecosystems and preventing the decline of biodiversity.

Globally, economic growth has often been associated with the overuse of natural resources, resulting in habitat destruction, pollution, and environmental instability. The SDGs emphasise the need to balance economic development with ecological sustainability and social well-being.

For the purpose of this research, it was not necessary to expand on all the Sustainable Development Goals. Instead, the focus is placed on the most relevant goal to this study, SDG 11 – Sustainable Cities and Communities.

Sustainable Development Goals (SDG) 11: Sustainable cities and communities

As stated in *Sustainable Development Goal 11* (2023:1), the goal is to make cities and human settlements safe, resilient, inclusive, and sustainable, with a focus on the role that cities will play as the global living environment of the future. However, it also highlights that many cities were ill-equipped to handle the rapid pace of global urbanisation. Goal 11 recognises urgent issues such as pollution, inequality, and rising urban energy use.

While SDG 11 includes a number of targets to be met, two are particularly relevant to this research and are described below:

- “Strengthen efforts to protect and safeguard the world’s cultural and natural heritage.”
- “By 2030, enhance inclusive and sustainable urbanisation and capacity for participatory, integrated and sustainable human settlement planning and management in all countries.”

Therefore, it is essential to disseminate information, advocate for the Sustainable Development Goals, and investigate strategies for preserving South Africa's natural environment for present and future generations.

“Take an active interest in the governance and management of your city. Advocate for the kind of city you believe you need.” *Sustainable Development Goal 11* (2023:1).

The above quote clearly indicates the need for humanity to take an active interest in and advocate for the type of city and environment it envisions. It also highlights the responsibility to contribute to the built environment to ensure its future sustainability.

1.3. Significance of the study

This research may contribute to the creation of a new body of knowledge by raising awareness and supporting the Sustainable Development Goals (SDGs). There is a need for a theoretical analysis of this critical problem (as indicated in section 1.2) in order to establish approaches towards an alternative human ecology wherein cultures and built forms can coexist harmoniously with natural landscapes.

The significance of iSimangaliso Wetland Park in this research lies in its role in raising awareness about the importance of preserving the natural environment within the built environment. The park is known for its remarkable biodiversity, hosting a wide range of

unique ecosystems. This setting offers opportunities to investigate how these ecosystems function and adapt in relation to the built environment. However, many environments that are perceived as unaltered, untouched, or natural have, in reality, been impacted by human activity and will continue to be affected in various ways. Similarly, iSimangaliso Wetland Park, despite its rich cultural heritage, remains subject to human influence as it continues to attract tourists.

Therefore, it is important to reconsider the manner in which humanity relates to the natural environment, and revisit effective substantiable strategies for integrating built forms into sensitive environments. It is both appropriate and relevant to explore sensitive landscapes that are designated as world heritage sites to raise awareness of alternative sustainable principles for conserving the environment, whilst still encouraging the development of the built environment.

This study critically examines how the environment within the research site originated and was declared a world heritage site, identifies the implications within and surrounding the park, and the built context. The study also identifies how the park operates from an architectural perspective and identifies the current activities within the wetland park. Furthermore, the research explores possibilities of moving towards a human ecology, where humankind coexists with nature by preserving the ecosystems and cultural landscapes within the built environment (Fujii 1999:33).

1.4. Aims and objectives of the study

1.4.1. Research aim

The aim of this research is to critically explore ecologically responsive architecture within a sensitive environment using a case study approach focused on the research site. The park is located in Kwa-Zulu Natal, South Africa. The research analyses theories, concepts, and principles related to the recognition of local communities, which is essential for the success of conservation initiatives. It explores and critically examines the relationship between built form, indigenous architecture, human well-being, and ecological conservation, with a specific focus on iSimangaliso Wetland Park.

1.4.2. Objectives

1. To understand the factors that led to the designation of iSimangaliso Wetland Park as a “world heritage site”.

2. To understand the importance of conserving the natural ecosystem in iSimangaliso Wetland Park.
3. To examine how sustainable ecological development can be implemented within a sensitive environment.
4. To enquire how traditional methods in the built environment (concepts and techniques, such as design principles, use of materials, construction techniques), found in historical cores, can be combined with the latest sustainable technologies to develop an alternative ecological response to built form.

1.4.3. Research Questions

1. What natural, environmental, cultural, and ecological factors led to the designation of iSimangaliso Wetland Park as a World Heritage Site, and how do these factors shape development within the park?
2. Why is the conservation of the natural ecosystem critical to the long-term ecological integrity of iSimangaliso Wetland Park, and how can sustainable ecological development be implemented without compromising that integrity?
3. How can traditional indigenous architectural knowledge be integrated with contemporary sustainable technologies to create ecologically responsive built form within sensitive environments such as iSimangaliso Wetland Park?

1.5. Definition of key terms

Built Environment – refers to all human-made structures and infrastructure (*Greening the built environment building a sustainable future* - Department of Environmental Affairs 2020).

Ecology- the relationship between living organisms, including humans, and their physical environment (Purwanti and Nazir 2022).

Ecological architecture - refers to an architectural approach that integrates ecological principles into the design and construction of buildings, aiming to create structures that harmonize with natural systems and minimize environmental impact (uGreen.io 2023).

Ecosystem –a geographic region “where animals, plants, and other organisms, as well as landscape and climate, work together to form a bubble of life” (*Ecosystem* n.d.).

Conservation - an effort to “manage natural resources wisely based on the principle of preservation” (Purwanti and Nazir 2022).

Culture – “is a term which encompasses the social behaviour, institutions, and norms found in human societies, as well as the knowledge, beliefs, arts, laws, customs, capabilities, and habits of the individuals in these groups” (Purwanti and Nazir 2022).

1.6. World Heritage Site

The research centres on a locale classified as a world heritage site, which involves adherence to rigorous criteria. Understanding the reasons behind the designation of iSimangaliso Wetland Park as a world heritage site is pertinent to the research.

Countries that are signatories to the World Heritage Convention, committing to safeguard their natural and cultural heritage, are eligible to propose nominations for areas within their borders to be evaluated for potential inclusion on UNESCO's World Heritage List. World Heritage sites include a diverse range of locations, man-made structures to natural landscapes that are recognised as being of outstanding international importance and therefore deserving of special protection. These sites are determined according to the United Nations Educational, Scientific and Cultural Organizations (UNESCO) World Heritage List. Heritage areas or sites are defined as having conspicuous universal importance under the Convention Concerning the Protection of the World Cultural and Natural Heritage (*World Heritage site 2022:1*).

There are three distinct categories of heritage sites: natural, cultural, and mixed sites. Cultural heritage locations include historical edifices and/or components of monumental paintings or sculpture. Natural heritage sites are restricted to natural places that provide illustrations of Earth's historical record of life or its natural geological processes. Additionally, these sites include distinctive, uncommon natural occurrences, or habitats for endangered plants or animals, as well as locations with extraordinary biodiversity. Sites that are distinguished as mixed heritage sites contain both cultural s and natural significance (*World Heritage site 2022:2*).

In order to be included on the World Heritage Site list, places or regions must meet at least one of the 10 selection criteria specified by UNESCO, indicating outstanding universal value. iSimangaliso Wetland Park, a remarkable natural wetland and coastal site in Africa,

fulfils three UNESCO criteria: these includes criterion (vii), criterion (ix) and criterion (x) (*WHC UNESCO: iSimangaliso Wetland Park 2023:1*).

The following describes the three selection criteria associated with iSimangaliso Wetland Park:

- Selection criterion (vii) - *WHC UNESCO: Criteria for Selection (2023:1)* defines criterion (vii) as locations of extraordinary natural beauty and artistic significance or outstanding natural occurrences.
- Selection criterion (ix) - *WHC UNESCO: Criteria for Selection (2023:1)* defines criterion (ix) as exceptional illustrations of ongoing ecological and biological processes in the evolution and development of freshwater, terrestrial, coastal, and marine ecosystems and plant and animal communities.
- Selection criterion (x) - *WHC UNESCO: Criteria for Selection (2023:1)* defines criterion (x) as including the most vital and noteworthy natural habitats for the in-situ preservation of biological diversity, particularly those that are home to endangered species of exceptional universal importance from a scientific or conservation perspective.

The Outstanding Universal value of the research site, as defined by *WHC UNESCO: iSimangaliso Wetland Park. (2023)*: comprises a broad variety of pristine terrestrial, coastal, wetland, estuarine, and marine ecosystems that are aesthetically pleasing and essentially unaltered by human activity. Numerous species from Africa's coasts, marshes, and savannahs depend on these habitats, which include coral reefs, long sandy beaches, coastal dunes, lake systems, swamps, and vast reed and papyrus wetlands. In the Park's transitional position, these ecosystems have interacted with significant floods and coastal storms to produce unparalleled species diversity and ongoing speciation. Large groups of flamingos and other birds, as well as turtles breeding, are among its striking natural sights.

Criterion (vii) for iSimangaliso Wetland Park highlights its geographical diversity, offering unparalleled scenic landscapes along 220 km of its coastline. It spans from the crystal-clear Indian Ocean waters to the extensive sandy beaches, forested dunes, and a varied landscape of grasslands, wetlands, savannahs and lakes. The park's aesthetic qualities are unmatched, with three remarkable natural phenomena contributing to its status. Firstly, the salt levels of

Lake St. Lucia vary in response to the alternating dry and rainy cycles, demonstrating the lake's capacity to adapt and shift between low and highly saline conditions. Secondly, the park is host to nesting turtles on its shores, along with the presence of dolphins, whale sharks, and migratory whales. Finally, large numbers of waterfowl and successful breeding colonies of pelicans, herons, storks, and terns add liveliness to the wild natural scenery of the area (*WHC UNESCO: iSimangaliso Wetland Park 2023:1*).

Criterion (ix) for iSimangaliso highlights the exceptional combination of fluvial, marine, and aeolian processes that began in the early Pleistocene and have shaped a variety of landforms that persist to the present day. The park's transitional location, situated between sub-tropical and tropical Africa, coupled with its coastal context, has fostered remarkable species diversity. Ongoing speciation events in the Maputaland Centre of Endemism contribute to the intricate tapestry of evolutionary processes in iSimangaliso. In the marine realm, underwater canyons on the continental shelf catch sediments transported by the Agulhas flow, creating unusually clear waters that support the formation of coral reefs. The environmental heterogeneity of the park is further enhanced by recurring major floods and coastal storms. The site's substantial size and retention of key ecosystem elements ensures the long-term viability of its ecosystems (*WHC UNESCO: iSimangaliso Wetland Park 2023:1*).

Criterion (x) for iSimangaliso Wetland Park highlights the five interconnected ecosystems that serve as habitats for a significant array of African biota, including a substantial number of endemic and or threatened species. iSimangaliso boasts over 6 500 plant and animal species, including 521 bird species. Among these, 11 species are endemic to the park, and 108 are exclusive to South Africa. Additionally, 467 species are classified as threatened in the country. The exceptional diversity of wetland, terrestrial, aquatic and coastal habitats sustain a broad spectrum of animal species, many of which reach the northern or southern limits of their geographical distribution here (*WHC UNESCO: iSimangaliso Wetland Park 2023:1*).

Even though the park meets the aforementioned requirements and is recognised as a World Heritage site due to its natural features, the World Heritage Conservation Act “obliges the

iSimangaliso Authority to promote, present and conserve the heritage of cultural significance within the park” (iSimangaliso Wetland Park Authority 2017:5).

1.7. Assumptions

The research is based on data collected from books, journals, online publications, case studies, site observation and online sources. The research will incorporate assumptions derived from collected data and subsequent analysis. As per Key assumptions include:

- As per Chu and Karr (2017), the rapidly expanding built environment poses a threat to the natural ecosystem and human welfare. This expansion may lead to resource depletion and environmental imbalance. built environment
- Sustainable architecture plays a key role in achieving sustainable development and mitigating environmental depletion
- Raising awareness and exploring strategies for conservation are essential for preserving South Africa’s natural environment and heritage sites.

1.8. Delimitation of the research

This research will not address all aspects of biodiversity, wetland systems, hydrology, cultural heritage, sustainability, green building practices, or economic issues present within iSimangaliso Wetland Park. However, the research, will focus on analysing and addressing existing norms of the built environment and their impact on natural ecosystems within iSimangaliso Wetland Park. It will investigate how buildings can be designed and built in a way that preserves natural resources.

1.9. Potential Outputs

The research aims to achieve the following potential outputs:

1. Contribute to the national knowledge base by conducting a research dissertation on ecologically responsive architecture within the iSimangaliso Wetland Park (KwaZulu-Natal).
2. Actively promote awareness of sustainable development within communities and emphasise the conservation of natural resources.
3. Raise awareness about the sensitivity of natural environments and the importance

of preserving these ecosystems within the built environment.

1.10. Summary

This introduction provides a broad overview of the research topic and the context of iSimangaliso Wetland Park. It highlights the problem of conservation and the challenges posed by the built environment from both a local and global perspective, emphasising the need to conserve natural resources, and support the SDGs. The section also highlights the aims and objectives of the research.

This research seeks to provide clarity on the importance of preserving natural resources and aims to raise awareness about ecologically responsive architecture within iSimangaliso Wetland Park, a designated World Heritage Site.

Chapter 2 Literature review

2.1. Introduction

This section explores the literature related to the research topic and objectives.

The relationship between humans, nature, and the built environment is a fundamental aspect of sustainability. Over time, human societies have shifted from an intrinsic dependence on nature to a more complex interaction shaped by industrialisation and urban expansion. This evolution has presented both opportunities and challenges in environmental stewardship and sustainable development. A major catalyst for contemporary environmental challenges has been rapid urbanisation, which has altered ecosystems and redefined the way humans perceive and interact with nature.

This chapter traces the transformation of human-nature relationships from early societies that lived in harmony with natural systems to modern urban landscapes that often prioritise economic growth over ecological balance. The main themes that emerge include the historical progression of human-nature interactions, the shift from traditional ecological wisdom to industrial dominance, and the role of sustainable design in addressing contemporary environmental challenges. The study highlights how the built environment has transitioned from simple, nature-integrated structures to complex urban ecosystems, making sustainable architectural practices increasingly essential. The study highlights the importance of blending traditional and modern approaches to create ecologically responsive spaces that support long-term sustainability. Ultimately, this chapter explores traditional methods in the built environment (concepts and techniques) that can be combined with the latest sustainable technologies to develop an alternative ecological response to built form.

2.2. Investigating the relationship between man, nature, and the built environment

The relationship between humans, nature, and the built environment is a linchpin for achieving sustainability. This relationship has been analysed through a historical lens, tracing the evolution of human interaction with the natural world from early hunter-gatherers to modern industrial societies. This chapter explores key transitions, such as the Neolithic Revolution, which marked the shift from a nomadic lifestyle to agriculture, leading to

significant environmental modifications. Further transformations occurred during the Industrial Revolution, where advancements in agriculture, energy, and urbanisation intensified human impact on ecosystems. By examining past human-environment interactions, valuable insights can be gained for sustainable resource management, conservation strategies, and biodiversity protection. This chapter references various scholars, including Bargaoui and Nouri (2021), Laljit (2019), and Watson (2012) to support discussions on deforestation, resource depletion, pollution, and climate change. It emphasises the consequences of human dominance over nature, stressing the need for sustainable approaches to ensure environmental integrity for future generations.

Analysing the historical relationship between humans, nature, and the built environment provides crucial insights for conservation, education, sustainable resource management, and cultural preservation. Understanding these interactions helps ensure that human activities respect ecological boundaries, protect biodiversity, and meet present needs without compromising future generations. Sustainable Development Goal 11 emphasises the creation of safe, resilient, and sustainable cities while acknowledging the challenges posed by rapid urbanisation, including pollution, inequality, and increased energy demands. Among its key targets, SDG 11 highlights the need to safeguard cultural and natural heritage and promote inclusive, sustainable urbanisation. Advocating for these goals and exploring strategies to preserve South Africa's natural environment is essential for long-term sustainability. As stated in *Sustainable Development Goal 11* (2023:1), individuals must take an active role in shaping their cities and built environments to ensure a balanced and sustainable future.

2.2.1. Defining the built environment

The relevance of the concept of the "built environment" to a place like iSimangaliso Wetland Park lies in the need to balance human development with environmental preservation. iSimangaliso is a unique and ecologically diverse area, making an understanding of the built environment crucial for sustainable development in and around the park.

The term "built environment" refers to all human-made structures and infrastructure (Department of Environmental Affairs 2020). It encompasses the manmade context that provides the setting for human activities at various scales, ranging from personal shelters, dwellings, and buildings, to neighbourhoods and cities. It also includes supporting

infrastructure networks such as waste management systems, energy networks and water supply systems.

The Department of Environmental Affairs (2020) further emphasises that for the built environment to function as a conducive habitat for humans, it must be planned, designed, built, maintained, and utilised in a manner that safeguards essential natural elements including water, air, soil, biodiversity and the broader environment.

2.2.2. Analysing the relationship between early humans and nature

Environmental changes occur naturally; however, many transformations are caused by human activities, dating back to the primitive period.

Fortunado (2018:776) indicated that, modern humans (*Homo sapiens*), the sole surviving members of the subtribe Hominina within the tribe Hominini, constitute the exclusive representatives of the family of great apes. Bargaoui and Nouri (2021:24) affirmed that human activities began approximately 2.5 million years ago in East Africa with *Homo habilis*, followed by *Homo erectus*, and eventually *Homo sapiens*, which developed around 40 000 years ago. Paleolithic man coexisted with other large predators and relied on the environment for survival by gathering fruits and hunting certain wild animal species, giving rise to the phrase "hunter-gatherers" (Bargaoui and Nouri 2021:24).

The first significant shift in the relationship between humans and nature occurred approximately 400 000 years ago with the discovery of fire. This period saw the emergence of essential tools such as sticks, stones, spears, and bows and arrows. A collective economy known as the clan economy, emerged, characterised by shared activities like hunting, fishing, food preparation, consumption, and communal living. This collaborative lifestyle empowered early humans to respond more effectively to natural challenges (Bargaoui and Nouri 2021:24).

The second significant shift in the relationship between humans and nature was the Neolithic revolution, characterised by the transition from hunting and gathering to an agriculture-based economy. This transformation marked a shift from relying on wild resources to actively cultivating crops and domesticating animals (Bargaoui and Nouri 2021:24). Furthermore, according to research by Laljit (2019:28), early human shelters were likely cave dwellings, modified from existing natural structures through for example, decorating the caves or excavating holes. Further evidence indicates that the hunter-gatherer way of life required

temporary structures to provide protection against the elements and potential dangers (Laljit (2019:28).

These traditional shelters, even in their simplest form depict the early relationship between man and the surrounding environment, laying the foundation for architecture as a response to the need for shelter (Laljit 2019:28).

Around 10 000 to 11 000 years ago, global warming initiated the end of the Ice Age, which had begun approximately 1.8 million years ago. This transition marked the start of a warming era that has continued for around 11 400 years, coinciding with the Mesolithic and Neolithic periods. The Mesolithic, also known as the "middle stone age," and the Neolithic, or "polished stone age," were characterised by advancements in stone tool technology and the transition to agricultural practices (Bargaoui and Nouri 2021:24).

According to Onion *et al.* (2018), the emergence of agriculture, known as the Neolithic Revolution, marked a pivotal shift in human history, transitioning communities from nomadic hunter-gatherers to the establishment of a more advanced civilisation through the continuous cultivation of a stable food source. The advancement of agriculture, crops and livestock led to extensive deforestation, disrupting ecosystem dynamics. Throughout human history, social systems of production have transformed, including primitive societies, communism, slavery, feudalism, and capitalism. The decline of primitive communism resulted from animal domestication and breeding. Animal breeding introduced a division of labour, facilitating trade between pastoral and other groups through a consistent supply of resources like milk, meat, skins, and wool. Additionally, agriculture bolstered stable sources of plant-based food. Innovations like weaving enabled the creation of woollen textiles and clothing.

Metallurgy emerged later stages in the Neolithic period, marking a critical advancement in material technology (Bargaoui and Nouri 2021:24). Onion *et al.* (2018) affirm that this era can be viewed as man's earliest dominance over nature. Watson (2012) provides further evidence that domesticating plants paved the way for the development of woollen fabrics, ceramics, garments, and, in the long run, the urbanisation of once rural areas.

The Industrial Revolution of the late 19th century initially transformed agricultural practices, but its impact intensified significantly after the First World War. Watson (2012) affirms that agriculture played a crucial role in this global revolution, with advancements such as the widespread adoption of agricultural machinery, the use of mineral fertilizers, and

improvements in plant and animal selection. These developments contributed to a growing human impact on the natural environment. The expansion of steam engines across various economic sectors, along with the increasing use of electricity, led to a substantial rise in coal extraction, particularly into the early 20th century. As a result, this period marked a turning point as human activities began to profoundly reshape the environment (Bargaoui and Nouri 2021:24).

The rapid population changes and the decline of smaller communities, such as tribes and villages, shaped the human experience in industrial society and contributed to the expansion of capitalist production. The industrial revolution introduced advancements in agriculture, demographics, urbanisation, industry, transportation, technology, and trade, which shielded humans from certain environmental threats (Bargaoui and Nouri 2021:24).

During this period, humans significantly altered their ecosystems, which became evident through various consequences such as deforestation, increased pressure on wildlife, rising sea levels, and a notable surge in energy consumption. These changes resulted in substantial ecological and environmental challenges (Bargaoui and Nouri 2021:24).

Bargaoui and Nouri (2021:24) affirm that the dominion of humans over nature has resulted in several significant outcomes, including:

- Forest depletion, negatively impacting the diversity of plant, animal life, removing carbon sinks and reducing the ability for carbon to be absorbed and oxygen to be produced.
- The creation of artificial environments, altering human perception of natural elements and surroundings.
- A rise in energy-intensive production processes, leading to heightened extraction of natural resources.
- The consumption of non-renewable energy sources and production of air pollution.

These consequences highlight the complex and interconnected relationship between human actions and the environment, showcasing the need for sustainable approaches.

2.2.3. The relationship between man and the built environment

The man-made surroundings that provide the background for human activities are referred to as the built environment. This relationship has evolved over time and continues to shape

how people interact with and respond to the spaces they inhabit. It refers to how people interact with, shape, and are influenced by the human-made surroundings in which they live, work, and play. This relationship has profound effects on individuals, communities, and societies as a whole.

According to Lamprecht (2016:65), the built environment is closely associated with the concept of culture; the concept of culture encapsulates both the spiritual and material heritage of humanity, encompassing everything that shapes the built environment. Lamprecht (2016:65) further states that human culture is composed of two artefacts: human behaviour and material culture. Material culture includes items of material nature, that is, all kind of artefacts. The built environment encompasses both human-made artifacts and natural elements altered by human activities, serving as a foundation for various aspects of social life. It also arises from the transformation of nature, including managed animals and plants. Defined as a manifestation of material culture, the built environment is the part of our surroundings shaped by culturally influenced behaviour. It is not only a creation of humanity but also a cornerstone of its progress and development (Lamprecht 2016: 66).

Lamprecht (2016:66) further emphasises the undeniable connection between individuals and their environment. Human skills, abilities, and aspirations mould the surroundings, which reciprocally offer context and influence behaviour. Human actions and constructed structures form an interdependent relationship. Consequently, the urban environment serves as a reflection of people, offering insights into both individual and societal attributes.

McConnachie (1998:100) highlights the importance of recognising the relationship between the built and natural environments, along with the explicit inclusion of 'monuments' within the built environment concept. According to McConnachie (1998:100), the term 'environment' signifies the interconnectedness between people and their surroundings. The human impact on the natural environment has resulted in a merging of the two, known as the spatial environment. McConnachie (1998:100) further states that the entire built environment represents a form of culture; the mention of 'monuments' specifically refers to elements with distinct cultural relevance and significance.

The link between people and the built environment is therefore described by a paradigm—conceptual framework that helps us understand and analyse the intricate interactions, influences, and dependencies between people and the spaces they create. This paradigm encompasses various dimensions, including cultural, social, psychological, economic, and

ecological factors. It serves as a lens through which we can examine how human actions, behaviours, and values shape the design, development, and utilisation of the built environment, and how, in turn, the environment influences human experiences and behaviours.

2.2.4. Ecologies of man and greening in local environments

Rapoport (2006:122) defines physical environments as an organisation of space, time, meaning and communication. According to him, the world has been altered by human action; therefore the concept of cultural landscape links urban and natural landscapes, which vary partly in the extent of their transformation and partly in the materials incorporated. He further affirms that cultural landscapes are defined as the result of human actions on the primeval landscape over periods of time.

Rapoport (1999:129) further states that traditional environments are characterised by cultural landscapes that are deeply intertwined with history and society, serving as the foundation for social sciences. These landscapes are personalised to meet the needs of local communities, embodying a strong sense of locality and ambiance specific to their environment. Cultural landscapes consist of fixed features like buildings and settlements, semi-fixed features, and non-fixed features like animals and vehicles (Rapoport 2006:129). Cultural landscapes are adaptable and allow for change, whether it occurs rapidly, gradually, or in response to countervailing forces. These forces can include long-term immigrants or the resurgence of religious and cultural groups seeking identity within an adaptive society (Rapoport 2006:129).

Fujii (1999:122) states that the world now exists in an age of knowledgism², an age where development relies on communication. In this modern world driven by knowledge and the global economy, the focus is on speed, movement, communication, and information exchange. Development spreads widely through import and export, increasing the likelihood of homogenisation of goods. This process alters cultural landscapes, potentially resulting in

² "Knowledgism" by Fujii (1999:122) refers to a philosophy or framework that explores the central role of knowledge in human development and society. It emphasises understanding knowledge not just as a collection of facts but as a dynamic, evolving process that shapes human consciousness, behaviour, and decision-making. The concept stresses the importance of managing knowledge effectively to enhance creativity, problem-solving, and adaptability. Applied across various fields, knowledgism suggests that knowledge, when properly understood and utilised, can be a powerful tool for personal and societal progress.

the loss of locality. Human ecology and culture are shaped by the progress of global human society.

The infrastructural demands this movement have led to the exploitation of natural green spaces, causing changes in the ecology of these areas. As humankind advances into the age of knowledgism, technology, communication, and information can be harnessed to revitalise and optimise natural landscapes as they coexisted with traditional environments—where greenery could grow naturally in open spaces between man-made buildings.

2.3. Ecological architectural design framework and design model

Ecological architecture, sustainable architecture and green design are closely interrelated, as they all focus on minimising environmental impact, conserving resources, and promoting energy efficiency. Ecological architecture emphasises harmony with natural ecosystems; sustainable architecture prioritises long-term resource efficiency; and green design integrates environmentally friendly materials and technologies. However, in order to move toward a new green ecological approach in design, there is a need for architects and designers to revisit their previous or existing sustainable models. This reflection enables them to recognise pertinent sustainable design techniques and methods in a coordinated way. The framework proposed by Yahya and Hassanpour (2022) presented in Figure 2.1, was chosen for exploration in this study to address this need and to underpin the analysis of the precedent study and the case study of iSimangaliso Wetland Park.

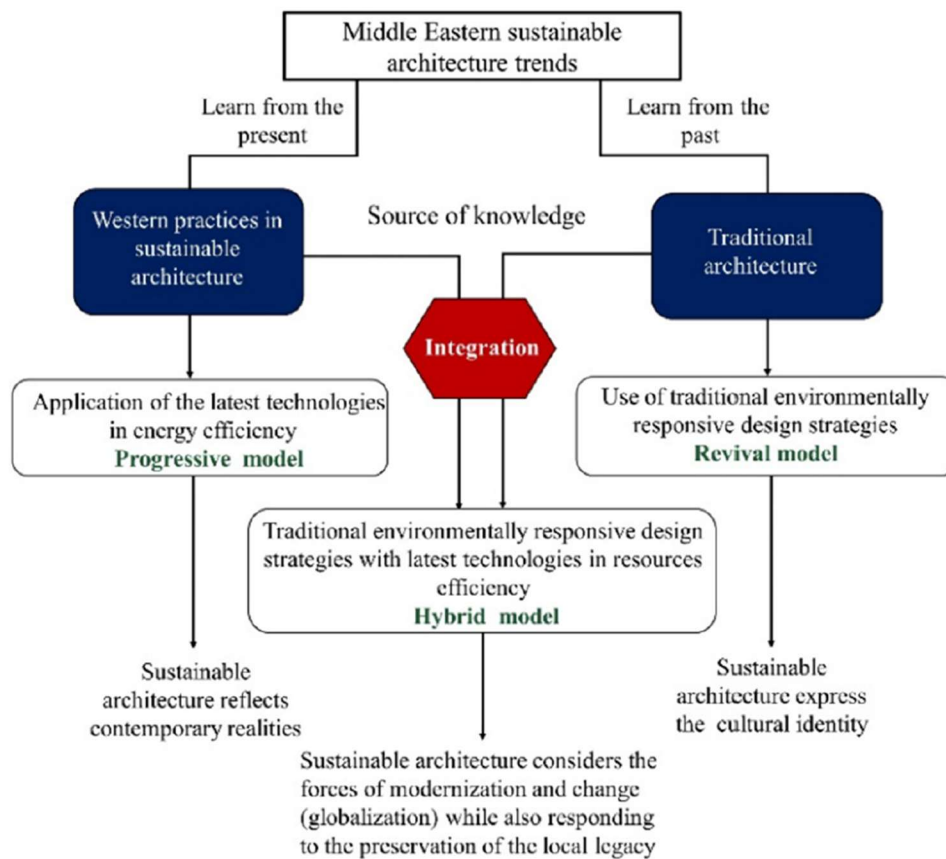


Figure 2.1 Sustainable architectural trends

Source: Yahya and Hassanpour (2022:3)

Figure 2.1 is significant as it illustrates the integration of Western sustainable architecture practices with traditional Middle Eastern architectural principles to create a balanced approach to sustainability. It highlights three key models: the **Progressive Model**, which focuses on incorporating modern energy-efficient technologies to address contemporary needs; the **Revival Model**, which emphasises the use of traditional, environmentally responsive design strategies to preserve cultural identity; and the **Hybrid Model**, which combines traditional sustainable design principles with modern technological advancements to enhance resource efficiency. The diagram underscores the importance of drawing knowledge from both the past and present, ensuring that sustainable architecture responds to modernisation and globalisation while preserving local heritage and environmental integrity. In reference to Figure 2.1, the study developed a framework that “transforms theoretical models into viable options for designers and scholars, and to select design approaches and strategies in an integrative manner” (Yahya and Hassanpour 2022:np). The model can be utilised either independently or by integrating multiple models to formulate a more adaptive

sustainable design approach (Yahya and Hassanpour 2022). Although the model, is designed for the middle East, it serves as a foundational tool for developing new ecological responses suitable for global context. This aligns with the Sustainable Development Goals (SDGs) and is particularly relevant within the scope of this research in iSimangaliso Wetland Park. The model is applicable to this study as it forms a source of knowledge that combines sustainable architecture with traditional architecture. The framework includes three design models, namely: revivalist, progressive, and hybrid model (Yahya and Hassanpour 2022:3).

2.3.1. The Revivalist Trend

The revivalist trend in utilising renewable natural resources goes hand in hand with the restoration of neglected local heritage. This approach is characterised by the adoption of strategies and techniques from traditional architecture, particularly those involving environmentally responsive cooling methods. According to Yahya and Hassanpour (2022), Hassan Fathy an Egyptian architect, criticises modernity's overreliance on technology and instead emphasises the interpretation of forms and practices from the past. His strategy places an emphasis on conventional design components like natural ventilation, shading, thermal mass, evaporative cooling, and microclimatic features like courtyards, in addition to the use of locally sourced, environmentally friendly materials (Yahya and Hassanpour 2022).

2.3.2. The Progressive paradigm

The progressive paradigm, which emphasises the use of resource-efficient technology, stands in stark contrast to the revivalist approach. It includes strategies such as thermal glass panels, wind turbines, bio-walls, integrated photovoltaic panels and roofs, envelope design, and the use of high-performance materials. Additionally, active solar energy systems are employed, leading to decreased energy and water consumption, reduced waste production, and more efficient utilisation of resources throughout the construction phase. (Yahya and Hassanpour 2022).

The hybrid approach represents a fusion of revivalist and progressive architectural concepts. This model harmoniously blends traditional architectural principles with modern sustainable technologies, acknowledging the influence of globalisation and the need to preserve local heritage. It seeks a balanced coexistence between tradition and innovation in architectural design.

The literature suggests that the combination of traditional and sustainable architecture can be achieved through a hybrid design model. This model is particularly relevant to the current

study, as it aligns with the research objectives by integrating both revivalist and progressive models.

2.4 Design Approaches

Given South Africa's varied climates, rich cultural heritage, socioeconomic challenges, and environmental issues—alongside its commitment to supporting the global Sustainable Development Goals³—the adoption of the hybrid model is especially pertinent to the nation. It takes a careful blending of traditional and modern techniques, a dedication to sustainability, and a sophisticated grasp of local contexts to successfully integrate the hybrid model into South Africa's architectural setting.

The research by Yahya and Hassanpour (2022) further developed a sustainable design model based on linking a framework of six sustainable logics defined by Guy and Farmer (refer to Figure 2.2). While the model by Guy and Farmer will not be discussed in detail in this study, it is acknowledged as a reference point for analysing sustainable design logics in comparison to the Hybrid model.

For reference purposes, the six logics defined by Guy and Farmer are as follows:

³ The Sustainable Development Goals (SDGs), as outlined by the United Nations Department of Economic and Social Affairs, are a set of 17 global objectives adopted by the UN Member States in 2015 as part of the 2030 Agenda for Sustainable Development. These goals aim to address a broad range of global challenges, including poverty, inequality, environmental degradation, peace, and justice, with the ultimate objective of achieving a more sustainable, equitable, and prosperous world for all. (*United Nations Department of Economic and Social Affairs Sustainable development* 2024:1).

Table 1 The six competing logics of sustainable architecture

Logic	Image of Space	Source of Environmental Knowledge	Building Image	Technologies	Idealized Concept of Place
Eco-technic	global context macrophysical	technorational scientific	commercial modern future oriented	integrated energy efficient high-tech intelligent	Integration of global environmental concerns into conventional building design strategies. Urban vision of the compact and dense city.
Eco-centric	fragile microbiotic	systemic ecology metaphysical holism	polluter parasitic consumer	autonomous renewable recycled intermediate	Harmony with nature through decentralized, autonomous buildings with limited ecological footprints. Ensuring the stability, integrity, and "flourishing" of local and global biodiversity.
Eco-aesthetic	alienating anthropocentric	sensual postmodern science	iconic architectural New Age	pragmatic new nonlinear organic	Universally reconstructed in the light of new ecological knowledge and transforming our consciousness of nature.
Eco-cultural	cultural context regional	phenomenology cultural ecology	authentic harmonious typological	local low-tech commonplace vernacular	Learning to "dwell" through buildings adapted to local and bioregional physical and cultural characteristics.
Eco-medical	polluted hazardous	medical clinical ecology	healthy living caring	passive nontoxic natural tactile	A natural and tactile environment which ensures the health, well-being, and quality of life for individuals.
Eco-social	social context hierarchical	sociology social ecology	democratic home individual	flexible participatory appropriate locally managed	Reconciliation of individual and community in socially cohesive manner through decentralized "organic," nonhierarchical, and participatory communities.

Figure 2.2 The six logics of sustainable architecture

Source: Guy and Farmer (2001:141)

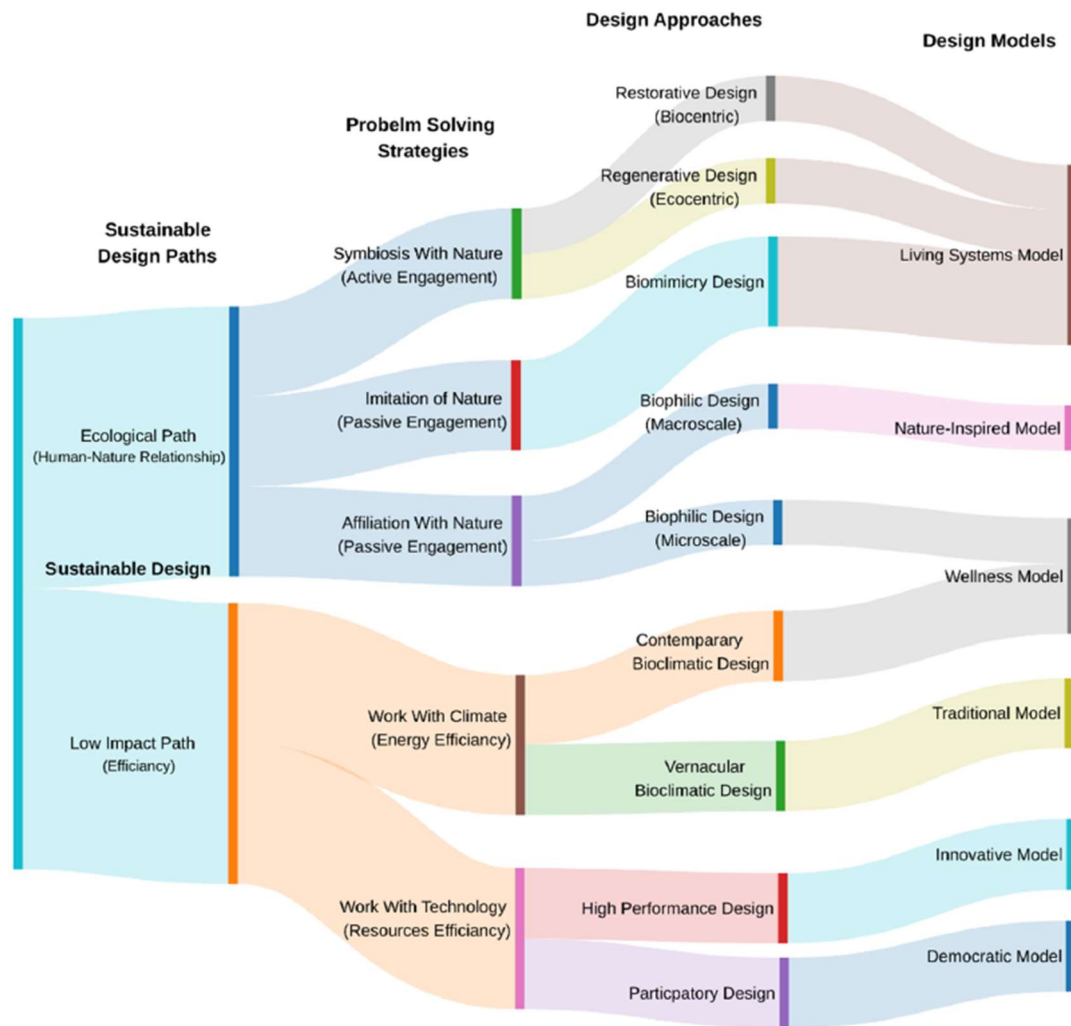


Figure 2.3 Design approaches and strategies

Source: Yahya and Hassanpour (2022:8)

2.4.1. Analysis of the Design Approaches and strategies framework

The framework by Yahya and Hassanpour (2022), as illustrated in Figure 2.3, depicts various approaches and strategies for sustainable architecture, categorising them into two main paths, both of which are explored in this study because of the various elements within them. The first path is the "ecological design" approach, which seeks integration with living processes and aims to minimise environmentally destructive impacts. This path can be either anthropocentric⁴ or non-anthropocentric,⁵ and includes biomimicry⁶ and biophilic design. It

⁴ Adopting a passive relationship with nature (Yahya and Hassanpour 2022)

⁵ Implying an active engagement between nature and humans (Yahya and Hassanpour 2022)

⁶ Is an ecological approach to design that seeks solutions to functional challenges by studying and emulating the behaviour of local organisms or ecosystems

extends beyond sustainability to improve wellbeing, health, and quality of life. (Yahya and Hassanpour 2022).

The second path is the "low-impact" approach, which focuses on engineering-based, resource-efficient strategies with an anthropocentric perspective. It emphasises quantitative improvements in building performance, compliance with global standards and regulations, and includes approaches like green design, sustainable design, and bioclimatic design (Yahya and Hassanpour 2022).

The principle of the ecological approach is grounded in the idea that nature functions as an organic, dynamic network of interconnected units. These units continuously exchange information and energy, adapting to coexist harmoniously with their immediate surroundings. This concept is demonstrated in Figure 2.3, which further illustrates how these interactions shape ecological balance and sustainability (Yahya and Hassanpour 2022).

This research focuses on the ecological approach methods, with emphasis on energy efficiency and resource efficiency.

Yahya and Hassanpour (2022) state that ecological design approaches can be categorised as either anthropocentric, adopting a passive relationship with nature, or non-anthropocentric, implying active engagement between nature and humans. According to their research, biomimicry design is an ecological approach that seeks solutions to functional challenges by studying and emulating the behaviour of local organisms or ecosystems. This approach draws inspiration from nature to address practical design problems.

In contrast, biophilic⁷ design intentionally incorporates nature into the built environment, directly, indirectly, or symbolically. This integration not only brings health and well-being benefits to occupants but also ecological advantages, by encouraging a passive connection with the natural world. This design concept centres on the infusion of nature into built environments, leading to improved physical and mental human health. Biophilic design is closely related to the principles of bioclimatic design⁸, especially due to their focus on

⁷ Design approach intentionally incorporates nature into the built environment, whether directly, indirectly, or symbolically

⁸ Bioclimatic design refers to an architectural approach that considers local climatic conditions to optimize building performance while minimizing energy consumption. It integrates passive design strategies such as solar orientation, natural ventilation, thermal insulation, and the use of locally sourced materials to enhance comfort and sustainability (Olgyay 1963).

integrating natural ventilation and daylight. Both bioclimatic and biophilic design share the aim of transcending basic sustainability by improving the overall quality of life, health, and well-being. This movement towards bioclimatic and biophilic design as a passive approach connects individuals with nature, leading to favourable outcomes for health, human performance, and emotional well-being. This approach is closely linked to the eco-medical logic, which emphasises creating a built environment that supports individual health and well-being by integrating nature into indoor spaces. In doing so, it reduces heavy reliance on technology for comfort, forming the basis of the fourth design model, known as the **wellness model**.

Govender (2016) argues that biomimicry, while offering a direct translation of nature's forms into technology-based design solutions, often fails to consider environmental and spatial contexts, thereby missing opportunities for cultural connection.

Kellert *et al.* (2008) state that biophilic design is the expression of the inherent human need to affiliate with nature in the design of the built environment. It fosters positive experiences with natural systems and processes within buildings and landscapes, playing a crucial role in human performance and well-being.

Biophilic design encompasses various patterns or strategies, categorised into three groups: natural analogues, nature in the space, and nature of the space. These patterns serve to facilitate human interaction with nature and enhance human well-being in both outdoor and indoor contexts. At a larger scale, biomorphy is employed to establish architectural forms that mimic natural life forms, resulting in organic and harmonious structures that emphasise the connection between man-made and natural elements. This approach aligns with the eco-aesthetic logic, which focuses on creating building forms that evoke sensual values and raise ecological awareness. Such designs contribute to sustainable architecture by leaving a lasting impact and enhancing community identity. These nature-inspired architectural forms promote the renewal and restoration of buildings, ensuring their longevity and sustainability, as they establish a strong connection with nature through design. This concept is part of the nature-inspired model in architectural design.

The **living systems model** proposes that buildings should be self-sufficient, meeting all their needs on-site while also contributing to the overall health of the environment. This model emphasises increasing biodiversity and maintaining a dynamic, interconnected relationship with the surrounding environment. The International Living Future Institute introduced the

‘Living Building Challenge standard’ (Yahya and Hassanpour 2022:8), which serves as an assessment system. It seeks to shift the prevailing paradigm from merely reducing harm to actively fostering sustainability and regeneration. This system can be applied as a comprehensive framework for guiding the design, construction, and operation of buildings while fostering a symbiotic relationship between people, communities, and the natural world. Whether aiming for restoration, regeneration, or achieving a net-zero environmental impact, buildings can align with this approach, promoting a truly sustainable and harmonious coexistence with nature.

Regenerative and restorative buildings go beyond self-sufficiency by actively seeking to improve and restore damaged surrounding environments. Restorative designs address specific sites temporarily, rectifying damage caused by nature or human activities. In contrast, regeneration aims for a more extensive and enduring positive impact, enhancing conditions to support life-enhancing ecosystems at various scales. These concepts closely align with the eco-centric logic, focusing on creating building designs inspired by ecological systems that are self-sustaining, efficient, and closed, ultimately thriving on both local and global biodiversity.

The literature suggests that ecologically responsive design methods focus on the active and passive engagement with nature but often overlook the integration of sustainable technologies, and the cultural connection within ecologically responsive architecture—highlighting a known gap.

Furthermore, it is important to highlight that low-impact approaches like this could form part of an ecologically responsible design method. Low-impact approaches, as indicated in Figure 2.3, align with mechanistic thinking, which attributes environmental issues to inefficient resource utilisation, and strives to prevent them through resource and energy efficiency, safe waste management, indoor environmental quality, sustainable materials, pollution control, and biodiversity conservation. This approach leads to measurable enhancements in building performance, more precise scientific assessments and predictions, and stricter oversight enforced by new global standards, policies, and regulations. Sustainable design, green building design, and bioclimatic design are part of this paradigm.

