Self Sufficient Urban Architecture

Reducing reliance on traditional sources for basic necessities

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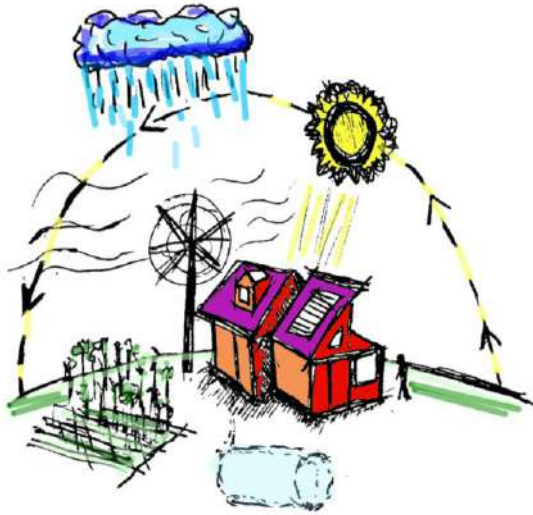
Content



Abstract

With the growing popularity of sustainable and self-sufficient living, architects and urban planners have discovered numerous examples of such communities located outside urban areas.

However, the principles of sustainable living can also be effectively applied within urban environments. The objective of this project is to explore the design principles and practices of off-the-grid, self-sufficient architecture, and assess its potential in creating more sustainable and self-reliant urban developments in cities or urban areas.

My grandmother, who has been residing on an off-the-grid self-sustaining farm for several decades, sparked my curiosity in investigating self-sufficiency. I firmly believe that the farm's design principles can serve as a solid foundation for architects and urban designers to create more self-sufficient urban developments. Despite the farm's simplicity, it embodies various sustainable design principles that can be seamlessly integrated into urban projects.

One remarkable feature demonstrated by the farm is its water conservation practices. Through the implementation of a simple water recycling system, the farm eliminates its dependence on municipal water sources. This noteworthy achievement inspires the incorporation of water-efficient fixtures in building designs. By including rainwater harvesting and grey-water recycling systems in architectural plans, reliance on conventional water sources can be further reduced, encouraging a more sustainable and responsible use of water resources.

The farm's agricultural aspect presents an opportunity to redefine the relationship between buildings and their surrounding environments. By embracing the concept of urban agriculture, designs can be crafted to encompass community gardens and green spaces, fostering a sense of shared ownership and sustainable food production within urban settings. Furthermore, the integration of rooftop gardens into building designs not only optimises land utilisation but also nurtures a harmonious synergy between nature and architecture. This approach simultaneously improves air quality, mitigates the urban heat island effect, and enhances overall urban aesthetics.

Ultimately, the farm's integration of sustainable design principles serves as an influential source of inspiration, providing a blueprint for creating environmentally conscious and socially responsible built environments. By thoughtfully incorporating these principles into designs, professionals can drive positive change by reducing energy consumption, conserving water resources, promoting self-sufficiency through urban agriculture, and mitigating the environmental impact of buildings. Embracing such practices will undoubtedly contribute to a more sustainable future, enhancing the overall quality of life within our urban communities and fostering a harmonious coexistence between human activities and the natural world.

Background

In the face of increasing urban population growth, resource depletion, climate change, the need for sustainable and self-sufficient lifestyles has become more pressing than ever. Architecture, as an integral part of the built environment, has a critical role to play in promoting self-sufficiency and reducing reliance on traditional sources for necessities. This project aims to explore the concept of self-sufficiency architecture and its potential to contribute to a more sustainable future.

Focus Questions

- What is self-sufficient urban architecture, and how does it differ from traditional approaches to architecture?
- What are the key design principles and strategies for achieving self-sufficiency in architecture?
- How can self-sufficient architecture contribute to reducing reliance on traditional sources for necessities, such as food, water, and energy?
- What are the economic, social, and environmental implications of self-sufficient architecture?

Methodology

The research will be conducted through a literature review of existing studies and reports on self-sufficient architecture and related fields such as sustainable architecture, technologies and green building. The study will also include case studies of self-sufficient architecture projects from around the world. The analysis will be based on qualitative methods, such as content analysis, to identify key themes and patterns in the data.

Expected outcomes

This project is expected to contribute to a better understanding of the concept of self-sufficiency architecture in an urban context and its potential to reduce reliance on traditional sources for necessities. The study will identify key design principles and strategies for achieving self-sufficiency in architecture and evaluate their economic, social, and environmental implications. The findings of this study could be used to inform the development of self-sufficient architecture projects and policies that promote sustainable and resilient built environments.

Keywords

Self-sufficient architecture, sustainable architecture, urban agriculture, green building, affordable housing, basic necessities, economic opportunity, sustainable future, ecological urbanism.

Introduction

The current state of South Africa's basic service delivery, including persistent power outages, an unstable electrical grid, inadequate water supply, and food shortages, demands that architects find solutions to reduce our reliance on government and large corporations for these fundamental necessities. (James & Lahti, 2004) As these entities have repeatedly demonstrated their inability to meet our basic needs, it is time to move towards a self-sufficient society.

To tackle the challenges posed by urbanisation, resource limitations, and climate change, we must reevaluate our approach to new developments. I believe that the design and construction of new living spaces should be self-sustaining from the outset, incorporating features such as energy positive housing, on-site organic food production, mixed renewable energy, water and waste recycling, and community empowerment.

Self-sufficiency is a critical concept for architects to understand and promote. It promotes independence and empowers individuals and communities to become less dependent on external authorities. This leads to greater resilience in the face of economic and environmental shocks, ensuring that basic requirements are met. Sustainable practices in architecture and urban planning can encourage eco-friendly lifestyles and reduce the harm that human activities have on the environment. (Seymour, 2023)

The incorporation of self-sufficiency in architecture can foster liveable and fairer communities by offering access to essential resources and empowering residents to manage their own welfare. This approach represents a novel perspective on the built environment, prioritising sustainability, resilience, and self-sufficiency. Its integration is a critical stride in advancing a more sustainable and equitable future for society. Using this type of thinking in a new development in the city of Cape Town is the path I am pursuing.

This project introduces an innovative self-sustaining structure that explores the design principles and practices of off-the-grid, self-sufficient architecture. This initiative extends beyond conventional sustainability, serving as a blueprint for more self-reliant urban development.

This project aims to spark fresh perspectives, challenge established norms, and contribute to a greener and more resilient urban future. Through a fusion of technology and environmentally conscious design, the self-sufficient building present's a functional design that embodies the potential for future urban life.

This thesis offers an extensive examination of the motivations, design considerations, implementation strategies, and potential impact of our self-sustaining building. It delves into the complex web of achieving energy independence, efficient water management and seamless community integration, striving to offer a comprehensive understanding of how this architectural innovation can transform urban living.

In conclusion, architects have a crucial role to play in creating more self-sufficient, sustainable, and resilient communities. By designing buildings and communities that are environmentally friendly, energy-efficient, and socially responsible, we can ensure a brighter future for generations to come. Through self-sufficiency and sustainable practices, we can reduce our dependence on external authorities, promote independence and resilience for future generations.

What is Self-sufficient Architecture?

This project explores the critical need to delve into self-sufficient architectural strategies in the context of Cape Town. The city and its urban centre is grappling with the pressing challenges of rapid population growth, dwindling resources and climate change. The unique environmental and social issues faced by the city demand innovative solutions. (Githahu, 2022) I believe that this approach should be one that emphasises reducing dependence on external resources while fostering sustainable, localised systems for energy, food, and water. Through the incorporation of these strategies, the city can effectively tackle its existing obstacles while also laying the foundation for sustainable and harmonious urban future developments.

Self-sufficient architecture refers to a design approach that aims to create buildings or structures capable of meeting their own energy, water, and waste management needs without relying heavily on external resources. It involves incorporating various sustainable technologies and practices to minimise the environmental impact and enhance the self-reliance of the building. (Flanagan & Jewell, 2010) The goal is to achieve a high level of autonomy and reduce dependence on traditional infrastructure systems. These systems encompass reliance on the electrical power grid, the capability of cultivating self-sustaining food sources, and the establishment of efficient water supply and wastewater recycling mechanisms.

Self-sufficient architecture typically involves the integration of renewable energy systems such as solar panels, wind turbines, or geothermal systems to generate electricity and heat. These systems harness natural resources and convert them into usable energy, reducing the reliance on fossil fuels and lowering greenhouse gas emissions. Energy-efficient design strategies, such as passive heating and cooling techniques, insulation, and efficient appliances, are also crucial in minimising energy consumption. (Steemers, 2010)

Water self-sufficiency is achieved through techniques such as rainwater harvesting, water recycling and purification systems, and efficient water management practices. These systems allow for the collection, treatment, and reuse of water, reducing the demand on conventional water supply sources and ensuring a sustainable water cycle within the building.

In terms of waste management, self-sufficient architecture emphasises the implementation of strategies like composting, on-site waste treatment systems, and recycling facilities. These measures help minimise waste generation, promote recycling, and allow for the conversion of organic waste into valuable resources like fertilisers. (van der Ryn & Cowan, 2007)

The concept of self-sufficient architecture aligns with broader sustainability goals, promoting resilience, reducing environmental impact, and fostering a more sustainable future. While achieving complete self-sufficiency may be challenging in some cases, the aim is to strike a balance between on-site resource generation and limited reliance on external systems.

Theoretical Studies

In the pursuit of establishing a theoretical basis for self-sufficient architecture, this exploration aims to delve into a realm where nature and architectural design converge. By examining various theories that underscore the inherent relationship between human-made structures and the natural environment, I seek to uncover insights and principles that can inform the creation of self-sustaining and ecologically harmonious architectural designs.

Through this investigation, I hope to achieve a deeper understanding of how architectural concepts rooted in the principles of nature can be harnessed to foster sustainable, regenerative, and self-sufficient built environments. By embracing these theoretical foundations, we aspire to pave the way for a transformative paradigm shift in architectural practices that harmonises with the ecosystem and cultivates a resilient, thriving future for humanity and the planet.

'The Three Ecologies'

"The Three Ecologies" by Félix Guattari is a philosophical and political work that examines the interconnectedness of three distinct but interrelated ecologies: the environment, society, and subjectivity. Guattari argues that addressing environmental crises necessitates a broader understanding that goes beyond focusing solely on the natural environment.

The First Ecology: The Natural Environment

The first ecology refers to the physical environment, encompassing natural ecosystems, climate, and biodiversity. Guattari emphasises the urgency of ecological issues such as deforestation, pollution, and climate change caused by industrial capitalism. He critiques the prevailing capitalist system that exploits natural resources and prioritises profit over ecological sustainability. Guattari calls for a radical reimagining of society's relationship with nature, advocating for ecological responsibility, sustainable practices, and the protection of ecosystems.

Self-sufficient architecture aligns with the first ecology by emphasising the importance of minimising the environmental impact of buildings. It promotes the integration of renewable energy systems such as solar panels, wind turbines, and geothermal systems to generate electricity and heat.

These systems reduce reliance on fossil fuels, mitigate climate change, and contribute to the preservation of the natural environment. Additionally, self-sufficient architecture encourages sustainable practices like rainwater harvesting, water recycling, and waste management, which help minimise resource consumption and reduce pollution, thus supporting the conservation of ecosystems.

In the context of Cape Town, similar to other urban centres, we face critical environmental challenges, including water scarcity and the loss of biodiversity, these issues require our immediate attention. Guattari's emphasis on the urgency of ecological concerns highlights the urgency for prompt action to safeguard the environment and secure the well-being of present and future generations.

Furthermore, Cape Town's past reflects instances of resource exploitation and inequitable access to environmental resources, notably water and green spaces. Guattari's critique of capitalist systems prompts us to question and seek equitable distribution of these resources, particularly in the context of urban development and planning.

IMAGE SOURCE: Curry, E. (2022) Article: 'Inequality in service distribution and environmental racism embedded in access to water and sanitation', EMG. Available at: https://www.emg.org.za/blog-about/2022/7/14/inequality-in-service-distribution-and-environmental-racism-embedded-in-access-to-water-and-sanitation.

The Second Ecology: Social Relations and Institutions

The second ecology delves into the realm of social relations, institutions, and power dynamics. Guattari argues that social and political structures play a significant role in shaping ecological and environmental conditions. He critiques hierarchical and oppressive systems, such as capitalism and authoritarianism, which perpetuate social and economic inequalities and contribute to ecological degradation.

Guattari emphasises the importance of social movements, grassroots activism, and collective action in challenging dominant structures and advocating for social and economic justice. He explores the potential for alternative models of governance and social organisation that prioritise ecological sustainability and promote egalitarian values.

Looking at 'the second ecology' through from the perspective of being a Capetonian, it easily resonates with our context. By recognising the social dimensions of our inequality and the built environment in the City of Cape Town. I believe that promoting self-sufficient urban architecture can seek to address social and economic inequalities by promoting access to affordable and sustainable housing. This is particularly in giving marginalised communities access to the CBD.

Self-sufficient architecture can empower communities by providing them with greater control over their energy, water, and waste management systems. It also supports the development of local economies and encourages community engagement through participatory design processes. By integrating social considerations, self-sufficient architecture fosters social cohesion, enhances quality of life, and promotes equitable access to resources and opportunities for all who live in the city

The Third Ecology: Subjectivity and Mental Life

The third ecology focuses on the realm of subjectivity, encompassing individual and collective mental and emotional states. Guattari argues that the capitalist system not only harms the environment but also alienates individuals from their desires, creativity, and authentic selfexpression. He highlights how capitalism's emphasis on consumerism, individualism, and the commodification of desires produces social and psychological pathologies. Guattari proposes the concept of an "ecosophy," which seeks to integrate ecological, social, and mental transformations. He calls for a reconnection with nature, a reshaping of our desires and values, and the creation of new forms of subjectivity that are in harmony with the environment.

Self-sufficient architecture intersects with the third ecology by considering the psychological and subjective aspects of the built environment in urban areas. It recognises the impact of the physical surroundings on human well-being and seeks to create spaces that support mental health and connection with nature. Self-sufficient architecture incorporates biophilic design principles, which integrate natural elements and materials, daylighting, and access to outdoor spaces.

These features enhance occupants' mental and emotional well-being, promote productivity, and foster a sense of connection with the environment. By creating harmonious and healthy living environments, self-sufficient architecture contributes to the transformation of subjectivity and promotes a more sustainable and fulfilling way of life.

The insights derived from Guattari's third ecology offer valuable lessons for promoting comprehensive well-being and establishing a more sustainable urban landscape. By recognising the impact of social and psychological factors on people and communities, Cape Town can adopt a compassionate and inclusive approach to urban planning and development. Acknowledging the adverse effects of consumerism and individualism, we should create spaces that encourage authentic self-expression and a sense of belonging.

Embracing the "ecosophy" concept, Cape Town can integrate ecological, social, and mental transformations, stressing the significance of reconnecting with nature and reshaping desires and values to align with environmental harmony. By prioritising the mental and emotional well-being of its residents and nurturing a stronger bond with the natural environment, Cape Town can strive to become a more resilient, vibrant, and socially conscious urban centre, setting an example for sustainable city living.

In summary, self-sufficient architecture embraces the principles of the three ecologies by prioritising environmental stewardship, social equity, and individual well-being. By integrating renewable energy systems, sustainable practices, and promoting community engagement, self-sufficient architecture can embody a holistic approach to the built environment that aligns with the broader vision of sustainable development and the interconnectedness of the ecologies presented in "The Three Ecologies."

Expanding on Guattari's idea in the third ecology which emphasises reconnecting with nature, the exploration of Louis Sullivan's theory on nature and architecture, I feel is relevant and captivating. Sullivan's architectural philosophy centres on the principle of "form follows function," stating that buildings should express their purpose and context while blending seamlessly with their natural surroundings. This aligns with Guattari's call for a deeper connection with the environment, as Sullivan recognised that buildings should evoke unity with the natural landscape, becoming a natural extension of it.

‘Nature and Design’

Louis Sullivan was a pioneering architect who lived from 1852 to 1924. He is renowned for his "form follows function" principle and innovative designs. His work remains relevant in today's world due to his visionary principles, which promote sustainable design, contextual sensitivity, and human-centred architecture. His ideas continue to guide modern architects as they seek to address contemporary challenges, create sustainable environments and a harmonious urban landscape.

“form follow function”

In the written work ‘ The Tall Office Building Artistically Considered’, Sullivan proposes that architecture should draw its primary inspiration from nature, which exemplifies flawless form and function. Through his architectural designs, Sullivan frequently intertwined nature with technology, resulting in distinctive American structures. His profound influence extended to Frank Lloyd Wright.

Nature possesses intertwined qualities of perfect form and function. Sullivan highlights the significance of nature in his 1896 essay, "The Tall Office Building Artistically Considered," where he underscores the perpetual, faultless, and uninterrupted life cycle inherent in nature. Nature's form perfectly fits its needs, and it follows that form should follow function. If there is no change in form, then there should be no change in function.

Sullivan argued that humans are part of nature and must adhere to its laws. This adherence leads to true art and architectural perfection. Self-sufficiency in architecture, which emphasises a building's ability to generate its own energy and resources, aligns with Sullivan's nature-inspired architecture. By designing buildings that utilise natural resources and follow natural principles, architects can create self-sufficient structures that harmonise with the environment. Building form should align with its function, just as nature's form follows its function.

The principle of form following function is relevant to self-sufficient architecture, where buildings are designed to efficiently meet specific needs. This involves creating adaptable and flexible spaces. Sullivan's emphasis on respecting nature's laws aligns with self-sufficiency architecture, prioritising sustainability. Incorporating self-sufficient features in architecture minimises environmental impact and promotes a sustainable society.

Integrating Sullivan's architectural principles into self-sufficient architecture paves the way for functional, sustainable, and visually appealing buildings that blend with the natural environment. Embracing his ideas, architects can design structures that not only meet the practical requirements of their inhabitants but also respect and enhance the surrounding ecosystem. By adhering to the principle of "form follows function," we as architects can ensure that the buildings, we create are not only aesthetically pleasing but also optimised for efficient resource use, aligning with the objectives of self-sufficiency architecture.

Considering the City of Cape Town's Tall Building Policy, architects can design tall buildings that fit harmoniously within the urban landscape. This includes preserving view corridors and ensuring their contribution to the city's character and heritage. This holistic approach towards architecture embodies a profound sense of ecological responsibility and seeks to foster a sustainable and symbiotic relationship between urban development and nature in the city.

Louis Sullivan's architectural principles, particularly his emphasis on the integration of nature and architecture, serve as a pivotal bridge to the philosophy of ecological urbanism. Sullivan's vision of buildings as extensions of the natural landscape aligns with the core tenets of ecological urbanism, which seeks to create cities that function as dynamic and interconnected ecosystems.

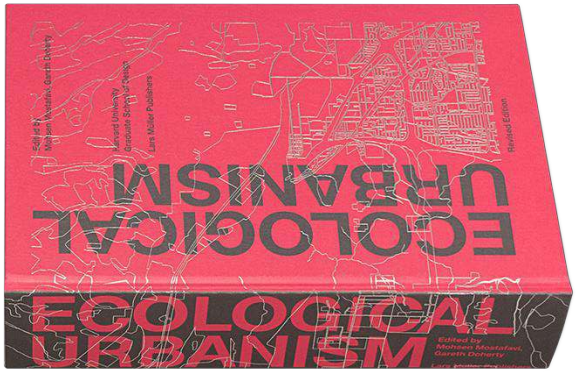
Drawing inspiration from Sullivan's "form follows function" approach, the following theory I delve into is Ecological Urbanism. It embraces the notion of designing urban environments that respond to their ecological context and promote sustainable, people-centred living.