While green and sustainable designs are recognised as technological solutions addressing intricate technical and environmental challenges, bioclimatic design is a low-impact approach tailored to local climates. Furthermore, eco-technic logic (refer to Figure 2.2)

prioritises innovation, emphasising efficiency and energy efficiency. It takes a global perspective and tackles environmental challenges through modernisation and technological advancements in building and service systems, aiming for significant reductions in energy consumption, embodied energy in materials, waste, and resource usage. This approach places sustainability in a broader context concerning space and time. The literature reveals that the low impact patch focuses mainly on technological solutions without the implementation and consideration of ecological approaches, highlighting another known gap. Therefore, this model alone cannot facilitate in an ecologically responsive design.

2.4.2. Critical Analysis

In reference to Figure 2.3, the design approaches and strategies model by Yahya and Hassanpour (2022) contradicts the *Hybrid Model* in Figure 2.1. While the *Hybrid Model* focuses on establishing a combination of progressive and revivalist approaches, the model in Figure 2.3 illustrates the implementation of various design approaches in isolation, such as the living systems model, nature-inspired mode, wellness model, traditional model, innovative model, and democratic model. The only design approach that appears to utilise a combination of strategies is the Wellness design approach. However, this approach is still limiting, as it primarily emphasises the incorporation of Biophilic and Bioclimate approaches to create the *Wellness Model*. Furthermore, it fails to highlight any sustainable measures within its framework. For this reason, the *Hybrid Model* is expanded for relevance to the study.

As previously mentioned, the Hybrid model by (Yahya and Hassanpour 2022:3) integrates aspects of both revivalist and progressive techniques, resulting in architecture that is adaptive and sustainable—effectively bridging the gap between traditional and contemporary construction methods.

The literature review identified two key segments within the model. The first segment, a framework to “learn from the past,” emphasises the use of traditional, environmentally responsive design strategies, which ultimately form the basis of the *Revival Model* (Yahya and Hassanpour 2022:3). The literature indicated that traditional shelters depict the foundational relationship between man and the environment, where architecture emerges as a response to the need for shelter (Laljit 2019:28). Furthermore, Lamprecht (2016:65), emphasises the concept of culture, which encapsulates both the spiritual and material heritage of humanity, underpinned by human behaviour and material culture. Rapoport

(2006) describes cultural landscapes as evolving through human interaction with natural environments, embodying local identity and history while adapting to societal changes. This supports the framework to “learn from the past” proposed by Yahya and Hassanpour (2022:3).

The research suggests that the Revival model is underpinned by sustainable architecture that expresses cultural identity and relies on the adaptation from traditional architecture. It highlights the importance of learning from past design strategies, which rely less on technology and more on traditional methods to create effective, sustainable, user-friendly, and purpose-driven buildings.

Based on these findings, the relevant architectural design elements embedded in the Revivalist model for analysis in the precedent and case studies were identified as follows:

- Cultural sensitivity;
- Utilisation of environmentally responsive design strategies such as:
 - Utilisation of natural ventilation strategies;
 - Shade design strategies;
 - Natural ventilation;
 - Evaporative cooling;
 - Thermal mass with microclimatic elements, similar to courtyard design strategies; and
- Use of local environmentally friendly materials.

It is evident that design strategies involving the use of traditional methodologies to create environmentally responsive buildings are encompassed within the Revivalist Model. It is also noted that this design approach does not rely on technological initiatives to support environmental responsiveness.

The literature further supports the Progressive model as a framework to “learn from the present.” The progressive model contrasts with the revivalist model, as the framework of the progressive model emphasises the application of the latest available technologies to achieve energy efficiency. Fujii (1999) highlights the impact of globalisation and technological advances, which risk homogenising cultural landscapes but also provide opportunities to harmonise natural and built environments. The *Progressive Model* is underpinned by the utilisation and reliability of sustainable, contemporary technologies in the built environment.

Based on developments to the *Hybrid Model* by Yahya and Hassanpour (2022:3), the relevant elements embedded in the Progressive model are identified as follows:

- The adaption of resource-efficient technologies such as:
- Solar panels and photovoltaic systems;
- Bio-walls;
- Thermal glazed panels;
- Wind turbines;
- Waste management systems;
- Envelope designs, and
- High-performance materials, aimed at attaining resource efficiency and sustainability.

The literature reveals that the combination of the *Revival* and *Progressive Models* results in the *Hybrid Model*, which serves as a knowledge source integrating traditional and sustainable architecture. Fujii (1999:122), states that the world has entered an age of knowledgism—a period where development depends on communication. In this modern era driven by knowledge and the global economy, the emphasis is placed on the importance of adaptability to preserve and conserve the built environment.

In conclusion, the *Hybrid Model* presents South Africa with a significant opportunity by combining the most successful aspects of conventional architectural techniques with cutting-edge sustainable technologies. The *Hybrid Model* ultimately responds to the preservation of local environments.

The precedent study in the subsequent chapter employs the *Hybrid Model* framework to analyse the buildings. To achieve this, an understanding of the elements within the *Hybrid Model* is deemed essential. Consequently, the study defines specific elements aligned with the *Hybrid Model* to facilitate the analysis of each precedent study.

2.5. Summary

The literature reviewed as part of the research project identifies a gap between the preservation of natural resources and the principles of modern green building. While current practices incorporate sustainable strategies, there is a missed opportunity to draw inspiration from the deep connection early humans had with nature. The literature explores the intricate relationship between humans, nature, and the built environment. It traces the historical

evolution of this relationship, from early human societies' deep connection to nature to the modern era's significant human impact on the environment. The study highlights the importance of understanding this historical context for making informed decisions about sustainable development.

The concept of ecological architecture, which integrates nature into the built environment, emerges as a promising approach to sustainable design. The *Hybrid Model* by Yahya and Hassanpour (2022:3), which combines traditional and modern approaches, is identified as a practical framework for creating sustainable and culturally relevant built environments. By combining these elements, the research aims to contribute to a future where human civilisation thrives in harmony with nature. The iSimangaliso Wetland Park provides an ideal setting to investigate the implementation of more sustainable building practices.

Chapter 3 Conceptual and Theoretical Framework

3.1. Introduction

To establish a solid foundation for an architectural design framework in sensitive ecosystems such as iSimangaliso Wetland Park, this study integrates multiple theoretical perspectives into a cohesive conceptual framework. The key principles drawn from Sense of Place, Conservation, Ecological Architecture, Sustainability, and Critical Regionalism provide interconnected insights into sustainable design. Sense of Place highlights the emotional and cultural connections between people and their environment, which is essential in preserving the park's ecological and cultural significance. Conservation focuses on responsible resource management and ecological restoration, ensuring the protection of biodiversity. Ecological Architecture builds on conservation by integrating environmental and architectural sciences, promoting sustainable building practices that harmonise with nature. Closely related, Sustainability ensures that development meets present needs while safeguarding resources for future generations. Finally, Critical Regionalism emphasises the importance of contextual and cultural identity in architecture, ensuring designs respect local traditions and environmental conditions.

Recognising overlaps between Conservation, Sustainability, and Ecological Architecture, this study integrates them into a unified ecological framework to streamline their shared goals of environmental preservation and sustainable resource use. To maintain coherence, a hierarchical integration approach is adopted, positioning Critical Regionalism and Sense of Place as foundational principles that shape architectural interventions. At the core of the framework, Ecological Architecture incorporates Sustainability and Conservation, ensuring a balanced relationship between the built environment and nature. Formalising this conceptual framework before designing the research project is crucial, as it establishes a structured theoretical basis for the methodology chapter. By clarifying these interconnections, the study provides a systematic approach to developing sustainable architectural solutions for iSimangaliso Wetland Park.

3.2. Sense of Place in Architecture from a Phenomenological approach

iSimangaliso Wetland Park is well-known for the 'sense of place' that visitors from diverse backgrounds experience there. This 'sense of place' is a deeply personal and individual phenomenon, varying from person to person (*iSimangaliso Wetland Park Authority* 2022:32). It is influenced by cultural, spiritual, and personal connections to the area. Recognising and preserving this 'sense of place' plays a pivotal role in safeguarding the natural and cultural significance of iSimangaliso. For this reason, it is relevant to explore "sense of place" theoretically in this research.

The Oxford Dictionary defines the term "place" as a particular location where human beliefs are formed and nurtured. Vali and Nasekhiyan (2014:3747) note that "Place is a result of interaction of three components: human behaviours, concepts, and physical features."

From a phenomenological perspective, "sense of place means a place to link with a place through understanding symbols and daily activities" (Vali and Nasekhiyan 2014:3750). Any part of the environment has the potential to evoke certain emotions, and these sentiments are key to understanding a place's true nature. In the phenomenology of place, lived experience holds utmost significance. Perceptions and feelings are shaped by the place where a person resides or cultivated through various experiences (Vali and Nasekhiyan 2014:3750-3751). The sense of place establishes a connection between people and their environment, allowing their perceptions and feelings to become integrated into the semantic character of the surroundings. As quoted in Vali and Nasekhiyan (2014: 3751), "Steele believes that sense of place of each environment depends on the individual's relationship to that environment, and that the most important physical factors influencing the perception and sense of place include size, location degree of enclosure, contracts, scale, proportion, human scale, space, texture, colour, smell, sound, and visual diversity".

Similarly, Kevin Lynch's Sense of Place framework explores the potential relationship between physical forms and people's perceptions. Lynch points out that the interaction between people and space depends on the physical form of the environment, as well as cultural background, personal experience and social status among others. His views and studies were rooted in a social science perspective of the sense of place (Hu and Chen 2018:3).

The theory of place prioritises the relationship between nature, humankind and architecture, and explores how these entities engage and complement one another. In a sensitive

environment such as iSimangaliso, sense of place enables socially and ecologically conscious design strategies. Thus, within the context of this research, the sense of place theory provides a framework for designing meaningful spaces that foster a feeling of inherent oneness with nature and other humans.

3.3. Conservation

The concept of “conservation is defined as an effort to manage natural resources wisely based on the principle of preservation. Natural resources are biological elements that consists of vegetal natural resources (plants) and animal natural resources with non-biological elements around them which as a whole form an ecosystem” (Purwanti and Nazir 2022:342). As stated by Purwanti and Nazir (2022:343), the purpose of conservation is “to achieve the realisation of the preservation of living natural resources and the balance of their ecosystems so that they can better support the efforts to improve community welfare and the quality of human life”. The conservation significance of iSimangaliso Wetland Park lies in its exceptional biodiversity, the protection of endangered species, the preservation of critical ecosystems, and its contribution to both regional and global conservation efforts. Its conservation initiatives encompass ecological, cultural, and economic dimensions, positioning it as a model for sustainable conservation and ecotourism.

According to Purwanti and Nazir (2022:343), additional conservation measures include the following:

- Recovery or restoration, which refers to fixing past mistakes that jeopardised the effectiveness of natural resource conservation.
- Reusing and recycling of waste materials from homes, businesses, and drinking water systems, highlighting the need for modern waste management,
- Searching for alternatives to comparable natural resources in case they are reduced or depleted entirely.
- Selecting the best possible site, which refers to choosing natural resources for maximum use in the most effective way.
- Integration, which refers to combining different interests in resource management to prevent waste or harm to one another.

The vision of the research site is documented as, “*A renowned World Heritage Park where conservation, sustainable tourism and benefit sharing prevails*” (iSimangaliso Wetland Park

Authority 2022:10). Therefore, the concept of conservation aligns with the park's vision, while providing a model for sustainable practices that can inspire similar approaches in other conservation areas.

3.4. Ecological Architecture

The relevance of incorporating ecological architecture into iSimangaliso Wetland Park lies in its ability to strike a balance between modern infrastructure needs and the preservation of the park's unique natural and cultural heritage. It promotes responsible construction and design practices that are harmonious with the environment, making it a model for sustainable development and conservation.

According to Purwanti and Nazir (2022:341), ecological architecture is a concept that combines environmental science and architectural science. Its goal is to create a balanced relationship between structures and people, as well as between artificial and natural environments. Time, place, environment, society/culture, and construction methods are all considered integral components of ecological architecture. Therefore, ecological architecture is a holistic approach encompassing various elements. The paradigm of ecological architecture underpins the notion of creating a balance between the natural environment, humans and the built environment (see Figure 3.1).

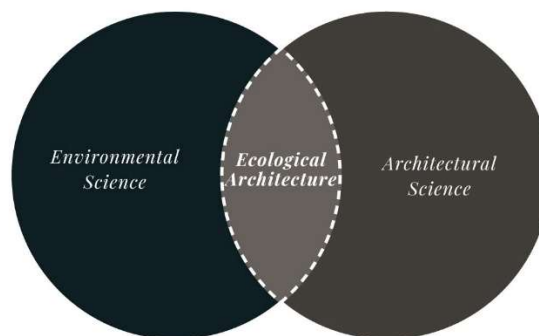


Figure 3.1 Ecological Architecture

Source: Author (2023)

Ecological architecture further emphasises harmony between nature and human beings. In addition, it takes into account aspects of nature, socioculture, time, location, and construction methods (Purwanti and Nazir 2022:341).

Purwanti and Nazir (2022:341) outline several ecological building principles:

- Adaptation to the natural environment.
- Energy conservation and reducing the use of non-renewable energy source.
- Protecting the natural environmental resources, such as soil, air, water.
- Improvement and maintenance of natural ventilation.
- Reducing dependence on service provider energy systems, (such as electricity, water) and waste management systems (wastewater and garbage).
- Encouraging the use of nearby natural resources for construction systems, including building materials and utilities (e.g., energy, water, and supplies).

The application of ecological architecture in iSimangaliso Wetland Park can thus serve as a bridge between human infrastructure and the park's unique natural and cultural heritage. It aligns with the park's mission of conservation.

3.5. Sustainability

According to Gucyeter (2016:239), the Brundtland Report elaborates on the concept of sustainable development with the definition: “Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” Gucyeter (2016:248) further states that responsive architecture should aim to establish a life-long learning process and the implementation of sustainability concepts.

The theoretical theme of sustainability emphasises that architecture holds the capacity to preserve ecological environments, contribute to social vitality and ensure a resilient future. The terms sustainable design and green architecture are widely used in the built environment. Sustainable design is a guiding principle that involves crafting both physical and conceptual elements within the constructed environment to align with the principles of ecological sustainability. The prevalence of sustainable designs has increased in response to growing environmental concerns such as the greenhouse effect, global warming, and climate change. (World Heritage Convention. 2020:1).

Green architecture is recognised and acknowledged as a strategy to minimise the adverse effects of built structures on their surrounding environment. This approach is rooted in a philosophy that draws inspiration from the environment to create spaces that are low-impact, adaptable, and conducive to well-being. The implementation of green building practices varies across regions and countries, considering unique factors such as climate, cultures, and

economic priorities. Successful green architecture is not merely an additional feature to enhance a building's performance; rather, it involves a holistic approach where buildings are designed, constructed, and operated with a primary focus on conserving energy, utilising eco-friendly and recycled materials, and safeguarding the biodiversity and natural ecology of the area (Wood 2022:1).

This research primarily aims to examine the built environment inside the iSimangaliso Wetland Park, since it may not be possible to cover all aspects of sustainable design and green building in this context. According to (Wood 2022:1), there is no single way to make a building environmentally friendly; rather, any structure that incorporates the following elements into its construction or design may be considered green:

- “Efficient use of water, energy, space and other resources” (Wood 2022:1).
- “Use of renewable energy, such as solar energy” (Wood 2022:1).
- Pollution-reduction strategies that make recycling materials possible.
- Exceptional indoor air quality.
- Use of materials that are sustainable and non-toxic to the environment and manufacturing processes.
- Environmental considerations at every stage of the process, from initial conception to final inspection and operation.
- Designs that enable adaption to a changing environment.

Wood (2022:1) further notes that green buildings differ across regions, climate, countries, cultures and economic priorities. No two building are exactly alike. Effective green architecture is not an add-on element But requires buildings to be designed and constructed with the natural environment and surroundings in mind from the planning phases to completion.

Sustainability is not only relevant but essential in iSimangaliso Wetland Park. It underpins the park's mission, and ensures the protection of its unique natural and cultural heritage for present and future generations. This study evaluates modern green building features and technologies in conjunction with traditional construction techniques that could be adopted within the park’s sensitive ecological context.

The study delves into the global environmental challenges we face today by critically analysing current phenomena. It aims to formulate hypotheses for the development of a new

human ecology, promoting coexistence with nature while preserving both green spaces and cultural landscapes. When the built environment harmonises seamlessly with its natural environment and surrounds, it has the potential to rejuvenate and support life effectively (Wood 2022:1).

3.6. Critical regionalism

Critical Regionalism is “an approach in architecture that strives to counter the lack of identity and relationship of architecture towards its location and context, its goal is to create intelligent and contextually suitable building by reviving architectural traditions that have strong roots in local circumstances” (Pragash n.d.). Ahmed (2021:101) states that Critical Regionalism, as a theoretical approach in architecture, underscores the division between local and global architectural forms. It places significant importance on respecting and understanding the local context, particularly by embracing vernacular design principles. The theory emphasises the importance of the contextual connection of built forms to society, physicality, and climatic responses.

Critical Regionalism critiques the nostalgic interpretation and representation of architecture in countries with colonial histories, calling instead for designs that are responsive to the local context and environment. Ahmed (2021:101) further argues a major shortcoming in contemporary architecture is the static nature of the built forms, which often stems from the lack of involvement of local communities in the design process. Ahmed (2021:102) affirms that built form can be modern in its outlook, while still maintaining strong connection to cultural heritage, always respecting the local context.

Incorporating critical regionalism into the research is crucial for highlighting the importance of early stage planning and design within sensitive environments such as iSimangaliso Wetland Park. This approach helps strike a balance between global influences and local specificities, ensuring that the architectural and design choices are not only functional but also respectful of the park's unique attributes. This, in turn, creates a more sustainable and harmonious environment for both nature and people.

3.7. Framework Integration

To establish a solid foundation for an architectural design framework in sensitive ecosystems such as iSimangaliso Wetland Park, this study integrates multiple theoretical perspectives to create a cohesive conceptual framework. By synthesising relevant secondary data from the

literature review, the research identifies key principles from five theoretical perspectives: **Sense of Place, Conservation, Ecological Architecture, Sustainability, and Critical Regionalism**. Each framework contributes unique yet interrelated insights into sustainable architectural design.

Sense of Place fosters emotional and cultural connections between people and the environment, while Conservation emphasises the responsible management of natural resources. Ecological Architecture integrates environmental and architectural sciences to balance human activity with natural ecosystems, closely aligning with Sustainability, which focuses on minimising environmental impact and ensuring resource preservation for future generations. Lastly, Critical Regionalism addresses the need for architecture to maintain cultural and contextual identity. The analysis reveals significant overlaps among Conservation, Sustainability, and Ecological Architecture, necessitating their integration into a unified ecological framework.

3.7.1. Fundamental ideas and principles identified in each framework

3.7.1.1. Sense of place

As previously discussed, the framework of sense of place empowers architectural design to evoke emotional and cultural connections, fostering harmony between people and the environment (Vali and Nasekhiyan 2014:3750). Moreover, the conceptual framework recognises that the sense of place in any environment is shaped by various elements, such as individuals' personal relationships with the space, the size and scale of the place (whether enclosed or open yet defined), proportion, human scale, texture, colour, smell, sound, and visual diversity. Similarly, research by Hu and Chen (2018:3) reaffirms that sense of place maintains a relationship between physical forms and people's perceptions, which is also influenced by an individual's cultural background, physical sense, and other factors.

3.7.1.2. Conservation

The conservation framework is defined as an effort to manage natural resources. Conservation serves as the cornerstone of this framework, focusing on preserving the environment for generations. The research emphasises the importance of protecting natural resources, restoring damaged ecosystems, and practicing sustainable resource management.

3.7.1.3. Ecological architecture

The framework of ecological architecture, as defined by Purwanti and Nazir (2022:341), combines environmental science and architectural science to create a balance between the

natural environment, humans and the built environment. Ecological architecture aims to bridge the gap between human activity and natural ecosystems, creating a harmonious balance.

The literature links the Revivalist Model to ecological architecture by highlighting shared design considerations, such as using locally sourced materials, minimising reliance on energy systems, and reducing environmental impact without heavy dependence on advanced technologies.

3.7.1.4. Sustainability

The sustainability framework is based on the principle that development should meet the needs of the present without compromising the ability of future generations to meet their own needs. This framework emphasises the preservation of ecological environments and the promotion of green architecture as a strategy to minimise the adverse effects of built structures on their surroundings. Green architecture involves creating spaces that are low-impact and conducive to the surrounding ecosystem.

While sustainability emphasises the preservation of ecological environments, green ecology supports this framework by focusing on strategies to minimise the environmental impact of the built environment.

The research further reveals that green architecture varies across regions and is not an isolated element added to a building. Instead, it is strategically designed from the conceptual stages, with a primary focus on conserving energy, utilising eco-friendly and recycled materials, and safeguarding the natural environment of the area.

Sustainability is closely linked to the Progressive Model as highlighted in the literature review, particularly in its reliance on technology to support sustainable practices in the built environment.

3.7.1.5. Critical Regionalism

The critical regionalism framework aims to address the lack of identity and the disconnection between architecture and its location and context. It focuses on reviving local traditions (Pragash n.d.). Ahmed (2021:101) further indicates that critical regionalism emphasises understanding the local context and integrating this understanding into building design. The Revival Model underpins the concept of "learning from the past," which aligns with critical

regionalism's aim to counter the lack of cultural identity and its disconnection from the local environment.

3.7.1.6. Commonality and overlapping conceptual frameworks

There are significant overlaps between conceptual and theoretical frameworks, especially regarding Conservation, Sustainability and Ecological Architecture. Conservation is defined as the effort to manage natural resources, which closely aligns with Ecological Architecture, as both emphasise protecting natural environmental resources. Similarly, Sustainability emphasises the preservation of ecological environments, and is defined as a development that meets the needs of the present without compromising the ability of future generations to meet their needs. All three frameworks share common objectives of resource preservation and environmental protection.

This analysis highlighted that while each framework is individually relevant to the study, they also share common and overlapping elements. Therefore, for the purposes of this research, consolidating Conservation, Sustainability and Ecological Architecture into a cohesive ecological framework is proposed, with an emphasis on preserving the natural environment and resources as relevant to the study.

3.7.1.7. Hierarchical integration approach

The above framework are relevant for the analysis of the study; however, to avoid contradictions and ensure clarity, a cohesive approach is necessary.

Given the shared elements between Conservation, Sustainability and Ecological Architecture, these theoretical and conceptual frameworks can be merged into a singular cohesive framework within the context of Ecological Architecture.

Therefore, the study proposes the following hierarchical approach:

- Critical Regionalism
- Sense of Place
- Ecological Architecture (incorporates the integration of Sustainability and Conservation)

3.8. Summary

The concepts and theories obtained were used to develop paradigms, themes, patterns and theories, that formed the notion of knowledge to critically analyse and interrogate the

relationship between the built environment, natural ecosystem, and human-wellbeing with the focus of iSimangaliso Wetland Park. The connection between the concepts of Sense of Place, Conservation, Ecological Architecture, Sustainability, and Critical Regionalism can be summarised as recognising the value of a deep connection with the environment and culture. Sense of Place and Critical Regionalism emphasise emotional and cultural attachment to a location, while Conservation, Ecological Architecture, and Sustainability seek to protect and preserve the natural and cultural aspects of these places.

These concepts are interrelated through their shared values of environmental stewardship, contextual design, and the promotion of well-being. They can work in harmony to create sustainable and culturally meaningful environments that balance the needs of both people and the planet.

Each paradigm offers a distinct lens through which to view the relationship between human culture, the environment, and the built environment. These concepts form a network of interconnected principles, and when applied to a specific locale, such as iSimangaliso Wetland Park, they encourage a holistic, responsible approach to preserving both natural and cultural heritage while promoting sustainable development. This collective perspective emphasises the importance of contextually relevant practices that respect and honour the unique characteristics of the region.

Chapter 4 Methodology

4.1. Introduction

This chapter outlines the methodological framework that underpins the research process. The preliminary literature survey revealed that a qualitative, inductive, and precedent-based approach, supplemented by correlational analysis, is most appropriate for investigating the interactions between the built environment and the natural ecosystem within the iSimangaliso Wetland Park.

The literature highlighted the importance of context-sensitive design approaches in ecologically sensitive environments, emphasising the need for case studies, direct observation, and cross-case comparison for drawing meaningful insights. Accordingly, this research adopted a qualitative methodology, an inductive data analysis process and a longitudinal time horizon, allowing for a deeper understanding of evolving spatial and ecological relationships over time.

A correlational component was included to identify recurring patterns, similarities, and contrasts among selected case studies and site observations. This facilitated the exploration of potential associations between architectural strategies and their ecological or social impacts—without implying causation, but rather highlighting relationships worthy of further study or design consideration.

The methodology was structured around primary site-based observations, secondary data analysis, and precedent study research, aiming to generate grounded theory and practical insights into ecologically responsive architectural solutions. The following sections detail the specific methods of data collection, analysis procedures, time horizon, ethical considerations, and study limitations.

4.2. Qualitative Research approach

This research was grounded in the principles of qualitative research. It addressed the difficulties involved in classifying a building as "green" and adopted a social constructivist viewpoint on the creation of sustainable architecture.

Bhandari (2020: para. 1 line 1) states that a qualitative case study involves examining and collecting non-numerical data, such as video, text or audio, in order to comprehend opinions,

concepts or personal experiences. this type of data can be further utilised to gain in-depth understanding of a problem or to produce new ideas for research.

The qualitative research technique was used to gain insight into individuals' subjective experiences of the world. As Bhandari (2020:4) explains, “While there are many approaches to qualitative research, they tend to be flexible and focus on retaining rich meaning when interpreting data in a specific field.”

Bhat (2014: para. 5 line 1) emphasises that qualitative research allows for the collection of non-numeric data from precedents (based on previous built structures and sustainable measures) and helps identify the manner in which decisions are made. This approach provides detailed insights that inform conclusions about ecologically responsive architecture within sensitive environments such as the iSimangaliso Wetland Park context.

Furthermore, qualitative research allowed for the collection of data on the sensitive environment within the iSimangaliso Wetland Park, enabling observation of existing conditions without harming or altering the environment in any way.

The qualitative research approach proved relevant to the iSimangaliso Wetland Park case study because it captured the nuanced interactions between diverse ecological, cultural, and social elements. Through qualitative data collection and analysis, the study also incorporated local communities' perspectives, cultural meanings, and human interactions with the landscape, contributing to a more holistic understanding of the context to inform more effective conservation and management strategies.

4.3. Precedent Study research

This research utilised the precedent study research method, which involved examining existing or past architectural works to inform future design decisions. This approach offered important insights into design strategies by analysing several buildings with similar contexts and features. The research precedents were carefully selected to match the study's context and setting, identifying the building designers wherever possible. The primary goal of precedent research is to understand how designers addressed similar problems in comparable contexts, providing insights that enhance design outcomes and avoid previously documented mistakes.

To ensure relevance and alignment with the study context, specific criteria were followed in the selection of precedents. Since the built environments under investigation often

incorporate unique cultural, historical, and environmental characteristics, buildings were first selected locally, based on their geographic location within similarly sensitive landscapes or their designation as world heritage sites within South Africa, and then compared with global precedents. Second, attention was given to the ways in which designers considered the surrounding contexts, especially how they preserved and blended in with the natural environment. The study focused on incorporating sustainable technology into buildings, highlighting innovative approaches to environmental stewardship and resource efficiency. This meticulous approach aimed to generate important insights into the connection between sustainability, context, and design.

The qualitative strategy based on precedent study research was relevant for developing a suitable framework, which used existing case studies, established criteria and precedent to appraise the research into ecologically responsive architecture of the iSimangaliso Wetland Park.

The study of buildings with a similar context was conducted through site visits, desktop research and the collection of data from books, journals and dissertations. No direct contact with human participants was made. Site visits were conducted to observe the natural surroundings, observe how the spaces functioned, and identify current activities, like daily tourist attraction points and social interactions within the iSimangaliso Wetland Park.

In order to develop a thorough understanding and analyse the relationship between the built form and the natural ecosystem, focusing on the iSimangaliso Wetland Park, the research design methods adopted for this research were based on evidence obtained from various sources. A series of qualitative techniques were utilised, including literature (e.g., books and journals) analysis of routinely collected data through precedent and case studies, and direct observations.

4.4. Data Collection Strategies

This study employed the following techniques for gathering data.

4.4.1. Primary data collection

Primary data refers to original, firsthand information collected directly by the researcher for the specific purpose of the study. It is typically unprocessed data that has not previously been analysed or interpreted by others. According to Kabir (2016), primary data is “collected

directly from first-hand experience,” and is essential for studies seeking to understand contemporary phenomena in context.

In the context of qualitative research, primary data is generally collected through non-numerical means such as interviews, observations, visual documentation, and participatory engagement. These methods are used to gather in-depth insights, understand meanings, and explore experiences or behaviours as they occur naturally within a given setting.

For this specific study, primary data was derived through a longitudinal, observational strategy, aligned with the time horizon discussed in Section 4.5. Data was collected over an extended period to track and interpret subtle changes in the spatial and ecological interactions within the iSimangaliso Wetland Park.

The primary data in this study was collected using the following tools:

- Physical site visits and direct observation, including spatial relationships, ecological features, and user interaction patterns.
- Photographic documentation, capturing visual evidence of architectural interventions, landscape features, and environmental context.
- Sketches and field notes, used to record spatial relationships, design strategies, and informal observations that may not be captured through photography alone.
- Longitudinal observation, involving repeated visits and consistent note-taking to identify temporal patterns or changes.

This multi-tool strategy ensured a holistic understanding of the built-environment-and-natural-ecosystem interaction, grounded in the specific context of the iSimangaliso Wetland Park. The data collected through these methods served as the foundation for identifying patterns, themes, and correlations during the inductive analysis process.

4.4.2. Secondary data collection:

Secondary data refers to information that has already been collected, processed, or published by others for purposes other than the current research. According to Saunders, Lewis, and Thornhill (2019), secondary data includes both raw data and published summaries that can be reanalysed to suit new research objectives.

In the context of qualitative research, secondary data serves as a valuable supplement to primary data by providing background information, contextual knowledge, theoretical grounding, and comparative insights. While primary data allows for direct observation of

the current context, secondary data enables the researcher to draw connections with prior studies, historical patterns, and broader theoretical frameworks.

The strategy for secondary data collection in this research was based on thematic correlation and comparative analysis. Specifically, key aspects related to ecologically responsive architecture—such as sustainability practices, contextual design approaches, and environmental impact—were identified and correlated across multiple sources. This process supported the emergence of themes, patterns, and precedents that informed the primary data analysis and guided the inductive reasoning process.

The tools used for capturing and processing secondary data included:

- Microsoft Excel for organising literature findings, categorising key themes, and tracking recurring concepts across different case studies and sources.
- Document analysis frameworks, used to evaluate content from scholarly journals, theses, policy documents, and design reports.

The secondary data sources included:

- Journals, particularly in the fields of architecture, sustainability, and ecological conservation.
- Theses and dissertations related to sustainable architecture or ecological design in sensitive environments.
- Websites and online databases of architectural case studies and environmental reports.
- Public records and official documents, such as development plans or heritage site management guidelines.
- Books and academic texts discussing theoretical perspectives and precedent studies relevant to the built-natural interface.

This structured approach allowed for triangulation between secondary data and firsthand observations, thereby enhancing the reliability and depth of the research findings.

4.5. Time horizon

A time horizon is used in this research to determine the period or duration over which the research was conducted. The choice of a time horizon is significant and relevant because it influences the research design, methodology, and the interpretation of results.

The longitudinal time horizon refers to the collection of various data over an extended period. An important aspect of a longitudinal time horizon is its ability to examine change over time (Thesis Mind. 2019:28).

Based on the research aims and objectives as determining factors, this study used a longitudinal time horizon. This approach was beneficial in identifying concepts and frameworks that evolved over time. It was crucial to identify case studies of buildings that had already been built in South Africa and abroad in previous years, and to analyse how these building responded to their respective contexts, as well as what insights could be extracted in the current period.

4.6. Data Analysis

An underlying assumption in this research was that data collected through various methods should, in turn, lead to conclusions that are similar in nature or approach the same issue from different perspectives, thereby facilitating the development of an atomistic understanding of the phenomenon (Creswell 2011:1). This study adopted a qualitative data analysis framework underpinned by an inductive approach. Inductive reasoning involves drawing general conclusions from specific observations, allowing themes, patterns, and meanings to emerge organically from the data without relying on preconceived hypotheses.

This approach aligned with the exploratory nature of the study, which sought to understand how architecture can respond ecologically within sensitive environments such as the iSimangaliso Wetland Park. The assumption underlying this method was that data collected through various qualitative strategies—such as precedent study, physical site observations, and literature reviews—would reveal consistent or complementary insights when triangulated. By examining recurring themes and correlations in architectural responses to ecological conditions, the study developed grounded theories rooted in real-world data. Data was reviewed iteratively. This process included systematically comparing new information with previously collected data (constant comparison), allowing for the refinement and validation of emerging patterns.

The analysis process concluded by clustering findings into coherent thematic categories that responded directly to the research objectives and questions. These findings informed recommendations for ecologically responsive architectural design strategies suited to similar

sensitive environments. The study did not involve human participants, and thus confidentiality and anonymity protocols for individuals were not applicable, however, the privacy of contextual data relating to the community of iSimangaliso Wetland Park's data was respected and maintained for the duration of the research, and will be disposed of securely thereafter.

4.6.1. Research materials

The research materials utilised in this study consisted of both primary and secondary sources, including academic journals, field notes, theses, books, and credible websites. These materials were collected, stored, and organised systematically to ensure traceability and academic integrity.

All materials were clearly referenced. Hard copies were printed or photocopied and marked with complete bibliographic details, while digital copies were stored in organised folders. This approach ensured that all sources used could be easily traced during the data analysis and reporting stages.

Each source underwent critical evaluation to determine its relevance, credibility, and contribution to the research objectives. Particular attention was paid to whether the material directly informed or supported the study's focus on the conservation of the built environment within the context of the iSimangaliso Wetland Park.

Materials were assessed using the following criteria:

- Relevance to ecologically responsive architecture and conservation principles.
- Alignment with the South African and global context of environmentally sensitive design.
- Applicability to the themes of cultural, environmental, and spatial interaction in protected areas.
- Contribution to the development of conceptual frameworks or precedent-based insights.

By ensuring that only contextually relevant and academically rigorous materials were included, this study maintained a high level of analytical integrity and supported the formulation of informed, grounded findings.

4.6.2. Data analysis

The research adopted an inductive approach. Inductive reasoning began with making observations and collecting facts or hypotheses. It included identifying patterns from observations and then developing explanations or theories for those patterns. This was done by analysing facts, theories, and ideas via a sequence of hypotheses (Business Research Methodology. 2022b:1). Constant comparison was employed by systematically comparing new data with previous data, refining, and expanding emerging patterns and themes. This process ensured that patterns were grounded in the data and contributed to a deeper understanding of the objectives.

The data was further reviewed and explored, which required multiple readings to gain a comprehensive sense of the contents. Additional notes were kept regarding my thoughts, ideas, or any questions that arose during this process.

Thereafter, a thorough review of the data was conducted to develop, revise or combine codes into themes related to the research objectives as stated in Section 1.4.2. Further, recurring themes, language, opinions, and beliefs relevant to the study were identified and analysed. Data related to each individual component was first scrutinised before making across case comparisons.

Upon completion of the analysis, conclusions were deduced through repeated reviewing and sorting, thereby clarifying the research questions. Attention was paid to variations within each precedent or study; where relevant, the relationships among various causes, outcomes, and effects in ecological responsive architecture were considered.

The reporting of the inquiry and findings provided crucial contextual information to explain the various processes followed and how the final conclusions were derived.

4.7. Data storage and disposal

The research data will be stored securely for five years and thereafter, hardcopies will be disposed of safely, and all electronic copies of data will be securely deleted.

4.8. Inclusion and Exclusion

The study did not involve human participants. It was based on the observation of the existing iSimangaliso Wetland Park and case studies of existing buildings in similar ecological and cultural contexts. The geographic scope of the building case studies was within South Africa,

with additional analysis of an international precedent where similar demographic and environmental factors were present.

Inclusion criteria were based on the relevance and appropriateness of the case studies to the research objectives. Selected case studies had to align with the study theme to ensure a consistent and manageable review process. Only journals and publications from reputable sources, authored by local and international writers were included. The research was limited to studies conducted in South Africa and published in English. The years of publication ranged from 2008 to 2023. Systematic reviews of original studies that met these criteria were also included.

Exclusion criteria included review articles, editorials, letters and publications in languages other than English.

4.9. Research instrument

The primary research instrument employed in this study was non-participant structured observation, which allowed the researcher to systematically examine the interaction between the built environment and the natural ecosystem within the iSimangaliso Wetland Park. This method aligned with the qualitative nature of the study and supported the inductive reasoning approach used to derive meaning from environmental and spatial conditions.

The basis for the observation method was drawn from established qualitative research protocols, particularly those outlined by Spradley (1980), who described observational studies as a systematic approach to documenting activities, interactions, and physical settings in their natural context. Furthermore, Creswell (2013) advocated for observational protocols that guide the researcher in recording visual and spatial data while minimising interference.

In this study, the observational framework included the following elements:

- Descriptive observations of physical characteristics, materials, landscape integration, and architectural features of structures within and around the park.
- Focused observations on specific phenomena such as human interaction with space, accessibility, orientation, and signs of ecological responsiveness (e.g., shading, water catchment, vegetation integration).
- Temporal observations conducted at different times of day and over a period of repeated visits to assess changes in spatial use, environmental conditions, and light

or weather-related influences (aligned with the longitudinal time horizon in Section 4.5).

The observation process was guided by a structured protocol, adapted from existing tools such as the “Systematic Social Observation” framework (Sampson & Raudenbush. 1999), which was modified to suit environmental and architectural contexts. A custom checklist was used during site visits to ensure consistency across observations. This included:

- Spatial characteristics (layout, form, scale, orientation)
- Environmental features (natural integration, flora/fauna, microclimate responsiveness)
- Materiality and construction techniques
- Sustainability elements (water use, energy features, waste management)

Observations were recorded through a combination of field notes, photographic documentation, and annotated sketches. These tools enabled the researcher to capture data in both visual and textual formats, which was then thematically coded and triangulated with secondary data sources during the analysis phase.

4.10. Study Population and Sampling

The study population and sampling were limited to the geographic area of iSimangaliso, focusing on the Wetland Park, situated within the province of Kwa-Zulu Natal, in South Africa. Precedents or case studies of existing buildings were selected from within South Africa. In addition, a limited number of international case studies were included through desktop-based study.

4.11. Ethics Consideration

This research did not involve any direct engagement with human participants; therefore, standard ethical protocols related to informed consent, and participant protection did not apply. However, ethical considerations remained a critical component of the research process—particularly in how data was collected, analysed, interpreted, and reported.

The study applied a formal correlational strategy to analyse the relationship between architectural interventions and ecological sensitivity. While these correlations were established through observation and secondary data rather than experimental manipulation, the ethical obligation lay in ensuring that such associations were not misrepresented,

overstated, or taken out of context. Patterns identified between precedent architectural responses and ecological variables were interpreted with careful attention to nuance, respecting the complexity of the built-environment-natural-ecosystem interaction. No causal relationships were assumed unless justified through strong evidence.

In terms of data ethics, all sources—whether obtained through primary site observations or secondary academic literature—were appropriately referenced and used in compliance with academic integrity standards. The researcher ensured that data sourced from local communities or case study environments such as the iSimangaliso Wetland Park was represented respectfully and sensitively, especially given the cultural and environmental significance of the site.

Furthermore, research validity was maintained through transparent documentation and triangulation of data across multiple reputable sources, such as peer-reviewed journals, books, and official reports. All data collected was securely stored and used solely for academic purposes.

The researcher committed to preserving the integrity of the natural context by avoiding any form of ecological disruption during site visits and ensuring that interpretations and recommendations contributed positively to sustainable and ecologically responsive architectural discourse.

Potential for harm: There was no potential for any physical harm to the environment as a result of this study.

4.12. Limitations of the Study

The study was limited to the requirements for case study research at Master's degree level, as described by the Durban University of Technology⁹. It did not address all aspects of biodiversity, wetland systems, hydrology, cultural dynamics, sustainability, green building standards, or economic issues present within the iSimangaliso Wetland Park.

However, the research sought to analyse and address existing norms of the built environment and its impact on natural ecosystems within iSimangaliso Wetland Park. It further aimed to investigate how buildings could be designed and built in ways that preserve natural resources.

⁹ <https://www.dut.ac.za/wp-content/uploads/handbooks/Postgraduate%20Handbook.pdf>

4.13. Summary

This chapter outlined the methodological framework for investigating ecologically responsive architecture within the iSimangaliso Wetland Park. The study adopted a qualitative, inductive, and precedent-based approach, supported by correlational analysis to explore relationships between architectural interventions and ecological systems.

A qualitative strategy was deemed appropriate due to the complexity of interactions between natural, cultural, and built environments. Data was collected through non-participant structured observations, precedent studies, site visits, and literature reviews, allowing for a rich understanding of spatial and ecological dynamics. The use of longitudinal observation enhanced the ability to detect changes over time.

Precedent study research drew insights from local and international architectural examples within ecologically sensitive landscapes, focusing on sustainable design strategies, contextual integration, and environmental responsiveness.

Primary data included observational field notes, sketches, photographs, and repeated site visits. Secondary data consisted of academic journals, theses, reports, and policy documents, organised using thematic and comparative analysis tools such as Excel and document analysis frameworks.

Data analysis followed an inductive approach, using constant comparison to identify recurring patterns and themes. Research materials were critically selected for relevance and stored systematically.

Chapter 5 Precedent Study

5.1. Introduction

The precedent study investigates various building typologies located within a similar context or landscape sensitivity as the iSimangaliso Wetland Park. These studies aim to explore how the natural ecological context is preserved within the built environment and analyse the sustainable techniques and methods utilised in these buildings, which could be adapted to developments within the iSimangaliso Wetland Park.

The framework informing the selection of the four precedent studies is based on the criteria outlined in Section 4.3, Precedent Study Research. Introducing precedent studies before delving into the iSimangaliso Wetland Park case study is essential to establish a broader perspective. It offers insights into the historical, contextual, cultural, sustainability, ecological and architectural design principles that may have influenced the region of interest. These precedent studies also enable comparative analysis, helping to identify through correlation the common trends, patterns and differences across design principles related to the Revival Model, Progressive Model, and Hybrid model, as discussed in Chapter 2, Literature Review. In essence, they provide a foundation for a more comprehensive and informed analysis, shedding light on how factors interact with and impact the local and regional dynamics of the specific area.

Table 5.1 is derived from the criteria outlined in Section 2.3, which presents the basis for analysing the three models.

Table 5.1: Analyses of the Revivalist model, Progressive model and Hybrid model

Model	Key Focus	Design Strategies and Elements	Philosophical/ Ecological Orientation	Strengths	Limitations
Revivalist Model	Learning from the past; cultural continuity and ecological wisdom	<ul style="list-style-type: none"> • Natural ventilation • Shading strategies • Evaporative cooling • Thermal mass and microclimatic design (e.g., courtyards) 	<ul style="list-style-type: none"> • Anthropocentric (passive relationship with nature) Eco-cultural 	<ul style="list-style-type: none"> • Culturally sensitive • Low energy demand • Utilises local knowledge and materials 	<ul style="list-style-type: none"> • Limited technological integration • May not meet all modern energy performance standards

		<ul style="list-style-type: none"> • Use of locally sourced, eco-friendly materials • Environmentally responsive passive strategies 			
Progressive Model	Learning from the present; innovation through advanced sustainable technologies	<ul style="list-style-type: none"> • Thermal glass panels • Bio-walls • Photovoltaic panels • Wind turbines • Envelope designs • High-performance materials • Active solar energy systems • Efficient water and waste management systems 	<ul style="list-style-type: none"> • Technocentric; • Eco-technic logic; • Anthropocentric 	<ul style="list-style-type: none"> • High performance in energy/resource efficiency • Measurable environmental impact reductions 	<ul style="list-style-type: none"> • Risk of cultural homogenisation • May neglect ecological and contextual sensitivity
Hybrid Model	Integrative approach; bridging traditional and contemporary methods for adaptability and resilience	<ul style="list-style-type: none"> • Fusion of Revivalist & Progressive strategies • Integration of passive and active systems • Cultural identity preservation • Use of both natural materials and green technologies • Adaptability to local and global contexts 	<ul style="list-style-type: none"> • Integrative ecological logic • Anthropocentric and non-anthropocentric blend 	<ul style="list-style-type: none"> • Balanced approach • Enhances resilience • Suited for diverse climates and socio-economic needs 	<ul style="list-style-type: none"> • Requires nuanced understanding and contextual expertise • Implementation can be complex

5.2. Precedent Study 1 - The Forum Homini Boutique Hotel – Environmentally-Friendly Tourism

5.2.1. Introduction

The first precedent study analysed was the Forum Homini Boutique Hotel, designed by Activate Architects in collaboration with GREENinc Landscape Architects, and located in Johannesburg South Africa. Completed in 2006, the hotel is situated near the Sterkfontein Caves within the Cradle of Humankind, a World Heritage Site on the outskirts of Johannesburg (Landezine. 2013:1).