By considering natural systems and resource efficiency, ecological urbanism aims to foster resilient cities that harmoniously coexist with nature while enhancing the well-being of their inhabitants. In this way, Sullivan's ideas act as a foundation for the evolution of urban planning and design philosophies, encouraging a more holistic, ecologically conscious and socially inclusive approach to shaping the cities of the future.

‘Ecological Urbanism’

In the context of Cape Town's future development, ecological urbanism offers a compelling and relevant approach. This theory prioritises ecological integrity, resource efficiency, and equitable urban planning to create a harmonious urban landscape that coexists with nature while fostering a thriving and sustainable city. I believe a further investigation into this theory can lead the city to embracing ecological urbanism. Cape Town can address urban challenges and envision a future that promotes well-being and resilience for its communities.

“ The urban, as the site of complex relations (economic, political, social, and cultural), requires an equally complex range of perspectives and responses that can address both current conditions and future possibilities. The aim of this book is to provide a framework that through the conjoining of ecology and urbanism can provide the knowledge, methods, and clues of what the urban can be in the years to come.” - (Mostafavi & Doherty, 2016)



Ecological urbanism is an approach to urban planning and design that seeks to create sustainable, resilient, and ecologically sensitive cities. It recognises the interconnectedness between human and natural systems and aims to integrate ecological principles into the design, development, and management of urban areas.

Regarding Mostafavi, he sees ecological urbanism as an essential approach to address the pressing challenges that cities face today. This is including environmental degradation, climate change, and social inequities. He emphasises the need to integrate ecological thinking into urban design and planning processes to create more sustainable and liveable cities. He believes that ecological urbanism offers a holistic framework that recognises the interdependencies between natural systems and human activities.

By integrating ecological principles and practices into urban development, Mostafavi argues that we can create cities that are not only environmentally responsible but also socially inclusive and culturally vibrant. Mostafavi also emphasises the importance of interdisciplinary collaboration and community engagement in the implementation of ecological urbanism. He advocates for the involvement of diverse stakeholders, including architects, planners, policymakers, scientists, and local communities, to develop innovative and contextually appropriate solutions.

This is an argument that I agree with due to self-sufficient urban architecture being a concept that aligns with the principles of ecological urbanism. It refers to the design and development of buildings and urban areas that can meet their own energy, water, and food needs, reducing their reliance on external resources and infrastructure.

In the context of ecological urbanism, self-sufficient urban architecture is seen as a means to promote sustainability and resource efficiency at the building and city scales. By incorporating renewable energy systems, water harvesting and recycling systems, and urban agriculture, self-sufficient urban architecture aims to minimise environmental impacts, enhance the resilience of urban areas and foster greater self-reliance.

A statement that I agree with is that there is a duty for architects to move from the word ‘sustain’ and to focus on the word ‘ability’. The notion of architecture being ‘Green and Sustainable’ is challenged by JDS architects due to its ambiguity. JDS architects argues that "Sustainability" has been standardised, commercialised, and certified. Prescribed checklists that pass for design principles. Instead of idealising sustainability we need to focus on tangible solutions that make real change in the lives of people in the communities we build.

Basic truths seem outdated and current solutions only work temporarily. Our generation of young architects must eagerly embrace fresh perspectives on sustainability, challenging conventional thinking, and creating innovative routes. To find new routes to a more ecological design, we must essentially integrate sustainable principles and combine historically validated methods with youthful innovation and enthusiastic invention. (Mostafavi & Doherty, 2016, pp122)

To move forward with self-sufficient urban architecture we must identify the tools of urban development. Gaining a deeper understanding of the spatial expression of ecological and social systems is crucial for integrating them into urban development practices. Currently, space plays a central role in supporting and guiding various social systems through elements like buildings and landscape planning. To accomplish this in an informed manner, contextual analysis is needed to comprehend the spatial logic of both social and ecological systems.

This contextual analysis is needed applies not only to urban design but also to other types of interventions such as urban planning or urban governance. These interventions can be viewed as different levels of directed actions aimed at the self-organising systems of the city, including social networks, economic markets, and ecosystems. (Barthel, 2013)

The focus of urban development is to utilises a system of nested tools at different levels. These tools, including urban governance, planning, and design, serve to guide self-organising systems towards political objectives. This framework helps identify knowledge gaps and underscores the role of urban design in shaping both social and ecological systems. By manipulating urban form, urban design can influence and manage multiple systems simultaneously. (Barthel, 2013) This cohesion of different systems can enhance the elements of self-sufficiency design in the urban context.

In conclusion, ecological urbanism emerges as a highly relevant and compelling approach for Cape Town's future development. By prioritising ecological integrity, resource efficiency, and equitable urban planning, the city can create a harmonious urban landscape that coexists with nature while fostering a thriving and sustainable environment for its communities. Mostafavi's advocacy for integrating ecological thinking into urban design and planning processes aligns with the principles of self-sufficient urban architecture.

To achieve this goal, it is imperative to understand the spatial expression of ecological and social systems for successful urban development practices. This allows for informed interventions and the manipulation of urban form to influence multiple systems simultaneously. By embracing ecological urbanism, Cape Town can pave the way for a more sustainable, inclusive, and resilient city for generations to come.

Technology

Urban Agriculture

The city centre of Cape Town holds a vast amount of potential to benefit from the integration of self-sufficient technologies. By embracing sustainable practices such as renewable energy and water harvesting, the CBD can reduce its ecological footprint. This will enhance resilience to climate change and foster a more vibrant and liveable urban environment. This section explores the advantages of self-sufficient technologies for future developments in Cape Town's CBD, that can pave the way for a greener and more sustainable urban centre.

I believe that there must be sufficient resources to feed an economy and its population, as well as sufficient environmental capacity to absorb any waste that results from that economy. There is an importance of addressing issues such as overconsumption, resource depletion, and environmental degradation. Society needs insights and strategies for achieving a more sustainable and balanced relationship with the Earth. (Wackernagel & Rees, 1996)

The implementation of Urban agriculture refers to the practice of cultivating, processing, and distributing food within urban areas. It involves growing crops, raising animals, and producing food products in or near cities. Urban agriculture can take various forms, ranging from small-scale backyard gardens and rooftop farms to community gardens, vertical farming systems, and aquaponics. (Urban Agriculture, 2020)

The primary objectives of urban agriculture include increasing access to fresh and nutritious food, promoting local food production, enhancing food security, and fostering community engagement. It often utilises innovative techniques and technologies to maximise limited urban spaces, such as vertical farming systems that stack plants in vertical towers or hydroponic systems that grow plants without soil. The aspect of urban agriculture I am particularly interested in is 'hydroponics

Hydroponics

The term "hydroponics" originates from the Greek words' "hydro" meaning water and "ponos" meaning labour. It was coined in 1929 by Dr Gericke, a California professor who transformed a laboratory technique into a commercially viable method of plant growth. During World War II, the U.S. Army utilised hydroponic culture to cultivate fresh food for troops stationed on infertile Pacific islands. By the 1950s, commercial hydroponic farms had emerged in various regions, including America, Europe, Africa, and Asia. (Singer, 2021)

he advantages of hydroponics include its applicability in regions where traditional inground agriculture or gardening is not feasible, such as arid deserts or cold climates. It offers greater control over nutrient content, pH levels, and the growing environment. I believe that the application of this in a location such as the Cape Town CBD would be immensely beneficial for the occupants.

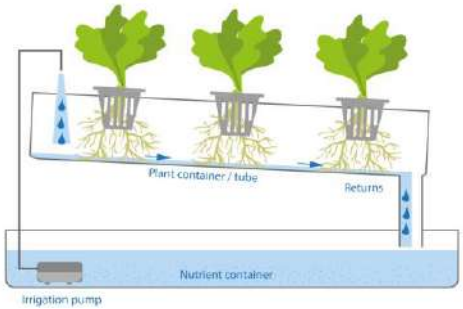
Hydroponics enables cost savings by recycling water and nutrients, promotes faster plant growth due to improved oxygen availability in the root area, and reduces issues related to soil-borne pests and diseases. It also leads to significantly higher crop yields, eliminates the need for weeding or cultivation, allows for convenient working conditions and lower labor costs with raised planting levels, eliminates the requirement for crop rotation or fallowing, and minimises transplant shock. (Dupuis, 2022)

On the other hand, there are a few disadvantages associated with hydroponics. It typically involves higher initial and operational costs compared to traditional soil-based cultivation. Adequate skill and knowledge are necessary to operate hydroponic systems effectively. Some diseases, such as Fusarium and Verticillium, can spread rapidly within a hydroponic system, although resistant varieties have been developed to combat these issues. (Stouvenakers, 2019)

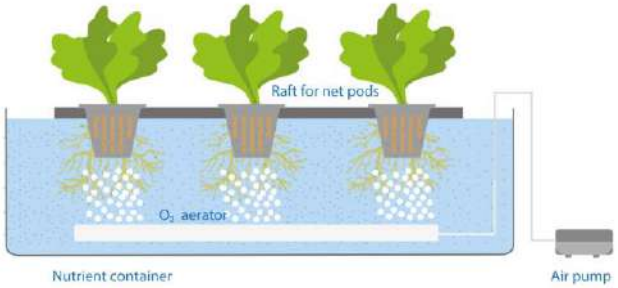
Hydroponic systems can be classified into two types: liquid systems and aggregate systems. Liquid systems do not utilise a supporting medium for the plant roots, while aggregate systems employ a solid medium for support. These systems can also be categorised as open or closed, depending on whether the nutrient solution is reused or not. (Dunn, 2013)

Hydroponic Systems:

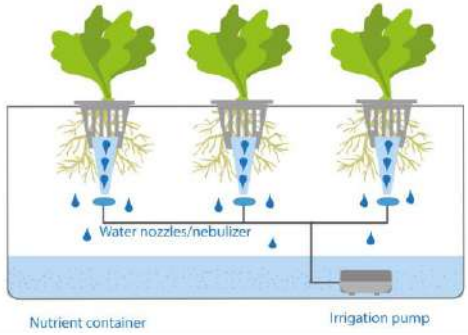
- Nutrient Film Technique (NFT): Plants are placed in a polyethylene tube with slits for root insertion, and a continuous flow of nutrient solution is pumped through the tube



- Floating Hydroponics: Plants are grown on a floating raft made of expanded plastic.

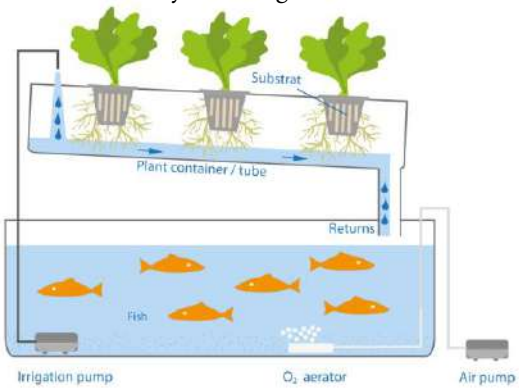


- Aeroponics: Plant roots are suspended in an enclosed growing chamber and are periodically misted with a nutrient solution.



IMAGES SOURCE: Various hydroponics systems, Hydroponic Urban Gardening. Available at: https://www.hydroponic-urban-gardening.com/rubriken/various-hydroponics-systems/.

- Aquaponics (Plant and Fish Farming) : Aquaponics combines aquaculture (fish farming) and hydroponics (plant breeding) into a single cultivation system. In this innovative method, fish excrements serve as a nutrient source for the plants, which are recycled and utilized as fertilizer. The conversion of these excretions into plant-friendly nutrients is facilitated by microorganisms.



Implementing hydroponic farming in the CBD of Cape Town holds numerous benefits that can positively impact the city and its residents. Hydroponic farming offers an efficient and sustainable solution to address the challenges of limited space and resources typically encountered in urban environments. By utilizing one of these farming techniques, hydroponics can maximize food production while minimizing the need for extensive agricultural space.

Hydroponic farming has the potential to create new job opportunities and stimulate economic growth in the CBD. Local farmers, agricultural experts, and technology specialists can collaborate to develop and manage these innovative farming systems, contributing to the city's economic diversity and growth.

Water Harvesting System

A water harvesting system refers to a set of techniques and infrastructure designed to collect and store rainwater or runoff for future use. It involves capturing rainfall from rooftops, land surfaces, or other surfaces, and directing it into storage tanks, underground reservoirs, or natural catchment areas. This harvested water can be used for various purposes such as irrigation, domestic use, and groundwater recharge. (Ogale, 2023)

Implementing a water harvesting system in self-sufficient developments brings numerous advantages. Here are a few reasons why it is highly recommended:

Water Conservation: By collecting rainwater, self-sufficient developments can decrease their dependence on external water sources like municipal supplies or wells. This promotes the preservation of water resources and fosters sustainable water management practices.

Increased Water Availability: Introducing a water harvesting system boosts the availability of water within the development. It serves as an additional water source during periods of dryness or droughts when traditional water supplies may be scarce.

Cost Savings: The collection of rainwater translates into significant cost savings by reducing the need for water purchases or costly infrastructure projects. It also lowers utility bills associated with water consumption.

Environmental Benefits: Water harvesting encourages sustainable practices by alleviating pressure on natural water sources and decreasing the energy required for water treatment and distribution. Additionally, it aids in mitigating urban flooding by capturing excessive rainwater.

Overall, the implementation of a water harvesting system in self-sufficient developments aligns with principles of sustainability, resource efficiency, and resilience. It contributes to a more sustainable approach to water management and supports the objective of achieving self-sufficiency in water supply.

IMAGE SOURCE: Rainwater harvesting system: Rainman (2023) Shay Murtagh Precast. Available at: https://www.shaymurtagh.co.uk/precast-concrete-products/rainman-rain-harvesting-system/.

The effectiveness of collecting rainwater and the quality of the collected water are influenced by the area that can effectively capture rain and the materials used for the collection surface.

Common materials used for roof catchment include corrugated aluminium, galvanised iron, concrete, fibreglass shingles, tiles, and slates. In rural areas, mud is often used, but bamboo roofs should be avoided due to potential health hazards. It's important that the materials used for catchment surfaces are non-toxic and do not contain substances that can harm the water quality

A rainwater harvesting system consists of different stages, including the transportation of rainwater through pipes or drains, filtration, and storage in tanks for future use or groundwater recharge.

The various components involved in these stages are described below. (Novak et al., 2014)

- Catchments: The catchment refers to the surface that directly receives rainfall. Rainwater harvesting can be implemented in various types of spaces, including both paved, such as building terraces or courtyards, and unpaved areas like lawns or open ground. A coarse mesh is placed on the roof to prevent debris from passing through

- Gutters: These are channels located along the edges of a sloping roof that collect and transport rainwater to the storage tank. The gutter size should be calculated to manage heavy rainfall effectively. It is crucial to provide sufficient support to prevent any sagging or detachment issues.

- Conduits: Conduits are pipelines or drains that carry rainwater from the catchment or rooftop area to the harvesting system. Common materials used for conduits include polyvinyl chloride or galvanised iron.

- First-flushing: It is valve used to prevent the entry of pollutants into the system. It guarantees that the runoff from the initial rainfall is cleared away and not channelled into the rainwater harvesting system.

- Filter: A filter is utilised to eliminate suspended pollutants from rainwater collected over the roof. The filter unit comprises a chamber filled with filtering media, like coarse sand, gravel layers, and fiber, which efficiently eliminate debris and impurities from the water before it enters the storage tank or recharge structure.

- Storage facility: When implementing a rainwater harvesting system, the storage facility plays a crucial role in preserving the collected water. The rainwater tanks can be installed above the ground, partially buried, or completely underground. It is crucial to conduct regular maintenance, which involves cleaning and disinfecting, to ensure their proper functioning

Diagram of the rainwater harvesting (RWH) system

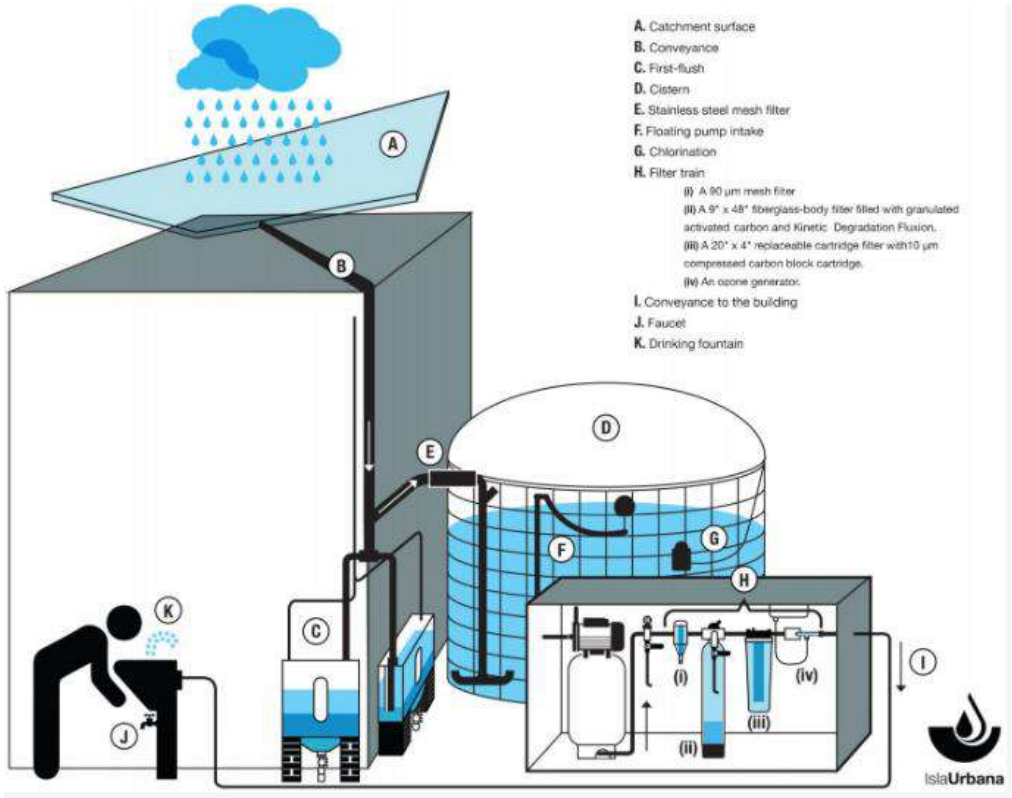


IMAGE SOURCE: Gispert, M.Í. et al. (2018) Rainwater harvesting as a drinking water option for Mexico City, MDPI. Available at: https://www.mdpi.com/2071-1050/10/11/3890.

Implementing a water harvesting system in a new development in Cape Town can bring numerous benefits, especially considering the city's ongoing water challenges. The city has experienced water scarcity issues in recent years, with periods of severe drought. By incorporating such system, the development can become more self-sufficient in water supply, reducing its dependence on external sources during dry spells.

The development can raise awareness about the importance of water conservation among residents, promoting responsible water use behaviours within the CBD area. It not only benefits the development itself but also contributes positively to the city's overall water conservation efforts.

IMAGE SOURCE: State of Western Cape Water Report to be launched This Week (no date) Western Cape Government. Available at: https://www.westerncape.gov.za/news/state-western-cape-water-report-be-launched-week. .