This study was chosen as a suitable and relevant example of a building that responds to sustainability in a tourism landscape, similar to that of the research site, which is located within a sensitive environment and a World Heritage Site. The aim of this precedent study was to investigate how the building responds to the sensitive ecological context of a world heritage site, and to analyse the sustainable methods and techniques used. It focuses on the synergy between the built form and the natural landscape. The framework that informed the selection of this precedent study is based on the criteria outlined in Section 4.3, Precedent Study Research. This precedent study was conducted using a combination of desktop research from reliable resources and visual observation carried out through a site visit.

5.2.2. Background

This precedent study relates to the research objectives outlined in Section 1.4.2, Research Objectives. The World Heritage Site of the Cradle of Humankind has attracted both local and international tourist interest due to its significant paleoanthropological value. The site has yielded hominid remains dating back as far as 3.3 million years. A notable discovery in the area is the skull of an adult female *Australopithecus africanus*, affectionately known as "Mrs. Ples". The developer purchased the land that contained an existing log-cabin style lodge. These lodge cabins were demolished, but the development rights remained in place. Construction of the earthworks commenced at the beginning of 2005, with the intention of establishing a hotel that integrates luxury with deep cultural and historical narratives (Landezine. 2013:1).

5.2.3. Concept and Design



Figure 5.1: Site Plan of Forum Homini Boutique Hotel

Source: Inhabitat (2011). The site plan shows that the buildings follow the natural contours of the landscape, demonstrating sensitivity to the existing topography. The buildings are arranged in a clustered formation, spaced apart and positioned with consideration for privacy, views, and the reduction of environmental disturbance. They are arranged along the contour lines and around the natural water body labelled 14, which in turn minimises earthworks and maintains natural drainage patterns, an essential aspect of ecologically responsive design.



Figure 5.2: Site Analysis

Source: *Inhabitat* (2011); edited by Author (2023). This annotated site plan of the precedent project illustrates a sensitive response to topography, orientation, and ecological context. The east–west sun path is used to optimise natural lighting and thermal comfort, while visual axes (green arrows) emphasise views towards surrounding water bodies and natural features. The separation of public and private zones, indicated through circulation routes and the zoning of amenities, reflects an ecologically conscious and guest-centred design approach.

According to Landezine. (2013:3), the architectural concept behind the Homini Hotel was to forge a strong connection with the surrounding palaeo-anthropological¹⁰ sites while expressing the natural environment, architecture, and art in a fluid and simple manner. The design’s response to the site and its surroundings resulted in a building that closely resembled a cave. A key aspect of the concept was the reinstatement of the indigenous Highveld landscape, which was extended over the flat roofs of the buildings, enhancing the integration between architecture and terrain. This seamless expression of landscape, building, and art was achieved through close collaboration among architects, interior designers, artists, structural engineers, and landscape architects. On arrival, the hotel is discreetly hidden within the landscape. Parking and service areas are positioned along a

¹⁰ Paleoanthropological – concerned with the origins and study of human evolution through the fossil and archaeological records (Jurmain et al. 2013).

winding access road and screened by vegetated berms to maintain the natural aesthetic and shield views from nearby residences.

The site plan, as illustrated in Figures 5.1 and 5.2 demonstrates a well-considered integration of environmental and spatial design strategies, establishing it as a strong precedent for ecologically responsive architecture. The orientation of buildings along the east–west sun path maximises passive solar gain in the mornings while mitigating afternoon heat, supporting energy efficiency and thermal comfort. The layout respects the site's natural topography and water bodies, with minimal disruption to the landscape. Key views are strategically preserved and enhanced through the positioning of guest suites and public amenities, offering immersive experiences of the surrounding environment. The separation of public and private circulation routes ensures both functional efficiency and privacy, while promoting walkability and reducing reliance on vehicles. This approach strongly aligns with sustainable design principles appropriate for sensitive ecological contexts like the iSimangaliso Wetland Park.

In reference to Figure 5.1 which depicts the plan view and location of the parking area, and Figure 5.3.3 the parking area in context, visual observation reveals that parking surfaces are constructed using a combination of natural materials, such as natural stones for the parking bay, and paved roads linking them. The carports are constructed with steel structure covered by canvas shade cloth. These design choices indicate an effort to incorporate environmental conversation techniques and local materials. However, observation revealed that there was an evident gap between the choice of materials used versus the theme of the facility.



Figure 5.3: Parking Bays for the Homini Forum Boutique Hotel

Source: Author (2023). The parking area demonstrates an effort toward environmentally conscious design through the use of natural stone surfacing for parking bays and permeable, locally sourced materials. The steel-frame carports with canvas shade cloth reflect a practical approach to solar protection using minimal resources. However, a noticeable disconnect exists between the materials used in the parking area and the architectural theme of the broader facility, suggesting a missed opportunity to fully integrate the parking infrastructure into the ecological and aesthetic narrative of the site.

As visitors approach the facility, the first building they come across creates a deliberate cut in the landscape, mimicking the entrance to a cave (refer to 5.4. Large hand-carved sandstone pillars, sculpted by artist Dave Rossouw, are incorporated into the entrance walkway of the hotel complex (refer to Figure 5.7). Public buildings such as the restaurant, library, reception, and conference facility are arranged around a lower courtyard.

The facility has a higher, landscaped terrace, while the lower courtyard area symbolically represents the “hard times” of human evolution. This is expressed through paved concrete, sandstone seating blocks, gravel and hard Wild Olive trees. As seen in Figure 5.9 and Figure 5.10, the sandstone seating blocks are arranged to create an informal amphitheatre, where guests are entertained with dancing, drumming and indigenous story telling. The abundant vegetation on the upper terrace symbolises the positive aspects of human existence. Many of the plant species used in this area were selected for their culinary or utilitarian significance in the daily lives of the early inhabitants of the Cradle of Humankind (Landezine. 2013:5). By observation it is evident that the facility incorporates a rich sense of connection to African ancestors.



Figure 5.4: Entrance to Homini Forum facility

Source: Greeninc (n.d.). The entrance evokes a cave-like experience as one approaches the facility from the parking area. Sensitivity to the surrounding context and natural landscape is evident in the building's integration with its environment, particularly through the use of materials such as natural stone, which reflect regional typologies.

The entrance incorporates a custom-made steel artwork titled "The Sum of Us" by artist Marco Ciandanelli (see Figure 5.5). This piece symbolises the gradual development of humankind over time, expressing the idea that we are the collective result of all those who came before us.



Figure 5.5: Custom made statue

Source: Author (2023) a custom-made steel artwork titled "The Sum of Us" by artist Marco Ciandanelli. The piece symbolises the gradual evolution of humankind, reflecting the notion that we are the collective outcome of all who came before us.



Figure 5.6: Walkway leading to the conference, reception, and restaurant

Source: Author (2023). This depicts the main entrance area leading to key public spaces such as the reception, restaurant, conference room, lounge, and library. Hand-sculpted sandstone pillars by artist Dave Rossouw and carved footprint pathways symbolise the evolutionary journey from ape to modern human. These elements reflect a deeper narrative of human origin and transformation, seamlessly woven into the architectural experience.

Figure 5.6 portrays the primary entrance area, guiding guests towards the reception, restaurant, conference space, lounge, and library. As shown in Figures 5.6 and 5.7, artist Dave Rossouw sculpted enormous sandstone pillars by hand. The sandstone walkways also feature footprint cutouts that vividly portray the evolutionary progression from ape-like to modern human feet. These imprints effectively illustrate the transformative journey of humankind and its consequences, reflecting the essence of humanity within the built environment.



Figure 5.7: Entrance walkway and footprints of apes evolving

Source: Author (2023). Carved footprint pathways symbolise the evolutionary journey from ape to modern human. These elements reflect a deeper narrative of human origin and transformation, seamlessly woven into the architectural experience.



Figure 5.8: Amphitheatre

Source: Author (2023). This showcases the amphitheatre featuring a central art piece that also functions as a custom-designed boma. This symbolic fire element highlights the historical significance of fire in human evolution. Locally sourced stone seating, cut into uniform square blocks, evokes ancestral gathering spaces while providing a tactile connection to the region's material heritage.

In reference to Figure 5.7, exposed aggregate, retaining walls covered with stone, and concrete walkways create a cohesive connection between the different structures (Landezine. 2013:7). The amphitheatre, as shown in Figure 5.8, features a central art piece with profound historical significance related to human evolution. This art piece also serves as a custom-made boma, where fire is kindled, symbolising the importance and impact of fire since ancestral times. The seating in the amphitheatre is crafted from locally sourced rock, cut into square shapes and uniformly arranged to provide comfortable seating reminiscent of ancestral times.

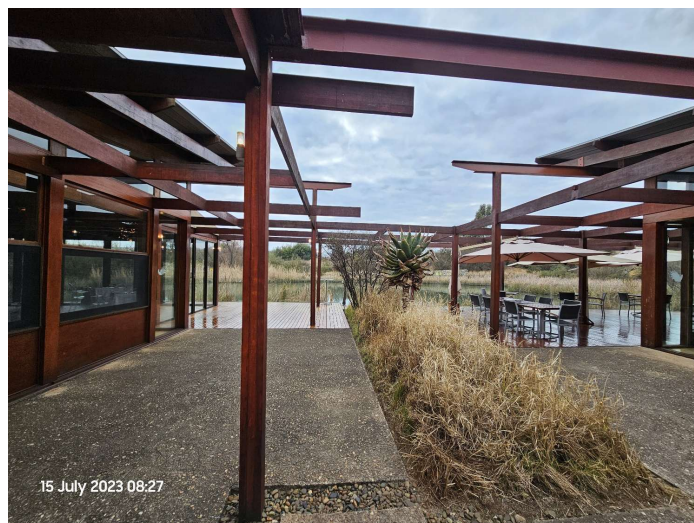


Figure 5.9: Restaurant and lounge

Source: Author (2023). This shows the spatial arrangement of the library, lounge, and restaurant, all strategically positioned to offer unobstructed views of the existing body of water—enhancing the guest experience through visual connection with the natural landscape.

It can be observed that the library, lounge, and restaurant are all arranged to provide views of an existing body of water (refer to Figure 5.9). Additionally, from the restaurant, a pathway meanders along the edge of this waterbody or dam, creating a connection between the public buildings and twelve private suites, a swimming pool, and a honeymoon suite (refer to Figure 5.10).



Figure 5.10: Buildings overlooking the water body

Source: Author (2023). The image captures the view from the suite pathway overlooking the waterbody. The restaurant and library/lounge buildings appear to merge seamlessly with the natural surroundings, with the material palette reflecting a sensitive and context-aware design approach.



Figure 5.11: Entrance to Hotel rooms

Source: Author (2023). The image shows the pathway leading to two private suites, which are partially embedded into the landscape with veldgrass-covered roofs. The structures blend seamlessly with their surroundings, enhanced by the use of naturally occurring, indigenous highveld plant species.

Figure 5.11 depicts the pathway that leads to 2 private suites. The rooms are partly buried with veldgrass roofs and blend into the surroundings. Many of the plant species occurred naturally on the site and are indigenous to the highveld (Landezine. 2013:7). The design of the suites is inspired by cave-like structures that the ancestors might have lived in. Figure 5.12 provides a sketch of the private suite plan, highlighting the strategic approach to design of the suite to mimic a cave-like structure. The private suites have been carefully crafted to prioritise elements such as privacy, natural lighting, scenic views, and a strong incorporation of cultural elements. The suite maximises the views by also mainlining privacy for the guest. Glass shower floods the bathroom with natural lighting thus minimising the use of energy, the roof consists of roof gardens that facilitate in thermal performance, refer to figure 5.12.

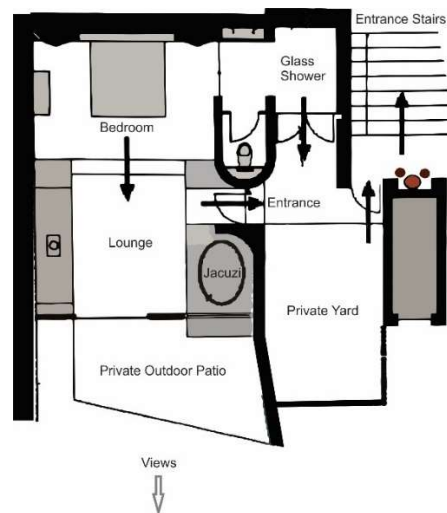


Figure 5.12: Plan View of private room

Source: Author (2023). Floor plan of a private residential suite featuring a bedroom, lounge, glass shower, and jacuzzi. The layout includes a private outdoor patio with scenic views, a private yard, and access via entrance stairs, providing a seamless blend of indoor comfort and outdoor relaxation.

In reference to Figure 5.13, the restaurant's structure is composed of a combination of timber, structural steel, reinforced concrete, and glazing. The design pays meticulous attention to architectural detailing, allowing for the strategic filtering of natural light into the building's deeper spaces and fostering a connection with the natural environment. This approach is evident in spaces such as the restaurant (Figure 5.13), the ablutions (Figure 5.14), and the private suites (Figure 5.15).



Figure 5.13: Skylight Detail in Restaurant

Source: Author (2023). Interior corridor showcasing a harmonious blend of natural materials and daylighting, with timber flooring, exposed beams, and clerestory windows that invite ample natural light. The design reflects a strong connection to nature and warm, contemporary aesthetics.

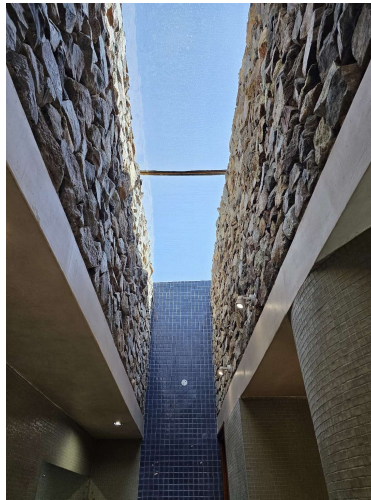


Figure 5.14: Skylight Detail in abluition

Source: Author (2023). The skylight detailing situated in the ablutions is designed to incorporate natural lighting into the space and fosters a connection between the built form and natural environment.



Figure 5.15: Balustrade Detail that mimics the reeds

Source: Author (2023). An elevated timber deck overlooking a wetland, demonstrates an ecologically responsive design that fosters a strong connection between built form and natural surroundings. This precedent exemplifies sustainable integration with the environment through minimal land disturbance, use of natural materials, and passive engagement with the site's biodiversity.

Figure 5.15 illustrates the relationship between the waterbody around the various spaces. Attention to detail is particularly evident in the custom-designed balustrades, which mimics the reeds found in the surrounding landscape. The buildings have a distinct appearance that makes them seem to rise out of the surrounding terrain. When approaching the parking area, visitors experience minimum visibility of the structures due to the way the buildings are designed and how they respond to the site's topography (Landezine. 2013:4).

Cave-style Suites: One of the standout features of Forum Homini is its cave-style suites. These uniquely designed accommodations are carved into the stone hillside, providing a sense of intimacy and privacy while offering modern comforts and amenities.

5.2.4. Analysis of the Revival, Progressive and Hybrid Models by Yahya and Hassanpour (2022:3) in the Design

Based on the data gathered from the precedent study (Section 5.2) and the data analysis process (Section 4.6.2), the investigation reveals that the architectural and design strategies implemented at the Forum Homini Boutique Hotel exhibit strong alignment with the Revival Model proposed by Yahya and Hassanpour (2022:3), as outlined in the literature review. The findings demonstrate that traditional, site-responsive, and ecologically conscious design approaches were adopted, in accordance with the Revival Model's emphasis on "learning from the past" and utilising local, context-driven solutions:

Revival Model:

The following Revivalist design strategies were observed:

- Utilisation of environmentally responsive design strategies:
 - Environmental Integration: The hotel's design incorporates the natural surroundings, allowing guests to experience the beauty of the landscape while minimising disruption to the environment. This was achieved by reinstating the indigenous highveld vegetation (Landezine. 2013:11).
 - Eco-Friendly Design: The hotel's architecture is deliberately designed to blend harmoniously with the landscape and natural environment.
 - Natural Lighting and Ventilation strategies: Implementing energy-efficient technologies and practices helps reduce the hotel's energy consumption and environmental impact. The hotel harvests natural lighting through large windows, effective orientation of the building and skylights, which allow light to penetrate into indoor spaces.
 - Wildlife and Nature Preservation: Given its location in a unique natural setting, the hotel's design incorporates efforts to protect local wildlife and preserve natural habitats.
- Use of local environmentally friendly materials:
 - Collaboration with Local Artists: According to Forum Homini Boutique Hotel (2013:10), the collaboration with local artists Dave Rossouw and Marco Cianfanelli resulted in the integration of sculptures and artwork that add depth and complexity as visitors move throughout the site. Timber artworks were created using were made using felled invasive species, and stone used in construction was sourced from a disused quarry on the game farm, ensuring that all materials were locally sourced.
- Symbolic and Cultural Referencing:
 - The entrance sequence mimics a primordial cave opening, while the overall design evokes early hunter-gatherer shelters, creating a narrative-driven experience that connects visitors to the anthropological significance of the Cradle of Humankind.
 - Elements such as the amphitheatre and terraced gardens metaphorically represent hardship and growth—an architectural reflection of the human journey.

These elements incorporated into the design of Forum Homini align with the Revivalist Model, as highlighted in Chapter 2, Literature Review, by integrating traditional methods to create effective, sustainable, and user-friendly buildings.

Further analysis reveals that the suites are embedded into the hillside and designed to blend seamlessly with the landscape, rendering them almost unnoticeable. The use of natural materials and earthy tones enhances the integration of the hotel with its surrounding environment.

Observational data suggests that Forum Homini evokes a strong “sense of place,” as defined in the theoretical framework—a deep emotional and perceptual connection between humans, architecture, and nature. This is achieved through:

- The seamless blending of built and natural environments through material choice and form.
- The symbolic storytelling of human evolution through spatial progression and artistic interventions.
- The grounding of architecture in its natural context, with vegetation overtaking building surfaces and forms that appear to emerge from the earth itself.

Furthermore, Place Theory emphasises the triadic relationship between nature, human experience, and architecture. This is reflected in the use of natural materials (e.g., exposed aggregate, natural stone, and steel), which are contextually appropriate and visually coherent with the landscape. The facility’s conservation ethos also aligns with the preservation principles embedded in the theoretical framework, emphasising responsible natural resource use.

According to the literature, ecological architecture is a theory that blends architectural and environmental sciences (Purwanti and Nazir 2022:341). This study reveals that the Forum Homini Boutique Hotel is firmly rooted in the principles of ecological architecture, demonstrated by:

- A harmonious relationship between people and nature.
- Spatial configurations that allow for natural evolution and adaptability over time.
- The incorporation of cultural memory and ecological sensitivity into design.
- A user-centred, immersive experience grounded in the cultural and biological history of the site.

This analysis suggests that the Forum Homini Boutique Hotel successfully embodies the principles of ecological architecture, while simultaneously serving as a robust example of the Revival Model in action.

Progressive model:

Limited information was available regarding the specific sustainability techniques utilised in the building, particularly in relation to water harvesting, energy usage, and sustainable technologies. However, the presence of large water storage tanks suggests water harvesting through boreholes or other storage mechanism. Additionally, standard HVAC (Heating, Ventilation, and Air Conditioning) systems were evident in the suites and various other spaces.

The following design elements were identified in the Forum Homini building, in line with the Progressive Model proposed by Yahya and Hassanpour (2022:3).

- Adoption of resource-efficient technologies:
 - Water Management: Forum Homini implements water-saving measures such as water-efficient fixtures, landscaping with indigenous plants that require minimal irrigation, and borehole water harvesting systems.
 - Energy systems: No evidence of solar panels or other sustainable energy technologies was identified within the facility.

The limited integration of technological systems represents a notable gap in the design of the facility, indicating weak alignment with the Progressive Model by Yahya and Hassanpour (2022:3). As a result, the facility falls short of achieving the characteristics of a hybrid model.

The architectural approach of the Forum Homini Boutique Hotel is firmly rooted in the Revival Model, emphasising tradition, ecology, and cultural storytelling through design. However, the limited adoption of advanced sustainable technologies indicates a weak alignment with the Progressive Model, thereby preventing the realisation of a fully integrated Hybrid Model, as defined by Yahya and Hassanpour (2022:3).

Table 5.2 provides a critical comparative overview of the Revival, Progressive, and Hybrid Models as applied and analysed in the Forum Homini precedent study.

Table 5.2: Analysis of the Forum Homini in relation to the Revival, Progressive, and Hybrid Models

	Revival Model	Progressive Model	Hybrid Model
Core Characteristics	Emphasises traditional and contextual architectural responses, integrating culture, climate, and natural landscape.	Focuses on high-tech, energy/resource-efficient systems and modern sustainability innovations.	Integrates both traditional (Revival) and technological (Progressive) approaches for contextual sustainability.
Evidence in Forum Homini	✓ Strongly evident – embedded in the landscape, mimics caves, uses local stone and timber, promotes sense of place and culture.	✗ Limited – absence of extensive sustainable tech. Minimal observable HVAC and water storage.	✗ Partial – lacks integration of advanced systems; heavy Revival lean prevents balance.
Architectural Expression	Architecture mimics natural formations and early human dwellings; materials and design evoke ancestral life.	Few indicators – no clear use of solar panels, smart tech, or advanced energy strategies.	Partially successful – some passive and environmental elements used, but modern sustainability is underrepresented.
Use of Local Materials	✓ High – use of stone from on-site quarry, reclaimed timber, indigenous vegetation.	✗ Low – reliance on local materials not enhanced by green-certified or composite innovations.	✓/✗ Somewhat – material use aligns with Revival but not optimised with new sustainable material innovations.

Cultural Significance	✓ Strong – integrates local heritage and human evolution narrative into the built form and user experience.	✗ Weak – limited modern cultural or digital user interaction; lacks global sustainability expression.	✓ Moderate – cultural narrative included, but not complemented by modern storytelling tools or tech.
Technological Integration	✗ Minimal – relies more on passive design, natural light, and ventilation.	✗ Minimal – water tanks observed, but no visible solar tech or green systems.	✗ Lacking – no effective combination of systems, suggesting missed potential for hybridisation.
Environmental Strategies	✓ Evident – vegetation over roofs, cave-like forms for thermal mass, indigenous landscaping.	✓ Partial – some water-saving strategies observed; no clear energy-efficiency tech.	✓/✗ Partial – passive techniques used but not fully augmented by active environmental strategies.
Alignment with Theory	✓ High – aligns closely with Yahya & Hassanpour’s Revival Model principles.	✗ Low – deviates from full Progressive model requirements.	✗ Weak – imbalance between the two approaches prevents full Hybrid realisation.
Sustainability Gaps	May lack long-term adaptability, innovation, or scalability beyond current cultural context.	Technological and systemic sustainability strategies are underutilised.	Misses’ opportunity to model a truly integrated, forward-facing sustainable typology.

Overall Evaluation	Forum Homini exemplifies a Revivalist architectural response with strong local, cultural, and ecological grounding.	Limited Progressive attributes – mostly passive water management; low tech adoption.	Fails to fully embody a Hybrid Model – strong revival presence overshadows innovation.
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5.2.5 Discussions and findings

The precedent study of the Forum Homini Boutique Hotel reveals that its architectural design demonstrates a profound integration with both the natural landscape and the cultural-historical context of the Cradle of Humankind. Rather than imposing upon the environment, the built form is embedded within it physically, symbolically, and materially. The architectural language draws from ancestral narratives, specifically the evolutionary journey of humankind, which is spatially and thematically expressed throughout the site.

A key finding that reflects the Revival Model’s principle of “learning from the past” is the cave-like design of the guest suites, which are partially submerged into the ground with veldgrass-covered roofs (refer to Figure 5.11). This recalls the shelter typologies of early human ancestors, offering thermal performance benefits while also evoking a sense of primal refuge. The suites’ interiors maintain modern comfort but are framed within a spatial experience that is symbolic of Stone Age cave dwellings, showing a deliberate cultural reference to human origins.

Another critical design move is the entrance sequence (Figure 5.4 and Figure 5.6), which mimics a cleft in the earth, simulating a cave opening. As visitors transition from the parking area to the main buildings, they pass through sculptural sandstone pillars carved by artist Dave Rossouw (Figures 5.7–5.8), which include footprint carvings transitioning from ape to modern human. These elements physically narrate the story of evolution and root the architectural journey in the palaeoanthropological significance of the site.

The use of indigenous materials—such as natural stone, veld vegetation, and locally sourced timber—further enhances the building’s ecological integration. The balustrade design

(Figure 5.15), inspired by wetland reeds, reinforces this biomimetic approach. It does not merely imitate nature but reflects a deep engagement with the site's ecological identity, aligning with the research objective of promoting environmentally sensitive architecture in protected landscapes like iSimangaliso.

Additionally, the amphitheatre space (Figure 5.8) and upper and lower terraces are not just functional outdoor areas—they are embedded with meaning. The lower terrace, using exposed aggregate and Wild Olive trees, references the “hard times” of early human life, while the lush upper level symbolises hope, growth, and cultural continuity. The use of culinary and utilitarian plants once used by early inhabitants underscores a design approach that goes beyond aesthetics, creating a tangible link between past and present ecological knowledge.

These findings demonstrate that the architectural strategy is not a superficial application of cultural themes but a deeply site-responsive design that reflects on the human condition, both past and present. The project aligns with the Revival Model by not only “learning from the past” but also reinterpreting historical and ecological knowledge into contemporary architectural form—offering key lessons for future developments within ecologically sensitive and culturally rich areas like the iSimangaliso Wetland Park.

5.2.6. Summary

The precedent study of Homini Boutique Hotel demonstrates and confirms that reinstating and preserving the natural landscape around and over a built form, such as a commercial node, can be achieved.

The study revealed that the Forum Homini Boutique Hotel project exemplifies how the history and cultural significance of a location can inform its architectural design. In this case, the design is driven by the unique characteristics of the Highveld landscape. The facility showcases how the visual impact of buildings can be minimised by integrating them into the natural environment, ensuring that they do not detract from or disrupt the inherent narrative and beauty of the site. This approach respects the site's history and cultural significance while creating a harmonious and poetic connection between the built environment and the natural landscape.

In addition, the precedent study highlights the importance of integrating the natural environment, with an emphasis on conservation and the sense of place theory. It

demonstrates how conservation and ecological architecture can be further advanced through collaboration with local artists, the integration of environmental considerations, the adoption of eco-friendly design language, the acknowledgement of cultural significance, and the promotion of wildlife and nature preservation.

However, there is limited information available regarding the sustainability principles and technologies employed in the building, which represents a notable gap. This suggests that the facility could have benefited from the incorporation of additional sustainable technologies within its built environment to enhance its overall sustainability.

5.3. Precedent Study 2 - Karoo Wilderness Centre -Preserving Wildlife

5.3.1. Introduction

The second precedent study investigated is the Karoo Wilderness Centre, designed by architectural firm Field Architecture. Although the Centre is unbuilt, it has been site designed specifically for the Karoo, in southern South Africa. The design of the Karoo Wilderness Centre aims to integrate seamlessly into the local landscape and applies various strategies to achieve energy efficiency and environmental preservation (SimplyGreen. 2022c:14).

This precedent study is relevant to the research as it underpins the connection between the Centre and the natural landscape of the harsh Karoo environment. Equally important, the study explores the applicability of the criteria associated with the Hybrid, Progressive and Revival Model as outlined in Section 5.1, while also examining the sustainability techniques and technologies used in the Centre's design.



Figure 5.16: Karoo Wilderness Centre, front view perspective

Source: Archdaily (2011). The building is shown in harmony with its natural surroundings, highlighting its seamless integration into the landscape through thoughtful material choices and contextual design.

5.3.2. Background

Michler (2011: para. 1 line 2-3) states that the Centre is designed to provide resources for visitors to learn more about the land, animals, and plants. According to Henry (2011:1), the Centre's mission is to restore the relationship between the natural world and the constructed environment. The design of the Centre makes it clear that it will produce its own energy, collect rainwater, handle its own waste, and offer thermal comfort without relying on any local services (Henry 2011:1). The Centre's architecture aims to create a permanent link between the natural environment and human well-being, fostering interdependence between ecosystem health and human welfare (Henry 2011:1). Figure 5.21 shows the front 3D perspective of the Centre, which appears to be seamlessly integrated into the landscape.

5.3.3. Concept and Design

The architectural design concept of the Karoo Wilderness Centre was aimed to redefining the relationship between human habitation and the natural world. The Centre consists of three clusters: researcher residences, a visitors' centre, a restaurant, a conference room, a library and a classroom (Michler 2011:2; refer to Figure 5.17 and Figure 5.18, which illustrate the three clusters).

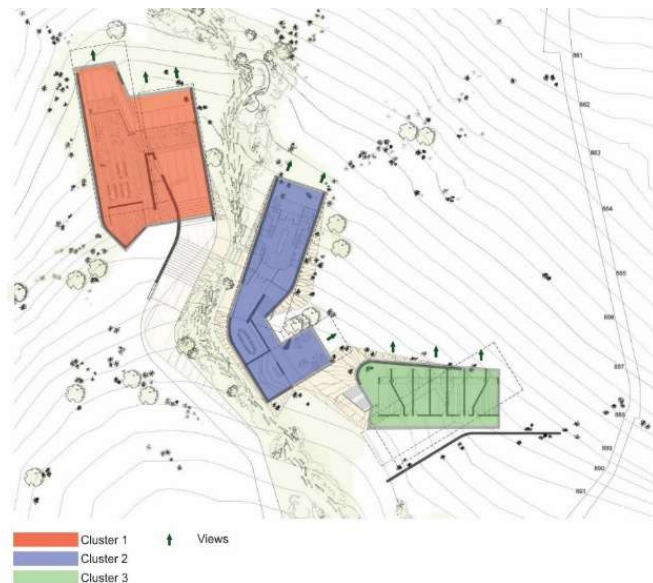


Figure 5.17: Site Plan

Source: Archdaily (2011). Site plan of the Karoo Wilderness Centre illustrating the three spatial clusters—public (Cluster 1), educational (Cluster 2), and residential (Cluster 3)—strategically integrated into the natural topography. The design emphasises minimal environmental impact, optimised views, and material sensitivity to the surrounding Karoo landscape.

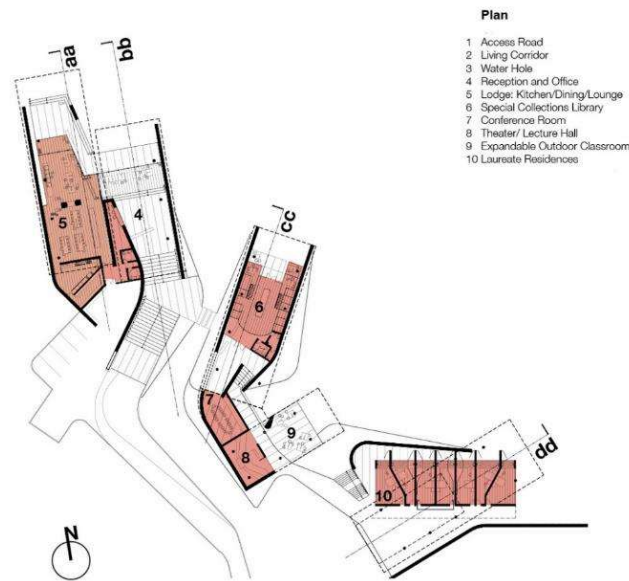


Figure 5.18: Floor Plan

Source: Archdaily (2011)

The architectural design concept of the Karoo Wilderness Centre reimagines the interaction between built form and the natural environment, emphasising ecological responsiveness and spatial integration. As illustrated in the site plan, the Centre is composed of three distinct yet interconnected clusters—each strategically positioned to respond to the topography, vegetation, and view corridors of the surrounding Karoo landscape (refer to Figures 5.17 and 5.18).

- Cluster 1 (Red) contains the visitor-oriented functions, including the reception area, restaurant, conference room, and exhibition spaces. This cluster is located closest to the entry point, anchoring the public-facing programme and serving as a welcoming threshold to the site.
- Cluster 2 (Blue) houses educational and shared research facilities such as the library, classrooms, and flexible workspaces. Its central location reflects its bridging role between public and private realms, facilitating knowledge exchange and collaboration.
- Cluster 3 (Green) comprises the more private researcher residences. Positioned on the periphery, this cluster ensures tranquillity and seclusion while maintaining visual and spatial connections to the broader landscape.

The building clusters follow the natural contours of the terrain, minimising site disturbance and optimising passive design principles. Materials and building forms were carefully

selected to resonate with the Karoo’s earthy textures and muted palette, further anchoring the architecture within its context. The orientation of the clusters also considers prevailing views (as indicated by the green arrows), reinforcing the building's dialogue with the natural setting and promoting a sense of immersion in the wilderness.

Together, the clusters form a coherent yet non-intrusive presence on the land, embodying the Centre’s ethos of sustainable, site-sensitive design.

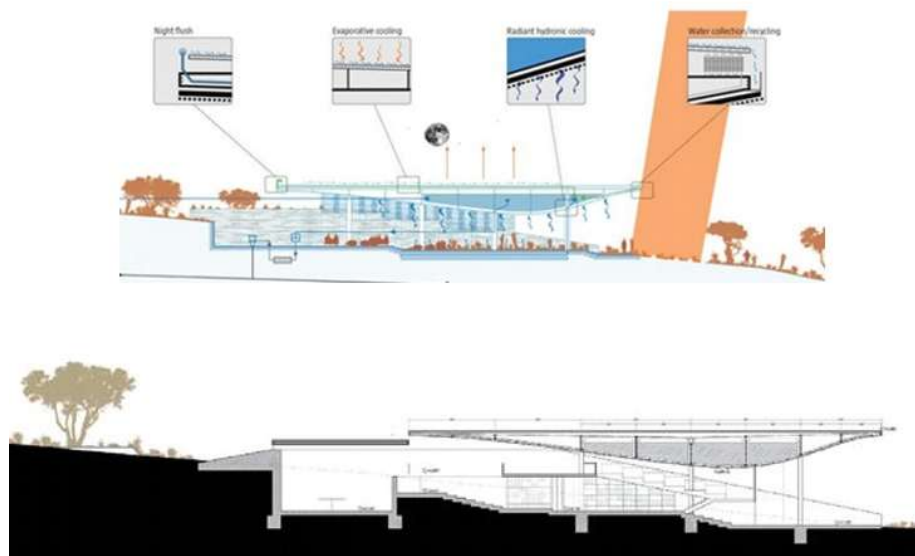


Figure 5.19: Section B-B

Source: Michler (2011). Section illustrating the Karoo Wilderness Centre’s passive environmental strategies, including night flush ventilation, evaporative cooling, radiant hydronic systems, and a biomimetic roof design inspired by the *Aloe ferox* plant. The roof functions as both a rainwater harvesting system and a thermal heat sink, reducing reliance on mechanical systems and enhancing climate responsiveness (Michler 2011:3).

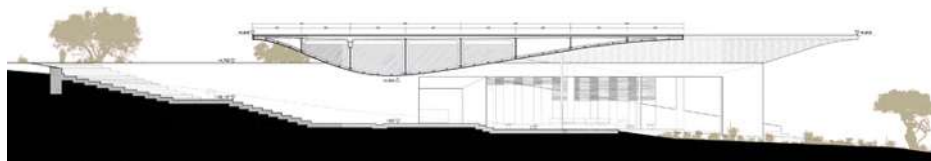


Figure 5.20: Section C-C

Source: Michler (2011). Section through the Karoo Wilderness Centre highlighting the biomimetic roof form inspired by the *Aloe ferox* plant. The curved roof structure enables efficient rainwater harvesting while blending seamlessly with the natural topography, demonstrating a sensitive response to site and climate (Michler 2011:3).

The building utilises a sophisticated rainwater harvesting system that mimics the shape of the local *Aloe forex* plant by acting as a water catchment system (Michler 2011:3); this is known as biomimicry. The roof of the building incorporates a large rain catchment tank system that serves a dual-purpose as both a heat sink and a water storage system. This design feature helps prevent daytime heat from infiltrating the building. By collecting rainwater,

the tank also contributes to the Centre's self-sufficiency in water supply (refer to Figures 5.19 and 5.20, which depict the *Aloe* plant shaped roof) (Michler 2011:3).

The roof's heat sink function is achieved through an elegant system that utilises evaporative cooling. As latent heat builds up inside the building, the rainwater in the tank absorbs this heat through evaporation, effectively cooling the interior. This process helps maintain a comfortable temperature within the building while reducing the need for traditional cooling systems that rely on energy-intensive methods (Michler 2011:3; refer to Figure 5.20).

Furthermore, during the night, cool air is flushed through the building to further assist with cooling. This overnight ventilation allows the thermal mass of the building, including the roof and other elements, to absorb more heat during the cooler night-time temperatures. This stored thermal energy can then be gradually released throughout the following day, reducing reliance on mechanical cooling systems (Michler 2011:3).

In addition to the rainwater-based cooling system, the roof's design incorporates hydronic tubes connected to the water supply. These tubes radiate heat through the ceiling when necessary, providing an efficient and controlled heating mechanism. This setup allows for effective temperature regulation while minimising energy consumption (refer to Figure 5.20) (Michler 2011:3).

Together, these systems create a climate-responsive design that aligns with the natural rhythms of the Karoo environment, reducing the need for mechanical systems and lowering the Centre's ecological footprint. This integration of biomimicry and passive systems exemplifies a holistic design approach, where architectural form and function are derived directly from the landscape and local climatic conditions (Michler 2011:3).



Figure 5.21: Karoo Wilderness Centre 3D Perspective

Source: Michler (2011). The building is shown in harmony with its natural surroundings, highlighting its seamless integration into the landscape through thoughtful material choices and contextual design.

5.3.4. Analysis of the Revival, Progressive and Hybrid Models by Yahya and Hassanpour (2022:3) in the Design

Revival Model:

The following highlights the design elements identified as being incorporated in the building in line with the Revival Model by Yahya and Hassanpour (2022:3):

- Utilisation of environmentally responsive design strategies:
 - Mimicking the Landscape: The low-slung buildings are designed to mimic the natural strata of the landscape, creating a harmonious integration with the environment. The prodigious ceilings reflect the gum-pole ceilings commonly found in the area, paying homage to local architectural traditions (Michler 2011:4).
 - Environmental Considerations: Construction activities are scheduled in accordance with the rain cycle to minimise disruption to the natural ecosystem. Displaced *Aloe* plants are carefully replanted, showcasing a commitment to preserving and restoring the native flora (Michler 2011:4).
 - Adaptation to Harsh Environment: The Karoo landscape is characterised by minimal rainfall and parched conditions. Plant and animal species in this region have had to adapt accordingly. The architecture of the Centre reflects these adaptations and the economy of means utilised by local species (Henry 2011:2).
 - Connection to Landscape: The architectural design of the Centre establishes an ongoing link to the surrounding landscape, reinforcing the interdependence between human well-being and ecosystem health (Henry 2011:1).
 - Aesthetics: The design of the Centre incorporates aesthetics that celebrate the imperfections and character of the materials used. The curved undersides of the roofs are clad with thin wooden strands, creating a handcrafted tapestry effect (Henry 2011:4).
- Use of local Environmentally friendly materials:

- Local Sourcing of Materials: Construction materials such as concrete aggregate are sourced locally. This integration of local materials creates a visual connection to the natural surroundings, with the colours and hues of the earth extending through the buildings (Henry 2011:4).

The literature suggests that the technological principles utilised in the building, such as the roof design of the Karoo Wilderness Centre, demonstrate an innovative and sustainable approach to thermal management. By harnessing rainwater, utilising evaporative cooling, and incorporating hydronic heating, the architecture promotes energy efficiency, reduces reliance on external power sources, and contributes to the overall comfort and well-being of the building's occupants. These design strategies concepts are notably embedded in the Revival model proposed by Yahya and Hassanpour (2022:3).

The literature further reveals that techniques of biomimicry are explored in the design by studying and emulating the behaviour of local organisms or ecosystems. This approach draws inspiration from nature to address practical design problems, for example, mimicking the shape of the *Aloe* plant found in the natural landscape in the design of the roof to harvest water. However, this does not reflect any cultural significance, as it is primarily a technological application. This is supported by Govender (2016), who argues that biomimicry offers only a direct translation of nature's patterns in a technological sense and that such sustainable solutions may be detached from the environmental and spatial context, consequently missing opportunities for cultural connectedness within the contextual spectrum.

It is further evident, through the analysis of Figure 5.19-5.21 that the design responds to the typography by emulating a cave-like structure that emerges from the landscape, similar to that of the Forum Homini Boutique Hotel.

Limited information is available on the cultural significance embedded in this building, which may be assumed as a gap in the design. Furthermore, since the buildings are not yet constructed, the sense of place theoretical approach cannot be fully analysed or identified at this stage.

Progressive Model:

The following highlights the design elements identified as being incorporated in the building in line with the Progressive Model by Yahya and Hassanpour (2022:3).

- Adaption of resource-efficient technologies:
 - Solar Power: The roof is equipped with solar electric panels, allowing the entire facility to operate off the power grid, thereby reducing reliance on conventional energy sources (Michler 2011:4).
 - Water Self-Sufficiency: On-site wastewater is processed and reused, ensuring the buildings are self-sufficient in terms of water use (Michler 2011:4).
 - Sustainability: The Centre serves as an exemplary model of sustainability by generating its own energy, harvesting its own water, and processing its own waste. It aims to be self-sufficient, reducing reliance on municipal resources (Henry 2011:1).

Overall, the Karoo Wilderness Centre design concept incorporates sustainable technological principles of the current era, which is linked to the Progressive Model by Yahya and Hassanpour (2022:3). It is also evident that the design incorporates the concept of conservation, and ecological architecture. Furthermore, the research reveals that the Karoo Wilderness Centre is a carefully planned and designed facility that respects the delicate nature of the region while celebrating its beauty.

Through the use of sustainable features, local materials (linked to the Revival Model), and an ecological architectural approach that reflects and considers the surrounding landscape, the Centre serves as a model for responsible and harmonious development in desert environments. By harnessing renewable energy and practising water conservation and thermal comfort strategies, the Centre sets a positive example for environmentally conscious design and operation.

Therefore, the Karoo Wilderness Centre was found to contain elements of both the Revival and Progressive Models. However, limited information was available regarding its cultural significance within the Revival Model framework. Ultimately, the building achieved the embedding of the Hybrid Model approach as defined by Yahya and Hassanpour (2022:3).

Table 5.3 provides a critical comparative overview of the Revival, Progressive, and Hybrid Models as applied and analysed in the Forum Homini precedent study.

Table 5.3: Analysis of the Karoo Wilderness Centre in Relation to the Revival, Progressive, and Hybrid Models

	Revival Model	Progressive Model	Hybrid Model
Core Characteristics	Emphasises ecological integration, biomimicry inspired by local flora, contextual materiality, and sensitivity to natural cycles and the landscape.	Focuses on off-grid systems, water harvesting, evaporative cooling, solar energy, and advanced climate-responsive technologies.	Integrates both nature-inspired design and advanced sustainability systems to create a resilient, responsive, and eco-conscious architectural approach.
Evidence in Karoo Wilderness	✓ Evident – landscape-mimicking form, local material use, site-specific design, and scheduling aligned with natural rain cycles.	✓ Strong – employs solar panels, rainwater collection, evaporative cooling, hydronic heating, and greywater reuse for complete energy and water self-sufficiency.	✓ Effective – combines passive and high-tech systems, contextual form, and self-reliance, though lacks cultural depth for a fully balanced Hybrid model.
Architectural Expression	Architecture mimics the natural stratification of the Karoo; biomorphic roof references <i>Aloe</i> plants; uses handcrafted wood elements and natural curves.	Strong emphasis on functional performance – roof acts as heat sink, water catchment, and energy regulator.	Architectural form is both symbolic and functional – achieves synergy between nature-inspired aesthetics and sustainable operation.
Use of Local Materials	✓ High – locally sourced aggregates and finishes reflect the	✓ Moderate – materials chosen for ecological and	✓ Good – maintains strong Revival alignment through

	hues and textures of the landscape.	thermal performance, but without innovation in sustainable composites.	materiality while achieving energy and thermal efficiency goals.
Cultural Significance	✗ Weak – little to no evidence of cultural storytelling or indigenous symbolism in form, space, or material beyond ecological representation.	✗ Absent – design is ecologically and technologically driven, with no clear cultural or historical reference.	✗ Partial – while the environmental design is strong, cultural rootedness is a known gap and limits the completeness of the Hybrid model.
Technological Integration	✗ Low – passive systems inspired by nature, but not culturally advanced or digitally integrated.	✓ Strong – solar power, thermal regulation, and water systems fully embedded in design for off-grid operation.	✓ Effective – balances natural logic with environmental technology; however, cultural and social technologies are missing.
Environmental Strategies	✓ Evident – passive cooling, evaporative strategies, biomimicry, replanting native flora, and careful siting practices.	✓ Strong – active water and energy systems, overnight ventilation, hydronic heating, and sustainable waste management included.	✓ Strong – employs both passive and active ecological systems harmoniously; limited only by absence of cultural or social dimensions.