Solar Energy system

South Africa's abundant sunlight creates a favourable environment for the efficient production of solar energy. The country experiences high levels of solar irradiation, making it an ideal location for solar panels to generate electricity effectively, even on cloudy days the effectiveness is barely reduced. Solar energy systems offer long-term cost savings by utilising the free and abundant sunlight, and excess energy can be sold back to the grid. (Igini, 2023)

Loadshedding is a widespread problem in South Africa, including Cape Town. It occurs when the national power grid struggles to meet the demand for electricity. This has severe implications for businesses, industries and households. It disrupts daily activities, affects productivity, and is leading to economic losses. This is a direct cause for the rise of the solar energy industry throughout the country. (Engel, 2023)

Solar energy systems harness the power of the sun to generate electricity or heat, offering a sustainable and renewable energy source. With advancements in technology and decreasing costs, solar energy has become increasingly accessible and practical for various applications. Implementing solar energy systems in self-sufficient developments brings numerous benefits, aligning with principles of sustainability and energy independence.

The use of solar panels, also known as photovoltaic panels, convert sunlight into usable electrical energy. They are made up of solar cells, typically composed of silicon, which generate electricity through the photovoltaic effect. When sunlight hits a solar panel, it contains packets of energy called photons. These photons interact with the silicon atoms in the solar cells, causing electrons to become excited and break free from their atomic bonds. (Dhar & Harvey, 2022)

How solar panels (Photovoltaics) work:

- Sunlight hits the solar panels, which are made up of solar cells.
- Solar cells are made from semiconductor materials like silicon.
- When sunlight is absorbed by the solar cells, it generates electric current by creating electron-hole pairs.
- An electric field in the solar cells separates the electrons and holes, preventing them from recombining immediately.
- The separated electrons are directed towards one side of the solar cell, while the positively charged holes are directed to the other side.
- Metal conductive plates collect the electrons and transfer them through external electrical conductors, creating a flow of electricity.
- The generated electricity can be used immediately to power devices or stored in batteries for later use when the sun is not shining.

Photovoltaics System Illustration

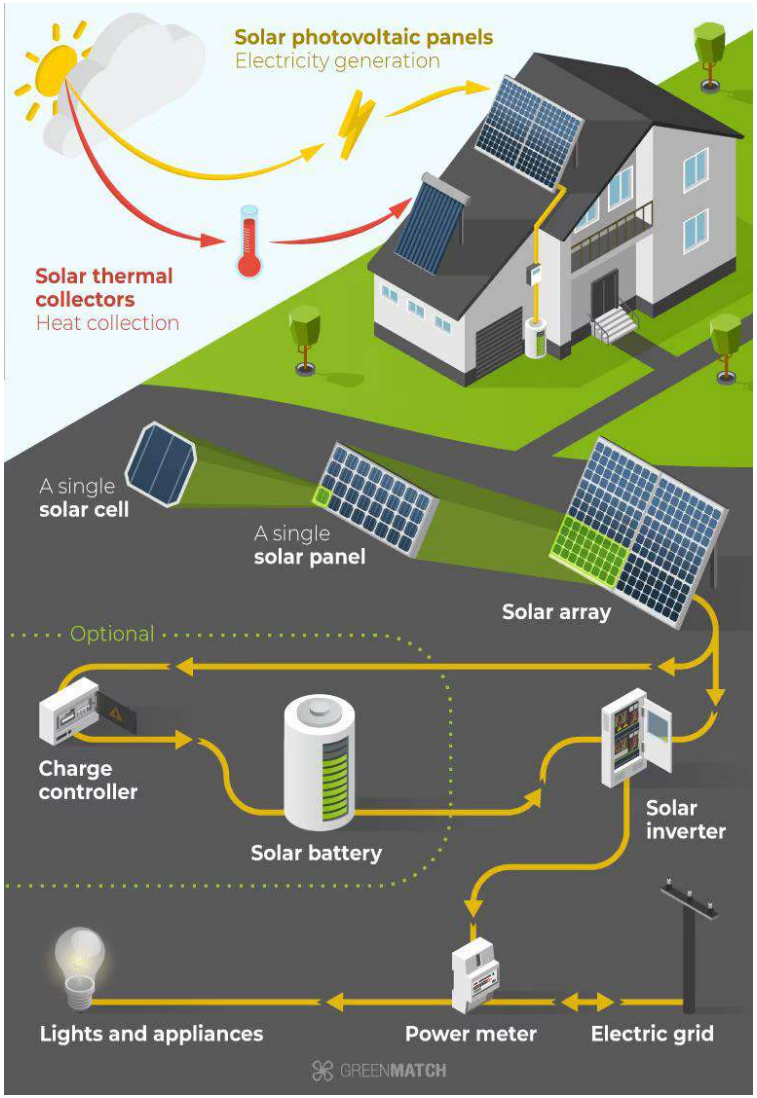


IMAGE SOURCE: Solar panels for your home: A complete guide (2023) (2023) GreenMatch.co.uk. Available at: https://www.greenmatch.co.uk/solar-energy/solar-panels#how-do-solar-panels-work.

In conclusion, adopting solar energy in Cape Town fosters self-sufficiency by utilizing the abundant sunlight to generate clean and reliable electricity. We need this sustainable solution more than ever due to the challenges of loadshedding faced by the country. Solar power reduces dependence on external sources, enhances energy security, and aligns with the city's commitment to environmental conservation.

Solar energy empowers individuals and communities to actively contribute to the energy supply or lighten the load on the national electric grid. Furthermore, with the rise in the solar energy industry, it is stimulating economic growth and job creation. Embracing solar power showcases Cape Town's dedication to sustainability and sets an example for others to follow in the pursuit of renewable energy solutions.

IMAGE SOURCE: Reporter, S. (2022) 41 Western Cape Schools to introduce solar power, Independent Online. Available at: https://www.iol.co.za/capetimes/news/41-western-cape-schools-to-introduce-solar-power-fbedd63d-0d54-4aed-b7de-7657d1142d18.

Case Studies

BedZED (The Beddington Zero Energy Development)

Location : London, United Kingdom

Architects : Bill Dunster Architects

Year : 2002

Sources : Schoon, N. (2016) BedZED, zedfactory. Available at: https://www.zedfactory.com/bedzed.

BedZED is located in south London and it holds a significant place in history as the UK's critically acclaimed large-scale, mixed-use sustainable community. Since its completion in 2002, it has served as a global model for eco-friendly housing developments. While some of its green technologies have presented implementation challenges, much of BedZED has endured the test of time.

BedZED has demonstrated that embracing sustainability on a large scale does not necessarily mean sacrificing comfort or convenience. The community's car-free streets provide a safe and enjoyable environment for children to play. The residents benefit from notably lower heating, power, and electricity costs compared to traditional housing. Furthermore, when BedZED homes become available for sale, they often command prices surpassing the local average, attesting to its desirability.

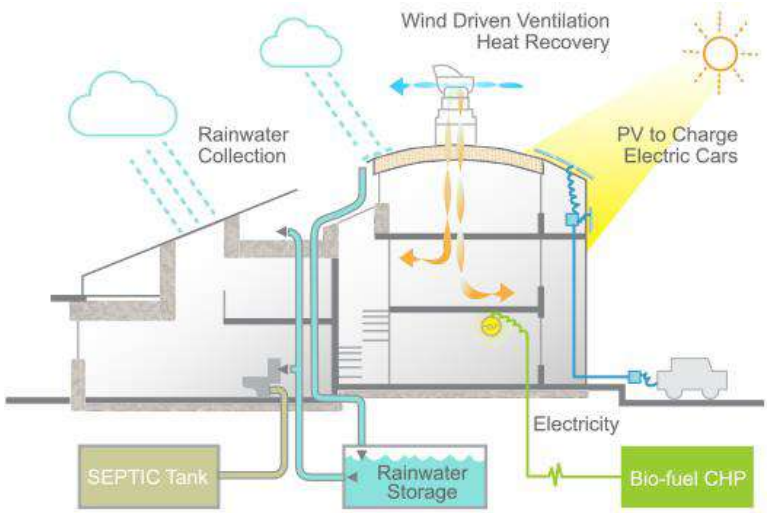
BedZED stands as a testament to the possibility of creating sustainable communities that are both environmentally conscious and economically viable. It exemplifies that sustainable living can be attractive, practical, and financially advantageous. As an influential pioneer, BedZED continues to inspire future sustainable housing projects across the globe.

BedZED was envisioned as a fossil-fuel-free community, aiming to greatly minimise carbon dioxide emissions and ensure energy self-sufficiency for its residents. This ambitious goal was pursued through several key strategies, including:

• Implementation of a wood-burning combined heat and power plant (CHP): BedZED employed a CHP system that utilised wood as a fuel source. This innovative approach allowed the generation of both electricity and heat for the entire site, reducing reliance on traditional fossil fuels.

• Integration of photovoltaic panels: A significant area of 777 square meters was dedicated to the installation of photovoltaic panels. These panels harnessed the power of sunlight to generate electricity, further decreasing the community's dependence on conventional energy sources.

• Emphasis on insulation, airtightness, and thermal mass: BedZED incorporated high levels of insulation, airtight construction, and thermal mass properties. These features enhanced the building's energy efficiency by minimising heat loss and maximising the utilisation of solar heat for space heating.



BedZED implemented a ventilation system with rooftop wind cowls to maintain high levels of airtightness while providing fresh air to the homes and workplaces. The wind cowls capture incoming fresh air, distribute it through vents, and expel stale air through a heat exchanger. This system ensures well-ventilated spaces without the need for electric fans and allows for natural ventilation through strategically placed windows.

Much like Cape Town, BedZED is in a region that experiences significant water stress, as identified by England's Environment Agency. To address this issue, the sustainable community was meticulously planned to minimise water consumption compared to conventional housing developments.

It achieves this minimising through water recycling practices, efficient water management, and measures to reduce excessive water runoff into the sewage system during periods of heavy rainfall. By implementing these strategies, BedZED aims to safeguard water resources and contribute to sustainable water management in the area. This is an initiative we can use in new developments our own city. Similar recycling practices are needed in Cape Town due to the recurring water shortages we experience.