Alignment with Theory	✓ High – closely aligns with Yahya and Hassanpour’s Revival principles in ecological form, materiality, and landscape sensitivity.	✓ High – embodies Progressive principles through autonomous systems and cutting-edge environmental control strategies.	✓ Effective – theoretically aligns with Hybrid model, but missing cultural components prevent a fully holistic application.
Sustainability Gaps	Cultural identity and place-making are underdeveloped; biomimicry lacks symbolic or ancestral meaning.	No engagement with social sustainability or cultural context; purely technical.	Cultural rootedness is the primary shortfall; otherwise, an exemplary case of integrated ecological and technological sustainability.
Overall Evaluation	Demonstrates a strong environmentally rooted Revivalist approach but lacks cultural anchoring.	Embodies a fully self-sufficient, technologically advanced sustainable design.	Represents a compelling Hybrid approach in ecological and technical terms; however, limited cultural integration prevents complete model fulfilment.

5.3.5 Discussion and findings

This section discusses the findings from the analysis of the Karoo Wilderness Centre as a precedent for ecologically responsive architecture. The discussion draws from the Revival, Progressive, and Hybrid Models by Yahya and Hassanpour (2022), evaluating the project’s ecological, technological, and cultural dimensions.

- Ecological Responsiveness and Landscape Integration

- The Karoo Wilderness Centre is carefully embedded in the arid topography of the Karoo, with three distinct spatial clusters—public, educational, and residential—arranged in relation to site contours, solar exposure, and native vegetation. This site-specific spatial arrangement reflects a biomimetic design philosophy, inspired by the *Aloe ferox* plant, whose form guides the iconic roof structure. The roof not only echoes the local ecology aesthetically but functions as a element element for water harvesting, heat storage, and evaporative cooling, demonstrating a reciprocal relationship with the desert climate.
- These features represent a strong ecological awareness that minimises environmental disturbance while enhancing human comfort. However, despite its ecological embeddedness, the design does not engage with the cultural or indigenous meanings of the landscape, which limits its expression of place beyond the environmental.

Revival Model:

The design integrates several elements of the Revival Model, including the use of local materials, mimicry of geological formations, and sensitivity to native flora and climatic rhythms. The scheduling of construction with seasonal rainfall and the replanting of displaced *Aloe* plants reflect an alignment with environmental cycles, consistent with revivalist ideals.

Additionally, handcrafted details such as timber cladding and the organic roof curvature reference local craft traditions. These aspects ground the building materially and tectonically in its context. However, the Centre lacks symbolic or narrative representation of indigenous knowledge systems, spiritual relationships with the land, or historical continuity. This weakens its cultural responsiveness despite its environmental performance.

Progressive Model:

In contrast, the precedent strongly reflects the Progressive Model through the integration of autonomous systems and technological innovation. It features:

- Off-grid solar electric generation
- Hydronic heating embedded in the roof system
- Greywater recycling

- Evaporative cooling and night ventilation

These strategies position the Centre as a self-sufficient, environmentally optimised structure. The biomimetic roof exemplifies multifunctional design, simultaneously addressing thermal regulation and water needs. While technologically impressive, the Progressive Model's application is primarily functional and does not engage local community participation or socio-cultural frameworks in its innovation process.

Hybrid Model:

The Centre successfully synthesises environmental sensitivity (Revival) and technical advancement (Progressive), aligning with the Hybrid Model. It balances form and function in response to the unique challenges of arid environments. However, the hybrid approach is skewed toward ecological and technological integration, with insufficient attention or evidence given to cultural symbolism, storytelling, or indigenous spatial logic.

This gap limits its effectiveness as a truly place-based architecture. While biomimicry introduces a symbolic connection to nature, it does not replace the depth of meaning conveyed through cultural expression and communal memory. Thus, the project's hybridity is technically strong but culturally shallow.

5.3.6. Summary

The Karoo Wilderness Centre provides an insightful precedent for ecologically responsive architecture that could inform sustainable development within the iSimangaliso Wetland Park. Its design thoughtfully integrates with the harsh Karoo environment through biomimicry, passive climate control, and site-specific planning, demonstrating strong environmental sensitivity and technological innovation.

The Centre embodies the Revival Model by deeply engaging with the local landscape and natural cycles. It uses locally sourced materials, mimics geological formations, and respects native flora through sensitive construction practices. These features align well with iSimangaliso's need for architecture that harmonises with its diverse ecosystems. However, the Centre's limited cultural expression and weak incorporation of indigenous knowledge highlight an important consideration for iSimangaliso, where cultural identity and community connection are vital to meaningful place-making.

Technologically, the Centre exemplifies the Progressive Model through self-sufficient systems such as solar power, rainwater harvesting, greywater recycling, and advanced

passive cooling strategies. These off-grid solutions support resilience and reduce environmental impact, making them highly applicable to remote and ecologically sensitive sites like iSimangaliso. Yet, the design's focus on technological innovation is largely detached from social or cultural dimensions, underscoring the need for more inclusive approaches in the park's future projects.

By combining ecological sensitivity with advanced sustainability technologies, the Karoo Wilderness Centre represents a Hybrid Model approach. This balance between form and function offers a useful framework for future developments in iSimangaliso that require both environmental responsiveness and operational autonomy. However, the hybrid model's lack of cultural integration limits its ability to foster a strong sense of place, an aspect crucial for sustainable stewardship in culturally rich contexts like iSimangaliso.

In summary, the Karoo Wilderness Centre highlights key strategies for integrating ecological responsiveness and technological innovation in sensitive landscapes. For the iSimangaliso Wetland Park, adopting a similar Hybrid Model could promote resilient and sustainable architecture. However, it is essential that future designs also deepen cultural engagement, ensuring that environmental sustainability is complemented by social and cultural sustainability to create truly place-based and meaningful architecture. Whilst there is a known gap in the building's cultural rootedness, the green building principles, sustainable technologies and techniques employed provide inspiration for future projects.

5.4. Precedent Study 3 - The Ridge

5.4.1. Introduction

The next precedent study is The Ridge building, located in Cape Town, South Africa, and designed by StudioMAS Architects. The relevance of this precedent study lies in its investigation of the construction methods, construction materials, technologies and design principles utilised in the building. This study analyses the technologies applied, the environmental benefits, use of material choices, the commitment to reducing environmental impact, and the creation of efficient, comfortable spaces for occupants. This precedent study is relevant to the broader research objective of determining which technological principles can be incorporated into ecologically responsive architecture. The framework that informed

the selection of this precedent study is based on the criteria outlined in Section 4.3, Precedent Study Research. This study was through desktop research using reliable resources.

5.4.2. Background

The Ridge is a commercial office building located within the Portsworld District commercial precinct in Cape Town, South Africa. According to *The Ridge* (2020:2), the vision behind the building was titled “*Our Normal*”, which aimed to raise the standards of sustainable office block developments nationwide. The building was designed to fulfil and surpass the specified accommodation requirements of Deloitte, a globally recognised consulting company, serving as its Cape Town Regional office (*The Ridge* 2020:2).

The Ridge offers a Gross Leasable Area (GLA) of over 8 500 m² and comprises four storeys of office accommodation, with three basement levels of parking (*The Ridge* 2020:2).

5.4.3. Concept and Design

The Ridge was designed to address the challenges of climate change and other future environmental concerns, while also reducing the building’s overall water and energy consumption costs (*The Ridge* 2020:2). It achieves this through the incorporation of sustainable features such as natural ventilation, thermally activated building structures and displacement ventilation. The building places strong emphasis on safety, comfort and productivity of its occupants, as well as the well-being of the public. This precedent study aims to analyse the sustainable techniques and technologies that enhance human well-being, and to identify the construction methods and techniques employed in the building.

The floor plan, shown in Figure 5.22, illustrates The Ridge building in Cape Town, a prominent example of environmentally responsive commercial architecture. The layout is organised around a central circulation spine featuring escalators, elevators, and staircases, allowing for efficient vertical movement throughout the building. This central corridor is flanked by large, open-plan office spaces, which support flexibility and enhance the flow of natural ventilation and daylight—key sustainable strategies integral to the building's design. Circular features along the corridor represent lightwells or atriums that channel daylight deep into the interior, reducing the need for artificial lighting.

Three core zones are visible in the plan, containing restrooms, service risers, and mechanical rooms, in order to centralise building services. At either end of the floor plan, entrance lobbies anchor the circulation axis, providing access to the broader structure. The building's

distinctive zigzag or pleated perimeter façade, evident in the plan, is designed to regulate solar gain while maximising views and daylight. This design reflects The Ridge’s commitment to environmental performance, energy efficiency, and sustainable reuse, all of which contribute to its reputation as a leading example of green commercial architecture in South Africa.

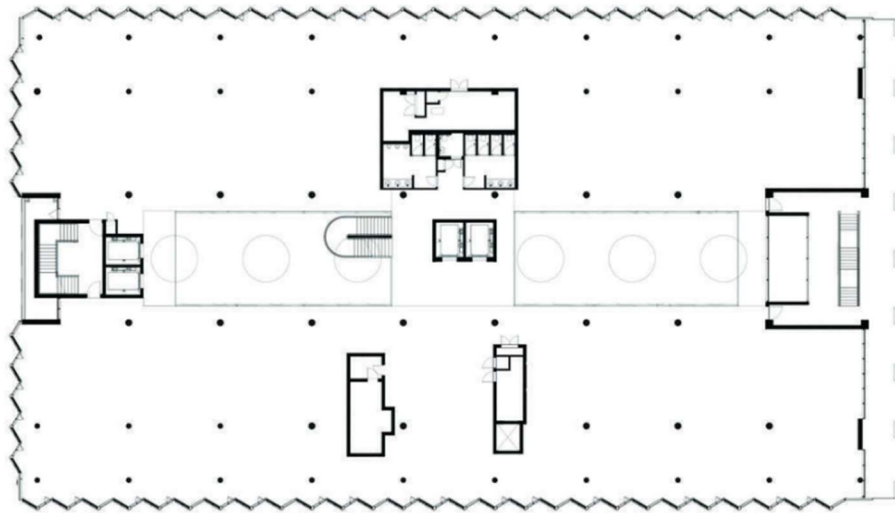


Figure 5.22: Floor Plan

Source: Archdaily (n.d.). Floor plan of The Ridge building in Cape Town, showcasing a central circulation spine, open-plan office areas, core service zones, and a distinctive zigzag façade designed to enhance natural ventilation, daylighting, and energy efficiency.



Figure 5.23: Sectional perspective of The Ridge

Source: Waterfront (n.d.). This illustrates its sustainable design features such as natural ventilation chimneys, daylight-filled atriums, modular structural system, and green breakout spaces that promote energy efficiency, occupant well-being, and environmental responsiveness.

The sectional drawing of The Ridge building (refer to Figure 5.23) reveals the thoughtful integration of passive design strategies and sustainable technologies within its architectural framework. At the top of the building, a series of green-coloured ventilation chimneys function as thermal stacks, promoting natural ventilation by allowing warm air to rise and escape while drawing in cooler air from below. This reduces reliance on mechanical cooling systems and enhances indoor air quality. The section also highlights the use of daylighting strategies, with large atrium-like voids and floor cut-outs that allow natural light to penetrate deep into the building's interior, minimising the need for artificial lighting. The building is organised into distinct functional layers, with basement levels likely used for parking and services, while the ground and upper floors accommodate open-plan office spaces. Several floors also include green breakout areas and terraces, encouraging user interaction with the outdoor environment.

The façade incorporates extensive glazing and external shading devices, controlling solar gain while maintaining transparency and access to views. Central vertical circulation cores, visible in the section, connect the various levels through staircases and elevators, while internal bridges and visual connections between floors enhance spatial fluidity and collaboration. The regular structural grid evident in the floor slabs and columns supports a modular design approach, allowing flexibility for future reconfiguration.

Below are the sustainable techniques used in The Ridge building:

- Passive ventilation technologies:

Unlike other buildings that utilise only passive ventilation strategies or solely mechanical systems for heating and cooling, The Ridge employs a hybrid approach. This integrates passive ventilation technologies complemented by mechanical air-conditioning systems that activate only when necessary. The building's design allows it to operate in two modes: during favourable weather, it operates as a naturally ventilated building; otherwise, it operates as a conventional sealed, air-conditioned structure (*The Ridge* 2020:5). This technology is configured to support health, productivity, and human well-being.

According to engineers cited in *The Ridge* (2020:5), natural ventilation is a highly beneficial method of climate conditioning due to its positive impact on health and well-being. It enhances the connection to the outdoors, promotes high-quality air, and reduces fossil-fuel-based energy consumption by minimising the need for

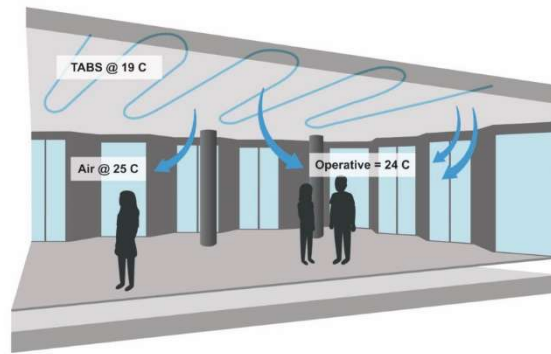
mechanical ventilation and cooling systems. The utilisation of the passive ventilation system is regulated by occupants, following instructions from the Building Management System (BMS). The BMS actively monitors environmental conditions both inside and outside the building and provides guidance accordingly (*The Ridge* 2020:6).

- Thermally Activated Building System (TABS):

By employing water pipes embedded in the concrete slabs to heat and cool the building mass itself, The Ridge uses a technique known as a thermally activated building system to control internal temperatures (*The Ridge* 2020:5). According to *The Ridge* (2020:6), with TABS in place, the building can naturally breathe for 75–85% of the year, which significantly reduces energy costs associated with the HVAC system.

Refer to Figure 5.24, which shows a diagram of the internal space cooling system. This image illustrates how the TABS works to cool interior spaces in The Ridge building. TABS involves running chilled water through pipes embedded within the concrete soffits (ceilings), turning the building's structure into a thermal mass that radiantly cools the space.

- TABS @ 19°C: The chilled water in the concrete soffit is maintained at around 19°C. This cool surface absorbs heat from the room below through radiant exchange, helping to reduce the overall room temperature without the need for high-volume air circulation.
- Air @ 25°C: The air temperature remains relatively warm at 25°C, but occupants still feel comfortable due to the cooler surfaces and radiant effect. This allows for a more energy-efficient cooling strategy, as it avoids excessive air conditioning.
- Operative Temperature @ 24°C: This represents the perceived temperature felt by occupants, combining both air temperature and surface radiation. Even though the air is 25°C, people perceive it as 24°C due to the influence of the cooler surrounding surfaces.



The chilled soffit provides radiant cooling to the space

Figure 5.24: TABS

Source: *Greeneconomy (n.d.)*. Diagram showing the Thermally Activated Building System (TABS) at *The Ridge*, where chilled concrete soffits provide radiant cooling, maintaining comfort while reducing HVAC energy use and enabling natural ventilation for most of the year.

- Heating Ventilation and Air Conditioning (HVAC):

The buildings' HVAC systems utilise displacement ventilation, which uses the spaces under the elevated access floor to move air upward at modest volumes before it is extracted at the soffit level. This system requires less energy for air distribution throughout the building compared to conventional HVAC systems, which distribute air at high levels and require it to descend (*The Ridge 2020:5*). Refer to Figure 5.25, which depicts the under-floor HVAC system that regulates air in an upwards direction. Furthermore, the underside of the slab soffits is exposed concrete, which works in conjunction with the TABS system. Custom-made acoustic panels are installed on the underside of the slab soffits.

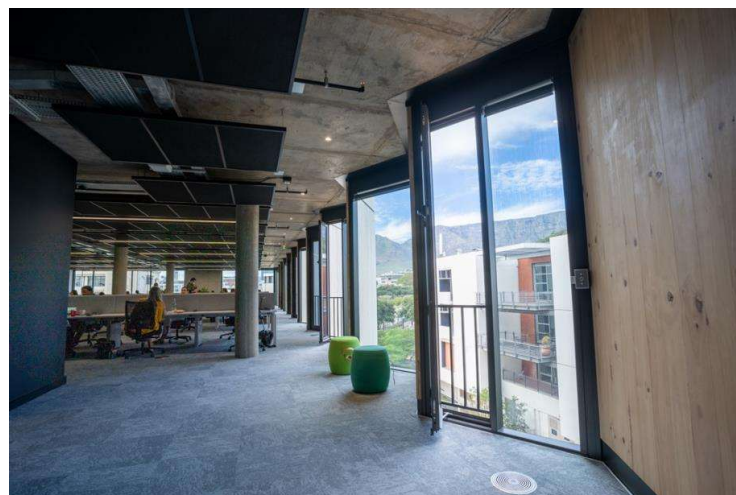


Figure 5.25: HVAC in the void beneath the floor

Source: Caboz (2021). Interior view illustrating the under-floor displacement ventilation HVAC system. Fresh air is supplied beneath the raised access flooring and moves upward through the space before being extracted at soffit level. This low-energy strategy is supported by the exposed concrete soffits, which function as part of the Thermally Activated Building System (TABS), while custom acoustic panels on the soffits aid in sound absorption and thermal performance.

- Natural lighting:

According to *The Ridge* (2020:7), the designers faced the challenge of maximising natural lighting in specific areas of the building. They therefore specified innovative and additional sources of natural light, including the use of a central atrium to harvest and distribute natural light across various building levels.

The designers also included intelligent lighting, which replicates the circadian rhythm of the human body by altering tone and mimicking the effects of daylight throughout different phases of the day. (*The Ridge* 2020:7). Refer to Figure 5.26, that which illustrates the roof drums that allow natural lighting to filter into the internal spaces.

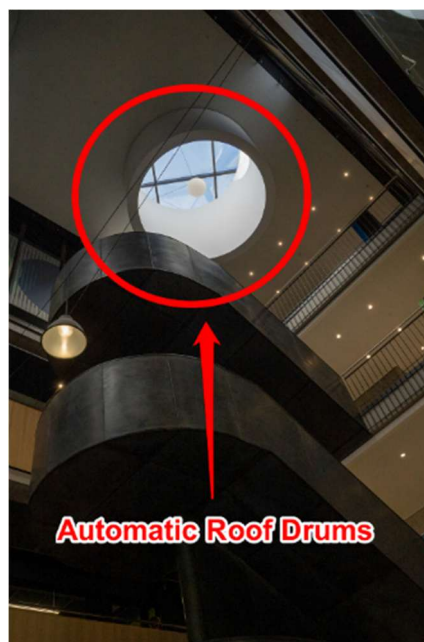


Figure 5.26: Roof Drum

Source: Caboz (2021). Roof drum structures at *The Ridge*, designed to channel natural light into the building's interior spaces. These architectural elements, along with a central atrium, enhance daylight penetration across multiple levels. Intelligent lighting systems complement this by simulating natural daylight cycles to support human circadian rhythms.

- Façade:

According to *The Ridge* (2020:7), the Ridge building is the first commercial building in South Africa to be clad externally with timber that is cross-laminated (CLT) (refer to Figure 5.27). The exterior timber cladding is installed in a zigzag manner; the

purpose of this is to reduce the carbon footprint of the project. The façade timber is constructed using cross-laminated South African pine. When compared to other conventional cladding systems like concrete, glass, or aluminium, the project's carbon footprint was reduced by the use of wood and cross-laminated wood (*The Ridge* 2020:7).



Figure 5.27: Zigzag-Shaped engineered timber facade

Source: Greeneconomy (n.d.). Exterior façade of The Ridge showcasing South Africa's first use of cross-laminated timber (CLT) cladding on a commercial building. The cladding is arranged in a distinctive zigzag pattern, designed to enhance aesthetics while significantly reducing the building's carbon footprint compared to conventional materials like concrete, glass, or aluminium. The façade is constructed using cross-laminated SA pine timber.

- **Ecobrick:**

Another special technology incorporated in The Ridge building is the use of ecobricks (refer to Figures 5.28 and 5.29). The ecobrick process involves filling a 2-litre plastic container with waste plastic until it cannot hold any more. Each ecobrick then goes through a compliance check (*Ecobricks* 2021:3). Ecobricks were used in the Ridge to reduce the footprint of concrete on various floor slabs. The conventional method for reducing the footprint of concrete in buildings uses polystyrene (EPS) blocks to form voids, which is not an environmentally friendly route (*Ecobricks* 2021:3). Ecobricks are therefore a perfect environmentally friendly alternative. According to *The Ridge* (2020:7), the volume of concrete displaced by ecobricks is estimated at 24 000 litres (24 m³), which constitutes a significant level of

dematerialisation and the removal of 9 000 tonnes of non-biodegradable plastic pollution by integrating it into the building.



Figure 5.28: Ecobricks that have been signed by the individuals who made them

Source: Ecobricks (2021). Illustration of the ecobricks, 2-litre bottles packed with waste that is tightly stacked to receive the concrete surface bed.

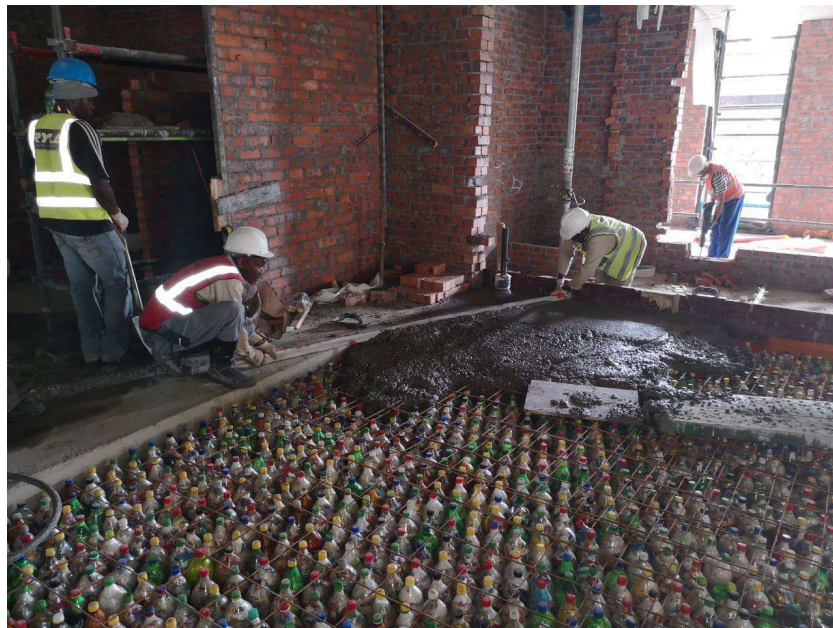


Figure 5.29: Ecobricks floor structure

Source: Ecobricks (2021). Implementation of ecobricks in the floor slab construction of The Ridge building. Each ecobrick—formed by tightly packing waste plastic into a 2-litre bottle—serves as a sustainable alternative to conventional void-forming materials like polystyrene (EPS).

- Sustainable harvesting techniques:

The Ridge also uses rainwater collection and greywater treatment systems. The greywater undergoes treatment and is thereafter utilised for irrigation and WC flushing. The building also incorporates solar harvesting techniques through the installation of photovoltaic panels on the roof (*The Ridge 2020:7*).

- **Recycled materials:**
Whenever possible, materials with recycled content are selected, reducing the demand for virgin resources and diverting waste from landfills.
- **Biophilic:**
In reference to Figure 5.30, it is evident that the building applies biophilic principles by incorporating greenery within the internal spaces.



Figure 5.30: Internal Space with greenery

Source: Waterfront (n.d.). Interior view of The Ridge showcasing the application of biophilic design principles through the integration of greenery within indoor spaces.

5.4.4. Analysis of the Revival, Progressive and Hybrid Model by Yahya and Hassanpour (2022:3) in the Design

Revival Model:

The following highlights the design elements identified as being incorporated in the building in line with the Revival Model by Yahya and Hassanpour (2022:3):

- **Utilisation of natural ventilation strategies:**
Unlike other buildings that rely solely on passive ventilation strategies or mechanical systems for heating and cooling, The Ridge employs a hybrid approach. It integrates passive ventilation technologies with mechanical air conditioning systems that activated only when necessary. The building is designed to operate in two modes: during favourable weather, it functions as a passive, naturally ventilated structure; under less favourable conditions, it operates as a conventional sealed, air-conditioned building (The Ridge 2020:5). This technological configuration supports health, productivity, and human well-being, effectively combining elements of both the Revival and Progressive Models as defined by Yahya and Hassanpour (2022:3).
- **Use of local environmentally friendly materials:**

- Natural lighting:
According to *The Ridge* (2020:7), the designers faced the challenge of maximising natural lighting in specific areas of the building. To address this, they incorporated innovative solutions, including harvesting natural light through a central atrium to illuminate multiple levels of the building. Additionally, they implemented intelligent lighting systems designed to replicate the circadian rhythm by adjusting tones to mimic daylight at different phases of the day.
- Ecobricks:
The Ridge building utilised ecobricks as a sustainable alternative to conventional polystyrene (EPS) void fillers, thereby reducing the environmental footprint of its floor slabs. Ecobricks, made by compressing waste plastic into 2-litre bottles.
- Recycled materials:
Whenever possible, materials with recycled content were incorporated, reducing the demand for virgin resources and diverting waste from landfills.

Progressive Model:

The following highlights the design elements that were incorporated into the building in line with the Progressive Model by Yahya and Hassanpour (2022:3).

- Adaption of resource-efficient technologies:
 - Thermally activated building system (TABS):
The Ridge employs a thermally activated building system (TABS) by embedding water pipes within concrete slabs to regulate the building's temperature (*The Ridge* 2020:5). This system allows the building to rely on natural ventilation for 75–85% of the year, significantly reducing energy costs associated with the HVAC system.
 - Building Management System (BMS):
The utilisation of the passive ventilation system is regulated by building occupants following instructions from the overall Building Management System (BMS). The BMS actively monitors environmental conditions both

inside and outside the building, offering guidance to the occupants (*The Ridge* 2020:6).

- Envelope Designs:

- Façade:

The Ridge building is the first commercial building in South Africa to feature external cladding made from cross-laminated timber (CLT). The cladding is installed in a zigzag pattern to reduce the project's carbon footprint. The façade, constructed from cross-laminated South African pine timber, significantly lowers the carbon footprint compared to conventional cladding materials such as concrete, glass, or aluminium.

- Sustainable harvesting techniques:

- Grey Water Systems:

The Ridge also uses rainwater harvesting and greywater treatment systems. The treated greywater is utilised for irrigation and WC flushing. The building also incorporates solar harvesting through the installation of photovoltaic panels on the roof (*The Ridge* 2020:7).

- HVAC (Heating Ventilation and Air Conditioning):

The building's HVAC system utilises displacement ventilation, directing air upwards from beneath the elevated access floor and extracting it at the soffit level. This approach requires less energy for air distribution compared to conventional HVAC systems that distribute air from above (*The Ridge* 2020:5).

Furthermore, The Ridge is a unique building that boasts advanced sustainable technologies and building methods. It contributes to addressing the current challenges of waste management, sustainable material choices and construction methodology. This aligns with the *National Framework for Sustainable Development in South Africa* (Department of Environmental Affairs 2018:22), which notes that South Africa's natural resource base is severely under pressure and its ecosystems face degradation.

The literature identifies that the Ridge introduces several groundbreaking initiatives within the green building and sustainability industry in South Africa. These innovations include energy-efficient and passive climate control measures, the integration of renewable energy

sources, sustainable water management, carbon footprint reduction, and a strong emphasis on natural lighting. The concept of dematerialisation, which advocates for the conscious use of fewer materials, plays a crucial role in reducing the building's environmental impact. The Ridge exemplifies this by designing its concrete structure with maximum efficiency.

One notable feature is the incorporation of plastic waste collected from various sources into the building's core, effectively sequestering plastic waste within the structure. Additionally, the use of timber as the building's façade material, particularly cross-laminated timber (CLT), is a pioneering approach in South Africa. This not only lends a warm and authentic aesthetic to the exterior but also significantly reduces the building's carbon footprint. The façade design promotes passive climate control, contributing to a comfortable and natural indoor environment for occupants. These pioneering aspects of The Ridge set new standards and mark a significant step forward in sustainable and environmentally conscious construction practices.

The sustainable methods utilised in the building provide an exceptional example of design principles that could be applied in the context of the iSimangaliso Wetland Park. However, limited literature is available regarding the ecological and cultural principles used in The Ridge building, as well as its critical regionalism, which appears to be a known gap. Furthermore, the sense of place theoretical approach in The Ridge is assumed to be explored within the internal spatial relationships of the building. Sense of place depends on the individual's relationship with an environment, and the key physical elements that significantly impact this perception include location, size, degree of enclosure, scale, proportion, human scale, space, texture, color, sound, smell and visual diversity. (Vali and Nasekhiyan 2014: 3751). Therefore, the literature reveals that the sustainable technologies incorporated in the building are designed to enhance human comfort, which is linked to the creation of a sense of place.

Ultimately, it is evident that The Ridge building incorporates elements of both the Revival and Progressive Models, as outlined by Yahya and Hassanpour (2022:3). However, there was limited integration of cultural identity within the building's design elements. This results in a gap in defining the building as a holistic Hybrid Model. Therefore, while The Ridge contains elements of both models, the lack of cultural significance means it cannot be classified fully as a Hybrid Model. Table 5.4 summarises the analysis of the Revival, Progressive and Hybrid Models.

Table 5.4: Analysis of the Ridge Building in Relation to the Revival, Progressive, and Hybrid Models

	Revival Model	Progressive Model	Hybrid Model
Core Characteristics	Focuses on passive strategies, use of natural light, recycled and local materials; promotes human well-being and comfort.	Emphasises advanced technologies (TABS, BMS, displacement HVAC), energy/resource-efficient systems, and green certifications.	Integrates natural/passive methods with high-tech systems, aiming for environmental responsiveness and occupant comfort.
Evidence in The Ridge	✓ Evident – passive ventilation, natural lighting, recycled/ecobricks, biophilic design for well-being.	✓ Strong – advanced HVAC, thermally activated building systems, BMS, greywater recycling, photovoltaics.	✓ Partial – tech and passive systems coexist, but limited cultural identity weakens full model integration.
Architectural Expression	✓ Present – emphasis on natural materials, daylight, human scale, and biophilia support sense of place.	✓ High – integration of TABS, smart lighting, displacement HVAC shows innovation and resource efficiency.	✗ Weak – lacks explicit cultural symbolism or regional narrative, limiting hybrid expression.
Use of Local Materials	✓ Strong – cross-laminated SA pine, ecobricks, recycled	✓ Moderate – locally sourced, but focus is on material	✓ Partial – innovative and eco-conscious but lacks

	materials; promotes low embodied carbon.	performance more than cultural value.	depth in cultural-local contextuality.
Cultural Significance	✗ Weak – minimal integration of local culture, heritage, or narrative elements.	✗ Absent – no digital cultural interaction or storytelling; purely performance-driven.	✗ Insufficient – strong environmental focus but no clear link to regional cultural identity.
Technological Integration	✗ Low – tech used in service of Revival goals (e.g., passive ventilation supported by BMS).	✓ Strong – use of smart systems (BMS), solar, TABS, HVAC show high-tech sustainability.	✓ Moderate – synergy between passive and tech systems, but no tech supporting cultural elements.
Environmental Strategies	✓ Evident – passive ventilation, biophilic design, recycled content, low energy use.	✓ Strong – solar PV, greywater, energy-efficient HVAC and TABS, intelligent lighting.	✓ Evident – good environmental synthesis; cultural strategies underdeveloped.
Alignment with Theory	✓ Moderate – aligns with Revival Model on ecological and human-centric design but lacks cultural depth.	✓ High – strong example of Progressive design according to Yahya and Hassanpour’s criteria.	✗ Lacking – absence of cultural/critical regionalism limits qualification as full Hybrid Model.
Sustainability Gaps	Weak cultural/heritage expression, limited regional symbolism or narrative.	May prioritise performance over user experience or	Lacks full integration of regional identity, limiting potential as

		contextual resonance.	a model for context-rich hybrid sustainability.
Overall Evaluation	Effective application of passive design principles and human well-being focus.	Excellent example of technological sustainability in South Africa.	Promising but incomplete Hybrid Model – high-tech + passive features present, but cultural grounding is weak.

5.4.5. Discussion and findings

The Ridge building in Cape Town stands as a landmark in South African commercial architecture, showcasing an ambitious vision to elevate sustainable office development through innovative and ecologically responsive design. This study has critically examines the building’s sustainable features, architectural strategies, and alignment with established sustainability models, revealing key findings related to environmental performance, occupant well-being, and contextual relevance.

The Ridge exemplifies a multifaceted approach to sustainability by integrating both passive and active systems that respond effectively to the local climate and environmental challenges. Its hybrid ventilation strategy, combining natural ventilation with mechanical HVAC systems, allows the building to adapt dynamically to weather conditions, optimising occupant comfort and reducing energy consumption. The incorporation of Thermally Activated Building Systems (TABS) significantly reduces reliance on conventional HVAC systems by using the building’s thermal mass for radiant cooling and heating, allowing for natural ventilation during 75–85% of the year.

The building also employs displacement ventilation with underfloor air distribution, further improving energy efficiency by reducing the volume and energy needed to condition interior air. Natural daylighting is maximised through large atria and lightwells, reducing artificial lighting demands while supporting occupant health through circadian lighting systems that mimic natural daylight patterns.

Material innovation is a standout feature, particularly the use of cross-laminated timber (CLT) cladding—the first of its kind in South African commercial buildings—highlighting the project’s commitment to lowering embodied carbon. Ecobricks, made from compressed plastic waste, replace conventional polystyrene void fillers in concrete slabs. This addresses both waste management and concrete reduction, aligning with dematerialisation principles. Additional sustainable harvesting techniques such as rainwater harvesting, greywater recycling, and rooftop photovoltaics further reinforce the building’s resource-efficient operations.

Human Well-being and Biophilic Integration

The Ridge prioritises occupant comfort, health, and productivity by embedding biophilic design elements such as internal greenery, natural ventilation, and access to daylight. These features create a tangible connection to nature within the workplace, supporting psychological well-being and aligning with current research that links environmental quality to human performance.

The Building Management System (BMS) plays a critical role in facilitating occupant interaction with environmental controls, enabling users to actively manage their comfort conditions. This participatory approach underscores the building’s design philosophy of balancing technological sophistication with human-centric strategies.

Applying the framework by Yahya and Hassanpour (2022), The Ridge building demonstrates a synthesis of both the Revival and Progressive sustainability models:

- **Revival Model Elements:** Evident in passive design strategies like natural ventilation, biophilic integration, the use of recycled and local materials (e.g., ecobricks, South African pine timber), and an emphasis on natural lighting. These features enhance occupant well-being and reflect an ecological sensitivity rooted in environmental responsiveness.
- **Progressive Model Elements:** Strongly represented by the adoption of advanced technologies such as TABS, a smart BMS, displacement HVAC systems, photovoltaic energy harvesting, and greywater recycling. These high-performance systems showcase resource efficiency and innovation, characteristic of cutting-edge sustainable architecture.

- **Hybrid Model Integration:** While the building successfully merges passive and active technologies, creating an environmentally responsive and comfortable workspace, it falls short of fully realising the Hybrid Model due to limited integration of cultural identity and critical regionalism. The absence of explicit cultural symbolism or local heritage narratives weakens the building's holistic connection to its users and geographical context.

Gaps and Opportunities

A notable gap in The Ridge's design is the minimal incorporation of cultural or regional identity, which limits its ability to resonate deeply with local heritage and create a strong sense of place from a socio-cultural perspective. While physical design elements—such as scale, materiality, and biophilic features—contribute to spatial experience and occupant comfort, the lack of cultural references constrains the building's contextual relevance. This limitation is significant considering the importance of cultural narratives in sustainable architecture, particularly in diverse and historically rich settings like South Africa.

While the building's focus on environmental and technological performance is commendable, it could be further enhanced by embedding local cultural principles and ecological knowledge. Doing so would align it more closely with the critical regionalism framework and support the development of a more nuanced Hybrid Model that balances ecological sustainability, technological innovation, and cultural expression.

Implications for Ecologically Responsive Design in South Africa

The Ridge serves as a pioneering example of how advanced sustainability technologies and material innovations can be successfully integrated into commercial architecture in South Africa. Its strategies offer valuable lessons for future developments, especially in ecologically sensitive and culturally significant areas like the iSimangaliso Wetland Park.

However, for architecture to be truly sustainable and contextually appropriate, it must transcend environmental metrics alone and embrace the cultural and ecological narratives unique to its place. Incorporating cultural identity alongside ecological responsiveness could deepen occupant engagement and strengthen the building's legacy as a model of holistic sustainability.

5.4.6. Summary

The Ridge building demonstrates advanced sustainable design strategies that could offer valuable insights for developments within the ecologically sensitive iSimangaliso Wetland Park. Its integrated passive ventilation thermally activated building systems, and efficient water and energy management align well with the environmental priorities essential for protecting the park's natural resources.

The use of locally sourced, low-impact materials such as cross-laminated timber and ecobricks presents an opportunity to reduce the ecological footprint of construction projects in the park while promoting resource efficiency. Furthermore, the incorporation of biophilic design principles, which enhance human well-being through connection to nature, could be particularly relevant for architecture within the park's unique natural landscape.

However, the limited integration of cultural identity and regional narratives in The Ridge's design indicates a gap that should be addressed when applying similar sustainable methods in iSimangaliso. Given the park's rich ecological and cultural heritage, future developments should incorporate critical regionalism and a sense of place to ensure that sustainability efforts also honor and reflect local cultural values.

In summary, while The Ridge offers exemplary sustainable technologies and strategies suitable for iSimangaliso's environmental conditions, adaptations that strengthen cultural contextuality and ecological sensitivity would enhance the holistic sustainability of projects within the park.

5.5. Precedent Study 4 – Bowali Visitors Information Centre

5.5.1. Introduction

This precedent study examines the Bowali Visitor Centre, designed by Glenn Murcutt in collaboration with Troppo Architectural Practice. The study is relevant to the research as the Bowali Visitor Centre is located within a World Heritage site, similar to the context of the research site. Its inclusion aims to explore how the building responds to its environmental setting, and to analyse the harmonious relationship it fosters between humans and nature. The selection of this precedent study is guided by the criteria outlined in Section 4.3, Precedent Study Research. The analysis was conducted through desktop research using reliable resources.



Figure 5.31: Bowali Visitor Centre

Source: Subtilitas (n.d.). Aerial View of the Bowali Visitors Centre. The image showcases the Bowali Visitor Centre seamlessly integrated within the surrounding woodland landscape of Kakadu National Park. The building's elongated, pavilion-like form and curved roof structures reflect a design that responds passively to the tropical climate, emphasising environmental sensitivity and a harmonious relationship between built form and nature.

5.5.2. Background

The Bowali Visitors Information Centre is located in Kadadu National Park, Northern Territory, Australia. The Kakadu National Park is a nature reserve that has been designated a World Heritage Site (Rael 2009:24). The Centre was completed in 1994. The Park is home to various wildlife, such as crocodiles, wallabies, dingoes, goannas, and a myriad of bird species.

5.5.3. Concept and design

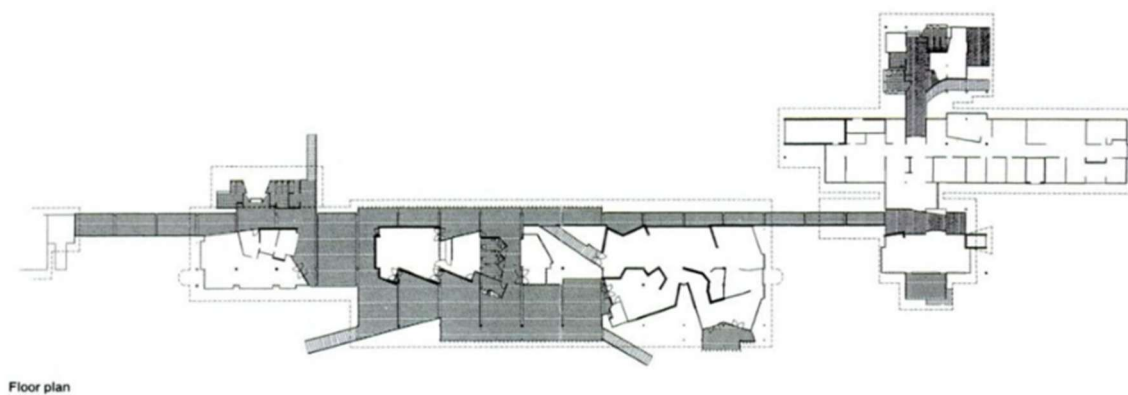


Figure 5.32: Bowali Floor Plan

Source: Rael (2009:26). Floor plan of the Bowali Visitor Centre showing a linear layout with an elongated walkway that offers full visibility of the building and a strong connection to the surrounding landscape. Openings and transitional spaces enhance natural ventilation, lighting, and ecological integration.

Figure 5.32 represents the floor plan of the Bowali Visitor Centre. It is evident that the walkway to the building allows the user to see the entire length of the structure, while also connecting visually with the natural landscape. The floor plan reveals a linear and open architectural layout that is closely integrated with its surrounding natural environment. The elongated walkway leading to the building is deliberately designed to offer a full view of the structure along its length, creating a sense of anticipation and spatial awareness as one approaches. This axial alignment not only highlights the building's architectural rhythm but also strengthens the user's visual and experiential connection to the landscape.

The orientation and flow of the plan promote transparency and accessibility, allowing visitors to engage with the natural surroundings. Large openings and transitional spaces—such as verandas and shaded walkways—act as boundaries between inside and outside, enhancing passive ventilation and natural lighting. Overall, the design reflects ecologically responsive planning, prioritising environmental harmony, user experience, and sustainability.

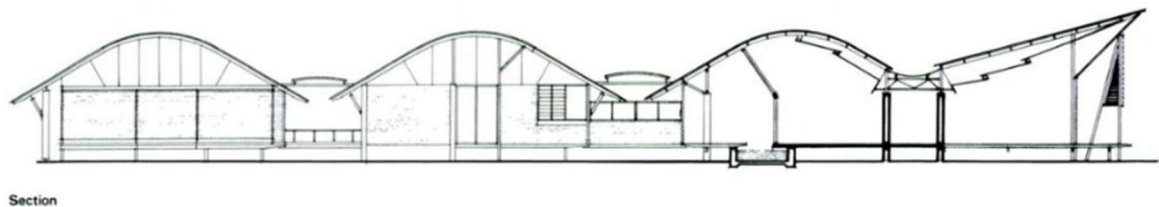


Figure 5.33: Sectional drawing

Source: Rael (2009:26). This sectional drawing illustrates the building's rhythmic roofline, natural ventilation strategies, rainwater collection strategies via channels and layered spatial organisation. The curved roof forms enable passive cooling by encouraging airflow and shading, while the raised structure minimises site impact and improves thermal comfort.

The Bowali Visitor Centre is designed with the following key principles:

- **Cultural Sensitivity** - The design respects and incorporates elements of indigenous culture and heritage from the Kakadu region. According to Rael (2009:24), the Bowali Visitors Information Centre drew its primary inspiration from the caves and escarpments found in Kakadu National Park. The main objective in the design was to create a structure that seamlessly integrated with its surroundings and encouraged

visitors to explore the park with a sense of environmental sensitivity (Suresh n.d.). Suresh (n.d.) states that the Centre's design was based around the culture of the Aboriginal people and their relationships with both people and the land. The center comprises an environmental interpretation centre, a bird information centre, a library, a café, a gallery, an audio/visual area, park headquarters, and a reception area.

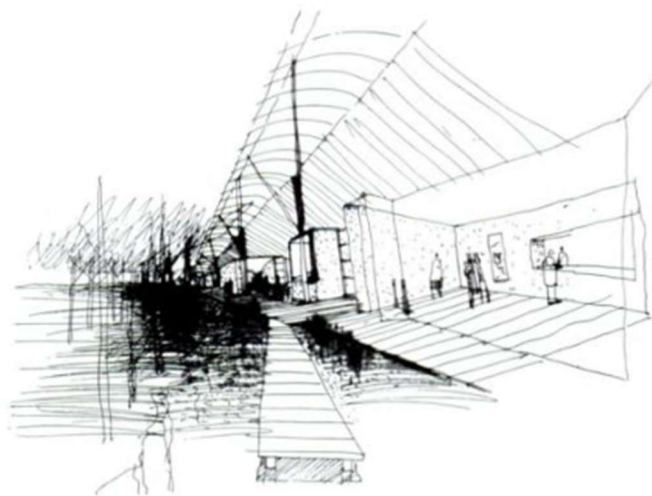
- Environmental Sustainability - The Centre is designed with a strong focus on environmental sustainability, incorporating energy-efficient systems, water conservation measures, and the use of sustainable, locally sourced materials. The Centre draws inspiration from local cultural heritage, using locally sourced materials, cultural decorations and rock paintings inspired by the Djabulukgu Association, which represents the Aboriginal Gagudju people and is renowned for its distinctive rock art paintings (Suresh n.d.). It is further affirmed that no imported timber was used. The coloured structural walls and their heights make the building reminiscent of termite mounds, which are visible when approaching the structure.

The Centre is constructed from rammed earth walls, ironwood floors and natural stone, which help it to blend into the landscape. Every area extends into a shaded outdoor space, organised along a lengthy central spine constructed from rammed earth. The wide verandas offer a close relationship with the bush setting and provide generous shade.

- Accessibility - The Centre ensures accessibility for all visitors, including those with disabilities, through features such as ramps and wide pathways. According to Rael (2009:24), the architect considered the traditional approach to Aboriginal sacred sites, always approached at an angle, in the design. The Centre's oblique pathway enables the user to have a clear view of the entire length of the structure (refer to Figure 5.32).
- Sustainability principles - The Centre has a long, reflective roof structure that encourages airflow via passive cooling strategies and harvests rainwater (refer to Figure 5.31 for an aerial perspective). During the monsoon seasons, rainwater is strategically collected into long central gutters, which channel the water to rainwater spouts, forming a waterfall like effect, similar to those that cascade from the park's cliffs. The water then flows into a pond that is designed to cool the surrounding spaces through evaporation (Rael 2009:24).

Paolella and Quattrone (2007:42) note that the Centre addresses the tropical climate of the region by incorporating a raised floor on stilts, which prevents flooding and facilitates ventilation underneath. The steep, overhanging roofs efficiently drain rainwater, while the veranda allows sunlight into the building during winter and mitigates sun exposure during the summer (refer to Figure 5.33 for a typical section of the building).

- Integration with the Natural Environment - The design seamlessly blends with the surrounding natural environment, utilising natural materials and green architectural features. Rael (2009:24) states that the Centre creates a dynamic experience similar to that of walking through the bush; this sense of immersion is achieved through the large, open outdoor areas that link the building with the natural environment. The outdoor spaces allow natural light to filter into the interior, casting shadow lines beneath the corrugated metal roof sheets (refer to Figure 5.35 and Figure 5.36). The light is further filtered through transparent corrugated fiberglass, perforated metal, and vertical slats that enhance the shadow effects.



Early sketch illustrating the airy roof canopy over the continuous wood deck

Figure 5.34: Sketch of roof canopy

Source: Rael (2009:26). An early design sketch capturing the open and airy character of the roof canopy suspended above a continuous timber deck. This drawing emphasises the architects' intent to create a light, breathable structure that engages with the natural surroundings while promoting passive design principles and user connectivity to the landscape.



Figure 5.35: Relationship between internal patio and exterior

Source: Gollings (2014). Relationship between internal patio and exterior — The image illustrates the seamless spatial transition between the internal patio and the surrounding natural environment, highlighting the building's open design and strong indoor-outdoor connection. The roof structure is designed to facilitate natural ventilation via passive cooling strategies, and the timber slats shield direct sunlight into the space.



Figure 5.36: Bowali Visitor Centre, illustration highlighting the materiality and walkways elevated off the natural environment

Source: Subtilitas (n.d.). Integration with the Natural Environment — The architectural design of the Bowali Visitor Centre blurs the boundary between built form and landscape by incorporating large open outdoor areas, natural lighting, and material transparency. Elements such as corrugated metal roofing, transparent fiberglass panels, perforated metal, and vertical timber slats filter light and create dynamic shadow patterns, evoking the sensory experience of walking through the bush.

5.5.4. Analysis of the Revival, Progressive and Hybrid Models by Yahya and Hassanpour (2022:3) in the Design

Revival Model:

The following highlights the design elements identified as being incorporated in the building in line with the Revival Model by Yahya and Hassanpour (2022:3).

- Cultural Sensitivity:

Cultural sensitivity is a key aspect of the design, which incorporates elements of indigenous culture and heritage from the Kakadu region. According to Rael (2009:24), the Bowali Visitors Information Centre was inspired by the caves and escarpments of Kakadu National Park. The primary objective was to create a structure that blended seamlessly with the environment and encouraged visitors to explore the park with a strong sense of environmental awareness (Suresh n.d.). Suresh (n.d.) noted that the design was rooted in the culture of the Aboriginal people, reflecting their connection to the land and community.

- Utilisation of environmentally responsive design strategies:

The utilisation of environmentally responsive design strategies is evident in the reflective roof structure that encourages airflow for passive cooling and rainwater harvesting. The building responds to the tropical climate with a raised floor on stilts, preventing floods and allowing ventilation—this, in turn, touches the earth lightly and is related to the concept of conservation. The integration with the natural environment is seamless, creating a dynamic experience akin to walking through the bush. The design's transparency, with its large patios that seemingly link the indoor and outdoor spaces, demonstrates a commitment to a sustainable and culturally rich architectural narrative.

- Use of local environmentally friendly material usage.

- The Centre drew inspiration from local cultural heritage, incorporating locally sourced materials, cultural decorations, and rock paintings inspired by the Djabulukgu Association, which represents the Aboriginal Gagudju people and is renowned for its distinctive rock art (Suresh n.d.). It was further confirmed that no imported timber was used. The coloured structural walls and their height were designed to resemble termite mounds, which become visible as one approaches the building.
- Constructed from rammed earth walls, ironwood floors, and natural stone, the Centre blends harmoniously with the landscape. Each area extends into a shaded outdoor space along a central spine made of rammed earth. The wide

verandas foster a close relationship with the surrounding bush and provides ample shade.

Progressive Model:

The following highlights the design elements identified as being incorporated in the building in line with the Progressive Model by Yahya and Hassanpour (2022:3).

- The adaption of resource-efficient technologies:
 - The literature reveals that environmental sustainability is a focal point, with the use of energy-efficient systems, water conservation measures, and sustainable materials.

Hybrid Model:

The Hybrid Model embodied by the Bowali Visitor Centre reflects a deliberate combination of cultural expression and sustainable design strategies. The building strongly adheres to Revival principles through its deep connection to place, use of local materials, and design inspired by natural forms and Aboriginal heritage. At the same time, it incorporates early eco-technological features such as passive cooling, rainwater harvesting, and raised floors. While it lacks the advanced smart systems and active controls typical of fully developed Progressive models, the Centre demonstrates a promising integration of both Revival and Progressive principles.

The research indicates that the building does not include many modern sustainable technologies, as discussed in Section 2, Literature Review. However, it is important to consider that the building was constructed in 1994, a time when many current technologies were not yet available. Given this context, the building's design can be seen as strongly aligned with the Progressive Model as defined by Yahya and Hassanpour (2022:3). If assessed at the time of its completion, the combination of Revival and Progressive elements could have been regarded as a significant step toward a Hybrid Model. Today, with advances in sustainable technology, retrofitting the Bowali Visitor Centre could further enhance its environmental performance and fully realise its potential as a Hybrid design.

Table 5.5 provides a critical comparative overview of the Revival, Progressive, and Hybrid Models as applied and analysed in the Bowali Visitors Centre precedent study.

Table 5.5: Analysis of the Bowali Visitor Centre in Relation to the Revival, Progressive, and Hybrid Models

	Revival Model	Progressive Model	Hybrid Model
Core Characteristics	Deeply rooted in place and culture; emphasises passive design, environmental harmony, use of local materials.	Focus on system efficiency, innovation, resource management, and sustainable performance.	Blends cultural expression and contextual responsiveness with functional sustainability strategies.
Evidence in Bowali Centre	✓ Strong – use of local materials, passive cooling, raised structure, and cultural referencing create strong Revival identity.	✓ Moderate – passive sustainability is present but limited technological systems due to 1994 construction timeline.	✓ Partial – integrates Revival and proto-progressive principles but lacks current-day technology for full Hybrid classification.
Architectural Expression	✓ High – inspired by termite mounds, rock formations, Aboriginal traditions; form and materiality resonate with landscape.	✗ Limited – innovation lies in spatial and climatic response, not in tech; technological form expression is minimal.	✓ Present – strong natural/cultural response combined with foundational eco-tech (e.g., rainwater cooling, raised floors).
Use of Local Materials	✓ Strong – rammed earth, ironwood, local stone, no imported timber; expressive of site.	✗ Weak – minimal advanced materials or performance-driven material selection.	✓ Evident – material choices support both sustainability and cultural identity, blending Revival

			with early eco-tech use.
Cultural Significance	✓ Strong – design celebrates Aboriginal culture, sacred site typologies, and local heritage.	✗ Absent – no integration of digital or technological cultural storytelling or expression.	✓ Present – meaningful cultural expression present but not technologically amplified.
Technological Integration	✗ Minimal – technology limited to passive systems and basic mechanical strategies.	✗ Weak – lacks modern smart systems, photovoltaics, or active controls.	✗ Incomplete – potential for integration exists (retrofitting possible), but original lacks high-tech sustainability features.
Environmental Strategies	✓ Strong – passive cooling, shaded verandas, rainwater harvesting, elevated floors, thermal mass, daylighting.	✓ Basic – early sustainability measures align with modern principles, though not tech-based.	✓ Evident – design integrates environmental logic and passive performance well; Hybrid potential exists.
Alignment with Theory	✓ High – closely aligns with Revival through context, culture, and passive design focus.	✓ Partial – progressive intent visible in sustainability awareness but not	✓ Emerging – clear integration of revival principles and early sustainability practices; potential

		supported by modern systems.	for Hybrid status if retrofitted.
Sustainability Gaps	Minimal tech-based innovation; reliant on environmental design rather than performance metrics.	Absence of tech-driven strategies limits optimisation of energy and water efficiency.	Technological incompleteness limits full realisation of Hybrid model.
Overall Evaluation	Exemplary Revival case – contextually rooted, culturally rich, and environmentally harmonious.	Progressive elements present for its time but lacking advanced systems seen in newer projects.	Strong candidate for retrofitted Hybrid model; foundational integration of revival + early sustainability systems is notable.

5.5.5 Discussions and findings

The design language reflects the Australian context, which is similar to that of the South African context and climate. This precedent study of the Bowali Visitor Centre, designed by Glenn Murcutt and Troppo Architectural Practice, offers valuable insights into how architecture within a World Heritage Site can respond harmoniously to its environment, culture, and climate. The relevance of this study lies in its location within Kakadu National Park, a protected natural and cultural landscape, which parallels the context of the research site. Through desktop research using reliable sources, the study identifies key design principles that align with sustainable and culturally responsive architecture.

The Bowali Visitor Centre exhibits a strong **Revival Model** approach, deeply rooted in cultural sensitivity and environmental harmony. The design respects indigenous heritage, drawing inspiration from the Aboriginal connection to the land and local natural formations such as termite mounds and escarpments. The use of locally sourced, environmentally friendly materials such as rammed earth, ironwood floors, and natural stone reinforces this connection. The building's layout, characterised by a linear floor plan and elongated walkways, enhances visual and spatial engagement with the surrounding landscape, strengthening the users' connection to nature. Passive environmental strategies such as

raised floors for ventilation and flood prevention, shaded verandas for solar control, and rainwater harvesting reflect a commitment to ecological responsiveness.

In terms of the **Progressive Model**, the Bowali Centre incorporates early resource-efficient technologies appropriate to its 1994 construction era, including passive cooling, rainwater collection, and water conservation measures. While these strategies align with sustainability goals, the building lacks advanced technological systems such as photovoltaics, smart controls, or active energy management that are common in more recent progressive designs.

The study finds that the Bowali Visitor Centre represents an emerging **Hybrid Model**, blending Revival cultural expression with foundational sustainability technologies. Although the Centre predates many modern sustainable technologies, its integration of cultural values and early eco-tech demonstrates a thoughtful balance between tradition and innovation. Given the building's age, it shows moderate alignment with Progressive principles and strong adherence to Revival ideals. With current technological advancements, the Centre presents a strong candidate for retrofitting to enhance its environmental performance, thereby fully realising the potential of the Hybrid Model.

Key Findings:

- The building excels in cultural sensitivity, integrating indigenous heritage and the local environmental context, consistent with the Revival Model.
- Passive design strategies and the use of locally sourced materials contribute to environmental sustainability without heavy reliance on mechanical systems.
- The absence of contemporary smart technologies limits its classification as a fully Progressive model but reflects the technological context of its time.
- The Bowali Visitor Centre's design supports a holistic approach, where architectural form, materiality, and environmental strategies work synergistically to create a sustainable and culturally meaningful visitor experience.
- Retrofitting opportunities exist to incorporate modern technologies, potentially elevating the building to a fully functional Hybrid Model.

Overall, the Bowali Visitor Centre serves as an exemplary precedent for ecologically responsive, culturally grounded architecture within sensitive heritage landscapes. Its balanced approach offers important lessons for contemporary design in similar contexts, highlighting how the integration of cultural respect and sustainability can be achieved, even with technological constraints.

5.5.6. Summary

The Bowali Visitor Centre exemplifies a holistic approach to ecologically responsive and culturally sensitive architecture within a World Heritage context, closely aligning with principles of Critical Regionalism. Designed by Glenn Murcutt and Troppo Architectural Practice, the building harmoniously integrates with the natural environment of Kakadu National Park through its use of local materials, passive environmental strategies, and respect for indigenous cultural heritage. Its linear layout, raised floors, shaded verandas, and rainwater harvesting reflect a thoughtful response to the tropical climate, fostering a strong connection between visitors and the landscape.

The Centre primarily embodies the Revival Model by deeply rooting its design in local culture and environmental harmony, while also incorporating early Progressive elements such as passive cooling and water conservation technologies. Although limited by the technological context of its 1994 construction, the building demonstrates promising foundations of a Hybrid Model that balances tradition with emerging sustainability strategies.

Overall, the Bowali Visitor Centre provides valuable insights into designing architecture that is simultaneously culturally grounded, environmentally sustainable, and contextually appropriate—offering an exemplary precedent for similar heritage-sensitive sites and contemporary ecological design.

5.6 Summary and findings for the four precedent studies

The precedent studies reveal both shared and distinct sustainable strategies employed across the four projects. Precedents such as Forum Homini Boutique Hotel, Bowali Visitor Centre, and Karoo Wilderness Centre clearly draw inspiration from their local contexts and cultural heritage. These buildings reflect a strong connection to place through the use of indigenous materials, landscape integration, and symbolic design. However, buildings like Forum Homini fall short in incorporating advanced technological systems, limiting their long-term performance and adaptability.

In contrast, The Ridge demonstrates a high level of technical innovation—integrating smart HVAC systems, thermally activated building structures (TABS), ecobricks, and greywater

recycling. Yet, this performance-driven design lacks a cultural narrative or regional symbolism, reducing its contextual richness.

This study evaluates the four case studies—Forum Homini Boutique Hotel, Karoo Wilderness Centre, The Ridge, and Bowali Visitor Centre—through the framework of Yahya and Hassanpour’s Revival, Progressive, and Hybrid sustainability models. Each project reveals a varying degree of alignment with three key principles: ecological integration, technological innovation, and cultural contextuality.

- Revival Models emphasise contextual responsiveness, ecological harmony, and cultural heritage. Forum Homini and Bowali Visitor Centre excel in this model by utilising natural materials, passive systems, and culturally rooted architectural language. However, their lack of advanced technology limits operational efficiency and scalability.
- Progressive Models, exemplified by Karoo Wilderness Centre and The Ridge, focus on cutting-edge environmental systems and energy self-sufficiency. While these projects succeed in technical innovation, they fall short in conveying local identity or integrating cultural meaning into the architecture.
- Hybrid Models attempt to fuse cultural, ecological, and technological dimensions. Among the precedent studies, Karoo Wilderness Centre comes closest to achieving this integration, combining nature-inspired forms with off-grid energy and water systems. However, the absence of cultural expression weakens its standing as a fully realised hybrid. The Ridge and Bowali Visitor Centre also demonstrate hybrid potential but lack a balanced integration of cultural and technological strategies.

A clear pattern emerges: the precedents above tend to succeed either in contextual-cultural sustainability (Revival) or in technical-environmental performance (Progressive), but rarely in both. This reveals a key challenge in ecological design—the need for truly holistic architecture that responds not only to environmental demands but also to cultural narratives and human experience. The Hybrid Model, though aspirational, remains underutilised, offering significant potential for a more integrated and future-ready architectural approach.

Table 5.6 provides a summary of the above precedent studies in relation to the Revival, Progressive and Hybrid Models.

Table 5.6: Analysis of the four-precedent study in Relation to the Revival, Progressive, and Hybrid Models

	Revival Model	Progressive Model	Hybrid Model
Core Focus	Cultural, ecological, and contextual integration using local materials and passive systems.	Technological innovation, resource efficiency, high-performance systems, and measurable sustainability.	Synthesis of ecological, cultural, and technological design principles for holistic sustainability.
Forum Homini Boutique Hotel – Precedent Study 1	✓ Strong alignment: embedded in landscape, cave-inspired, uses local stone and timber, evokes ancestral life.	✗ Weak: lacks advanced systems; minimal water storage, no observed tech integration.	✗ Weak: heavily revivalist; minimal tech weakens balance.
Karoo Wilderness Centre – Precedent Study 2	✓ High: biomimicry, ecological materials, landscape sensitivity.	✓ Strong: solar, water reuse, full off-grid systems.	✓ Effective: environmental Hybrid achieved; cultural layer missing.
The Ridge – Precedent Study 3	✓ Present: biophilic design, recycled local materials, passive systems.	✓ Strong: TABS, BMS, solar, HVAC, greywater reuse.	✓ Partial: passive-tech synergy, but weak cultural expression limits full Hybrid.

Bowali Visitor Centre – Precedent Study 4	✓ Strong: passive systems, cultural referencing, local materials.	✓ Partial: early sustainable ideas, but outdated tech.	✓ Emerging: proto-hybrid with potential; lacks current systems.
Overall Evaluation	Revival models show strong contextual and passive ecological design with cultural depth (Forum Homini, and Bowali Visitor Centre).	Progressive models excel in technical and environmental systems (Karoo Wilderness centre, and The Ridge).	Hybrid potential evident in Karoo and Ridge but weak in cultural integration; Bowali Visitor Centre shows foundational potential for retrofitting.

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6. Case Study – iSimangaliso Wetland Park

6.1. Introduction

This section presents the case study of iSimangaliso Wetland Park, located in KwaZulu-Natal, South Africa. As outlined in Chapter 1, the park is a designated UNESCO World Heritage Site and encompasses a diverse range of ecological systems, including the St Lucia estuary, surrounding wetlands, grasslands, dune systems, woodlands, forests, coastal marine environments, beaches, and coral reefs.

The case study is structured into two main parts. The first part provides a contextual background of the research site, while the second part applies the three evaluative models—Revival, Progressive, and Hybrid—based on the framework developed by Yahya and Hassanpour to assess the site’s architectural and ecological responsiveness. The relevance and importance of this case study are discussed in Section 1.3. The research methodology combines a desktop study with visual site observation to address the primary research objectives within iSimangaliso Wetland Park. This case study does not focus on the oceanographic features, geology, soils, hydrology and geohydrology.

6.2. Background

Name	iSimangaliso Wetland Park
Location	KwaZulu-Natal
Extent	358,534 ha
District Municipalities	❖ Umkhanyakude District Municipality ❖ King Cetshwayo District Municipality
Neighbouring Municipalities	❖ Mtubatuba Local Municipality ❖ Big 5 False Bay Local Municipality ❖ Jozini Local Municipality ❖ uMhlabuyalingana Local Municipality ❖ uMfolozi Local Municipality
International Status, Agreements and Obligations	❖ UNESCO World Heritage Convention ❖ Ramsar Convention

Figure 6.1: Site details

Source: iSimangaliso Wetland Park Authority (2017:8). The table outlines key information about iSimangaliso Wetland Park, located in KwaZulu-Natal and covering an area of 358 534 hectares. It falls under the jurisdiction of Umkhanyakude and King Cetshwayo District Municipalities and is bordered by six local municipalities. The park holds international environmental importance, as it is protected under the UNESCO World Heritage Convention and the Ramsar Convention, which underscores its global ecological value and the conservation obligations associated with it.



Figure 6.2: The research site map

Source: St Lucia (2023:1). This map illustrates the full extent of iSimangaliso Wetland Park along the northeastern coast of KwaZulu-Natal, South Africa, stretching from Maphelane in the south to Kosi Bay at the Mozambique border in the north. The park comprises a variety of ecological zones including marshes, lakes, rivers, estuaries, and coastal forests, as indicated by the legend. Key features such as Sodwana Bay, Lake St Lucia, Cape Vidal, False Bay, and Kosi Bay highlight the park's ecological richness and diversity. The map also shows nearby towns, access roads, park gates, and boundaries, as well as important conservation and tourism nodes, emphasising the park's role in regional connectivity, biodiversity conservation, and eco-tourism.

This section outlines the background and location of the park. The United Nations Educational, Scientific and Cultural Organizations (UNESCO) has designated the research site a World Heritage Site (*Isimangaliso Wetland Park* 2022:1). Located on the eastern coast of KwaZulu-Natal, South Africa, iSimangaliso Wetland Park is approximately 235 km north of Durban (Wikipedia. 2023:1; refer to Figures 6.1 and 6.2). According to the article *History of the iSimangaliso Wetland Park* (2022:1), the research site covers approximately 358 534

hectares. Refer to Figure 6.2, the research site map, which illustrates the extent of the park boundaries.

A name change from Greater St. Lucia Wetland Park to iSimangaliso Wetland Park was officially implemented on November 1, 2007, with the intention of emphasising its unique African identity. The name *iSimangaliso* means “miracle and wonder” (Saarinen *et al.* 2009:233). According to Saarinen *et al.* (2009:233), the research site was the inaugural site in South Africa to attain World Heritage status. Roxanne (2018: para. 1 line 1) states that in “1999, UNESCO designated iSimangaliso as a World Heritage Site due to its natural beauty, distinctive natural attributes, and rich biological diversity”.

The park was recognised for three of the ten natural and cultural qualities identified by the World Heritage Convention, namely: “outstanding examples of ecological processes, superlative natural phenomena and scenic beauty, and exceptional biodiversity and threatened species” (Nibela Lake Lodge. 2022a:5). According to Saarinen *et al.* (2009:233), the survey site is South Africa’s third-largest park, spanning 280 km of Indian Ocean coastline. Refer to Figure 6.2, iSimangaliso Wetland Park map. Saarinen *et al.* (2009:233) further state that a key challenge is retaining its World Heritage status by protecting and maintaining the park’s ecological integrity by preventing degradation from tourist activities and local community pressures.

The park stands as one of Africa's exceptional natural wetland and coastal sites. “The park includes a wide range of pristine marine, coastal, wetland, estuarine, and terrestrial environments which are scenically beautiful and basically unmodified by people. These include coral reefs, long sandy beaches, coastal dunes, lake systems, swamps, and extensive reed and papyrus wetlands, providing critical habitat for a wide range of species from Africa's seas, wetlands and savannahs” (*Isimangaliso Wetland Park* 2022:1).

6.2.1. Access into iSimangaliso Wetland Park

iSimangaliso Wetland Park is accessible via two main routes: the N2 and R22 highways. From the south, visitors can enter through Maphelane by passing through towns like Mtunzini and Kwambonambi. The N2 also provides access to the town of St. Lucia via the Mtubatuba exit, which leads to the Eastern and Western Shores of the park. The R22 branches off from the N2 at Hluhluwe, guiding travellers to False Bay, uMkhuze (via the D820 to Ophansi Gate), and further north to Sodwana Bay, Lake Sibaya, and the Coastal

Forest area. The park’s northernmost section, Kosi Bay, is accessible through Manguzi/KwaNgwanase (see Figure 6.3).

According to the study by Laljit (2019:93), to preserve the integrity of the wetland, restrictions are enforced on specific activities, categorised under a three-part strategy:

- “A low-intensity zone – allowing for foot entry only.”
- “A moderate-use zone – allowing for vehicle entry and usage of campsites.”
- “A high-intensity zone – that includes roads, educational facilities, guided walks, and accommodation.”

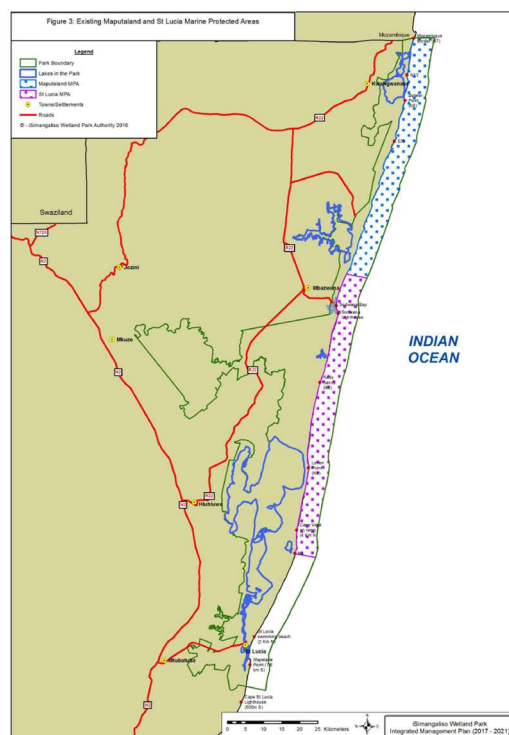


Figure 6.3: Access to the park

Source: iSimangaliso Wetland Park Authority (2017:151). The map highlights the primary road infrastructure providing access to and within iSimangaliso Wetland Park. Major regional roads such as the N2 and R22 are clearly marked in red, connecting key towns including Hluhluwe, Mkuze, Mbazwana, and Manguzi. These roads serve as the main transport routes for visitors entering the park and accessing its various sections. The network supports connectivity to important conservation zones and marine protected areas, enhancing tourism accessibility and management operations across the park’s diverse landscape.

6.2.2. History and Cultural Significance of the research site

This section describes the history and cultural significance of the park that underpins the study aims and objectives.

As reported in *iSimangaliso Wetland Park Authority* (2022:17), the park represents a lengthy history of human habitation, spanning from the Stone and Iron Ages to the more recent forced removal of people in the 1950s and 1980s, and is rich in cultural value.

The array of cultural heritage resources that form the historical foundation of the park encompasses “archaeological and palaeontological sites, artifacts, historical buildings and jetties, graves, fish traps, shipwrecks, landscapes with natural features, and tangible resources like places, oral traditions, and rituals” (*iSimangaliso Wetland Park Authority* 2022:17).

The key cultural heritage resources of the park include the following:

- iSimangaliso Wetland Park stands as “the largest protected area with documented potential Stone Age and Iron Age sites in South Africa. The sites have evidence of the presence of Nguni-language speaking South Africans and provide evidence of how African people adapted socially and culturally over time in Southeast Africa” (*iSimangaliso Wetland Park Authority* 2022:17).
 - Three sites within the park have revealed “early Stone Age culture (between 500 000 and a million years BC), and also evidence of Middle and Late Stone Age occupation postdating (about 110 000 years ago)” (*iSimangaliso Wetland Park Authority* 2022:17).
 - iSimangaliso is abundant in artifacts and remnants from “Early Iron Age (250 – 1000 AD) and Late Iron Age (1000 – 1840 AD) settlements, particularly in the vicinity of Lake St Lucia and other wetlands” (*iSimangaliso Wetland Park Authority* 2022:17).
- Historical interest areas include:
 - “Sites which commemorate land claimants’ loss of land and subsequent restitution” (*iSimangaliso Wetland Park Authority* 2022:17).
 - Artifacts from both World Wars, such as “Catalina Bay on Lake St Lucia, utilised as a flying boat base by the Royal Air Force,” are still present (*iSimangaliso Wetland Park Authority* 2022:17).
 - David Webster’s (anti-apartheid activist) research camp at KwaDapha (*iSimangaliso Wetland Park Authority* 2022:17).
 - “The establishment of an active military site in a conservation area at the Nhlozi Peninsula” (*iSimangaliso Wetland Park Authority* 2022:17).

- Records of historical incidents pertaining to the Zulu and Thonga people that occurred within or close to the park include:
 - “The Battle of eTshaneni, in which King Dinizulu triumphed over Chief Zibhehu of the Mandhlakazi clan, occurred in the uMkhuze River Gorge” (*iSimangaliso Wetland Park Authority 2022:18*).
 - “The integration of the Thonga people into the Zulu state occurred during the colonial period, coinciding with the establishment of the Mozambique border” (*iSimangaliso Wetland Park Authority 2022:18*).
- Over the years, the iSimangaliso Wetland Park has been referred to by various names. When “occupied by the Tsonga People, it was known as Tembeland or Thongaland.” However, these names fell out of use in the early 1900s (Nibela Lake Lodge. 2022a:1).
- The Park holds significance as it showcases numerous instances of living heritage, where age-old traditions continue to be practised today. “These encompass oral histories, cultural traditions, land use, resource management practices, and indigenous knowledge systems” (*iSimangaliso Wetland Park Authority 2022:18*). An illustrative example can be observed in the enduring fish-trapping techniques of Kosi Bay (*iSimangaliso Wetland Park Authority 2022:18*).

It is evident that iSimangaliso Wetland Park is associated with a rich historical and cultural heritage. As reported by *iSimangaliso Wetland Park Authority (2022:18)*, the park is acknowledged for its "sense of place," which embodies particular qualities that people experience in their own unique ways and that are maintained by individuals and communities with a variety of backgrounds, cultural norms, and beliefs.

The cultures within iSimangaliso Wetland Park provide valuable insights and lessons that can be learned and appreciated. Here are some key aspects that can be gleaned from these cultures:

- Indigenous knowledge and conservation: As mentioned above, the park is home to various indigenous communities, such as the Zulu and Tsonga people, who have a deep understanding of the local ecosystems and natural resources. Their traditional knowledge about medicinal plants, sustainable fishing practices, and land management can teach us about the importance of conservation and the sustainable use of natural resources.

- **Coexistence with nature:** The cultures in the park have a long history of coexisting with the natural environment. Their practices, rituals, and beliefs are often intertwined with nature and reflect a profound respect for the interconnectedness of all living beings. This harmonious relationship with the environment teaches us the significance of living in balance with nature and valuing biodiversity.
- **Cultural heritage and identity:** The cultures within iSimangaliso Wetland Park have a rich cultural heritage, including traditional music, dance, storytelling, and crafts. Preserving and celebrating this cultural heritage is essential not only for the local communities but also for the broader society. Learning from these cultures encourages us to appreciate and respect diverse cultural identities and to value the intangible heritage passed down through generations.
- **Adaptation and resilience:** Many cultures within the park have faced challenges such as colonialism, apartheid, and environmental changes. Yet, they have shown resilience and adaptability in the face of adversity. Their ability to adapt their livelihoods, cultural practices, and knowledge systems teaches us the importance of resilience and flexibility in a changing world.

Through the various cultures within iSimangaliso Wetland Park, we can gain a deeper appreciation for the interconnections between humans and nature, learn sustainable practices, and recognise the importance of cultural diversity and heritage. This knowledge can inform our own efforts in resource conservation, community development, sustainable living and architecture.

6.2.3. Climate

iSimangaliso Wetland Park lies within the subtropical climate zone of Africa, which is characterised by scorching summers and moderate winters. High humidity is common throughout the region. The spring and summer months, spanning from September to March, account for approximately 60% of the yearly rainfall. While an in-depth climatic analysis falls outside the scope of this study, a basic understanding of the prevailing climate is essential to contextualise the environmental responsiveness examined in this research.

6.2.4. Topography

iSimangaliso Wetland Park represents a harmonious blend of diverse landscapes that support self-sustaining biological systems with minimal external interference. The wetland and freshwater habitats encompass salt marshes, mangroves, swamp forests, riparian forests, and

rocky terrain interspersed with woodlands, grasslands, and forests, each contributing to the ecological richness of the area (iSimangaliso Wetland Park Authority 2017).

The research site comprises five primary biological systems. While a detailed analysis of these systems falls outside the scope of this study, a general overview is provided to highlight their presence and ecological importance within the broader context of the site.

Eastern Shores: The eastern shores, located in the coastal region of the reserve, are characterised by dunes, subtropical forests, and grasslands (iSimangaliso Wetland Park Authority 2017:14).

Western Shores: Representing the driest part of the park, the western shores consist of sand forests, dry savannahs, and ancient coastal terraces on elevated ground between the Lubombo Mountains and the coastal plain (iSimangaliso Wetland Park Authority 2017:14; Laljit 2019:95).

Estuarine System: Lake St. Lucia, which spans 85 km, supports diverse wildlife including hippos, crocodiles, reptiles, and numerous bird species (Laljit 2019:95).

Swamp System: Northern Lake St. Lucia includes the Mkuze marshes, which are dominated by reeds and lilies. The Mfabeni and Mfolozi marshes formed from sediment deposited in former lagoon valleys (Laljit 2019:95).

Marine System: This encompasses the park's coastal areas along the Indian Ocean, including sandy beaches and coral reefs.

Water Bodies and Systems: The park has freshwater lakes (Bhangazi North, Bhangazi South, Ngobozeleni) as well as the estuarine-linked Lake St. Lucia, which is Africa's largest estuary covering 36 826 hectares (Ramsar 1998:9). While St. Lucia is primarily saline, it has freshwater zones near the mouths of its feeder rivers.

6.2.5. Conservation significance in iSimangaliso Wetland Park

As indicated in Section 1, to attain World Heritage Status, a site must be listed under one or more of the ten criteria defined by UNESCO. iSimangaliso Wetland Park is listed under three criteria. The park has fifteen interrelated ecosystems support a wide range of African wildlife, including several rare, threatened, and unique species. Although each of these habitats may not be individually unique, their coexistence within a single protected area is rare on a worldwide scale and stands out within the South African context.

These ecosystems can be broadly classified into three main biomes: marine, terrestrial, and aquatic, aligning with criterion (vii) concerning biodiversity and threatened species (iSimangaliso Wetland Park Authority 2017:14).

The study by Laljit (2019:96) further affirms this; refer to Figure 6.4, which presents a diagram of the interrelated ecosystems. While a detailed analysis of each biome lies beyond the scope of this research, a brief contextual overview is provided to support the study’s environmental framing.

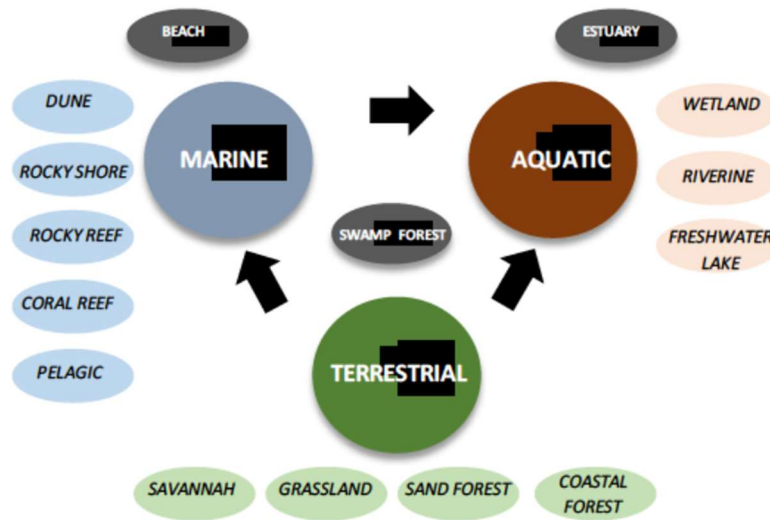


Figure 6.4: The fifteen interlinking ecosystems

Source: Laljit (2019:96). This diagram illustrates the dynamic relationship between the marine, terrestrial, and aquatic biomes of iSimangaliso. Each biome consists of unique ecosystems—ranging from coral reefs and dunes to wetlands and coastal forests—linked through transitional zones such as beaches, estuaries, and swamp forests. These connections support the park’s rich biodiversity and ecological resilience.

In reference to Figure 6.4, the biomes are outlined below:

- **Marine biome:** This includes dune, rocky shore, reef, and pelagic ecosystems. The coastline is divided into two marine biogeographic regions at Cape Vidal. North of this point lies the Maputaland Sub-province, part of the Tropical Indo-West Pacific, home to species not found elsewhere in South Africa. South of Cape Vidal is the Natal Sub-province, within the Sub-tropical East Coast region, featuring unique endemic species (iSimangaliso Wetland Park Authority 2017:14).
- **Terrestrial biome:** This consists of savannah, coastal forest, sand forest, and grasslands. Subtropical forests dominate the eastern shores, while the western shores include ancient shoreline terraces and woodlands along the Lubombo Mountain slopes (iSimangaliso Wetland Park Authority 2017:14).

- **Aquatic biome:** This includes wetlands, rivers, and freshwater lakes such as Sibaya, Bhangazi North and Bhangazi South. The uMkhuze River supports swamp forests, while the uMfolozi floodplain hosts extensive reed and papyrus wetlands—critical for regional biodiversity (iSimangaliso Wetland Park Authority 2017:14).

6.2.6. Economic Opportunities

According to iSimangaliso Wetland Park Authority (2017:17), tourism and agriculture are the two most significant economic sectors within the uMkhanyakude District Municipality.

Tourism

As noted by iSimangaliso Wetland Park Authority (2017:34), “The iSimangaliso Wetland Park is an important natural attraction in KwaZulu-Natal’s tourism economy.” St Lucia, Cape Vidal, and Sodwana are popular destinations that attract tourism. The uMkhuze Game Reserve has seen an increase in visitor numbers following the introduction of lions and wild dogs.

Visitors to iSimangaliso Wetland Park have access to various recreational opportunities, including wilderness trails, guided walks, and vehicle and boat tours. Diving on the coral reefs is regulated and managed through diving concessionaires. Additionally, visitors may explore the park's wildlife and landscapes using a network of roads, often in their own private vehicles, for game-viewing purposes (Ramsar 1998:10).

In several areas of the park, such as St Lucia, Sodwana Bay, Manzenywa, and Kosi Bay, there has been a noticeable increase in the number of tourists visiting the beaches. iSimangaliso Wetland Park offers a range of accommodation options, including self-catering campsites, cabins, and high-end lodge facilities. The park has three high-density areas: St Lucia, Cape Vidal, and Sodwana, while the rest of the park is designated for low-density development or wilderness conservation (iSimangaliso Wetland Park Authority 2017:21).

6.2.7. Current activities within iSimangaliso Wetland Park

The research site is regarded as an important economic asset with significant tourism potential. iSimangaliso is the largest estuary and coastal reserve in South Africa and is particularly known for its rich biodiversity. The majority of visitor activities within the park are focused around two main hubs: St. Lucia in the south and Kosi Bay towards the north (see Figure 6.5; LifeJourney4Two. 2023:1).

Lake St. Lucia incorporates a mix of salt and freshwater, supporting a wide variety of marine and terrestrial life. It is home to a variety of wildlife such as hippos, crocodiles, various antelope species, numerous bird and waterbird species, frogs, and coral reefs that host a rich variety of marine life. In the northern part of iSimangaliso, Kosi Bay is popular for fishing and snorkelling.

A variety of daily activities are available within the park, which attract tourists, such as day trips through the iSimangaliso Park, exploring the St Lucia estuary and beach, safari tours, turtle-spotting tours, visiting the crocodile centre of St. Lucia, trips to uMkhuze Game Reserve, exploring Kosi Bay, snorkelling, angling, visiting the traditional fish kraals of Kosi Bay and tours to Tembe Elephant Park (LifeJourney4Two. 2023a:1). The research site is a renowned World Heritage Site that attracts tourists from around the world.



Figure 6.5: St Lucia and Kosi Bay

Source: Google Earth; edited by Author (2023). This image illustrates the geographical positioning and extent of two major sites within the iSimangaliso Wetland Park: Kosi Bay (top) and St Lucia (bottom). The central map highlights their relative locations along the eastern coastline of South Africa, stretching from the Mozambique border in the north to St Lucia in the south. The red overlays delineate the built-up zone and settlement boundaries of Kosi Bay and St Lucia, situating these areas within the broader ecological and conservation context of the UNESCO World Heritage Site.

6.3. Traditional construction methods and culturally rooted architecture within the iSimangaliso Wetland Park

The initial subsections of this section offer an overview of the site's architecture, construction techniques, and culturally rooted architectural practices, and site-specific observations, providing essential insights that underpin the subsequent analysis. Following this overview, the section evaluates the site's architectural and ecological responsiveness through the application of three models: Revival, Progressive, and Hybrid, based on the framework established by Yahya and Hassanpour.

6.3.1. Traditional building methods – iSimangaliso Wetland Park

Traditional methods and knowledge in the built environment include the strategies and technologies that were used by ancestral communities in different regions – whether or not they are still in use today—that may offer valuable insights for modern society, particularly when considering environmentally conscious building designs.

South Africa's complex history of colonisation, cultural diversity, segregation, and democratic transformation is reflected in its multicultural and multiethnic society. Therefore, this research does not cover all traditional building methods historically utilised in the country.

The original inhabitants of iSimangaliso Wetland Park appear to have belonged to Zulu and Thonga ethnic groups. The fact that many Thonga people falsely claim Zulu ancestry adds another layer of complexity, due to the perceived superiority of Zulu people (Serfontein 2010:51). According to a study conducted by Western researchers, the Thonga were often found living in small, scattered units across the landscape (Serfontein 2010:51).

There is increasing evidence that traditional Thonga practices offer valuable contributions to modern society, leading to greater prominence of the Thonga way of life. Hence, the study includes both Thonga and Zulu cultural approaches. However, it does not cover extensive ecological and cultural reporting; instead, it concentrates on the constructed environment.

6.3.2. Architecture of the Thonga Culture

In order to adapt to their environment, the Thonga people developed a unique manner of life (Serfontein 2010:52). Known for their extensive knowledge of local flora and wildlife, studies have shown that this expertise is put to use in building dwellings, fences, and other functional structures (Serfontein 2010:54).

Settlements and Materials

Serfontein (2010:53) states that the Thonga people's way of life was enhanced by artifacts directly linked to the environment and terrain, resulting in a profound feeling of belonging and individuality. Typical Thonga communities were small, rural homesteads inhabited by a single family located in the naturally forested regions of what was formerly Thongaland. To minimise interpersonal conflict and reduce the likelihood of resorting to witchcraft as a solution, the families lived in relative isolation (Serfontein 2010:53).

According to Roodt and Steyn (n.d.:198), Thonga parents sleep in the same hut as their children under the age of twelve. Older children would then sleep in beds arranged separately for boys and girls. The extended Thonga family resided in nearby villages. The Thonga people erected wooden fences around their huts, as they believed the nearby woods were inhabited by wild spirits. The men's centre served as a gathering place and tool-making space, and each complex looked like a little town in its own right (Roodt and Steyn n.d.:198). Refer to Figure 6.6, that shows a typical plan view and isometric view of a Thonga compound.

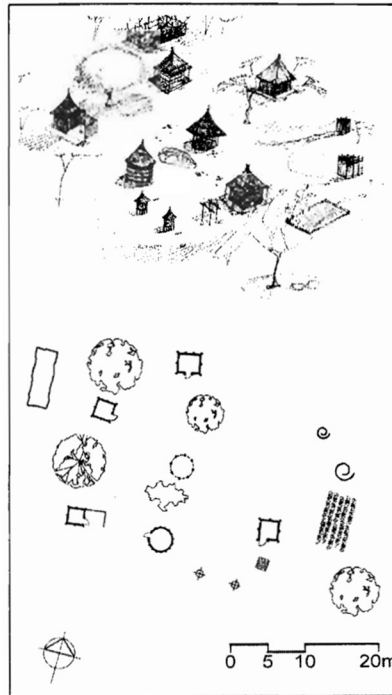


Figure 6.6 Plan and isometric view of the Thonga Compound

Source: Roodt and Steyn (n.d.:203). An isometric and plan view of a typical Thonga compound, showing scattered huts within a forested area. The layout reflects cultural beliefs in maintaining isolation to preserve harmony. Fenced enclosures provide protection, and a central men's hut serves as a communal space for gathering and tool-making.

Locally Sourced materials

The Thonga crafted chairs from solid wood and constructed beds using mopane poles (Roodt and Steyn n.d.:189). According to Serfontein (2010:55), instead of using adobe, the Thonga figured out how to make houses and other structures using pieces of native plants. These techniques involved mostly weaving, binding, knotting and carving.

Bark baskets were woven to hold personal items inside their dwellings. For their building materials, they relied on a wide range of native plant species, including palm leaves (such as iLala Palm), tree trunks (e.g., *Trichilia emetica*), hibiscus trees (for sticks), and a variety of reeds and grasses (for thatching, weaving, and producing walls). Refer to Figure 6.7, which shows local inhabitants harvesting Ncema Reeds.



Figure 6.7: Illustration of the harvesting of Ncema reeds

Source: Serfontein (2010:55). This image shows local Thonga individuals collecting Ncema reeds, a key natural material used in weaving, thatching, and wall construction. The Thonga people skilfully utilise indigenous plants such as iLala palm, hibiscus sticks, and mopane poles in their building techniques, emphasising weaving and carving rather than adobe construction.

Hut Structure

It is evident that two traditional types of huts are associated with Thonga culture: circular and rectangular forms (Roodt and Steyn n.d.:199). These huts were labour-intensive to construct due to the extensive weaving and binding required.

According to Serfontein (2010:55), the walls of the rectangular hut were made from woven wood lattice panels, while the circular hut was mostly covered with reeds. The roofs and walls of both circular and rectangular huts were typically constructed independently and then joined. Because of their unique design and construction, the roofs could often be reused.