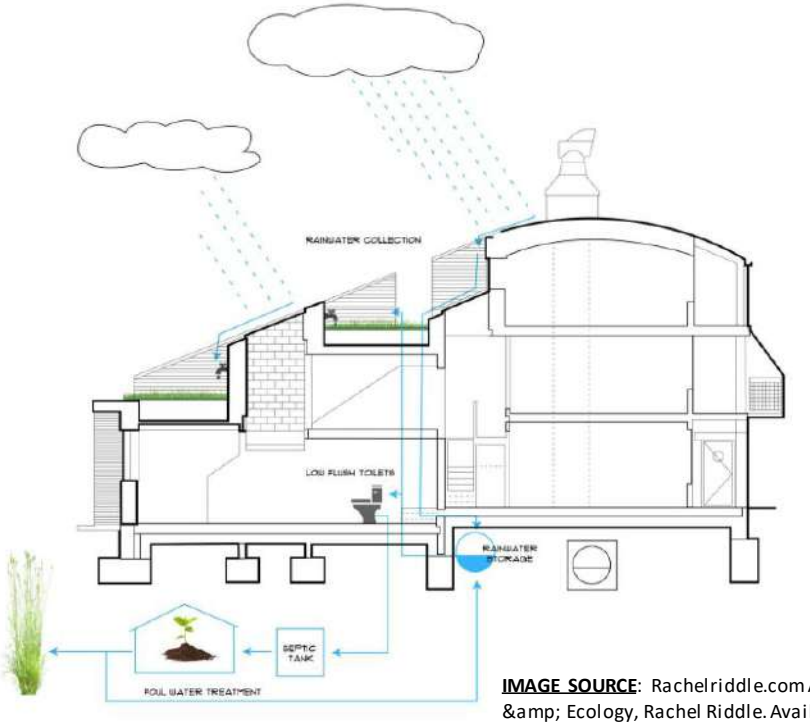
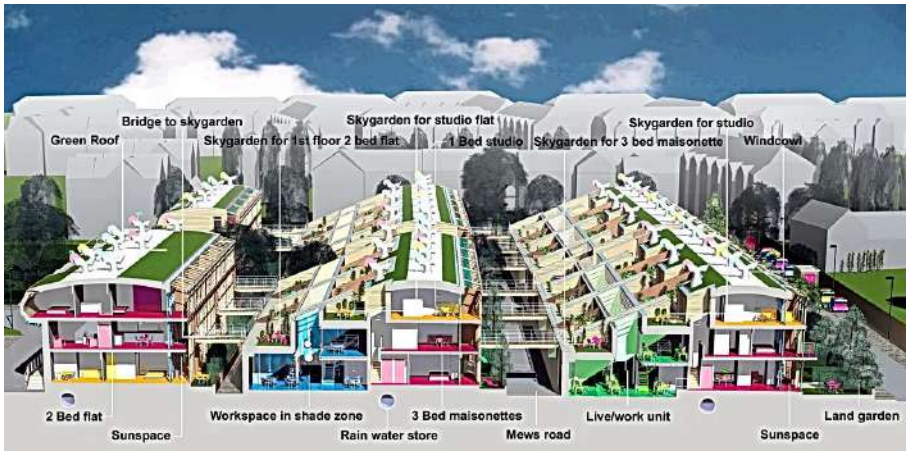


IMAGE SOURCE: Rachelriddle.com Architecture & Ecology, Rachel Riddle. Available at: https://www.rachelriddle.com/architectureecology. .

In conclusion, BedZED stands out for its strong emphasis on sustainability and environmental awareness while fostering a self-reliant urban community. It offers appealing and comfortable homes with reduced energy and water expenses, encouraging a sustainable lifestyle and ensuring residents' well-being and contentment. This aspect of BedZED inspires me in my quest to learn more about self-sufficient urban architecture.

The emphasis on community, demonstrated through shared spaces like the Pavilion and communal green areas, fosters a sense of belonging and connection among the residents. This integrated approach to sustainable living, combined with the promotion of community engagement, exemplifies how BedZED contributes to self-sufficiency in urban areas. By incorporating elements of energy efficiency, water conservation, and social cohesion, BedZED serves as a model for sustainable developments, inspiring and encouraging similar initiatives in other urban communities.



One Central Park

Location : Sydney, Australia

Architects : Ateliers Jean Nouvel and Foster and Partners

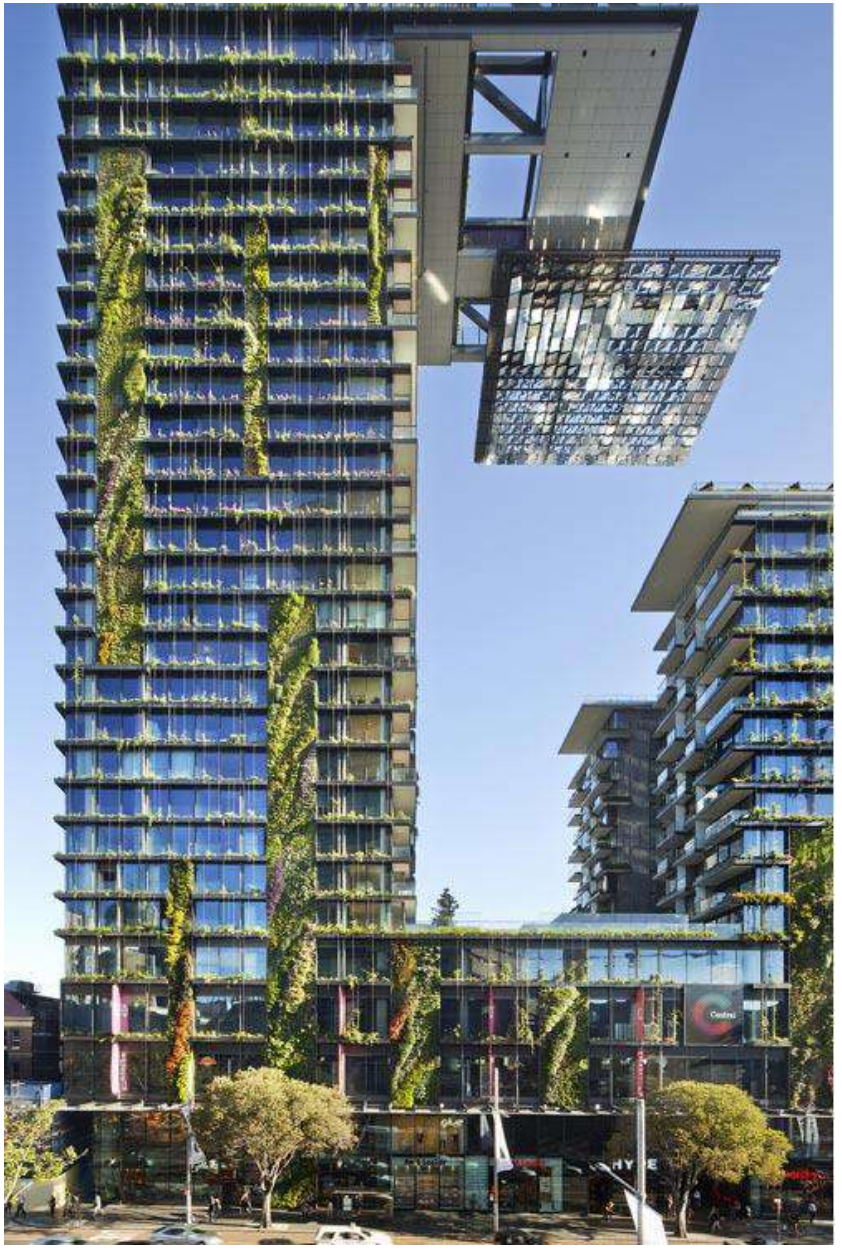
Year : 2014

Sources : urbanNext, 2017 One Central Park.<https://urbannext.net/one-central-park/>

One Central Park emerged as a direct response to the increasing need for housing in central Sydney. The developers and designers took the opportunity to create a tall building that not only addresses the demand but also makes a significant ecological impact. This project defies the traditional Modernist approach by incorporating a green facade that purifies the air, offers shade, and represents a harmonious integration with the urban environment.

One Central Park utilises advanced technology to efficiently harness sunlight and direct it to the areas where it is most required. Through its innovative design, One Central Park showcases a harmonious blend of nature and technology, making a bold statement about sustainability and urban vitality.

The collaborative efforts of Ateliers Jean Nouvel and Foster and Partners resulted in the master plan for Central Park, which was further refined by the design team to enhance public open spaces and pedestrian connectivity. It embraces eco-friendly initiatives such as green roofs, material recycling, adaptive reuse of structures, water harvesting, and sustainable transportation options. The initial vision aimed to seamlessly integrate the lively and diverse ambiance of the neighbouring Chippendale area into Central Park.



One Central Park utilises the innovation of 'living architecture' by its inclusion of vertical gardens consisting of walls and horizontal planter boxes supported by steel cables. The green facades are on the two towers located at Central Park. These living installations provide a unique opportunity for vegetation to flourish both upwards and downwards along the building structure.

The irrigation systems for each horizontal and vertical planter are individually sustained by the on-site water treatment facility, which recycles water. This system utilises treated wastewater, local rainwater, stormwater runoff, and groundwater to supply water suitable for its intended purpose. Additionally, the system continually monitors the surrounding environmental conditions.

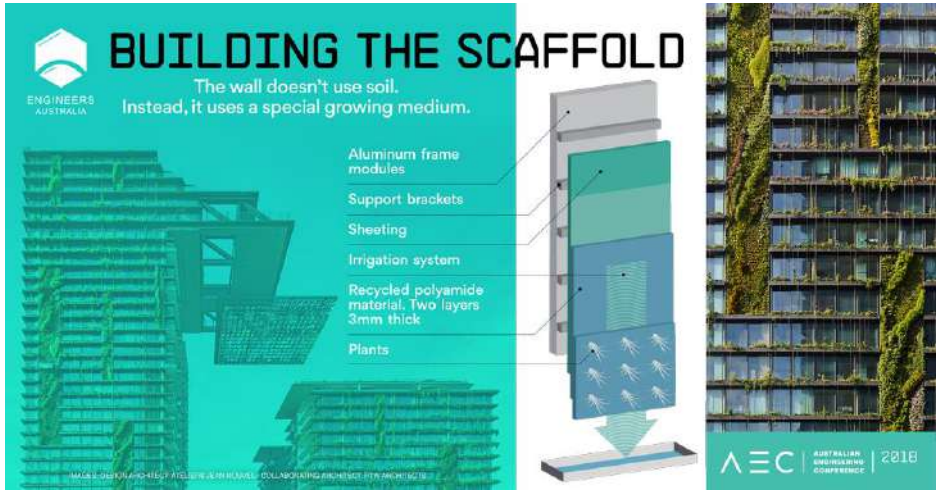
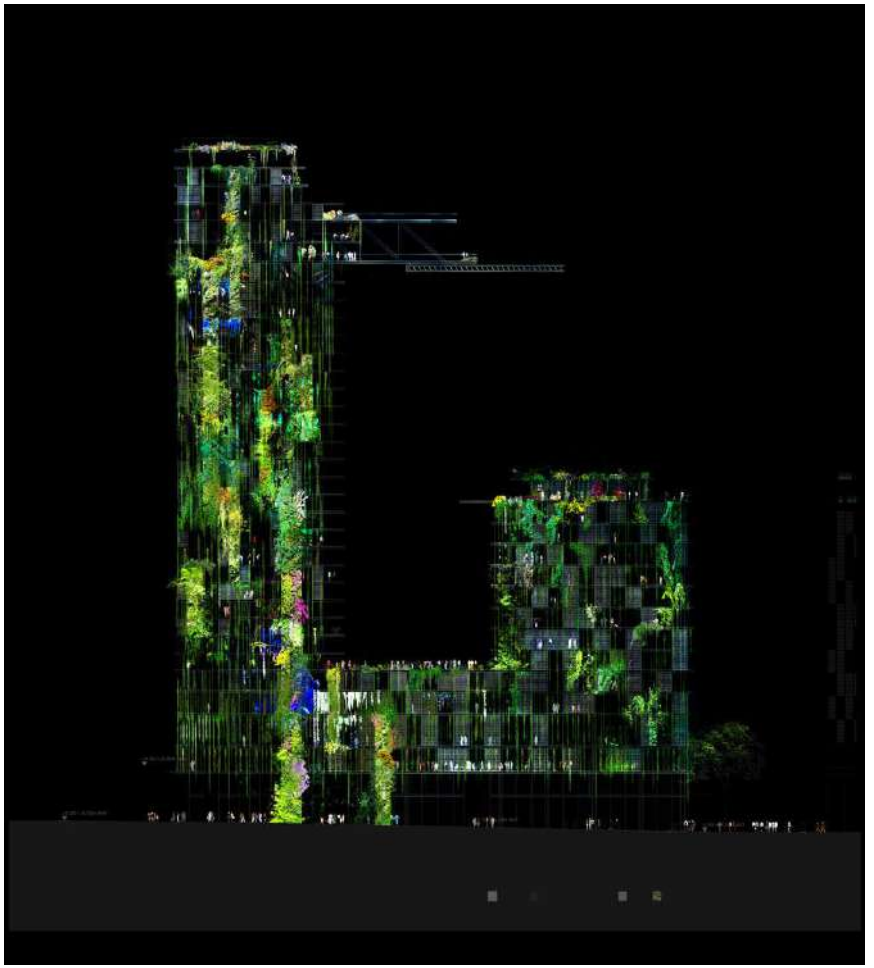
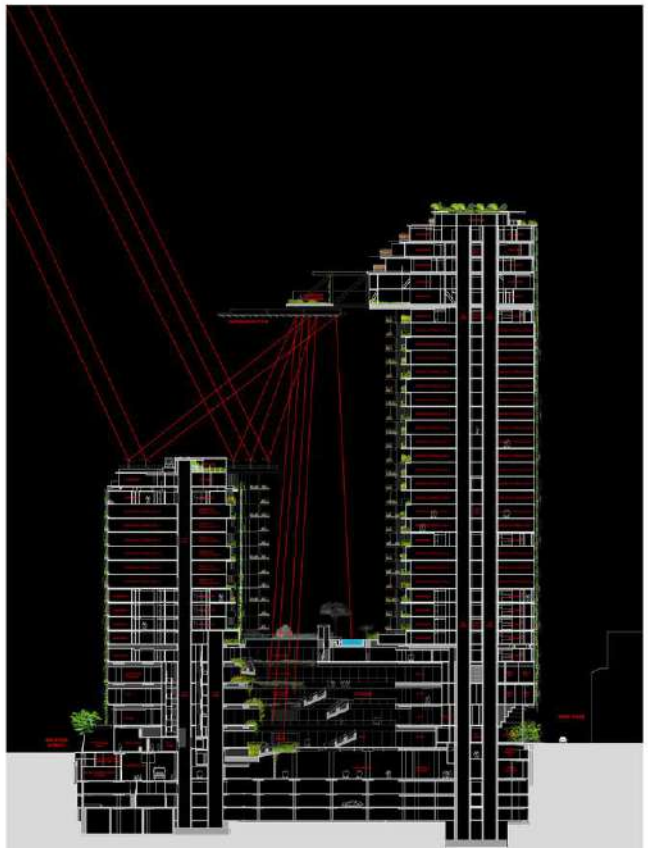


IMAGE SOURCE: Brown, R. (2019) One Central Park: Anatomy of an award-winning Green Infrastructure Project, Create. Available at: https://createdigital.org.au/one-central-park-anatomy-of-an-award-winning-green-infrastructure-project/.

One Central Park utilises solar energy as an integral part of its sustainable design. The building features several solar panels strategically placed on its rooftops and facades to harness the power of the sun. These solar panels are designed to capture sunlight and convert it into usable electricity, helping to reduce the building's reliance on conventional energy sources.

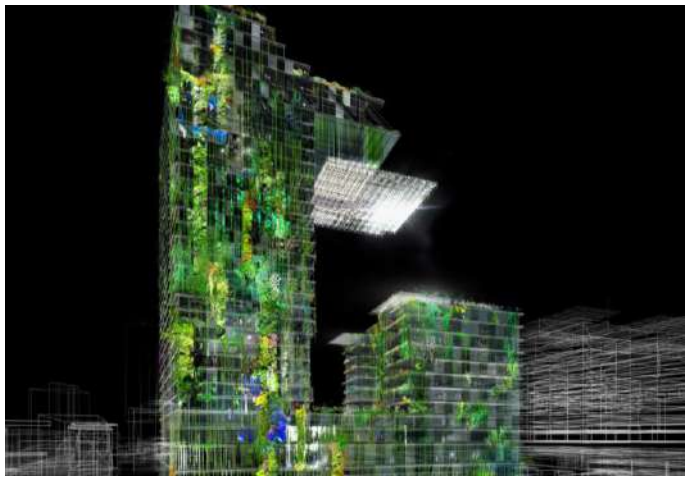


The design of One Central Park addresses specific challenges related to the tall buildings on the north side of the site, such as the issue of shadowing and lack of natural light within the podium block. To overcome these challenges, the building's massing is divided into a shorter tower and a taller tower on a five-story podium. On the roof of the lower tower, there are 40 sun-tracking heliostats that redirect sunlight to 320 reflectors positioned on a cantilever extending from the taller tower. These reflectors then direct the sunlight into an atrium, pool deck, and other shaded areas.



The red lines represent the sun rays being reflected by the mirrors (heliostats); this allows natural sunlight to be redirected into the courtyard below.

By utilising the heliostats, the atrium can receive natural light throughout the year, even in areas that would typically have limited direct sunlight. The heliostats are equipped with motion controls that are programmed to adjust hourly and seasonally, ensuring the optimal amount of brightness and warmth in each specific location. This allows the dappled lights to create a dynamic and useful lighting choreography across the site, enhancing the overall lighting conditions and experience.



In conclusion, Cape Town's architectural projects can learn significant insights from the pioneering and renowned One Central Park building. The incorporation of sustainable design, vertical gardens, and energy-efficient technologies demonstrated by One Central Park stands as an inspirational model for harmonizing urban architecture with nature and addressing environmental issues to follow in the pursuit of renewable energy solutions.

By incorporating similar features and principles into future projects, Cape Town can create developments that prioritize sustainability, enhance green spaces, and promote energy efficiency. Learning from One Central Park can pave the way for a more eco-conscious and visually stunning urban landscape in Cape Town, benefiting both its residents and the environment.

Pixel

Location : London, United Kingdom

Architects : Melbourne, Australia

Year : 2010

Sources : King, V. (2011) Pixel / studio505, ArchDaily. Available at: https://www.archdaily.com/190779/pixel-studio505.