The building process begins with the insertion of temporary spacer poles into the footprint of the hut. These are secured by inner and outer horizontal ring made from bunches of thin laths bound together. The framework is then covered with vertical reeds to create a screen. The reeds are bound together using cords traditionally made from dampened bark, which gives the cords temporary flexibility. As the binding process progresses and the structure is completed, the spacer poles are removed and the excess reeds are cut (Serfontein 2010:56). Figure 6.9 shows the roof being constructed either before or after the walls are built. The method is similar to that used for circular walls, but forms a cone shape instead. At the top, it is bound together using climber plant material and plaited rope, and the roof is thatched with premade bunches of reeds laid over the reed frame.

Conventional materials for making pivoting doors include horizontally staked *Raphia* palm leaf stems or twine-bound laths (Serfontein 2010:57). The interior of the huts were adorned

with palm leaf weavings in v-stitch patterns, especially beneath the roof peak and on the wall panels (Serfontein 2010:58). Refer to Figure 6.8.



Figure 6.8: Reed panel construction

Source: Serfontein (2010:56). This image illustrates traditional reed panel construction featuring intricate palm leaf weaving in V-stitch patterns, commonly used in wall panels and beneath roof peaks to enhance both structural cohesion and decorative expression.

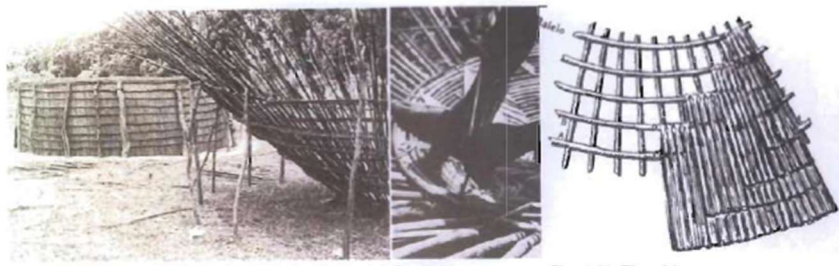


Figure 6.9: Construction of the roof

Source: Serfontein (2010:57). This image shows the roof structure made of laths, which are built either before or after the walls are erected.

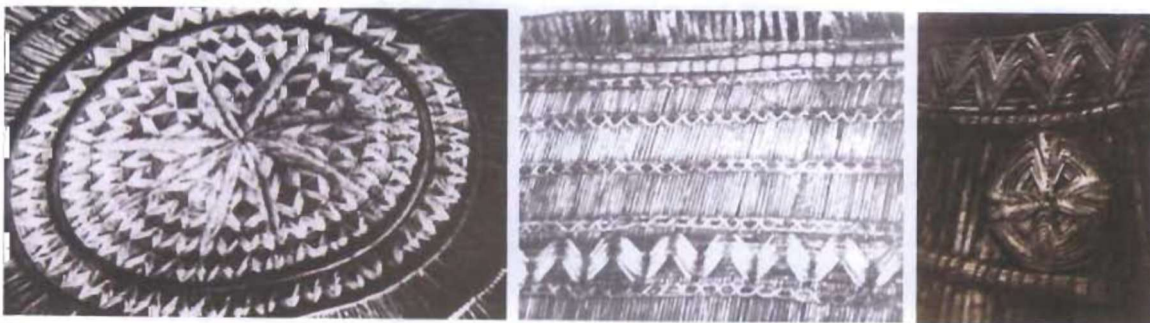


Figure 6.10: Decorative apex patterns

Source: Serfontein (2010:57). Decorative apex patterns formed at the peak of the roof, reflecting cultural significance and symbolic craftsmanship.

The research by Roodt and Steyn (n.d.:199) identified that both round and rectangular huts have also been constructed with clay brick walls in more recent periods, with thatched roofs.

Each hut includes a door, and some have small window openings that can be secured with solid wooden shutters (refer to Figure 6.11 and Figure 6.12). Some huts also have large roof overhangs, which serve as verandas (Roodt and Steyn n.d.:199). Both handmade sun-dried and burnt clay bricks are evident in use. The brick walls are plastered and often decorated. The floors are generally made from traditional dagga, which is a mud and manure mixture that is left with a natural finish. Foundations are generally constructed from locally sourced. Figure 6.11 represents a sketch of a typical hut construction. This image illustrates that the walls are constructed using one of the following techniques: sun-baked walls plastered with dagga, or walls clad with reeds or wattle.



Figure 1 Round Hut structure

Source: Roodt and Steyne (n.d.:199). This image illustrates a traditional round hut structure showing a timber roof framework and stone foundation. The walls are typically constructed using sun-baked mud plastered with dagga, or clad with reeds or wattle, reflecting locally sourced materials and vernacular building methods.

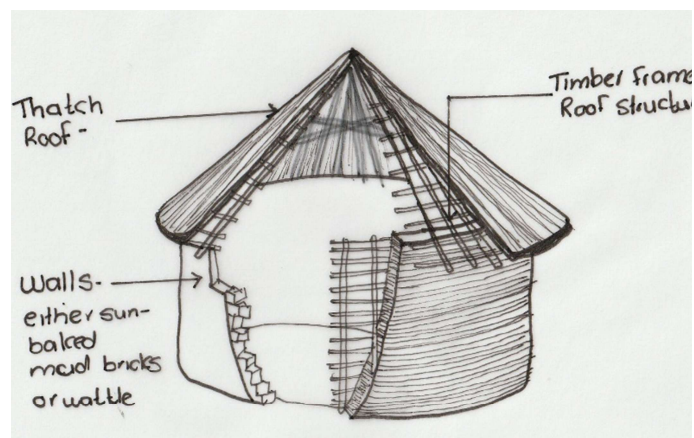


Figure 6.12: Sketch of a typical hut structure indicating two wall configurations, sun-baked mud bricks and wattle walls

Source: Author (2023). This image illustrates a sectional view of the traditional round hut structure showing a timber roof framework and stone foundation. The walls are typically constructed using sun-baked mud plastered with dagga, or clad with reeds or wattle, reflecting locally sourced material.

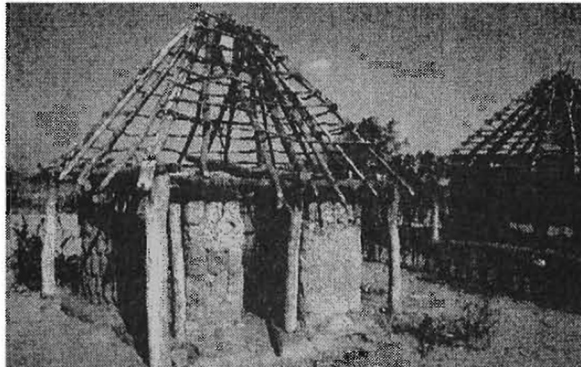


Figure 6.13: A Thonga Hut structure showing the larger roof overhang which is used as a veranda

Source: Roodt and Steyne (n.d.:200). This image illustrates a traditional round hut structure showing a timber roof framework. The walls are typically constructed using sun-baked mud plastered with dagga, or clad with reeds or wattle, with a larger roof overhang that is supported by exterior timber columns which creates a veranda.

This section was organised according to the methods and materials that the Thonga people used to build their houses. If these traditional materials, techniques, and knowledge are to be applied to current contemporary buildings, it is necessary to consider the appropriateness and relevance in the modern context. For instance, it may no longer be appropriate or relevant in today's built environment to construct walls and roofs out of reeds, laths and bark. However, these methods present valuable opportunities to inform sustainable practices and further inspire the development of new applications.

In essence, simplifying construction traditions into fundamental elements paves a way for the seamless integration of modern materials and techniques. By breaking down traditional techniques, one can evaluate the suitability of contemporary building methods based on their inherent properties of techniques and crafts, building types and forms, features responsive to the environment and climate, and the use of locally sourced materials.

6.3.3. Architecture of the Zulu Culture

The Zulu people are widely recognised for their rich artistic heritage and cultural practices, particularly their adept skills in beadwork and their participation in traditional ceremonies such as the reed dance. Traditional Zulu architecture reflects an appreciation for ancestral techniques and locally available materials. It is characterised by traditional huts and beehive houses, which employ homogeneous techniques throughout their interiors (Saxena 2021).



Figure 6.14: Beehive hut in Venyane Village near iSimangaliso Wetland Park

Source: Serfontein (2010:59–60). The hut was constructed using modern bright orange nylon rope in place of traditional woven rope. The circular layout with a central kraal reflects traditional Nguni spatial planning, while the structure integrates overlapping thatch layers, raised brick-and-mortar foundations, and plastered finishes. Low wooden doors with traditional handles and fencing made from indigenous branches further illustrate the blend of vernacular form with modern adaptations.



Figure 6.15: Beehive Hut structures in a village formation (left) and a typical timber structure clad with thatch (right)

Source: Serfontein (2010:59). Venyane Village, illustrating a fusion of modern construction techniques—such as the use of nylon rope and brick structures—with traditional Zulu beehive hut forms.

Serfontein (2010:59) examined Zulu buildings close to the iSimangaliso Wetland Park, focusing on structures in Venyane Village, near Bhangazi. In contrast to the typical Nguni vernacular timber lattice structures, the beehive hut in Venyane was built using modern bright orange nylon rope rather than traditional woven rope (see Figure 6.14). The layout of the hut was circular with a central kraal.

As described by Serfontein (2010:60), the architectural features include three or four overlapping layers of thatch, a foundation wall that is about half a meter above ground, and the use of plastered and painted brick and mortar in the construction. Each hut has a classic

low entry with a wooden door that is hinged and features a traditional handle. Additional means of area demarcation and fencing included the use of branches from indigenous trees. Figure 6.15 shows the Venyane Village, where modern building techniques (using materials like nylon rope and brick buildings) are combined with traditional Zulu beehive construction methods. Research by Serfontein (2010:61) adds credence to the view that the structures along Kosi Lake's shoreline represent a progressive architectural tradition, one that incorporates Western building methods while continuing to use locally sourced materials, like *Raphia* palm leaf stems.

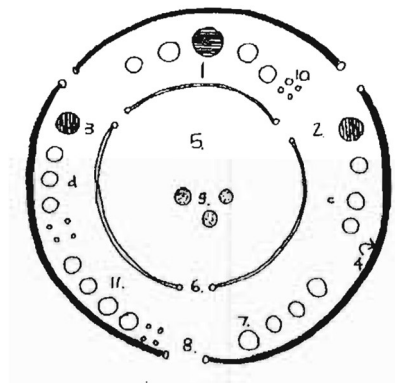


Figure 6.16: Homestead layout

Source: Whelan (2001:9). This diagram shows a generic homestead layout illustrating the central cattle enclosure surrounded by multiple huts forming the perimeter. The arrangement reflects a traditional spatial hierarchy, with each hut's form and placement indicating its specific function within the homestead.

Figure 6.16 represents a generic homestead layout based on a central cattle kraal, with number of huts around it, defining the perimeter. The hierarchy of the huts and their uses remains fairly standard, and often, individual huts are identifiable by their specific forms within the homesteads.

6.3.4. Forms of homesteads

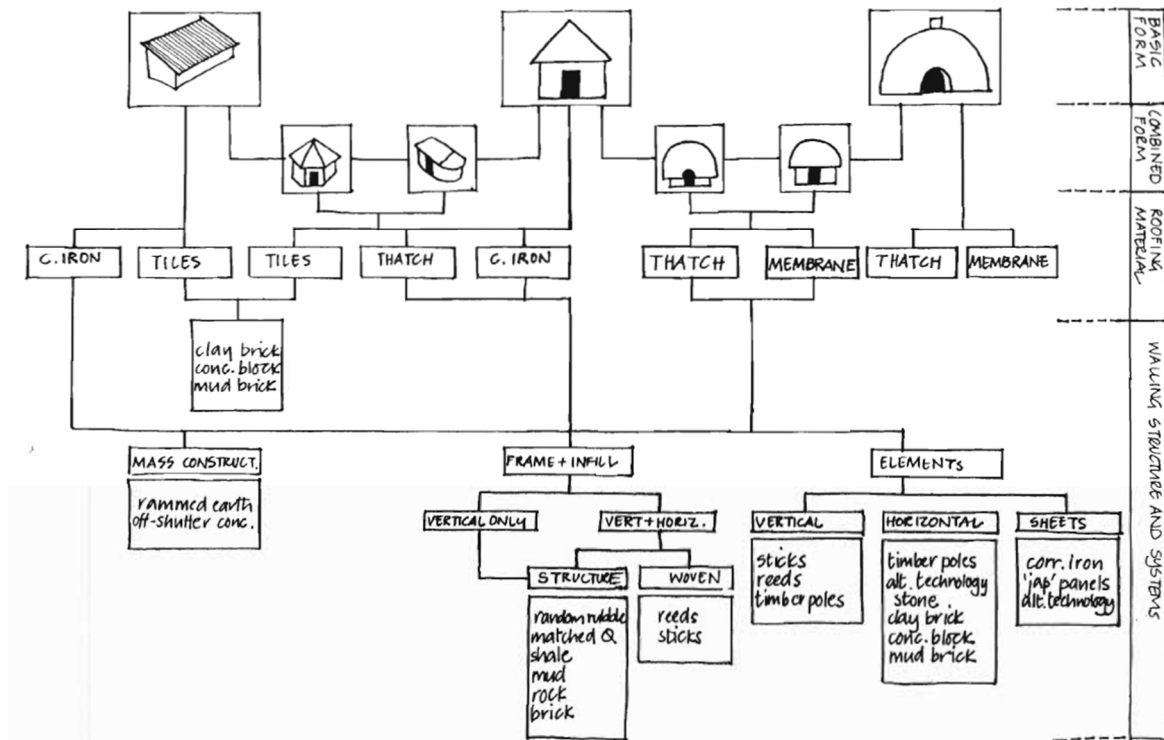


Figure 6.17 Analysis of the various indigenous vernacular building forms

Source: Whelan (2001:12). The diagram illustrates the classification of indigenous vernacular architecture in KwaZulu-Natal based on basic form, roofing material, and walling structure and systems. The chart categorises building types by construction approach—such as mass construction, frame and infill, or elemental systems—alongside material choices like thatch, corrugated iron, reeds, rammed earth, and mud brick, highlighting the diversity and adaptability of vernacular building methods.

Figure 6.17 illustrates the diverse forms of indigenous vernacular buildings, showcasing their variations in elevation, roofing types, materials, and structural systems. According to a study conducted by Whelan (2001:11), indigenous vernacular buildings in KwaZulu-Natal fall into different classes based on their architectural forms. These classes can be further refined by considering their structural and material characteristics. Recognising the range of indigenous vernacular architecture forms is essential, as visual observations and case studies conducted within the iSimangaliso Wetland Park and its vicinity reveal a wide array of building variations.

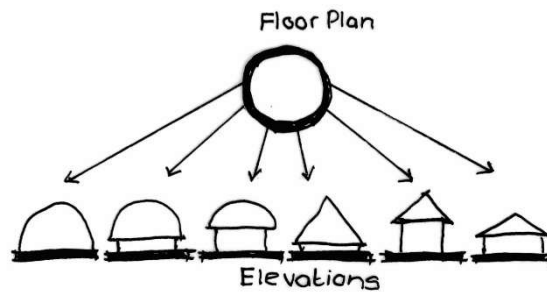


Figure 6.18: Possible elevational projection from a typical circular plan of a hut

Source: Author (2023). This image shows the floor plan of a typical circular hut, accompanied by elevation views that follow the circular layout. Circular buildings are generally designed using two main approaches, with the selected form influencing the roofing style.

Figure 6.18 depicts the floor plan of a typical circular hut, along with illustrations of various elevations that conform to the circular floor plan. According to a study by Whelan (2001:11), circular buildings are typically resolved in two primary ways, with the chosen form often dictating the roofing solutions adopted.

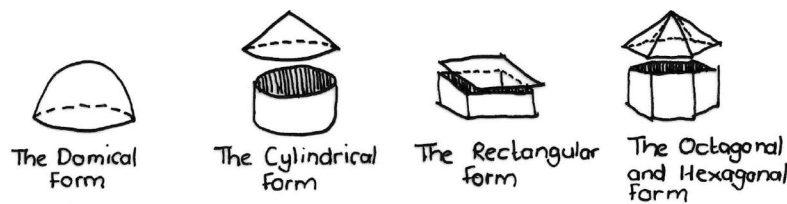


Figure 6.19: Hut forms

Source: Author 2023). Illustration of various traditional hut forms: the domical beehive hut, typically constructed using grass-based techniques and built on low or high stone walls—with the latter more common today—offering better protection against insects and livestock by keeping the grass off the ground (Whelan 2001:4). The cylindrical form, exemplified by the rondawel, varies in construction and materials used (Whelan 2001:4). Rectangular buildings, often featuring two-room layouts similar to cottages, are becoming more popular, while square huts appear in grassland areas and near Hluhluwe, with their roofing style influenced by the floor plan (Whelan 2001:4). Less common hexagonal and octagonal forms serve as practical adaptations of the circular form, typically featuring sheet metal or tiled roofs (Whelan 2001:4).

In reference to Figure 6.19, the **domical form** refers to the construction of beehive huts, typically made using grass-oriented technology. These structures feature a dome-shaped roof raised on either a low or high stone wall, with the latter being more common today. This variation is less susceptible to degradation caused by insects and livestock, as the grass does not touch the ground (Whelan 2001:4).

The **cylindrical form** is characterised “by the cylinder/rondawel, constructed in various ways and defined by the materials used” (Whelan 2001:4).

Rectangular form buildings are gaining popularity, with spatial configurations that include two rooms resembling a cottage. Square buildings are also found in the grasslands and areas near Hluhluwe, where the plan layout influences the roofing type (Whelan 2001:4).

Hexagonal and octagonal forms are less common, often seen as practical adaptations of the circular form, constructed with sheet metal or tiled roofs (Whelan 2001:4).

6.3.5. Architecture surrounding iSimangaliso Wetland Park

According to Laljit (2019:102), “The predominant land uses within the municipalities surrounding the park includes, agriculture and commercial timber plantations, conservation/eco-tourism, settlement, and subsistence activities (agriculture, harvesting of natural resources).”

From more conventional building techniques in rural townships and underdeveloped regions to contemporary designs close to St. Lucia town and within the park itself, visitors to iSimangaliso Wetland Park can see a broad variety of architectural styles. Most dwellings and informal settlements in the park's surrounding rural areas, such Khula Village, Mtubatuba, and KwaNibela, are self-built, employing vernacular building methods that make use of resources sourced from the area.

Laljit (2019:102) confirms that local vernacular architecture in these areas is usually made from sticks and mud structures. The sticks are bound together with reeds collected from adjacent rivers, after which the assembled buildings are packed with mud and allowed to dry. Communities like Khula Village and Mtubatuba still have these kinds of buildings standing today, as illustrated in Figure 6.20.



Figure 6.20: Photograph of a house made of sticks, reeds and mud in the Mtubatuba Village

Source: Laljit (2019:102). This image illustrates local vernacular architecture, typically constructed from sticks bound with reeds gathered from nearby rivers and filled with mud that is left to dry.

Further evidence that conventional construction methods are noticeably changing in the surrounding communities can be found here. Many contemporary building techniques are increasingly being used with traditional architectural designs to create hybrid forms. A notable example in many rural communities around the park is the construction of houses that combine concrete blocks with mud and stick techniques (Laljit 2019:102; refer to Figure 6.21).



Figure 6.21: A photograph of a hut made from concrete blocks, with an adjacent hut made from seamless thatch

Source: Laljit (2019:102). This image illustrates the shift in local construction methods, showcasing hybrid buildings that blend traditional mud and stick techniques with modern concrete block construction, a common sight in rural communities surrounding the park.

Thatch remains a common building material in both the urban core of St. Lucia and the surrounding rural areas. In the Mtubatuba region, thatched roofs are still widely visible, with some structures, like the beehive huts in Figure 6.21, appearing to rise out of the ground, fusing architecture with the environment in a seamless manner. Thatching is a traditional construction method, which uses materials sourced locally, and may be seen as a way of anchoring architecture to its specific context (Laljit 2019:103).

Laljit (2019:103) notes that though construction materials have changed from reeds and sticks to concrete and bricks, the traditional circular shaped homes are still popular. Circular forms combined with corrugated steel roofing, often recycled from nearby sources, are hybrid models employed in these contemporary building endeavours.

6.3.6. Analysis of the Revival, Progressive and Hybrid Models in cultural architecture

This subsection analyses traditional construction methods and culturally rooted architecture within the iSimangaliso Wetland Park, focusing on a critical evaluation of the Revival, Progressive, and Hybrid models, as formulated by Yahya and Hassanpour (2022:3). To

provide a contextual foundation, it is important to first present a summary table outlining the culturally rooted architectural practices discussed in Sections 6.3.1 to 6.3.5.

Table 6.1 compares key aspects of traditional building methods and architectural expressions of the Thonga and Zulu cultures, including settlement patterns, building forms, construction techniques, cultural significance, material use, and ecological sustainability. This comparison highlights how each culture’s distinct relationship with the environment, social structures, and spiritual beliefs influenced their architecture, reflecting both functional and symbolic meanings within the local context.

Table 6.1: Provides a summary of the analysis between the Thonga Culture and Zulu Culture in the built environment

	Thonga Culture	Zulu Culture
Settlement Pattern	Scattered homesteads for individual families, often in forested areas for privacy and spiritual reasons	Centralised kraal (homestead) layout with circular arrangement around a central cattle enclosure
Building Form	Circular and rectangular huts; isolated layout to reduce interpersonal conflict	Beehive-shaped huts (iqukwane) made from grass thatch over a flexible wooden frame
Construction Techniques	Woven and knotted structures using reeds, bark, and vines - carved wooden poles (e.g., Mopane) - use of native plant materials like iLala Palm, <i>Trichilia emetica</i> - no adobe; relied on weaving and binding for structure	Wattle-and-daub construction - Grass thatching with structural timber framing - Enclosures made with reed fencing (isihehlo) for privacy and animal control

<p>Cultural Significance</p>	<p>Structures symbolised harmony with nature</p> <ul style="list-style-type: none"> - functional zoning: separate huts for sleeping, cooking, storage, and tools; use of carved furniture (beds, chairs) - strong symbolism in layout and material selection 	<p>Architecture reflected social hierarchy (chief's hut central)</p> <ul style="list-style-type: none"> - built form reinforced community values and ancestral reverence - strong integration of spiritual beliefs into layout and structure
<p>Material Use</p>	<p>Reeds (Ncema), palms, hibiscus sticks, bark, and grasses</p> <ul style="list-style-type: none"> - wooden fences for protection from spirits - baskets and storage containers woven from bark and reeds 	<p>Indigenous grasses, hardwoods, and earth, clay mixture for floor plastering and walls</p> <ul style="list-style-type: none"> - use of symbolic motifs in decorative elements
<p>Sustainability & Ecology</p>	<p>Passive design: well-ventilated, climate-appropriate</p> <ul style="list-style-type: none"> - materials were locally sourced and biodegradable - structures were easily repairable and had low ecological impact 	<p>Similar ecological approach</p> <ul style="list-style-type: none"> - structures designed for local climate and natural integration - cattle and agricultural patterns influenced placement and form

The traditional architecture in iSimangaliso reflects the deep ecological knowledge, social structures, and spiritual beliefs of its people. These methods offer valuable insight for developing culturally responsive and ecologically sustainable architectural solutions in the region. Modern redevelopment should draw from these vernacular practices to enhance both the sense of place and environmental harmony within the park.

Revivalist Model Analysis

As introduced in Section 5, the Revivalist Model places significant emphasis on the preservation and reinterpretation of traditional knowledge systems in architecture. This

model advocates learning from the past by maintaining cultural continuity, integrating eco-cultural wisdom, and employing passive design strategies that have been developed and refined over generations. Within the context of iSimangaliso Wetland Park, a UNESCO World Heritage Site rich in ecological and cultural diversity, the Revivalist Model becomes particularly relevant. The park is home to the Thonga and Zulu communities, and the following analysis applies the Revivalist Model framework to their architectural traditions.

Key Alignments with the Revivalist Model:

- **Material Use:** The Thonga and Zulu use of local, natural materials, such as reeds, grasses, tree bark, palm leaves, mud bricks, and thatch, reflects eco-responsiveness and low embodied energy—both core Revivalist values.
- **Passive Systems:** The use of natural ventilation, thermal mass floors (dagga), and deep overhangs/verandas for sun protection shows intuitive environmental adaptation.
- **Cultural Expression:** Decorative palm leaf weaving, the layout of homesteads, and sacred/ritual space organisation support the Revivalist emphasis on cultural identity and heritage.
- **Environmental Symbiosis:** Settlement patterns in isolated homesteads (Thonga) and the circular arrangement around central kraals (Zulu) show a sensitivity to both social structure and land use.

Limitations from a Revivalist Perspective:

- While deeply rooted in sustainable practice, these methods may not meet modern durability or health standards, especially under changing climate conditions (e.g., intense rain or flooding).
- Traditional forms may have limited structural resilience and scalability for contemporary applications without adaptation.

Progressive Model Analysis

As identified in the Chapter 5 introduction, the Progressive Model focuses on innovation, technological advancement, and measurable environmental performance through active systems and modern materials. The following analysis applies the Revivalist Model framework to the culturally rooted architecture within iSimangaliso Wetland Park.

Key Alignments with the Progressive Model:

- Adaptations in Venyane Village: The use of bright nylon rope instead of traditional materials and construction with brick and mortar indicates a shift toward contemporary technologies.
- Modernisation in St. Lucia and Mtubatuba: The integration of concrete blocks, corrugated steel roofs, and recycled urban materials aligns with Progressive values of material efficiency and structural performance.
- Transition from Reed/Mud to Brick: Seen as a response to durability concerns, these material upgrades aim to improve longevity and comfort.

Limitations from a Progressive Perspective:

- These technological adaptations often lack a connection to traditional aesthetics and may erode cultural identity.
- While efficient, there is a lack of sensitivity to the local ecological context, especially where design follows generic modern models rather than regionally responsive strategies.
- The use of sustainable technologies is absent.

Hybrid Model Analysis

As introduced in Chapter 5, the Hybrid Model seeks to integrate the traditional and the modern, combining passive and active systems to create contextually resilient, and culturally relevant architecture. The following analysis evaluates the cultural architecture of the park using this framework.

Key Alignments with the Hybrid Model:

- Blended Construction Methods: The coexistence of traditional rondawels and concrete block structures (e.g., huts with concrete walls and thatched roofs) reflects a hybridised architectural language.
- Material Synthesis: The structures that use modern materials (e.g., cement, bricks) while retaining circular forms, deep thatch overhangs, and low door entries (inspired by beehive structures) successfully blend past and present approaches.
- Cultural Continuity with Innovation: Communities adapting traditional structural forms and elements to modern techniques such as raised foundations to prevent moisture intrusion or using wire and rope to bind structures—demonstrate the Hybrid Model’s core values.

Challenges of Hybrid Integration:

- Knowledge Gap: The successful implementation of hybrid frameworks demands both technical skill and ecological sensitivity, which are often lacking in the structures observed within the studied communities.

Concluding Analysis

The traditional architecture of the Thonga and Zulu cultures around the iSimangaliso Wetland Park naturally embodies Revivalist values. However, contemporary developments in areas such as Venyane, Mtubatuba, and St. Lucia reveal Progressive strategies in response to structural needs, comfort, and modernisation.

What is most evident, however, is the emergence of a Hybrid model framework in the region, where cultural forms are retained but updated through selective technological integration. This synthesis of tradition and innovation offers a compelling framework for ecologically responsive architecture that is both *climate-conscious* and *culturally grounded*. Ultimately, the Hybrid Model emerges as the most contextually appropriate framework for guiding future development in iSimangaliso.

Table 6.2 summarises the key findings of the above analysis.

Table 6.2: Comparative Analysis of Revivalist, Progressive, and Hybrid Models in Relation to cultural influence within iSimangaliso Wetland Park

	Revivalist	Progressive	Hybrid
Key Characteristics	Emphasises cultural heritage, eco-cultural wisdom, local materials, and passive systems	Focuses on innovation, active systems, modern materials, and structural performance	Integrates traditional and modern techniques; blends cultural identity with resilience and functional upgrades
Examples / evidence related to the Revival, Progressive and	✓ Strong - Reeds, grasses, bark, mud, thatch	✓ Partial - Nylon rope in Venyane	✓ Strong - Circular huts with concrete walls - Thatch roofing on modern walls

Hybrid Framework	<ul style="list-style-type: none"> - Dagga floors - Decorative weaving - Thonga homesteads and Zulu kraals 	<ul style="list-style-type: none"> - Brick and mortar, concrete blocks - Corrugated steel roofs - Material reuse in urban nodes like St. Lucia 	<ul style="list-style-type: none"> - Raised platforms - Wire/rope binding methods
Strengths	<ul style="list-style-type: none"> - Low embodied energy - Passive climate adaptation - Culturally expressive - Deeply rooted in local identity 	<ul style="list-style-type: none"> - More durable structures 	<ul style="list-style-type: none"> - Balanced approach - Climate and culture resilient - Adaptive for diverse social and environmental demands
Limitations / Challenges	<ul style="list-style-type: none"> - Poor resilience to severe weather conditions - May not meet modern or current building compliancy regulations. - Lack the use of technically advanced technologies 	<ul style="list-style-type: none"> - Loss of traditional aesthetics - Poor contextual sensitivity 	<ul style="list-style-type: none"> - More technically complex - High design/knowledge demands - Cost barriers pose a challenge in rural or under-resourced communities

<p>Concluding insight</p>	<p>Deep traditional alignment, but insufficient for modern needs</p>	<p>Strong for performance but weak on cultural continuity, local ecology and modern technically advanced sustainable methods.</p>	<p>Most appropriate for iSimangaliso Wetland Park: merges tradition and innovation, supporting sustainable, place-based architectural development</p>
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6.4. Field Work – Site Observations and identified Gaps



Figure 6.22: Site Plan of iSimangaliso Wetland Park

Source: St Lucia (2023:1); edited by Author (2023). This image highlights the full spatial extent of iSimangaliso Wetland Park, shaded in green, overlaid with the sun path corresponding to the region's geographical orientation. It also

includes key road networks leading to the eastern and western shores, as well as the park's prominent lake and ocean features.

Figure 6.22 revisits the iSimangaliso Wetland Park region highlighted in green; the blue areas indicate the protected coastlines and marine ecosystems of the park.

As stated in the Section 6.1, a combined approach of desktop study and on-site visual observation was employed to investigate the primary research objectives related to iSimangaliso Wetland Park. This section is based on first-hand observations made during a two-day visit to the park. The significance of the visual observation lies in its contribution to examining how the site aligns with the research goals, contributing to addressing the objectives and generating contextual knowledge. The research objectives addressed were:

Objective 2: To understand the importance of conserving the natural ecosystem in iSimangaliso Wetland Park.

Objective 4: To enquire how traditional methods in the built environment (concepts and techniques, such as design principles, use of materials, construction techniques), found in historical cores, can be combined with the latest sustainable technologies to develop an alternative ecological response to built form.

The site visit and visual observations will help respond to the research objectives by investigating the perspective of the sense of place that the park creates, to understand the current activities, tourist attractions, typography of the park, wildlife, architectural context within the park and in surrounding areas.

Figure 6.23 illustrates the region of the Western Shores and Eastern Shores.

Site visit overview:

Day Visit 1 - The first day of observation was conducted by the author on the Eastern Shores. Access to the Eastern and Western Shores of iSimangaliso Wetland Park is possible via the town of St Lucia, following the N2 turnoff at Mtubatuba.

Day Visit 2 – The second day of observation was conducted within the Western Shores. It was noted that the St Lucia River system physically separates the Eastern and Western shores. Therefore, the Eastern shores can only be accessed via the Dukuduku Gate and the Nhlozi Gate.

6.4.1. Conservation of the ecosystem within iSimangaliso Wetland Park

An understanding of conservation serves as a key determinant in the analysis of the site and informs the response to Objective 2. As indicated in Section 3, “The concept of conservation is defined as an effort to manage natural resources wisely based on the principle of preservation.” According to Purwanti and Nazir (2022:343), conservation “aims to achieve the realisation of the preservation of living natural resources and the balance of their ecosystems so that they can better support the efforts to improve community welfare and the quality of human life.”

The relevance of the visual observation undertaken during the site visit was to evaluate how the park responds to the concept of conservation. Ferraro and Pressey (2015:1) state that the “success in conservation depends on our ability to reduce human presence in areas that harbour biological diversity and ecosystem services.” However, this claim must be supported by scientific evidence to assess the degree to which protected areas affect the environment and social activities.

The literature addresses this by noting that the iSimangaliso Wetland Park has been designated a World Heritage Site because of its unique ecosystem. However, there is a dual perspective on the impact of restricting human presence. On one hand, limiting human activity can be beneficial as it curbs development pressures and preserves the natural ecosystem. On the other hand, it hinders the public from fully experiencing the sense of place within the park, potentially limiting awareness and knowledge acquisition.

During the visual observation, it was evident that iSimangaliso Wetland Park is presently safeguarded by security fencing that encloses the park, and security personnel stationed at designated check-in points across access areas. It was observed that access to the park is restricted to designated access points, and admission is granted only upon the purchase of an entry ticket. This protective measure is implemented by restricting human presence within the boundaries of the park.



Figure 6.23: Map showing the region of the Eastern and Western shores of iSimangaliso Wetland Park

Source: St Lucia (2023:1). The image distinguishes the Western Shores (dark green) and Eastern Shores (light green) of iSimangaliso Wetland Park, highlighting their geographical relationship to the lake and ocean. Key road networks traversing both shores are also depicted.



Figure 6.24: Image of the Bhangazi Gatehouse at the entrance of iSimangaliso Wetland Park, and access into the Eastern Shores

Source: Author (2023). This image depicts the main entrance gatehouse leading to the Eastern Shores of iSimangaliso Wetland Park, with a focus on the construction methods and materials utilised in the building's design.

The visual observation indicates that upon entering the park through the eastern shores (refer to Figure 6.24), an asphalt road leads to various off-road tracks known as loops, which feature picnic and sighting spots and extend to beaches such as Mission Rocks, with Cape Vidal being the furthest destination. The eastern shores exhibit extensive dunes along the coastline, accompanied by dense forests that serve as habitats for diverse wildlife and bird species. Notably, the eastern shores have minimal built structures, primarily consisting of ablution facilities and picnic sites.

However, at Cape Vidal, the observation reveals a more developed area, including caravan parks, accommodations, shops, picnic spots, an inactive fuelling station, and a lighthouse structure. It was noted that a significant number of tourists were concentrated on the beaches at Cape Vidal.

The visual observation notes similarities in architectural design between the Dukuduku Gatehouse and the Bhangazi Gatehouse. Access to the Western Shores involves a combination of asphalt and gravel roads, with construction work underway to develop new asphalt road infrastructure. The Western Shores feature diverse landscapes, including dense forests, savannah woodlands, open plains, swamps, woodlands, and sand forests, providing habitats for various wildlife and bird species.

In line with Section 6.2, these features are characteristic of the Western Shores' geology, which comprises Cretaceous rocks overlaid by sedimentary rock and covered in dune sands. Similar to the Eastern Shores, the Western Shores include various picnic spots, sighting areas, and off-road loops. Accommodations are situated within Makakatana Bay, with Chapters Creek as the furthest spot visited during the observation.

Access to Fani's Island was restricted during the visit; it is identified on the map as the farthest accessible spot in the Western Shores (refer to Figure 6.24). Notably, ongoing infrastructure development and upgrades were observed within the western park.

Conservative efforts must be made to protect the iSimangaliso Wetland Park for the benefit of future generations, in order to ensure that the park's distinctive and rare ecosystems are preserved.

To revisit the above statement, “conservation is defined as an effort to manage natural resources wisely”; furthermore, conservation “aims to achieve the realisation of the preservation of living natural resources and the balance of their ecosystems” (Purwantiand

Nazir 2022:343). The on-site observation indicates that the iSimangaliso Wetland Park Authority is actively engaged in managing natural resources and wildlife, demonstrating a commitment to sustaining a harmonious ecosystem.

However, as a prominent tourist attraction, the iSimangaliso Wetland Park also faces the ongoing challenge of accommodating the evolving needs of visitors. In addition to natural changes occurring within the park, redevelopment efforts are essential to meet tourism demands. As highlighted by Ferraro and Pressey (2015:1), managers or authorities of protected areas are often less interested in the impacts of what they have already done and more focused on the likely impacts of what they are planning to do. In this context, there is a pressing need to raise awareness within the park and foster a deeper understanding of the importance of sustainability and conservation for its long-term future. Balancing the requirements of tourism with the imperative to conserve the park's ecological integrity is a delicate task, emphasising the significance of informed and forward-thinking management practices.



Figure 6.25: Map and site photographs of the ecosystem identified within the Eastern Shores

Source: Author (2023). This image captures the geological and infrastructural character of the Eastern Shores of iSimangaliso Wetland Park, where Cretaceous rock formations are overlaid by sedimentary layers. Visible features include upgraded infrastructure, ablution structures, dense vegetation off-road loops, and picnic areas.

6.4.2 Architecture within iSimangaliso Wetland Park

The primary objectives of the site visit for observation were to gather data through visual examination of the built structures within iSimangaliso Wetland Park. The criteria for the visual assessment encompassed the following key points:

- Biodiversity and conservation
- Construction methods
- Energy Efficiency
- Eco-friendly materials
- Eco-cultural
- Ecological Architecture

As stated above, the observation revealed a minimal presence of structures towards the Eastern Shores, while notable development appears to be concentrated near Cape Vidal.

iSimangaliso Wetland Park Information Building



Figure 6.26: Map identifying the location of the Bhangazi Gatehouse, Information building, ablutions and Crocodile park

Source: Author (2023). This image captures the dense vegetation enveloping the Gatehouse, Information Building, ablutions, and Crocodile Centre, illustrating their spatial arrangement within the site. It also includes sun angle and wind direction diagrams, highlighting the environmental interactions that influence the design and orientation of these structures.

The first structure identified is the iSimangaliso Wetland Park Information building, situated near the entrance along the Eastern Shore before the Bhangazi Gate (refer to Figure 6.26). This Information building serves as the point for purchasing park entrance tickets and acquiring visitor information. The iSimangaliso Information buildings are relatively small and blend into the surrounding landscape. Additionally, the Bhangazi Gatehouse follows similar design principles, displaying a comparable aesthetic in both design and construction methods, including material choices (refer to Figure 6.27).



Figure 6.27: Image depicting the study site and architectural features of the Information facility and Bhangazi Gatehouse

Source: Author (2023). This image presents a site map indicating the location of various buildings, alongside an overview of their diverse construction methods, architectural styles, and materials used. It also depicts sun paths and prevailing wind directions, demonstrating how each structure responds thoughtfully to the environmental context.

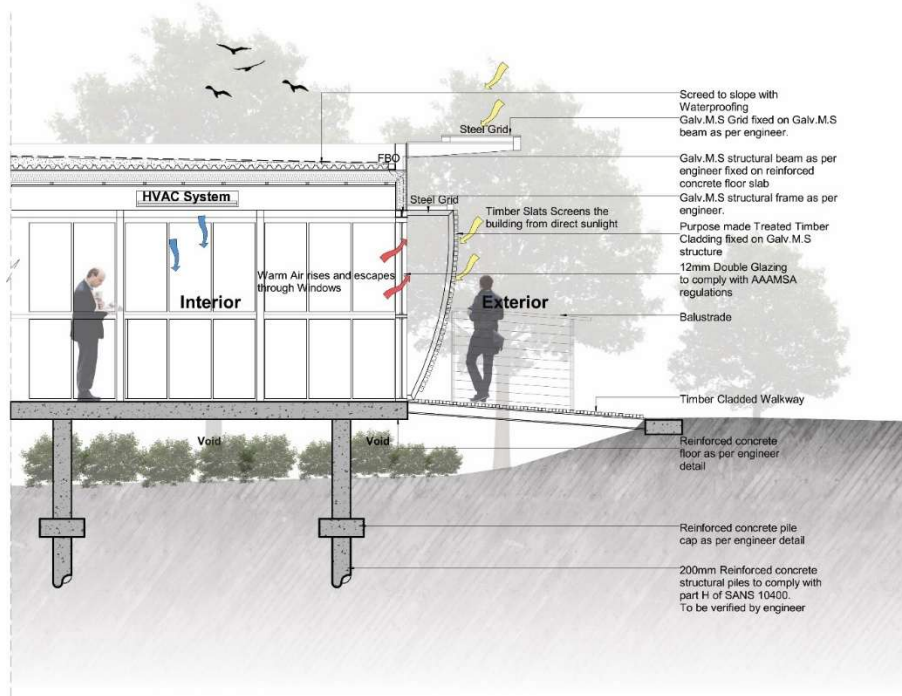


Figure 6.28: Sectional Analysis of the Information Building

Source: Author (2023). This sectional perspective of the Information Building highlights the detailing, material selections, and passive design strategies integrated into the newly constructed facility within the park. Special emphasis is placed on the building's elevated interaction with the ground, showcasing sustainable design methods that respond thoughtfully to the site conditions.

Conservation – The visual analysis indicates that the iSimangaliso Wetland Park Information Building and the Gatehouse incorporate conservation initiatives. This is notably demonstrated through their architectural design, particularly the way the structures interact with the natural environment. The decision to elevate these buildings from the ground, reminiscent of the "touch the earth lightly" concept observed in the Bowali Visitors Centre precedent study, reflects a commitment to conservation (refer to Figure 6.28).

The elevated structures serve the purpose of protecting and preserving the diverse biodiversity of the park. This design choice not only minimises the impact on the natural surroundings but also promotes the idea of sustainable construction. Walkways, also elevated, are seamlessly integrated into the landscape, connecting to paved walkways. The presence of abundant vegetation surrounding the buildings further emphasises the commitment to maintaining the ecological balance.

However, the use of mass concrete piles and suspended surface beds raises concerns about the eco-friendliness of the material choices. In the context of conservation initiatives, there could be room for exploring more sustainable and environmentally friendly alternatives for

construction materials, aligning with broader goals of reducing ecological impact (refer to Figure 6.28).

Construction methods: The construction methods employed in the iSimangaliso Wetland Park Information Building and the Gatehouse are characterised by conventional techniques. The building is elevated off the ground, utilising reinforced concrete piles for support. The superstructure consists of a reinforced concrete slab surface, with structural steel columns fixed to the concrete floor slab, creating a sturdy foundation. The exterior of the building is clad with timber slats, which exhibit a weathered appearance over time.

However, it is noteworthy that no traditional building techniques or methods are visibly incorporated into the structure, representing a potential gap in the utilisation of indigenous or traditional construction practices. Integrating such methods could enhance the building's connection to local cultural and architectural contexts, fostering a harmonious relationship with the surrounding environment.

Energy Efficiency: In terms of energy efficiency, the park's Information Building and the Gatehouse exhibit limited observable features. The buildings use traditional HVAC (heating, ventilation, and air conditioning) systems to regulate the interior environment. The presence of large glass facades suggests a reliance on natural lighting, and these facades are screened to prevent overheating during summer months. However, specific details regarding space heating and energy generation were not discernible from the visual observation.

The placement of water storage tanks near the buildings indicates a potential water harvesting system, either through rainwater harvesting methods or borehole facilities. While water conservation measures are evident, additional information on comprehensive energy-efficient strategies would provide a more holistic understanding of the buildings' sustainable practices.

Eco-friendly materials: The visual observation indicates that the iSimangaliso Wetland Park Information Building and the Gatehouse predominantly use conventional materials in their construction. The structural components, such as the piles and suspended surface bed, employ reinforced concrete. Structural columns and beams are made of steel, and glass panels are utilised for the exterior. Internal partitions feature masonry walls, while the building's exterior is clad with timber fixed to a custom-made steel framing system.

While these materials are standard in contemporary construction, the absence of traditional or eco-friendly materials is noteworthy. A more sustainable approach might involve exploring alternative materials with lower environmental impact or incorporating recycled and renewable resources to align with eco-friendly building practices.

Eco-Cultural: The visual observation suggests a lack of incorporation of cultural roots in the iSimangaliso Wetland Park Information Building and Gatehouse. These structures appear to lack a sense of place and cultural identity, which could be crucial for visitors to appreciate and connect with the rich cultural heritage of the iSimangaliso Wetland Park. The buildings may benefit from design elements or features that reflect and celebrate the cultural diversity and significance of the park, providing visitors with a more immersive and culturally enriching experience. Incorporating local art, symbols, or architectural motifs that resonate with the park's cultural context could enhance the eco-cultural aspect of the buildings.

Crocodile Centre:

The visual observation highlights the presence of a Crocodile Centre near the offices, constructed using traditional masonry methods with a thatch roof. The main structure features masonry bricks and timber poles as a roof structure covered with thatch. The thatch roof adds a traditional touch, potentially reflecting a connection to cultural heritage. However, it is noted that this building seems somewhat disconnected from the broader cultural context of the research site.

The architectural language of the Crocodile Centre contrasts with that of the nearby iSimangaliso Wetland Park Information Building and Gatehouse, raising concerns about architectural consistency within the park. It is important to consider that the Crocodile Centre appears to be an older structure, and its preservation and conservation strategy might involve maintaining its original character without significant alterations.

Traditional Village

While driving along the Western Shores, a significant observation was made of a fenced-off section with several traditional huts, which appeared to be abandoned and devoid of roof coverings, as illustrated in Figure 6.29. These hut structures feature masonry brick walls and timber roof frameworks constructed from locally sourced wood, suggesting they were designed for thatch roofs. Notably, public access to this secured area was restricted. The

Google image of the region's plan highlighted a molecular organisation with multiple compounds.

The research findings unveiled that the plan configuration resembles that of the Thonga Homestead, with the architectural language reminiscent of developed Thonga Huts. The circular layout of the huts strongly suggests their historical association with the Thonga people. Despite the fenced-off and protected nature of this region, accessible only to authorised individuals, the future purpose of this Homestead remains uncertain. Nevertheless, any potential redevelopment should carefully consider preservation and conservation principles.



Figure 6.29: Traditional Village identified within the Western Shores

Source: Author (2023). This image presents a traditional village, pinpointed on the accompanying map. It highlights the village's hut formation and key structural elements, including timber roof frameworks combined with modern masonry walls. Notably, this village is currently abandoned but remains well secured.

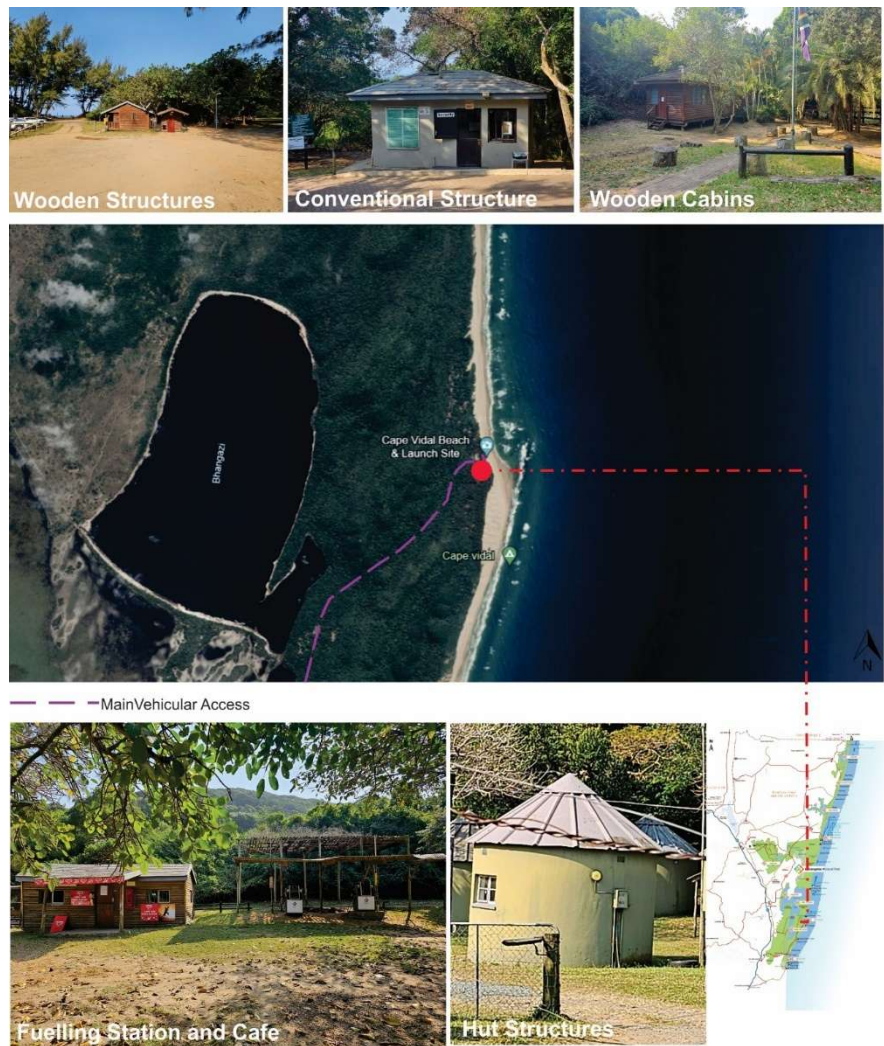


Figure 6.30: Various Buildings identified within the Eastern Shores at Cape Vidal

Source: Author (2023). This image illustrates the range of architectural structures observed during the site visit, highlighting their respective locations within the iSimangaliso Wetland Park. It clearly reveals the diversity in building typologies and construction methods, including timber-based structures, conventional masonry buildings, and traditional hut forms enhanced with modern materials. The image underscores the park's layered architectural character, reflecting both cultural heritage and contemporary adaptations.

Architecture within Cape Vidal

Conservation: The visual analysis reveals an inconsistency in the architecture within the Cape Vidal area. Upon observation, the region exhibits a mix of conventional buildings, timber structures, and hut-like constructions. Regarding conservation programmes, there seems to be a lack of commitment to effectively and prudently manage natural resources with the goal of preservation. The disjointed architectural styles pose a challenge for conservation, as many of the structures seem to overlook conservation concepts and disregard the sensitivity of the surrounding ecosystems. Overall, the buildings within Cape Vidal do not align with ecological architecture principles.

Construction methods: The construction methods employed in Cape Vidal are characterised by conventional building techniques, including standard brick-and-mortar construction and timber log cabins. Most buildings are situated directly on the natural ground, without elevation from the ecosystem, although a few timber cabins are visibly elevated. Notably, a traditional hut building is present in this region, contributing to a sense of cultural identity. However, the purpose of this building was not determined, as it appeared to be private cottages. The expression of cultural identity and traditional building techniques should be encouraged within the iSimangaliso Wetland Park.

Energy Efficiency: Upon observation, there is limited evidence of energy efficient design in the buildings. Visible features include water harvesting tanks and air-conditioning units, but no other alternative energy initiatives were apparent.

Eco-friendly materials: It is evident that conventional materials such as brick and mortar, timber logs, and a combination of steel and tiled roofs are used in construction. The observation indicates a lack of eco-friendly materials in these structures.

Eco-Cultural: The visual examination suggests a lack of incorporation of cultural roots in Cape Vidal's built environment. The structures seem to lack a sense of place and cultural identity, elements crucial for visitors to appreciate and connect with the rich cultural heritage of the iSimangaliso Wetland Park. Considering that Cape Vidal beach attracts many visitors in the Eastern Shores, emphasising cultural identity and a sense of place is essential.



Figure 6.31: Siyabonga Building Location and photographs of the building

Source: Author (2023). This image illustrates the Siyabonga Jetty Building in relation to its immediate site context, highlighting both interior and exterior architectural features. It showcases the use of local materials and construction methods applied throughout the structure, including the amphitheatre. The depiction emphasises the building's integration with the natural landscape, the choice of finishes, and the spatial configuration that supports environmental responsiveness and community engagement.

Siyabonga Jetty – St Lucia

The Siyabonga Jetty is situated outside the iSimangaliso Wetland Park nature reserve (refer to Figure 6.31); however, the map indicates that the structure falls within the protected area of iSimangaliso Wetland Park. It is noteworthy to recognise this building, as visual observation highlights a distinct sense of place and cultural significance incorporated into its design.

Conservation: The visual analysis reveals a sense of conservation initiatives incorporated into the building. There appears to be an effort to manage natural resources, demonstrated by the rich vegetation and the building's connection to water and the surrounding natural environment. It is further evident that an attempt to combine environmental science and architectural design is somewhat visible, pointing towards elements of ecological architecture.

Construction methods: The construction methods employed in the Siyabonga building are contemporary, incorporating a culturally rich identity. The structure seems to consist of a combination of concrete surface beds, flat concrete roofs, masonry walls, and timber columns and beams.

Energy Efficiency: Upon observation, there is limited evidence of energy-efficient systems in the building. However, certain features, such as large windows and skylights, allow for natural lighting and ventilation. The timber structure contributes to thermal conform control, and the reinforced concrete slab facilitates thermal heat gain.

Eco-friendly materials: It is evident that conventional materials such as brick and mortar, reinforced concrete, steel, and timber are used in construction. Notably, local reeds have been used for the ceiling, drawing inspiration from traditional cultural techniques of the Thonga and Zulu people.

Eco-Cultural: The visual examination suggests a sense of place and connection, inspired by traditional Thonga and Zulu architecture. Angled timber columns appear to mimic the natural environment. The floor of the building is notably carved with a cultural decoration that resembles the flow of life, and the walls and ceiling show decorative elements that seem to draw inspiration from traditional methods. The building also incorporates an outdoor amphitheatre evoking traditional gathering spaces, and further connects to the water's edge with a timber jetty, where reeds naturally blend with the structure.

Gaps – Based on observation, there are significant gaps in the built environment within the iSimangaliso Wetland Park. As a tourist attraction and world heritage site, the application of sense of place theory and the principle of conservation is of vital importance. However, the park lacks a "sense of place," which hinders people from fully appreciating its global historical and cultural value.

It was observed that there is a significant disconnect in the architectural language of the park. The park holds various types of built structures, ranging from modern structures like the Information Building, to traditional thatch roof huts, masonry constructions, and timber structures. Each building reflects a unique conservation theory, and some do not align with environmental conservation principles.

It is evident that the park lacks a suitable information centre or amenities that can effectively educate visitors on its rich cultural significance. It is assumed that the inclusion of educational facilities, such as interactive displays, multimedia presentations, and interpretive signage, which highlight the park's ecology, history, and cultural importance, is both necessary and essential. Additionally, the park lacks a visitors' centre that highlights its heritage and underscores the importance of conserving the built environment. It also lacks public gathering spaces and restaurant facilities.

6.4.3. Discussion and findings

The case study analysed the history and cultural significance of iSimangaliso Wetland Park. The study determined that local establishments and communities are well accustomed to traditional materials, culturally significant practices and indigenous construction techniques. Thus, to keep local traditions and the essence of place alive, while also empowering local workers to transmit their expertise on to the next generation, vernacular architecture must be celebrated. However, the buildings within iSimangaliso Wetland Park lack inspiration drawn from these historical and cultural foundations.

It is relevant to revisit and expand on Objective 3, in line with the conceptual and theoretical framework applied to iSimangaliso Wetland Park.

Objective 3 To examine how sustainable ecological development can be implemented within a sensitive environment.

The researched identified that the following conceptual and theoretical frameworks can be applied within the iSimangaliso Wetland Park context.

- Critical Regionalism

According to Pragash (n.d.), critical regionalism in architecture aims to address the lack of identity and the disconnection between architecture and its location or context. Its primary goal is to create intelligent and contextually suitable buildings by reviving architectural traditions deeply rooted in the local environment.

Research indicated strong cultural roots within iSimangaliso Wetland Park, which can be traced back to the early Stone Age. Additionally, the park holds significant historical significance from both World Wars. It also comprises five distinct biological systems: the Eastern Shores, Western Shores, Estuarine System, Swamp System, and Marine System, each with unique flora and fauna.

Critical regionalist architecture opposes the trend of designing generic buildings that lack a sense of place. By employing locally sourced materials, vernacular elements, and indigenous techniques, architects can craft designs that are deeply tied to specific locations. This approach embraces cultural, social, and historical insights to create architecture that balances modernity with tradition. However, the case study of iSimangaliso Wetland Park revealed a disconnection between modern structures and the cultural roots of its built environment. Modern buildings in the park often fail to integrate cultural influences into their designs. While replicating traditional structures may not have been practical in the contemporary era, a deeper understanding of the park's cultural and historical roots could have contributed to designs more rooted in its identity.

Observation suggested minimal exploration of these cultural connections in the park's architecture. For example, the Siyabonga Jetty appears to incorporate elements inspired by traditional Thonga and Zulu cultures. Its timber columns, angled to mimic outward-growing tree branches, resemble Thonga hut structures with extended roofs supported by timber posts. The building's floor features cultural decorations reflecting the flow of life, and its walls and ceiling include artistic elements rooted in Zulu traditions. An outdoor amphitheatre resembles traditional gathering spaces. However, the incorporation of modern design features, such as mono-pitched roofs and large glazed panels, adds a contemporary aesthetic. While the Siyabonga Jetty demonstrated some cultural integration, these elements were absent in other modern park buildings.

For instance, the Information Building and Bhangazi Gatehouse, key structures at the park's entrance, lack significant cultural or traditional integration in their designs. These buildings feature locally sourced materials such as timber cladding, concrete, and steel, which align with critical regionalist principles of environmental sensitivity. However, they fall short in expressing cultural heritage.

In contrast, the Crocodile Centre incorporates traditional construction techniques, such as masonry bricks and timber poles supporting a thatch roof. This design echoes the construction methods of the Thonga people and incorporates cultural elements from both Thonga and Zulu heritage. Despite this, the building appears somewhat disconnected from the broader environmental and cultural context of the site.

Incorporating critical regionalism into architectural planning and design within sensitive environments like iSimangaliso Wetland Park is vital. It helps achieve a balance between global design influences and local cultural and environmental specificities, promoting sustainability and a deeper connection to the site's identity.

- **Sense of Place**

The "sense of place" is a deeply personal and individual experience, varying among individuals based on their cultural, spiritual, and emotional connections to a location (iSimangaliso Wetland Park Authority 2022:32). In the context of iSimangaliso Wetland Park, this unique sense of place is essential for preserving of the park's natural and cultural significance.

The Oxford Dictionary defines "place" as a specific location shaped by human beliefs and experiences. Vali and Nasekhiyan (2014:3747) explain that "place" emerges from the interaction between three components: human behaviours, concepts, and physical features. According to phenomenologists, a sense of place involves forming a connection through understanding symbols and daily activities (Vali and Nasekhiyan 2014:3750). Environmental elements evoke emotions that reveal the true nature of a place. In the phenomenology of place, personal experiences play a significant role in shaping perceptions, and these connections are cultivated

through residence or other experiences within the environment (Vali and Nasekhiyan 2014:3750-3751). A sense of place creates a bond between people and their environment, integrating their emotions and perceptions into the surrounding context.

The theory of place emphasises the interplay between nature, humanity, and architecture, exploring how these elements engage and complement one another. This research suggests that applying the sense of place theory in design could result in meaningful spaces fostering a harmonious connection between people, nature, and cultural heritage.

However, visual observations revealed that the Information Building and Gatehouse lack such cultural integration and identity. These structures do not offer visitors a connection to the rich cultural heritage of the park. Incorporating design elements such as local art, symbols, or architectural motifs resonating with the park's cultural context could enhance visitors' experience, fostering a deeper appreciation for its eco-cultural significance.

In contrast, the Siyabonga Jetty Building partially incorporates traditional cultural elements from Thonga and Zulu heritage, contributing some sense of place. Features such as timber columns, symbolic of natural tree branches, and other traditional influences are evident. However, the building lacks a strong emotional connection to the surrounding landscape and cultural context. As a result, the design falls short of fully articulating the park's sense of place, thereby limiting visitors' ability to appreciate iSimangaliso's global historical and cultural value.

- Ecological Architecture (integration of Conservation and Sustainability)

The goal of ecological architecture is to establish a balanced relationship between structures and people, as well as between artificial and natural environments (Purwanti and Nazir 2022:341). This approach encompasses time, place, environment, society/culture, and construction methods, presenting a holistic integration of various elements. The paradigm emphasises creating harmony between the natural environment, humans, and the built environment.

Visual analysis indicated that the iSimangaliso Wetland Park Information Building and Gatehouse incorporate conservation principles in their architectural designs. Elevated off the ground, they reflect the "touch the earth lightly" concept, which minimises environmental impact and preserves the park's biodiversity. Elevated walkways seamlessly integrate with paved paths, while the abundant surrounding vegetation reinforces the ecological balance.

The construction methods utilised conventional techniques, including reinforced concrete piles to support the elevated structures, reinforced concrete slabs forming the superstructure, and structural steel columns providing additional stability. The exterior is clad with timber slats, which gradually weather to blend with the natural surroundings.

However, traditional building techniques were notably absent in these structures, representing a missed opportunity to incorporate indigenous construction methods. Such integration could have enhanced the buildings' cultural and architectural connection to the local context. Regarding energy efficiency, observable features were limited. The buildings rely on traditional HVAC systems for climate control, while large glass facades allow natural lighting and are screened to prevent overheating during summer. Water storage tanks suggest the presence of a water conservation system, potentially utilising rainwater harvesting or borehole facilities. Despite these efforts, the incorporation of more advanced sustainable technologies could have further supported the park's ecological goals.

The Siyabonga Jetty displayed some conservation-oriented features, with rich vegetation and a strong connection to the surrounding natural environment. The building reflects efforts to integrate environmental science with architectural design, aligning it partially with ecological architecture principles. Its construction methods are contemporary, combining culturally inspired elements with materials such as concrete slabs, flat roofs, masonry walls, and timber columns and beams. The building utilises large windows and skylights for natural lighting and ventilation, and timber elements contribute to thermal comfort. Local reeds are used in the ceiling, reflecting traditional Thonga and Zulu techniques. However, the building shows minimal reliance on sustainable technologies and incorporates limited energy-efficient practices.

In contrast, Cape Vidal exhibits inconsistent architectural styles, ranging from conventional brick-and-mortar buildings to timber log cabins and hut-like constructions. Conservation efforts in this region appear insufficient, with limited emphasis on resource preservation or ecosystem sensitivity. Most buildings sit directly on the ground, with only a few timber cabins elevated. A traditional hut was observed, contributing to cultural identity, but its private use limits its broader impact on the area’s architectural context.

Energy efficiency measures within Cape Vidal buildings are sparse, Limited to water harvesting tanks and air-conditioning units. Alternative energy initiatives are absent. Conventional materials such as brick, mortar, timber logs, steel, and tiled roofs are predominantly used, with little evidence of eco-friendly materials or sustainable construction practices.

Overall, the analysis highlighted a disparity in the application of ecological architecture principles across iSimangaliso Wetland Park. While some structures showed partial alignment with conservation goals, there was a general lack of integration of sustainable technologies, traditional methods, and culturally inspired designs. These gaps underscore the need for a more cohesive approach to balance ecological and cultural considerations within the park’s built environment.

Table 6.3 provides a structured summary of the key points discussed in the preceding section.

Table 6.3: Evaluation of selected sites in iSimangaliso Wetland Park relative to Critical Regionalism, Sense of Place, and Ecological Architecture

	Critical Regionalism	Sense of Place	Ecological Architecture
Siyabonga Jetty	- Integrates Thonga/Zulu cultural elements (e.g., timber posts mimicking tree branches)	- Stronger symbolic gestures (tree-like columns, cultural floor and wall decorations)	- Rich vegetation integrated - Natural lighting via skylights and large windows

	<ul style="list-style-type: none"> - Incorporates traditional spatial ideas (e.g., amphitheatre, symbolism) 	<ul style="list-style-type: none"> - Partial cultural immersion 	<ul style="list-style-type: none"> - Some use of local reeds - Minimal use of renewable technologies
<p>Information Building and Bhangazi Gate</p>	<ul style="list-style-type: none"> - Uses local materials (timber, concrete, steel) - No distinct cultural or historical integration 	<ul style="list-style-type: none"> - Lacks cultural identity and storytelling - Lacks symbolic or emotional connection to the site 	<ul style="list-style-type: none"> - Elevated structures minimise ground impact - Paved paths with walkways - Rainwater harvesting observed - HVAC technologies- dependent with limited energy efficiency features
<p>Crocodile Centre</p>	<ul style="list-style-type: none"> - Uses traditional methods (timber poles, thatch roof) - Culturally inspired by Thonga/Zulu techniques 	<ul style="list-style-type: none"> - Traditional aesthetic present - Emotionally less connected to broader site narrative 	<ul style="list-style-type: none"> - Culturally grounded construction - Less clarity on ecological performance or sustainability technologies
<p>Cape Vidal area</p>	<ul style="list-style-type: none"> - Inconsistent architectural language 	<ul style="list-style-type: none"> - Generic design - Minimal emotional or cultural engagement 	<ul style="list-style-type: none"> - Low conservation focus - Mostly ground-based buildings

	- Little reference to local heritage or materiality	- Traditional hut privately used, limiting public impact	- Sparse sustainability efforts (few tanks, no solar/wind energy) - Lack of material innovation or passive design strategies
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6.4.4. Analysis of implementing Yahya and Hassanpour’s (2022:3) Progressive, Revivalist and Hybrid Models within iSimangaliso Wetland Park

For the purpose of this analysis, all buildings within the park, as outlined above, were examined using a holistic approach in accordance with the Revival and Progressive Model framework to determine whether a Hybrid Model had been formed.

Revival Model:

The following outlines the embedding of Revival Model techniques and methods implemented in the built structures of the iSimangaliso Wetland Park:

- Cultural sensitivity:
 - The park demonstrated a strong connection to cultural heritage, particularly the Thonga and Zulu cultures. The Thonga people built circular homesteads using locally sourced materials and native plants, with both circular and rectangular huts. Similarly, the Zulu people constructed beehive-shaped huts from woven thatch, also with a circular layout. Over time, these homesteads evolved to include domical, cylindrical, rectangular, and octagonal forms. The literature highlighted the cultural significance of these traditional village layouts, adapted to suit the needs of the people.
 - The Siyabonga Jetty Building in St Lucia reflected this cultural connection, with timber columns angled to mimic the natural environment, cultural decorations on the floor and walls, and a ceiling inspired by traditional methods. An outdoor amphitheatre and a timber jetty connecting to the water

further strengthened the sense of place. However, other buildings within the park lacked the same cultural identity and connection to heritage.

- Utilisation of environmentally responsive design strategies:
 - The iSimangaliso Wetland Park Information Building and the Gatehouse incorporated design conservation strategies, particularly through their architectural design and interaction with the natural environment. Elevating these buildings, echoing the "touch the earth lightly" concept observed in the Bowali Visitors Centre, demonstrated a clear commitment to conservation. The elevated structures were designed to protect and preserve the park's biodiversity, minimise impact on the surroundings and promote sustainable construction practices. Elevated walkways, integrated into the landscape, connected to paved paths, while abundant surrounding vegetation reinforced the focus on ecological balance.
 - In contrast, the Cape Vidal area exhibited a mix of conventional buildings, timber structures, and hut-like constructions. Conservation programmes appeared limited and the disconnection between architectural styles presented a challenge for resource management and environmental sensitivity. The buildings within Cape Vidal did not align with the principles of ecological architecture.
 - The Siyabonga Jetty Building however, showed efforts to manage natural resources, with rich vegetation and a strong connection to the surrounding water and nature. Additionally, it was evident that there was some integration of environmental science and architectural design in the building, partially aligning with the principles of ecological architecture.
- Use of local environmentally friendly material usage:
 - Thonga and Zulu cultural structures demonstrated a strong use of locally sourced, environmentally friendly materials, such as traditional dagga (a mud and manure mixture), local stone, reeds, and plants. Over time, material use evolved with the introduction of clay bricks, laths, concrete, roof tiles and roof sheeting.
 - The Bhangazi Gatehouse and Siyabonga Jetty incorporated locally sourced materials, including traditional timber, brick and mortar walls (plastered and

painted), IBR roof sheeting, steel structures, and local reeds in the ceiling. These materials drew inspiration from the traditional culture within the park.

Progressive Model:

The following outlines the embedding of Progressive Model techniques and methods implemented in the built structures of the iSimangaliso Wetland Park:

- The adaption of resource-efficient technologies (envelope design, waste management systems, glazed panels:
 - During the Thonga and Zulu periods, limited technologies were available for use in construction.
 - The Park's Information Building and Gatehouse exhibited limited observable energy-efficient features. They utilised traditional HVAC (heating, ventilation, and air conditioning) systems to regulate the internal environment. Large glass facades suggested a reliance on natural lighting, with these facades screened to prevent overheating during the summer months. However, specific details regarding space heating and energy generation were not discernible from the visual observation. The placement of water storage tanks near the buildings indicated a potential water harvesting system, possibly through rainwater harvesting or borehole facilities. While water conservation measures were evident, additional information on comprehensive energy-efficient strategies would provide a more holistic understanding of the buildings' sustainable practices.
 - Cape Vidal buildings showed limited evidence of energy efficiency. Visible features included water harvesting tanks and air-conditioning units, but no alternative energy initiatives were apparent.
 - The Siyabonga Jetty displayed limited evidence of energy efficiency. Visible features included large windows and skylights that allowed natural lighting and ventilation into the space. The timber structure facilitated thermal comfort control, while the reinforced concrete slab contributed to thermal heat gain.
- Bio-walls, wind turbines:
 - No use of bio-walls was identified.
- High-performance materials aimed at resource efficiency and sustainability:

- No high-performance materials, such as those used in the Ridge Building for sustainable design strategies, were identified. The Siyabonga Building utilised standard materials, including brick and mortar, reinforced concrete, steel, and timber. Local reeds were also used for the ceiling, reflecting traditional cultural techniques of the Thonga and Zulu people.

Hybrid Model Integration

The analysis revealed that the current built environment does not fully embody the Hybrid Model, which combines the Revival and Progressive Models. Traditional cultures effectively utilised available resources, drew inspiration from the past, and adapted their structures over time to meet evolving needs. However, this adaptive approach is less evident in current buildings. Not all structures within the iSimangaliso Wetland Park fully embraced the "Learn from the Past" principle of the Revival Model or the "Learn from the Present" principle of the Progressive Model. The result is a noticeable lack of cultural integration in the built environment and a failure to incorporate available technologically advanced strategies across all buildings.

To achieve well-designed built environments, alignment with the Sustainable Development Goals is essential, which can only be accomplished through a cohesive Hybrid Model approach.

Table 6.4 provides a summary of the above analysis.

Table 6.4 : Analysis of the Revivalist Model, Progressive Model and Hybrid Model within iSimangaliso Wetland Park

	Revivalist Model	Progressive Model	Hybrid Model
Core Characteristics	Emphasises indigenous knowledge, local materials, passive systems, and cultural identity tied to land and community.	Focuses on durability, infrastructure integration, and modern construction systems using	Seeks a contextual balance between traditional practices and modern performance— adaptive, flexible, and locally embedded.

		industrial materials.	
Evidence in iSimangaliso	✓ Strong – seen in traditional huts in Khula and rural homesteads using reeds, dagga, thatch, and kraal layouts.	✓ Partial – evident in Venyane and St. Lucia with brick, concrete, and corrugated steel buildings.	✓ Moderate – emerging in urban areas with blended forms (e.g., circular huts with concrete walls and thatch roofs).
Architectural Expression	Architecture reflects Thonga and Zulu heritage, with organic layouts, sacred spaces, and hand-crafted details.	Generic forms: functionality and performance prioritised over aesthetic or symbolic expression.	Visual and spatial references to tradition retained but often diluted inconsistent application of design principles.
Use of Local Materials	✓/✗ Moderate – evident use of reeds, mud, timber, and palm leaves in cultural buildings but little in modern buildings within the park.	✗ Moderate – relies on materials like concrete, bricks, and steel.	✓/✗ Moderate – mixes traditional and modern materials, though modern elements are often not ecologically optimised.
Cultural Significance	✓ Strong – embeds ritual, social organisation, and identity in architectural form and materiality.	✗ Weak – detachment from indigenous cultural codes and social structures.	✓ Moderate – respects cultural layout and form but lacks full integration with contemporary cultural storytelling or technology.

Technological Integration	✗ Minimal – relies on natural systems (ventilation, shading, mass); lacks active systems.	✓ Moderate – includes brick/block for longevity, but lacks broader sustainable technologies (e.g., solar, greywater systems).	✗ Limited – few signs of integrated systems; hybridisation not fully realised due to knowledge or resource constraints.
Environmental Strategies	✓ Evident – passive thermal mass, local vegetation, shaded courtyards, vernacular orientation.	✓ Partial – materials are durable but often high-impact; minimal ecological integration.	✓/✗ Partial – includes passive elements; limited use of modern active strategies for sustainability enhancement.
Alignment with Theory	✓ High – aligns with Yahya and Hassanpour’s Revivalist principles of context, identity, and climate responsiveness.	✗ Low – does not meet the full intent of the Progressive model due to limited system innovation and ecological focus.	✓/✗ Partial – aligns with Hybrid Model in intent but struggles in execution due to imbalance or limited resources.
Sustainability Gaps	May lacks resilience in extreme weather, scalability, and alignment with modern building standards.	Overlooks ecological and cultural sensitivity; unsustainable reliance on industrial systems.	Lacks full integration potential; opportunities for design-led innovation and local capacity building often underutilised.
Overall Evaluation	Strong Revivalist presence in rural areas—deeply rooted,	Functional but contextually detached; best for	Holds greatest long-term promise but requires stronger

	eco-sensitive, and culturally meaningful.	service integration, not cultural or ecological continuity.	design thinking, training, and policy support to become a truly responsive architectural strategy in iSimangaliso.
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7. Research results and discussion

This section presents all the data collected on the iSimangaliso Wetland Park and various case studies. The data was collected through a literature review, maps, photographs and visual observations. The research analyses ecological conservation through responsive architecture.

The research results and findings will subsequently serve as the foundation for designing a scheme that the researcher will utilise to propose a suitable response to ecological responsive architecture within iSimangaliso Wetland Park. This process aims to align with the research parameters and objectives.

7.1. Research Results

Objective 1 stated the following:

To understand the factors that led to the designation of iSimangaliso Wetland Park as a “world heritage site.

The first objective of the study was to explore the factors that led to the recognition of iSimangaliso Wetland Park as a historical site. According to UNESCO, World Heritage Sites are places of Outstanding Universal Value, recognised for their exceptional cultural or natural significance to humanity and protected under the Convention Concerning the Protection of the World Cultural and Natural Heritage (World Heritage Site 2022). Only countries that are signatories to this convention and demonstrate a commitment to preserving their heritage may nominate sites for inclusion on the World Heritage List.

The literature indicates that the iSimangaliso Wetland Park was recognised as a UNESCO World Heritage site under the natural category. It possessed Outstanding Universal Value due to its pristine and diverse environments, including marine, coastal, wetland, estuarine, and terrestrial landscapes. iSimangaliso Wetland Park is unique, consisting of large areas that were untouched, featuring coral reefs, sandy beaches, coastal dunes, lakes, swamps, and reed and papyrus wetlands, providing critical habitats for numerous species.

iSimangaliso Wetland Park was inscribed in 1999 under the natural category, meeting three of UNESCO’s ten selection criteria: criterion (vii) (natural beauty), criterion (ix) (ongoing

ecological and biological processes), and criterion (x) (biodiversity and conservation value) (WHC UNESCO: iSimangaliso Wetland Park 2023).

Criterion (vii) underscored the park's geographical diversity, spanning 220 km of coastline with crystal-clear waters, undeveloped sandy beaches, and a varied landscape of wetlands, grasslands, forests, lakes, and savannahs. Three remarkable natural phenomena, including the adaptability of Lake St. Lucia, nesting turtles, and abundant waterfowl, contribute to its outstanding aesthetic qualities (WHC UNESCO: iSimangaliso Wetland Park 2023).

Criterion (ix) highlighted the unique combination of fluvial, marine, and aeolian processes shaping diverse landforms since the early Pleistocene. The park's unique geographical position, and its proximity to the shore, have resulted in a remarkable variety of species, including continuous processes of speciation in the Maputaland Centre of Endemism. The formation of coral reefs and clear seas was influenced by marine sediments, undersea canyons, and environmental variability. Additionally, the role of the **Agulhas Current** in transporting marine sediments to underwater canyons enhances water clarity and supports vibrant **coral reef ecosystems**, further contributing to the site's ecological dynamism (WHC UNESCO: iSimangaliso Wetland Park 2023).

Criterion (x) emphasised the presence of five interconnected ecosystems supporting a significant array of African biota. With over 6 500 plant and animal species, including 521 birds, the park boasted the region's lengthiest species lists. Eleven species were endemic to the park, and 108 were exclusive to South Africa, with 467 species classified as threatened. The exceptional diversity of habitats sustained a broad spectrum of animal species, contributing to the ecological significance of iSimangaliso Wetland Park (WHC UNESCO: iSimangaliso Wetland Park 2023).

In summary, iSimangaliso Wetland Park's designation as a UNESCO World Heritage Site is underpinned by its extraordinary natural beauty, ongoing ecological processes, and exceptional biodiversity. Its value is amplified by its transitional ecological positioning, geological history, and marine dynamics. Understanding these attributes not only satisfies Objective 1 but also lays a crucial foundation for examining sustainable ecological development and architectural responses in later stages of this study.

Table 7.1 reinforces the argument that iSimangaliso met the necessary standards of Outstanding Universal Value, thereby justifying its designation as a World Heritage Site under Objective 1.

Table 7.1: Provides an evaluation of iSimangaliso Wetland Park against UNESCO Criteria for World Heritage

UNESCO Criterion	Description of Criterion	How iSimangaliso Meets the Criterion
Criterion (vii) Outstanding Natural Beauty	Sites that contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance.	iSimangaliso features 220 km of uninterrupted coastline, clear estuarine waters, towering coastal dunes, pristine beaches, and lush wetlands. Natural spectacles include mass nesting of leatherback and loggerhead turtles, migratory birds, and the dynamic hydrological systems of Lake St. Lucia, all contributing to its scenic and visual significance.
Criterion (ix) Ongoing Ecological and Biological Processes	Sites that are outstanding examples representing significant ongoing ecological and biological processes in the evolution and development of ecosystems.	The park illustrates the interaction of marine, estuarine, fluvial, and aeolian processes that have shaped the landscape since the Pleistocene. It serves as a key zone for species diversification and speciation within the Maputaland Centre of Endemism, and showcases natural coastal and wetland processes still actively shaping the terrain.
Criterion (x) Biodiversity and Conservation Value	Sites that contain the most important natural habitats for in-situ conservation of biological diversity, including threatened species of outstanding universal value.	iSimangaliso supports five interconnected ecosystems and over 6 500 plant and animal species, including 521 bird species, 11 endemic species, and 467 classified as threatened. Habitats range from coral reefs to swamps, offering protection to both aquatic and terrestrial species. It is one

		of the most biodiverse conservation areas in Africa.
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Understanding these factors is essential not only for heritage recognition but also for guiding future conservation strategies within the park.

Objective 2 stated the following:

To understand the importance of conserving the natural ecosystem in iSimangaliso Wetland Park.

Objective 2 sought to underline the importance of conserving the natural ecosystem in the park. The term “conservation” is broad and multifaceted, and understanding its meaning within the context of iSimangaliso Wetland Park is essential. The conceptual and theoretical frameworks suggest that conservation refers to the wise management of natural resources, based on the principle of preservation. The natural resources include biological elements, such as vegetation and animal life, as well as non-biological elements that together form an ecosystem (Purwanti and Nazir 2022:342).

According to Purwanti and Nazir (2022:343) the purpose of conservation is to preserve living natural resources and the balance of ecosystems, in ways that support improved community welfare and the overall quality of human life. This understanding of conservation is applicable to iSimangaliso Wetland Park, where the management approach balances ecological systems while promoting sustainable use that enhances community welfare and long-term biodiversity protection.

Saarinen *et al.* (2009:233) further state that a key challenge is to retain the park’s World Heritage status by protecting its ecological integrity preventing degradation from the activities of tourists and local communities.

Moreover, it is essential to understand the importance of conservation within the research site. As identified in Objective 1, the main reason for conserving the park is to maintain its World Heritage Site status. Furthermore, iSimangaliso is home to four Ramsar sites, internationally recognised for the ecological importance of wetlands and their contributions to the economy, culture, science, and recreation. Conservation must address the risks posed

by redevelopment of the built environment, tourism and local communities and in order to preserve the park's natural environment and heritage for the future generations.

However, conservation in iSimangaliso Wetland Park should not rely solely on its World Heritage status. While the designation brings international recognition and support, the intrinsic value of preserving the natural resources, in general, is paramount. Healthy ecosystems play a vital role in sustaining biodiversity, supporting species survival, and contributing to ecological balance.

The case study further reveals that iSimangaliso Wetland Park consists of fifteen interconnected ecosystems that serve as habitats for a wide range of African wildlife, including many rare, threatened, and endemic species. These ecosystems can be further categorised into three general biomes: marine, terrestrial, and aquatic (*iSimangaliso Wetland Park Authority 2017:14*). It is worth noting that these habitats are not inherently distinctive on their own, but their combination within a single protected region is uncommon on a worldwide scale and is unparalleled in South Africa. The iSimangaliso Wetland Park's conservation significance lies in its exceptional biodiversity, the protection of endangered species, the preservation of critical ecosystems, and its role in both regional and global conservation efforts. Its conservation initiatives encompass ecological, cultural, and economic dimensions, making it a model for sustainable conservation and ecotourism.

According to the National Framework for Sustainable Development in South Africa (Department of Environmental Affairs 2008:6, 7, 22), the country's development trajectory has placed immense pressure on its natural resource base. Many communities, while benefiting from basic services, still live in degraded environments that threaten their long-term well-being. This reality reinforces the need for conservation areas like iSimangaliso to serve as models of sustainable ecological management, where development, social equity, and environmental preservation are balanced.

The Sustainable Development Goals (SDGs) offer a broader global context for this challenge. Specifically, SDG 11 calls for inclusive, resilient, and sustainable cities, with a mandate to "protect and safeguard the world's cultural and natural heritage" (UN DESA 2024:1). SDG 15 further emphasises halting biodiversity loss and ensuring the health of terrestrial ecosystems. The park's vision, "a renowned World Heritage Park where conservation, sustainable tourism, and benefit sharing prevails" aligns directly with these global commitments (*iSimangaliso Wetland Park Authority 2022:10*).

In addition, South Africa's Constitution (Section 24) enshrines every citizen's right to an environment that is not harmful to health or well-being and mandates the protection of ecological sustainability for present and future generations. iSimangaliso's conservation model directly supports this constitutional obligation by preserving biodiversity, promoting sustainable livelihoods, and raising environmental awareness.

Lastly, the Times of Crisis (2023:19) warns that without immediate and transformative change, the deterioration of ecosystems and loss of planetary resilience will continue to accelerate. Conservation efforts must therefore be proactive, intersectional, and grounded in the principles of equity, solidarity, and long-term sustainability.

As highlighted, the park's vision, "A renowned World Heritage Park where conservation, sustainable tourism and benefit sharing prevails" (*iSimangaliso Wetland Park Authority* 2022:10), reinforces the relevance of conservation as a central principle. It provides a model for sustainable practices that can inspire similar approaches in other conservation areas.

The conservation of iSimangaliso Wetland Park is essential not only for protecting biodiversity but also for upholding constitutional rights, achieving global sustainability goals, and fulfilling national development mandates. It represents a living model of ecologically responsible development—one that balances environmental integrity with human prosperity. Its ecosystems are critical not only to species survival, but also for the resilience and well-being of current and future generations.

Objective 3 stated the following:

To examine how sustainable ecological development can be implemented within a sensitive environment.

This study critically investigates how sustainable ecological development can be achieved within sensitive environments, specifically within the iSimangaliso Wetland Park. The objective is grounded in the framework of the United Nations Sustainable Development Goals (SDGs), particularly SDG 11, which emphasises the need to make cities and human settlements inclusive, safe, resilient, and sustainable (United Nations Department of Economic and Social Affairs 2024:1). This goal underscores the importance of protecting natural and cultural heritage and fostering sustainable urbanisation.

SDG 11, focusing on sustainable cities and communities, promotes environmentally friendly urban development (*United Nations Department of Economic and Social Affairs Sustainable Development 2024:1*). Within this context, SDG 11 outlines several targets, among which the following is particularly relevant to this research:

- “Strengthen efforts to protect and safeguard the world’s cultural and natural heritage” (*Sustainable Development Goal 11 2023:1*).

The study adopted a qualitative, inductive methodology incorporating precedent analysis, theoretical frameworks and architectural critique to assess how architectural responses within iSimangaliso Wetland Park can promote biodiversity, conserve heritage, and ensure community well-being.

At the core of the findings is the adoption of ecological architecture, which merges environmental and architectural sciences to promote designs that are contextually appropriate and environmentally responsible. It encompasses time, place, culture, nature, construction technologies, and human harmony with the natural world, and is interrelated with the concepts of conservation and sustainability.

The study found that ecological architecture can be related to the following principles:

- Adaptation to the local natural environment
- Conservation of non-renewable natural energy sources and reduced energy use
- Protection of environmental resources (air, soil, water)
- Maintenance and improvement of natural circulation
- Reduced dependence on central energy (electricity, water) and waste (wastewater and garbage) systems
- Enabling residents to meet their own daily needs
- Utilisation of natural resources from the surrounding area for building systems, both related to building materials and for building utilities (energy sources, water supply)

However, according to the precedent study (Chapter 5) and the case study (Chapter 6), these principles are often applied inconsistently. The study found that many developments, including buildings within iSimangaliso Wetland Park, lack full integration of either cultural sensitivity or technological innovation. To bridge this gap, the research employed the **Hybrid Model** by Yahya and Hassanpour (2022), which integrates the Revivalist and Progressive models:

- **The Revivalist Model**, “learn from the past”, values traditional construction methods, climate-responsive vernacular forms, and cultural symbolism (e.g., circular huts, indigenous materials, passive design). Key elements identified include:
 - Cultural sensitivity.
 - Utilisation of environmentally responsive design strategies such as:
 - Natural ventilation strategies
 - Shading strategies
 - Natural ventilation
 - Evaporative cooling
 - Thermal mass with microclimatic elements, similar to courtyard design strategies
 - Use of local, environmentally friendly material

- **The Progressive Model**, “learn from the present”, promotes innovation and measurable performance, including technologies such as solar panels, high-performance materials, smart ventilation, and greywater systems. Identified features include:
 - The adoption of resource-efficient technologies, such as:
 - Solar panels and photovoltaic systems
 - Bio-walls
 - Thermal glazed panels
 - Wind turbines
 - Waste management systems
 - Envelope designs
 - High-performance materials, aimed at attaining resource efficiency and sustainability

The Hybrid Model serves as a framework for balancing these paradigms, creating architecture that is both rooted in tradition and driven by modern sustainability.

To deepen this approach, the study drew on additional theoretical frameworks outlined in Chapter 3:

Critical Regionalism

This theory critiques placeless, globalised architectural forms and instead advocates for site-specific, culturally informed design (Pragash n.d.; Ahmed 2021:101). Critical Regionalism aligns closely with the Revivalist Model and calls for early-stage planning that considers local vernacular traditions, climate, and community input. This is especially relevant in postcolonial contexts like South Africa, where architectural identity has been disrupted. The application of Critical Regionalism in iSimangaliso ensures the built form is an extension of local traditions, rather than an imposition of foreign ideals.

Sense of Place

This phenomenological framework recognises the emotional, symbolic, and cultural ties people form with places. According to Vali and Nasekhiyan (2014:3750), sense of place emerges from the interaction between human behaviour, environmental features, and social meanings. iSimangaliso, with its cultural richness and natural beauty, offers unique spatial experiences that should be preserved through design. Elements like enclosure, scale, texture, smell, and sound (Steele, in Vali and Nasekhiyan 2014:3751) must be considered in future developments to maintain the park's identity. Kevin Lynch's theory (Hu and Chen 2018:3) further supports designing spaces based on how people perceive and remember them.

Ecological Architecture

As discussed above, Purwanti and Nazir (2022:341) define this as a holistic framework combining environmental science with architectural strategies to create synergy between people, buildings, and ecosystems. It includes:

- Natural ventilation and lighting
- Site-responsive material use
- Minimal reliance on external energy systems
- Community-led construction strategies

This approach overlaps significantly with both conservation and sustainability and thus forms the core integrated framework for design in sensitive ecosystems like iSimangaliso.

The literature revealed that the integrating the Revival and Progressive models results in the **Hybrid Model**, which combines the "Learn from the Past" approach of the Revival Model with the "Learn from the Present" emphasis of the Progressive Model. Furthermore, this

supports one of the objectives of Sustainable Development Goal 11: “Strengthen efforts to protect and safeguard the world’s cultural and natural heritage” (*Sustainable Development Goal 11 2023:1*).

Table 7.2 provides a summary of the Revival, Progressive and Hybrid Models as revisited from Chapter 5.

Table 7.2: Analyses of the Revivalist model, Progressive model and Hybrid model

Model	Key Focus	Design Strategies and Elements	Philosophical/Ecological Orientation	Strengths	Limitations
Revivalist Model	Learning from the past; cultural continuity and ecological wisdom	<ul style="list-style-type: none"> • Natural ventilation • Shading strategies • Evaporative cooling • Thermal mass and microclimatic design (e.g., courtyards) • Use of locally sourced, eco-friendly materials • Environmentally responsive passive strategies 	Anthropocentric (passive relationship with nature) Eco-cultural	<ul style="list-style-type: none"> • Culturally sensitive • Low energy demand • Utilises local knowledge and materials 	<ul style="list-style-type: none"> • Limited technological integration • May not meet all modern energy performance standards
Progressive Model	Learning from the present; innovation through advanced sustainable technologies	<ul style="list-style-type: none"> • Thermal glass panels • Bio-walls • Photovoltaic panels • Wind turbines • Envelope designs 	Technocentric; Eco-technic logic Anthropocentric	<ul style="list-style-type: none"> • High performance in energy/resource efficiency • Measurable environmental impact reductions 	<ul style="list-style-type: none"> • Risk of cultural homogenisation • May neglect ecological and contextual sensitivity

		<ul style="list-style-type: none"> • High-performance materials • Active solar energy systems • Efficient water and waste management systems 			
Hybrid Model	Integrative approach; bridging traditional and contemporary methods for adaptability and resilience	<ul style="list-style-type: none"> • Fusion of Revivalist and Progressive strategies • Integration of passive and active systems • Cultural identity preservation • Use of both natural materials and green technologies • Adaptability to local and global contexts 	<p>Integrative ecological logic</p> <p>Anthropocentric and non-anthropocentric blend</p>	<ul style="list-style-type: none"> • Balanced approach • Enhances resilience • Suited for diverse climates and socio-economic needs 	<ul style="list-style-type: none"> • Requires nuanced understanding and contextual expertise • Implementation can be complex

Precedent Study Synthesis

In the precedent study, Yahya and Hassanpour's (2022:3) critical evaluation of the Forum Homini Boutique Hotel's design, which was framed within the Hybrid Model, identified both significant strengths and limitations in terms of its conformity to the Revival and Progressive models. The design closely followed the Revival Model, combining traditional techniques with ecologically sensitive tactics. The hotel's use of locally obtained materials, like stone from a nearby quarry and lumber from invasive species, as well as its eco-friendly architecture that blended well with the Highveld terrain, demonstrated strong integration with the natural surroundings. Natural lighting, skylight ventilation, thoughtful orientation,

and initiatives to protect wildlife and habitats were among the features that highlighted the building's compliance with ecological architecture principles. These components improved the visitor experience by evoking a strong "sense of place," reflecting the area's natural and cultural identity.

On the other hand, the design's conformity to the Progressive Model was limited. The lack of cutting-edge sustainable technologies like solar panels exposed a significant gap, even though certain resource-efficient techniques were adopted, such as water-efficient fixtures, native landscaping, and borehole water collecting. This deficiency was further highlighted by the dependence on conventional HVAC systems. The facility's capacity to fully implement the Hybrid Model which blends conventional and innovative methods for all-encompassing sustainability was hampered by the lack of substantial technological integration.

In conclusion, the Forum Homini Boutique Hotel effectively exemplified the Revival Model through ecological architecture, environmental harmony, and cultural integration. However, it was unable to fully utilise the Hybrid Model due to its limited adoption of Progressive Model components, especially in terms of advanced sustainable technology. Retrofitting contemporary sustainable systems to close these gaps would improve the design and align it with modern hybrid architectural standards.

The Karoo Wilderness Centre exemplified the Hybrid Model by Yahya and Hassanpour (2022:3) through its integration of Revival and Progressive design principles, although with notable gaps in cultural significance. The Revival Model's influence was evident in its environmentally responsive strategies, including mimicking the landscape, utilising local materials, and integrating design features inspired by the Karoo's ecology, such as roof structures modelled after aloe plants. The architecture emphasised sustainability and conservation, reflecting the adaptations of local flora and fauna to harsh conditions and fostering a connection between human well-being and the ecosystem. However, these biomimicry techniques lacked cultural integration, as they focused solely on technological and ecological solutions detached from the region's cultural identity.

From the Progressive Model perspective, the Centre adopted advanced resource-efficient technologies, including solar power, water self-sufficiency through on-site wastewater processing, and off-grid energy systems, establishing it as a model for sustainable, self-reliant development. While the Centre incorporated ecological and sustainable principles,

the absence of detailed cultural elements and the inability to assess its sense of place due to its unbuilt status represented limitations. Despite these shortcomings, the Karoo Wilderness Centre's design reflected a thoughtful blend of Revival and Progressive elements, achieving an embedded Hybrid Model approach, albeit with room for further cultural and contextual enhancement.

The critical analysis of The Ridge building, within the context of the Hybrid Model by Yahya and Hassanpour (2022:3), demonstrated its integration of Revival and Progressive design elements while highlighting certain limitations. The building adopted environmentally responsive strategies characteristic of the Revival Model, such as hybrid ventilation systems that combined passive and mechanical approaches, the use of locally sourced materials, and innovative solutions for maximising natural lighting. Sustainable practices included the use of ecobricks, recycled materials, and cross-laminated timber (CLT) for its façade, reducing its environmental footprint. Moreover, The Ridge exemplified Progressive Model principles through advanced resource-efficient technologies, including thermally activated building systems (TABS), greywater recycling, solar energy harvesting, and an intelligent Building Management System (BMS). These features enhanced energy efficiency, reduced carbon emissions, and improved occupant comfort.

However, despite these strengths, the analysis revealed notable gaps. Limited emphasis on cultural identity and ecological principles hindered the building's ability to fully embody a sense of place, a key aspect of the Revival Model. Additionally, critical regionalism was underexplored, and while sustainable technologies supported human comfort and environmental integration, the lack of cultural significance prevented The Ridge from achieving a holistic Hybrid Model. Ultimately, The Ridge set benchmarks for sustainable construction but fell short of fully aligning with Yahya and Hassanpour's conceptual framework due to the absence of a robust cultural and regional identity.

In contrast, the study found that The Ridge Building was heavily influenced by technological features, advanced design principles, and high-performance materials. However, this building lacked regional cultural identity. Similarly, the conceptual design of the Karoo Wilderness Centre demonstrated the use of modern sustainable technologies, advanced material usage, and biomimicry principles, but lacked alignment with the sense of place theory and failed to reflect cultural identity, revealing a clear gap in uniting cultural expression with sustainable technological implementation.

The critical analysis of the Bowali Visitors Information Centre within the framework of the Hybrid Model by Yahya and Hassanpour (2022:3) highlighted its successful integration of Revival and Progressive design elements, albeit with limitations shaped by its era of construction. The building reflected cultural sensitivity by incorporating indigenous cultural elements and heritage from the Kakadu region, including locally inspired designs such as termite mound-like walls and rock art motifs. Environmentally responsive strategies were evident in its passive cooling techniques, raised stilts for flood prevention and ventilation, and seamless integration with the natural environment. The use of local, environmentally friendly materials, such as rammed earth walls and ironwood floors, further strengthened its alignment with the Revival Model by fostering a sustainable and culturally rooted architectural narrative.

However, the Progressive Model's influence was limited due to its construction in 1994, which predated many modern sustainable technologies. While resource-efficient features like water conservation and energy-efficient systems were present, the building lacked advanced technologies now considered standard in sustainable design. This limitation, though understandable in its historical context, restricted its ability to fully realise the Hybrid Model. Retrofitting the Centre with current technologies could enhance its alignment with Progressive principles and modern sustainability standards, bridging the gap and advancing its alignment with the Hybrid Model.

The application of the Hybrid Model within iSimangaliso Wetland Park revealed partial integration of Revival and Progressive Model principles, with notable shortcomings. Revival Model elements were present in culturally sensitive design features, such as the Siyabonga Jetty Building's timber columns, cultural decorations, and traditional-inspired ceiling, as well as the use of local materials reflecting Thonga and Zulu heritage. However, many park structures lacked similar cultural connection, and inconsistencies in architectural styles undermined the ecological and cultural cohesion of the park's-built environment. Environmentally responsive strategies were inconsistently applied; while some buildings embraced conservation principles, others, such as those in Cape Vidal, demonstrated a lack of alignment with ecological architecture.

Progressive Model features, such as resource-efficient technologies, were minimally implemented, with limited reliance on alternative energy sources or high-performance

materials. The absence of bio-walls and innovative sustainable technologies further highlighted gaps in the Progressive Model's integration. Overall, the park's built environment demonstrated an incomplete Hybrid Model, failing to fully embody the cultural integration and technological advancements necessary to align with the principles of sustainable development and the Hybrid Model's holistic vision.

In relation to the implementation of ecologically responsive design, the precedent study found that various buildings incorporated different ecological principles. For instance, the Forum Homini Boutique Hotel and the Bowali Visitor Centre were deeply rooted in cultural heritage, as reflected in their design and alignment with the sense of place theory. These designs responded to their local contexts and were driven by cultural roots. However, there was little information or visible evidence regarding the implementation of advanced technological strategies and techniques in these buildings, highlighting a clear gap in their ecological design approaches.

The case study of iSimangaliso Wetland Park confirmed the park's rich cultural identity and heritage, as outlined in Objectives 1 and 2. Despite this cultural wealth, the buildings within the park exhibited diverse architectural languages and aesthetics, often lacking the integration of cultural identity and sustainable principles.

The Information Building of iSimangaliso Wetland Park, a relatively new structure, was analysed as relevant to the study. Its design language was observed to be replicated across guard houses and ablution facilities throughout the park. Although the building was elevated off the ground, aligning with ecological preservation by reducing its impact on the surrounding ecosystem, little consideration was given to the materials used or the incorporation of advanced technological systems. Furthermore, the building did not embody cultural identity or align with the sense of place theory. Despite its intent to set a precedent within the park, the structure did not respond effectively to ecologically responsive architectural principles, revealing a clear gap.

Hybrid Model Integration

The Hybrid Model, as proposed by Yahya and Hassanpour (2022:3), is a vital framework in architectural design, bridging the Revivalist and Progressive models to produce built environments that are both culturally grounded and technologically sustainable. When

comprehensively applied, the Hybrid Model addresses the growing demand for structures that honour cultural heritage while integrating modern technologies, aligning with broader sustainability imperatives such as the United Nations' Sustainable Development Goal 11, which advocates for inclusive, safe, resilient, and sustainable human settlements.

In the context of iSimangaliso Wetland Park, the application of the Hybrid Model revealed both significant potential and challenges. While the region's ecological and cultural sensitivities call for a nuanced design approach, the inconsistent implementation of the model across various buildings highlights missed opportunities in achieving cohesive, sustainable development.

From the Revivalist Model perspective, the emphasis on cultural integration is particularly relevant due to the rich Thonga and Zulu heritage embedded within the landscape. The Siyabonga Jetty Building is a notable example, incorporating local materials and design motifs drawn from indigenous architectural traditions. However, such cultural responsiveness is not uniformly reflected across the park's infrastructure. Many buildings lack symbolic or material connection to local traditions, resulting in weakened expressions of sense of place, diminished conservation value, and compromised ecological harmony. The Revivalist principles of embracing vernacular knowledge and fostering community identity remain underutilised, limiting the park's architectural cohesion and visitor engagement.

From the Progressive Model standpoint, the adoption of sustainable technologies within the park was also uneven. Some buildings incorporated basic ecological strategies—such as elevated floor systems to reduce land disruption and rudimentary water conservation features—but generally lacked advanced systems such as solar panels, bio-walls, thermal glazing, or intelligent building management systems. In areas like Cape Vidal, reliance on conventional methods failed to address the park's ecological demands or model the progressive standards expected in protected environments.

The critical value of the Hybrid Model lies in its capacity to synthesise these two paradigms, establishing an architectural language that is both contextually grounded and forward-looking. In iSimangaliso, the fragmented implementation of Revivalist and Progressive elements underlines the need for an integrated, site-specific strategy. A cohesive Hybrid Model would enhance the park's architectural identity, strengthen its cultural narrative, and

ensure that all developments meet ecological performance criteria in line with international sustainability benchmarks.

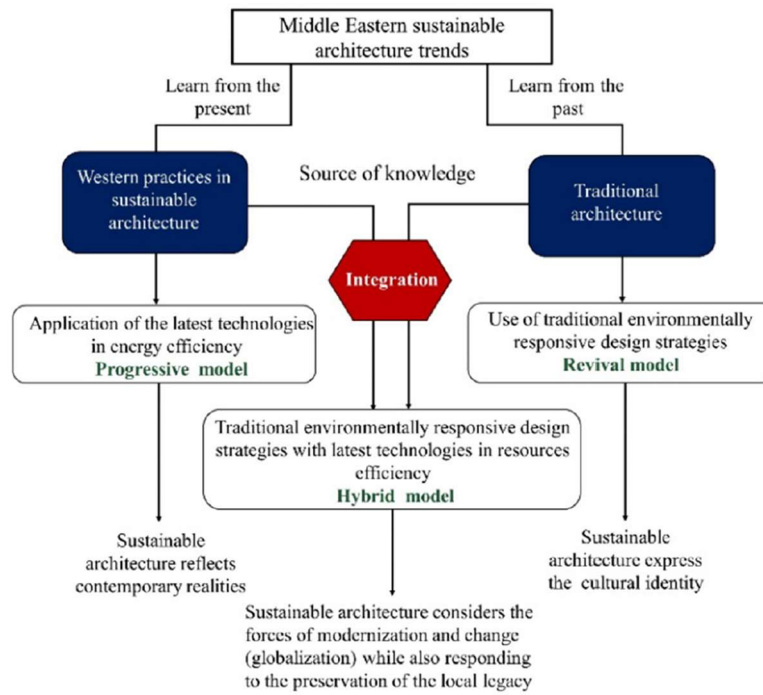


Figure 7.1: Sustainable architectural trends

Source: Yahya and Hassanpour (2022:3)

Figure 7.1 revisits Yahya and Hassanpour’s Hybrid Model as a globally relevant yet locally tailored architectural approach. The model promotes the principle of “learning from the past”, through the application of traditional, climate-responsive design strategies, alongside “learning from the present”, by incorporating cutting-edge, energy-efficient technologies. This fusion fosters alignment with the Sustainable Development Goals while also contributing to the protection of South Africa’s World Heritage sites.

Despite its transformative potential, the research in iSimangaliso revealed a disconnect between intention and execution. The Hybrid Model was not fully embraced across all building projects. The new Information Building, for instance, is elevated to protect local ecosystems a progressive ecological response but fails to demonstrate cultural integration or technological advancement. This partial application undermines the park’s potential to serve as a global benchmark for sustainable ecological architecture.

To realise its full potential, the Hybrid Model must be implemented in a way that:

- Embeds cultural values and indigenous traditions in architectural expression
- Utilises advanced, low-impact technologies for energy, water, and waste management
- Maintains design continuity and architectural consistency throughout the park
- Directly supports the objectives outlined in SDG 11

By fully realising the Hybrid Model, iSimangaliso could become a global exemplar of ecologically responsive and culturally rooted development. Future buildings within the park should therefore adopt a comprehensive design framework that draws equally from past traditions and present innovations.

The integration of the Hybrid Model with these theoretical frameworks reveals that iSimangaliso Wetland Park has the potential to become a global exemplar of sustainable ecological development. However, the research highlights inconsistencies in current implementations often lacking either cultural resonance or ecological performance. Through a rigorous application of the Hybrid Model and its embedded frameworks Sense of Place, Ecological Architecture, and Critical Regionalism iSimangaliso can achieve architectural integrity, ecological harmony, and community inclusion.

The research concludes that although the iSimangaliso Wetland Park has made commendable progress in incorporating sustainable design principles, the absence of a fully implemented Hybrid Model constrains its architectural cohesion and ecological responsiveness. A comprehensive application of the Hybrid approach has the potential to strengthen the park's identity, improve functional performance, and elevate its status as a benchmark for sustainable development in sensitive environments.

Accordingly, this study recommends the Hybrid Model as the most effective design framework for implementation within ecologically and culturally rich contexts such as iSimangaliso Wetland Park. This aligns directly with Objective 3, which aims to examine how sustainable ecological development can be achieved within sensitive landscapes. As illustrated in Table 7.3, the Hybrid Model synthesises core elements of the Revivalist and Progressive Models, while integrating critical theoretical frameworks Sense of Place, Critical Regionalism, and Ecological Architecture to enable a holistic, contextually grounded, and resilient design strategy.

By fully embracing this integrated model, iSimangaliso Wetland Park could serve as a leading example of ecologically responsible and culturally embedded architectural development—one that may be replicated in other protected areas worldwide.

Table 7.3: Provides a summary of the Hybrid Model synthesis

	Hybrid Model
Key Focus	Integrative design approach that balances cultural continuity, ecological architecture, and technological innovation for adaptable, resilient, and context-responsive built environments.
Integrated Design Strategies and Elements	<ul style="list-style-type: none"> - Fusion of passive (learn from the past) and active systems (learn from the present). - Natural ventilation, courtyards, thermal mass, and shading (Revivalist) - High-performance envelopes, solar panels, water/waste management, wind turbines (Progressive) - Vernacular materials and symbolic forms (Sense of Place, Critical Regionalism) - Biophilic integration, decentralised utilities (Ecological Architecture)
Philosophical / Ecological Orientation	<ul style="list-style-type: none"> - Integrative ecological logic blending anthropocentric (human needs, cultural values) and non-anthropocentric (ecological systems) worldviews - Grounded in phenomenology, ecocentrism, and regional responsiveness
Embedded Theoretical Frameworks	<ul style="list-style-type: none"> - Revivalist Model: cultural memory, traditional materials, passive systems - Progressive Model: advanced technology for energy/resource efficiency - Sense of Place: emotional, sensory, and symbolic spatial qualities

	<ul style="list-style-type: none"> - Critical Regionalism: local identity, climate-appropriate design - Ecological Architecture: harmony with natural systems, resource regeneration
Strengths	<ul style="list-style-type: none"> - Holistic and adaptable across socio-cultural and environmental contexts - Promotes cultural identity and community belonging - Integrates measurable sustainable performance - Supports SDG 11 and biodiversity conservation - Aligns modern innovation with ecological and traditional values
Limitations	<ul style="list-style-type: none"> - Requires deep contextual and cultural understanding - Demands interdisciplinary collaboration and planning - Implementation can be resource-intensive and complex, especially in under-resourced or heavily regulated environments

“Take an active interest in the governance and management of your city. Advocate for the kind of city you believe you need.”

(Sustainable Development Goal 11 2023:1)

Objective 4 stated the following:

To enquire how traditional methods in the built environment (concepts and techniques, such as design principles, use of materials, construction techniques), found in historical cores, can be combined with the latest sustainable technologies to develop an alternative ecological response to built form.

It is relevant to revisit the problem that led to the inquiry into developing an alternative ecological response to the built form. Accordingly, the study's Section 2.2 demonstrated that,

in its most basic form, the traditional shelter represented the emergence of humankind's interaction with its surroundings. The need for shelter also influenced the development and expression of architectural forms. The findings from the study determined that the built environment refers to human-made surroundings that provide the setting for human activity. This relationship has evolved over time and continues to shape how people interact with and respond to the spaces they inhabit. The literature review underscored that the relationship between humans, nature, and the built environment is crucial for achieving sustainability.

The research traced humanity's interaction with nature through key historical transitions—from the Paleolithic hunter-gatherers to the Neolithic agricultural revolution and the Industrial era. These transitions progressively increased human impact on ecosystems. Scholars such as Bargaoui and Nouri (2021) and Watson (2012) demonstrated how developments like domestication, agriculture, industrialisation, and urbanisation profoundly altered natural landscapes, resulting in deforestation, pollution, biodiversity loss, and climate change.

The built environment, as defined by Lamprecht (2016) and Greening the Built Environment (Department of Environmental Affairs 2020), represents human interventions in nature, encompassing not only physical structures but also socio-cultural frameworks. The transformation of landscapes into built environments has both enabled human advancement and introduced ecological challenges that threaten long-term sustainability.

Understanding this evolving relationship between humans and their environment offers essential insights for the future. It suggests that sustainability is best achieved through balance: drawing wisdom from the past while addressing present and future needs. This balance is the premise of the Hybrid Model, discussed in detail, in Objective 3, which merges traditional ecological knowledge with advanced sustainable technologies.

According to Section 1.2, economic growth, and the increasing impact of today's rapidly expanding built environment pose a threat to the sustainability of the natural ecosystem. This was highlighted as a major concern affecting both environmental stability and human welfare. The ongoing problems posed by local industries, lifestyles, and buildings have significantly contributed to the depletion of the natural ecosystem, destroying the green ecology and natural resources to the extent that a critical shift towards ecologically responsive architecture became necessary aimed at conserving natural ecology in the built environment.

With a particular emphasis on iSimangaliso Wetland Park, the case study in Section 6 concluded that the park possesses a rich cultural heritage, spanning from the Stone and Iron Ages to the most recent forced relocation of people from the 1950s to the late 1980s. This cultural heritage, found in historical cores, acts as a foundation from which architects and designers can extract key principles from the past for present-day designs. The research affirmed that the park is home to various indigenous communities, such as the Zulu and Tsonga people, who have a deep understanding of the local ecosystems and natural resources. Their traditional knowledge on medicinal plants, sustainable fishing practices, and land management provides valuable insight into conservation and the sustainable use of natural resources within the built environment.

Furthermore, in the traditional era, they learned to work with and adapt to nature. In contrast, today, we are not adapting; rather, we are depleting resources due to rapid economic and redevelopment growth. This highlights the need to raise awareness of the principles found in historical cores that could benefit future development. Limited information was available for traditional cultural methods prior to the Thonga and Zulu eras; however, the case study analysed how the Thonga and Zulu built structures adapted to the environment and highlighted the potential to learn from vernacular buildings.

Traditional Design Principles:

The research revealed that traditional principles, as embraced by the Thonga and Zulus, revolved around harmonious coexistence with the environment. These communities intricately adapted their way of life to ensure survival within the local natural landscape. However, contemporary practices often involve modifying the natural surroundings to suit lifestyle preferences. The typical dwellings of the traditional Thonga people were modest, solitary homesteads, especially in heavily forested regions. Thonga beliefs associated surrounding woodlands with evil spirits, leading to the practice of enclosing homesteads with timber fences. Each compound resembled a self-contained village with a central area predominantly utilised by men for meetings and tool-making (Roodt and Steyn n.d.:198). These insights into the Thonga culture's social structure and spatial organisation shed light on the historical context of their traditional settlements.

The Zulus, renowned for their arts, cultural beliefs, beadwork, and reed dance, incorporated these elements into built structures. Zulu architecture comprised traditional huts and beehive houses, with interior structures applying homogeneous techniques.

The precedent study of Forum Homini Boutique Hotel (Section 5.2), revealed that the design achieved harmonious integration with the contextual landscape, emphasising a seamless connection with nearby palaeo-anthropological sites. The design evoked a cave-like appearance and atmosphere, blending the structures with the surrounding environment. The concept also involved reinforcing the sense of the "original indigenous highveld landscape", extending this idea to the edges and even over the roofs of the buildings. It evoked the cultural roots of humanity in the primitive era, referencing early cave dwellings and their evolution over time. Further, the design included an open amphitheatre linked to the culture of the area, and the layout was similar to that of a traditional village, with distinct structures for different functions arranged in a village-like formation, showing the cultural significance of spatial organisation in traditional settlements.

The Bowali Visitors Centre precedent study (Section 5.5), revealed that the design respected and incorporated elements of indigenous culture and heritage from the Kakadu region. Emphasising environmental sustainability, it incorporated energy-efficient systems, water conservation, and locally sourced materials. Paying homage to the Aboriginal Djabulukgu Association and the Gagudju people, the design integrated cultural elements, aligning with the Critical regionalism approach. Sustainability was evident in features like the reflective roof for passive cooling and rainwater harvesting. The raised floor on stilts responded to the tropical climate, preventing floods and promoting ventilation, embodying the concept of conservation. Seamlessly blending with the natural environment, the design provided a dynamic experience akin to walking through the bush, showcasing a commitment to a sustainable and culturally rich architectural narrative.

Therefore, to bridge the gap between traditional and contemporary design principles, the research suggested that cultural roots could influence region-specific architecture. In iSimangaliso Wetland Park, there was a deep connection with various cultures other than the Thonga and Zulu, and designers could draw inspiration from them, incorporating their elements into the buildings. This could be done by creating a village-like facility where buildings are designed independently according to their functions yet interlinked in a way that responds to the spatial framework of local culture. Such an approach would incorporate traditional skillsets related to craftsmanship and spatial decoration. However, not all traditional building methods are applicable in terms of sustainability for the current period. For example, Thonga and Zulu buildings were built directly on the ground, a practice that may not align with sustainability standards.

This could be addressed through modern-day technologies, by elevating the buildings off the ground, similar to the Bowali Visitors Centre (refer to Figure 6.20) and the contemporary buildings in iSimangaliso Wetland Park. Therefore, some traditional design principles could be used in combination with the latest technologies as part of the Hybrid Model, as discussed in the findings of Objective 3, enabling the development of more sustainable buildings that promote conservation and foster greater synergy between the built and the natural environment.

Traditional use of materials:

The study revealed that both the Thonga and Zulu people utilised locally sourced materials and natural elements in their construction, decorative features, and furniture. The Thonga, in particular, employed various techniques like weaving, binding, knotting, and carving to create baskets from bark, which served as storage for personal belongings in their huts. They utilised leaves, bark, and stems from various indigenous plant species, including palm species like iLala Palm for weaving, various trees such as *Trichilia emetica* for carving, Hibiscus trees for sticks, and various reeds and grasses for thatching, weaving, and wall construction. The Zulus also used locally sourced reeds for thatch roofs and trees for timber poles.

Forum Homini Boutique Hotel strategically employed locally sourced traditional materials, such as carving stone for the amphitheatre, natural stone for wall construction and internal cladding, repurposing existing reeds for the roof gardens, and timber for the pergola. Additionally, The Ridge building used technologically developed natural materials like cross-laminated timber, ecobricks, recycled materials, and biophilic principles for interior spaces and ceiling elements. The Ridge building further explored the concept of dematerialisation, aiming to address excessive plastic pollution by incorporating it into the concrete slabs, thus reducing the quantity of concrete used—a positive step toward conservation. These strategies could be applied in pro-ecological development, moving towards a new ecology.

Therefore, it is evident that the materials used by the Thonga and Zulu people, as indicated above, were locally sourced, and that technological limitations at the time restricted material development. In the contemporary era, there is a growing recognition of the need to draw wisdom from traditional materials. This involves acquiring a deep understanding of the natural environment, including the characteristics of local fauna, flora, and ecosystems. The

objective is to identify properties within these resources that can be harnessed for construction and development, thereby minimising environmental impact.

However, building structures entirely from reeds, grass, trees, and mud may no longer be practical. Nevertheless, the underlying principles of adapting to the environment and using readily available, low-impact resources remain relevant. These principles can inform modern building practices, such as the use of naturally sourced materials for aesthetic decoration to embrace cultural identity, and the use of local materials for wall cladding, shading devices, louvers, pergolas, acoustic ceiling elements, and other non-structural elements. Furthermore, the concept of dematerialisation should be explored in all new buildings to address the global crisis of pollution.

It is also important to identify how traditional methods in the built environment within iSimangaliso Wetland Park could influence the response to Objective 4. Day-visitor numbers have increased significantly in recent years, necessitating the redevelopment of some accommodation options within the park to cater for a wider market and remain aligned with current with market trends (iSimangaliso Wetland Park Authority 2017:21). In addition, there is a need to create visitor centres, restaurants, and gathering spaces in the park to align with evolving market trends and visitor preferences. This redevelopment is a crucial step in advancing the transformation of the tourism sector.

The exploration of traditional construction methods reveals their rich cultural and historical significance. Three prominent techniques, Adobe construction (using sun-dried clay bricks), timber framing, and stone masonry, have distinct advantages that contribute to their enduring appeal and sustainability and are notably used in traditional structures within the park.

Adobe Construction:

- Energy-efficient: Offers excellent insulation, maintaining comfortable temperatures in various climates.
- Environmentally friendly: Utilises abundant and biodegradable resources sand, clay, and water makes adobe construction an eco-friendly choice (*Traditional vs Modern Construction Cultural perspectives* 2023).

Timber Framing:

- Durable: Timber structures are renowned for their strength and long-lasting nature.

- Offers design flexibility: Timber framing allows for intricate architectural details, fostering design creativity.
- Sustainable: The use of wood, a renewable resource, aligns with sustainable construction practices (*Traditional vs Modern Construction Cultural perspectives 2023*).

Stone Masonry:

- Durable: Stone structures withstand the test of time, ensuring longevity for centuries.
- Aesthetically pleasing: The natural beauty of stones enhances architectural designs, providing a unique and appealing aesthetic.
- Fire resistant: Stone buildings offer high resistance to fire, enhancing safety and reducing potential damage (*Traditional vs Modern Construction Cultural perspectives 2023*).

Preserving these traditional construction methods not only honours history but also adds authenticity and character to communities. The enduring advantages of energy efficiency, environmental friendliness, durability, design flexibility, aesthetics, and fire resistance highlight the importance of maintaining a balance between modern development and the preservation of traditional architectural heritage. Striking this balance ensures a sustainable and culturally rich built environment for future generations.

Integrating Traditional and Modern Construction techniques:

The theoretical framework outlined in Section 3.6, which explores critical regionalism, emphasises the importance of architectural traditions rooted in local conditions. This approach results in intelligent and contextually appropriate architecture and is a key consideration for developing ecological responses to new developments within iSimangaliso Wetland Park and the broader global context. The construction techniques of the Thonga and Zulu people relied on locally available materials and practical solutions. For instance, foundations were built with stone, huts were clad with reeds and sun-baked bricks, with craftsmanship intricately woven into their structures.

Traditional construction methods, such as adobe construction, timber framing, and stone masonry, hold significant cultural and historical value. Each offers distinct advantages: adobe construction is energy-efficient and environmentally friendly; timber framing is

durable and flexible in design, and stone masonry provides longevity, aesthetics, and fire resistance. Preserving these techniques honours history and adds authenticity to architectural communities. The balance between modern development and traditional architectural heritage is crucial for creating a sustainable and culturally rich built environment for future generations.

The findings demonstrate the potential for integrating traditional construction methods with modern sustainable technologies to create an alternative ecological approach to building design, particularly within iSimangaliso Wetland Park. Increasing visitor numbers necessitate the redevelopment of facilities such as accommodations, visitor centres, restaurants, and gathering spaces. This redevelopment offers a unique opportunity to combine traditional practices with contemporary sustainability strategies, promoting cultural preservation and advancing the tourism sector.

Techniques like adobe construction, timber framing, and stone masonry offer advantages when combined with modern technologies. Adobe construction, known for its insulation properties, can be enhanced with advanced thermal technologies. Treated timber can improve thermal efficiency and pest resistance, while recycled or engineered stone can reduce environmental impact. In the park, these methods can be supplemented by passive solar design, natural ventilation, renewable energy systems, and water conservation initiatives like rainwater harvesting and greywater recycling. Elevated structures, inspired by the "touch the earth lightly" principle, could further minimise environmental disruption while protecting biodiversity.

Balancing traditional techniques with modern sustainability aligns redevelopment efforts with the Sustainable Development Goals, particularly in promoting energy efficiency, cultural preservation, and ecological sensitivity. This approach ensures a sustainable and culturally enriched built environment that meets the needs of present and future generations. Furthermore, integrating findings from Objective 3 with Objective 4 highlights the interconnection between learning from the past and adapting to current needs, encapsulated in the Hybrid Model.

The research underscores that designers do not need to replicate traditional methods but can draw inspiration from the past and adapt materials to address contemporary challenges. For example, The Ridge building precedent study showcased innovative construction methods using ecobricks made from plastic waste, demonstrating a sustainable solution to reduce

environmental impact. Similarly, the Karoo Wilderness Centre employed sustainable techniques tailored to the local context to promote energy efficiency. These examples highlight the potential for applying such precedents across construction projects, adapting traditional methods to suit current needs while fostering ecological sensitivity.

As Fujii (1999:122) observed, the modern era is one of "knowledgism," where development relies on effective communication. Identifying current challenges and integrating traditional and contemporary methodologies are vital steps in achieving ecologically responsive designs in the built environment.

8. Conclusion and Recommendations

This chapter's primary objective is to present conclusions drawn from the comprehensive study, which incorporated site observation as well as primary and secondary data collection. Following these conclusions, the chapter offers recommendations based on the findings.

The study revealed that globally, and in South Africa, the natural resource base is under significant strain, leading to the destruction of ecosystems. The rapidly expanding built environment poses a growing threat to the sustainability of the natural ecosystem. This is a major concern that affects both environmental stability and human well-being, creating disparities between available resources and socio-economic development goals. Moreover, there is a critical need to raise awareness and explore strategies to preserve and conserve the natural environment in South Africa for present and future generations.

The study identifies the threats posed by economic growth and rapid urban expansion to the natural ecosystem, emphasising the urgent shift towards ecologised architecture for conservation. It underscores the need for an alternative ecological response to the built environment, emphasising the historical significance of traditional shelters as a starting point for understanding human-environment relationships. The built environment, shaped by the evolving interaction between humans and their surroundings, plays a crucial role in achieving sustainability. Equally important is the preservation and conservation of South Africa's heritage sites. Therefore, this research focused on the context of the park.

The study explored the multifaceted concept of conservation within the research site context. Conservation is the prudent administration of natural resources, with a focus on safeguarding living components and maintaining ecological equilibrium, as described by the conceptual and theoretical framework. The literature emphasises that conservation activities aim to improve community well-being and the overall quality of human life, with particular attention to iSimangaliso Wetland Park. The park's objectives align with the notion of conservation, stressing the establishment of a prestigious World Heritage Park where sustainable practices, tourism, and the sharing of benefits are prioritised.

The conclusion of this study demonstrates that the research questions were effectively addressed through the investigation of iSimangaliso Wetland Park as a sensitive ecological and cultural landscape.

Research Question 1:

- *What natural, environmental, cultural, and ecological factors led to the designation of iSimangaliso Wetland Park as a World Heritage Site, and how do these factors shape development within the park?*

This question is answered through the findings under **Objective 1**.

Objective 1 of this research sought to explore and understand the factors that led to the designation of iSimangaliso Wetland Park as a UNESCO World Heritage Site. Through a comprehensive review of literature, the study confirmed that the park's global recognition is firmly rooted in its Outstanding Universal Value, as defined by UNESCO's selection criteria under the natural heritage category.

iSimangaliso Wetland Park was inscribed in 1999 based on three specific criteria:

- **Criterion (vii)** for its exceptional natural beauty, expressed through its diverse geographical features such as coastal dunes, pristine beaches, estuarine systems, and vast wetland and savannah landscapes.
- **Criterion (ix)** for its ongoing ecological and biological processes, evident in the dynamic interactions between marine, fluvial, estuarine, and aeolian systems. The processes of speciation and ecological succession, particularly in the Maputaland Centre of Endemism, further underscore the park's evolutionary significance.
- **Criterion (x)** for its extraordinary biodiversity, with over 6 500 species of flora and fauna, including 467 classified as threatened and several endemics. These rich and varied ecosystems—marine, estuarine, terrestrial, freshwater, and wetland—provide crucial habitats for globally significant wildlife.

The research also revealed that iSimangaliso's transitional ecological positioning—where tropical and subtropical systems converge—and its geological and hydrological complexity enhance its ecological and aesthetic value. The park's coral reefs, underwater canyons, nesting turtle populations, and the vast estuarine network of Lake St. Lucia form part of an irreplaceable natural heritage tapestry, unique on both regional and global scales.

Furthermore, iSimangaliso stands as a symbol of ecological resilience, where conservation efforts are interlinked with broader themes of cultural history, socio-economic transformation, and sustainable tourism. The World Heritage status not only recognises the park's intrinsic environmental worth but also obligates national and international stakeholders to preserve its integrity for present and future generations.

Importantly, understanding the significance of iSimangaliso's UNESCO designation is not a static academic exercise. Rather, it forms a foundation for the study's broader objectives, particularly in informing how sustainable ecological development and culturally responsive architectural strategies can be integrated into sensitive landscapes. Recognising the ecological and symbolic importance of iSimangaliso as a World Heritage Site reinforces the need for contextually grounded development that safeguards biodiversity, upholds aesthetic value, and respects the ongoing natural processes that define the park's uniqueness.

Research Question 2:

- *Why is the conservation of the natural ecosystem critical to the long-term ecological integrity of iSimangaliso Wetland Park, and how can sustainable ecological development be implemented without compromising that integrity?*

This question is answered through the findings under **Objective 2 and 3**.

Objective 2, the findings underscore the vital importance of conserving the natural ecosystem within iSimangaliso Wetland Park, not only as a protected World Heritage Site but as a living model of ecological resilience and sustainability. Conservation, as contextualised through both literature and case study analysis, is a multidimensional effort rooted in preservation, sustainable management, and the promotion of long-term ecological balance. The study confirmed that iSimangaliso Wetland Park's conservation value lies in its unique configuration of fifteen interconnected ecosystems marine, terrestrial, and aquatic which support a wide array of biodiversity, including rare, threatened, and endemic species. Its designation as a UNESCO World Heritage Site, recognition under the Ramsar Convention, and national legal protection all reflect its ecological and cultural importance at global, regional, and local scales. However, the research emphasises that conservation must extend beyond legal status. The intrinsic ecological value of the park and its contribution to human well-being, biodiversity, and climate stability position it as a key site for sustainable development and responsible environmental stewardship.

Within this context, conservation is not an isolated environmental concern but is inherently linked to community well-being, tourism management, and the built environment. As noted by Saarinen *et al.* (2009), challenges such as tourism pressure and infrastructural development pose a constant risk to ecological integrity. Therefore, any future development within the park must be guided by conservation-centric principles that prioritise ecological protection, community benefit, and cultural sensitivity.

The study integrates perspectives from the *National Framework for Sustainable Development in South Africa* (Department of Environmental Affairs 2018), which acknowledges the growing pressure on the country's natural resource base, and highlights conservation areas like iSimangaliso as vital models for ecological sustainability. Additionally, global frameworks such as the Sustainable Development Goals (particularly SDG 11) and constitutional mandates (Section 24 of the South African Constitution) reinforce the imperative to protect the park for current and future generations.

Furthermore, literature by *Times of Crisis* (2023) emphasises the urgency of ecological conservation in the face of accelerating environmental degradation. It advocates for a transformative and intersectional approach to conservation, one that aligns equity, resilience, and sustainability in response to planetary crises. iSimangaliso's strategic vision, which embraces conservation, sustainable tourism, and benefit-sharing, encapsulates this holistic approach.

The conservation of iSimangaliso Wetland Park is central to achieving ecological sustainability, fulfilling constitutional and global obligations, and safeguarding one of South Africa's most valuable natural and cultural landscapes. It represents more than a protected area it is a symbol of how responsible stewardship of the environment can be harmonised with community prosperity and sustainable development. The park offers a replicable model for ecologically responsive management, ensuring that both biodiversity and human well-being are preserved for generations to come.

Objective 3, which examined how sustainable ecological development can be implemented within sensitive environments, revealed both the promise and the complexity of achieving such integration in a place as environmentally and culturally significant as iSimangaliso Wetland Park. Anchored by the principles of Sustainable Development Goal 11, the study demonstrated that effective ecological development is inseparable from the protection of cultural identity, biodiversity, and community well-being.

At the core of the research is the Hybrid Model by Yahya and Hassanpour (2022), which emerged as the most comprehensive framework to balance tradition and technologically advanced systems. The Revivalist Model, rooted in indigenous practices, passive design, and cultural symbolism, offers critical lessons in low-impact, place-sensitive design. Conversely, the Progressive Model provides pathways to integrate advanced sustainable technologies, performance-based systems, and climate resilience into the built environment. However, the

findings from both precedent studies and the case analysis of iSimangaliso Wetland Park reveal a consistent shortcoming: a disjointed or partial application of either model, leading to architectural solutions that fall short of achieving holistic sustainability.

The Hybrid Model, supported by the theoretical pillars of Critical Regionalism, Ecological Architecture, and Sense of Place, offers a compelling, integrative approach that is contextually grounded, ecologically responsible, and culturally meaningful.

The research found that although isolated architectural examples in iSimangaliso demonstrate ecological awareness or cultural sensitivity, they often lack coherence in architectural language, strategy, and intent. Some buildings exhibit environmentally responsive features but are devoid of cultural depth; others draw on tradition yet lack technological innovation. This misalignment undermines both ecological performance and user experience, limiting the park's capacity to serve as a global exemplar of sustainable design in protected areas.

Thus, sustainable ecological development in iSimangaliso Wetland Park requires more than technical solutions, it demands a visionary, place-specific, culturally integrated and inclusive approach to architecture and planning. The Hybrid Model provides this framework, allowing built form to operate not as an imposition on the landscape but as an extension of it—both a cultural artifact and a regenerative environmental strategy with technologically advanced systems.

If fully realised, this Hybrid Model approach can transform iSimangaliso into a benchmark for resilient, contextually relevant, and ecologically grounded development not only within South Africa, but across sensitive environments globally, as illustrated Table 7.3 in Chapter 7.

Research Question 3:

- *How can traditional indigenous architectural knowledge be integrated with contemporary sustainable technologies to create ecologically responsive built form within sensitive environments such as iSimangaliso Wetland Park?*

This question is answered through the finding under **Objective 4**.

Objective 4 analysed the inquiry into how traditional methods in the built environment, through design principles, material use, and construction techniques, can be combined with modern sustainable technologies, revealing a powerful and necessary synergy for developing

alternative ecological responses. This study has shown that the ecological wisdom embedded in historical cores, especially those rooted in indigenous cultures such as the Thonga and Zulu, holds enduring relevance for contemporary sustainable design, particularly in environmentally sensitive and culturally rich landscapes like iSimangaliso Wetland Park.

Drawing from the traditional principles of these communities, the study uncovered deep-rooted site-specific adaptations: passive design techniques, locally sourced biodegradable materials, and spatial organisation that fostered cultural identity, resource efficiency, and environmental harmony. These approaches were not only functional but also philosophical framing architecture as a dialogue with nature, not an imposition upon it. However, the limitations of traditional materials and methods in meeting contemporary performance, safety, and resilience standards necessitate their thoughtful reinterpretation and enhancement through modern technologies.

The analysis of case studies such as the Forum Homini Boutique Hotel, Bowali Visitors Centre, and The Ridge building further demonstrated that while traditional design inspiration offers cultural depth and contextual relevance, modern innovations such as passive energy systems, high-performance materials, greywater systems, and biophilic interiors, can address pressing ecological challenges. These examples underscored the importance of hybridising tradition and technology to achieve designs that are culturally resonant, environmentally responsive, and technologically advanced.

Within iSimangaliso Wetland Park, the increased demand for ecotourism infrastructure presents a critical opportunity to adopt this integrated design philosophy. The study identified that new developments, whether in accommodation, interpretive centres, or communal spaces, should move beyond generic architecture to adopt place-based, culturally informed, and ecologically attuned solutions. This includes using natural, locally available materials for non-structural elements, elevating buildings off the ground to reduce ecological disruption, and reinterpreting spatial forms such as village-like layouts to reflect indigenous cultural patterns.

Ultimately, Objective 4 confirms that sustainability in the built environment must not be rooted solely in technological advancement but must also reclaim and evolve the cultural intelligence embedded in historical building practices. The integration of traditional knowledge with cutting-edge sustainable systems is best framed by the Hybrid Model, as

proposed in Objective 3 a model that does not replicate the past but learns from it to inform ecologically grounded futures.

By embracing this fusion, iSimangaliso Wetland Park and similar contextual areas can become exemplars of architectural development that is ecologically restorative, culturally affirming, and technologically relevant, advancing global sustainability goals while reinforcing local identity and resilience.

The synthesis confirms that the research questions were successfully addressed through the findings of the study. The first question was answered by identifying the natural, ecological, and environmental attributes that justified iSimangaliso Wetland Park's UNESCO World Heritage designation and that continue to shape development within the park. The second question was addressed by demonstrating that conservation is essential to preserving ecological integrity and that sustainable ecological development must be implemented through conservation-led strategies. The third question was resolved by showing that traditional indigenous architectural knowledge, when meaningfully integrated with modern sustainable technologies, can generate ecologically responsive built form. Collectively, these findings support the adoption of the Hybrid Model as a contextually grounded framework for development within sensitive environments.

In conclusion, this study calls for a fundamental paradigm shift in architectural practice one that synthesises the enduring wisdom of traditional building methods with the transformative potential of modern advancements, in direct support of the Sustainable Development Goals. The study promotes a built environment that not only meets contemporary functional needs but also safeguards ecological integrity, strengthens cultural identity, and nurtures a symbiotic relationship between human-made and natural systems. While the scope of this research does not extend to formulating specific design solutions, it has sought to examine, in detail, the shortcomings and gaps present within existing architecture in sensitive environments such as iSimangaliso Wetland Park. Through this analysis, the study identifies a cohesive *Hybrid Model* that is both contextually relevant to iSimangaliso Wetland Park and adaptable to other ecologically fragile settings or similar contextual sites, offering a framework of value to the broader South African context.

The research, though rooted in the distinctive ecological, cultural, and historical fabric of iSimangaliso, generates insights that extend far beyond its geographical boundaries. It

underscores that the preservation of natural resources is not an isolated environmental goal but an essential architectural responsibility, particularly in areas of exceptional biodiversity and cultural heritage. The findings reaffirm the necessity for an integrative, context-specific approach to sustainable architecture, one that acknowledges and honours the accumulated knowledge embedded in indigenous traditions while strategically embracing contemporary technologies to enhance performance, resilience, and adaptability.

When fully implemented, the *Hybrid Model*, reinforced by the theoretical pillars of Sense of Place, Ecological Architecture, and Critical Regionalism, offers a compelling pathway toward achieving architectural outcomes that are environmentally harmonious, culturally resonant, and socially responsive. In the context of iSimangaliso Wetland Park, this approach has the potential to protect and enrich one of South Africa's most treasured natural landscapes while setting a precedent for similar interventions across KwaZulu-Natal and beyond. More broadly, it positions architecture as an active agent in balancing conservation imperatives with human development, ensuring that future generations inherit environments that are not only functional and beautiful, but also ecologically and culturally sustainable.

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