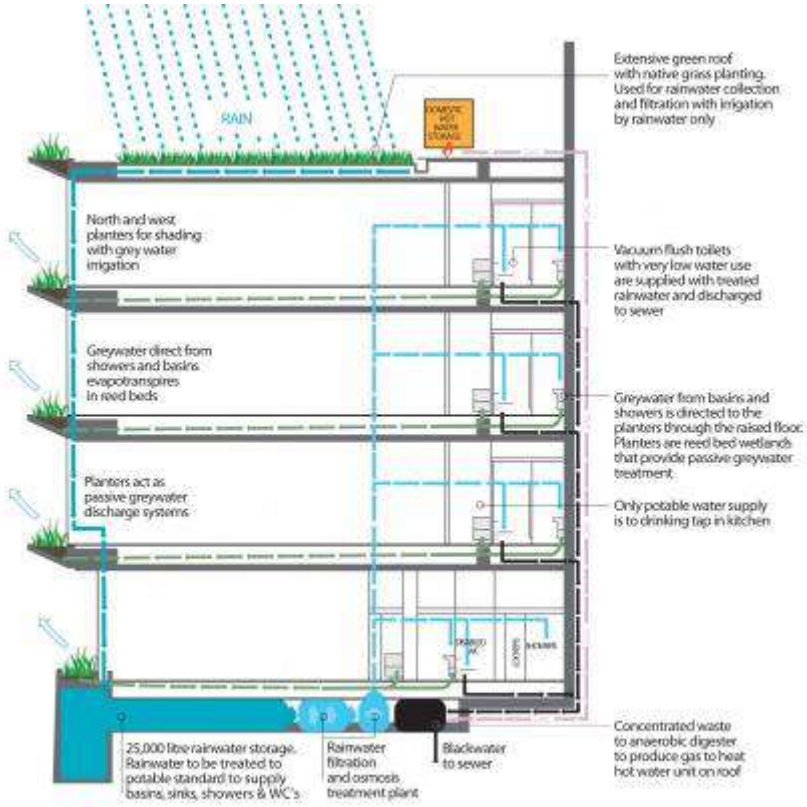
The Pixel building, located in Australia, is an iconic and pioneering example of sustainable architecture and green design. Situated in the heart of Melbourne, this distinctive structure has gained international recognition for its innovative approach to energy efficiency, renewable technologies, and sustainable living. The Pixel building serves as a testament to the possibilities of creating environmentally responsible and visually stunning developments in urban areas.

Designed by Studio 505 and completed in 2010, the Pixel building stands as a showcase of sustainable principles and practices. It embodies a holistic approach to sustainability, incorporating a wide range of innovative features and technologies. From its unique exterior design to its advanced energy systems, the Pixel building sets a new standard for environmentally conscious construction.

One of the standout features of the Pixel building is its striking façade, which is adorned with an array of coloured panels. These panels not only add a visually captivating element to the building's aesthetics but also serve a functional purpose. They are embedded with solar photovoltaic cells that harness sunlight to generate clean and renewable energy. This integration of solar power showcases the building's commitment to reducing reliance on fossil fuels and minimising its carbon footprint.

The Pixel building showcases an exceptionally advanced water treatment and usage system, representing a remarkable achievement in sustainable design. Its design aims to achieve water balance, ensuring self-sufficiency in water supply.

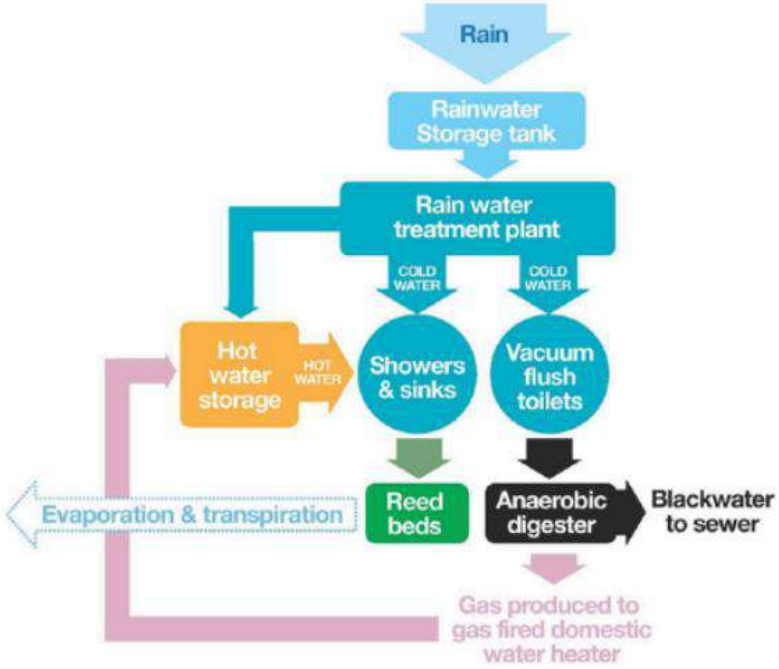
The building incorporates various water collection methods, such as an extensive green roof that captures rainwater, as well as perimeter planters and balconies. To achieve water demand reduction, various measures are implemented, including the incorporation of specially designed vacuum toilets that significantly minimise water consumption. The illustration below describes how this system operates.



Reuse is implemented through multiple strategies at Pixel. Rainwater that falls on the building is collected and utilised for irrigation purposes in the roof garden, supporting the growth of native Victorian grassland species. The rainwater is stored in tanks and undergoes treatment through reverse osmosis, ensuring it meets the standards for potable water.

This treated water is then distributed to all fixtures and fittings within the building. The resulting grey wastewater is carefully filtered and directed to living edge reed beds, where it is utilised for irrigation of reeds and plants.

As a result of this process, the amount of grey water waste discharged from the Pixel site is significantly minimised throughout the year, apart from the wettest month in Melbourne. This reduction in waste flow to the sewer system is a notable achievement of the building's water management system.



The Pixel building serves as an exemplary case study for self-sufficient urban architecture due to its carbon-neutral design and highly efficient water management system. By achieving a balance between water supply and demand through innovative practices such as rainwater collection, treatment, and reuse, the building demonstrates the potential for sustainable water utilisation in urban areas.

Additionally, the incorporation of vacuum toilets and other demand reduction measures showcases effective strategies for minimising water consumption. The building's commitment to reusing water at multiple levels further highlights its dedication to resource conservation and environmental awareness. As a carbon neutral and water efficient structure, the Pixel building provides valuable insights and inspiration for future urban architectural designs seeking self-sufficiency, sustainability, and a reduced ecological footprint

In conclusion, the Pixel Building serves as a remarkable example of sustainable architecture, particularly in its water recycling initiatives. As Cape Town faces ongoing water challenges, developments in the city can find inspiration from the Pixel Building's innovative approach to water conservation and reuse.

By incorporating similar water recycling systems and embracing other sustainability attributes demonstrated by the Pixel Building, Cape Town developments can contribute significantly to water resilience and environmental preservation. Taking inspiration from this structure can lead to the creation of more eco-friendly, self-sufficient, and water-conscious urban projects, ensuring a greener and more sustainable future for the city.

Conclusion

The exploration of various topics, including self-sufficient architecture, Guattari's three ecologies, Louis Sullivan's architectural principles, and the relevance of ecological urbanism in the context of Cape Town's future development, has illuminated valuable lessons for shaping a sustainable and resilient urban landscape.

The concept of self-sufficient urban architecture has showcased the potential to create functional and eco-friendly buildings that harmonise with the natural environment while reducing resource consumption and promoting ecological responsibility. Louis Sullivan's emphasis on "form follows function" highlights the importance of purpose-driven design and integration with the surrounding environment. His principles serve as a bridge to the philosophy of ecological urbanism, which advocates for sustainable, contextually sensitive, and people-centred urban development.

In the context of Cape Town's future development, ecological urbanism emerges as a compelling approach to address urban challenges and envision a city that prioritises ecological integrity, resource efficiency, and well-being for its communities. Considering the significance of urban agriculture, hydroponics, water harvesting, and solar energy, we recognise the potential for self-sustainable practices to transform Cape Town's CBD. By embracing these technologies, the city can reduce its ecological footprint, enhance resilience to environmental pressures, and create a more vibrant and liveable urban environment.

Overall, the lessons learned from these discussions emphasise the importance of integrating sustainable practices, ecological thinking, and community engagement in urban planning and development. By applying these insights, Cape Town can embark on a transformative journey towards a greener, more inclusive, and prosperous city that embodies the values of sustainability, resilience, and harmonious coexistence with nature.

The next step in this project will be the selection of a suitable site. This is a critical aspect when undertaking self-sufficient urban architecture. In my pursuit of exploring sustainable and innovative design solutions within an urban context, I set out to find an ideal location that would offer unique opportunities and challenges. With a focus on urban centres and their potential for self-sufficiency, I directed my attention to the CBD of Cape Tow

Design Development

Basis

This project is my attempt to use architecture to empower local people to be more self-sufficient and self-reliant when it comes to their basic needs in an urban context.

I believe it's crucial to recognize the ongoing challenges we face with inadequate basic services in our country, including an unstable electrical grid, water shortages, and food scarcity.

As we confront these issues, architects play a pivotal role in seeking innovative design solutions to reduce our reliance on government and large corporations. Drawing inspiration from my grandmother's self-sustainable farm in the Eastern Cape, I think we should consider transitioning towards self-sufficiency living in future urban developments.

By combining theories surrounding Resources, Urban Planning & Ecology, we can reach a cohesive urban development and urban ecology. That in turn can lead to an urban architecture that is more biophilic and natural light orientated. This urban ecology can lessen the burdens caused by social and institutional relations.

'Felix Guattari' & 'Mohsen Mostafavi, Gareth Doherty'

Preface

This Project investigates and incorporates the design principles and practices of off-the-grid, self-sufficient architecture.

The aspects that I wanted incorporate are in the collage on the right.

WATER CONSERVATION & RECYCLING
RENEWABLE ENERGY
AFFORABLE HOUSING
SELF SUSTAINING ARCHITECTURE
URBAN AGRICULTURE

The Main Focus was to Design a building that use water-efficient fixtures, such as low-flow faucets and toilets, and incorporate rainwater harvesting and greywater recycling systems, reducing our reliance on municipal water sources.

Incorporating urban agriculture into the designs, creating community gardens and green spaces and designing buildings with space for rooftop gardens and hydroponic farms.

Design buildings that use renewable energy sources, such as solar power and reduce the energy consumption through energy-efficient appliances and insulation.

Client

FUTURE FARMS SOUTH AFRICA

- Focuses on the design, provision and management of all controlled agriculture, including agricultural tunnels and greenhouses, both indoor and outdoor hydroponic systems and modern irrigation methods.

- Range is from rooftops, open fields or warehouses

- Hydroponic School： two main courses:

An Introductory course called" Hydroponics: A Broad Overview"

A business course called "Step by Step Guide to Make Money From Hydroponics".

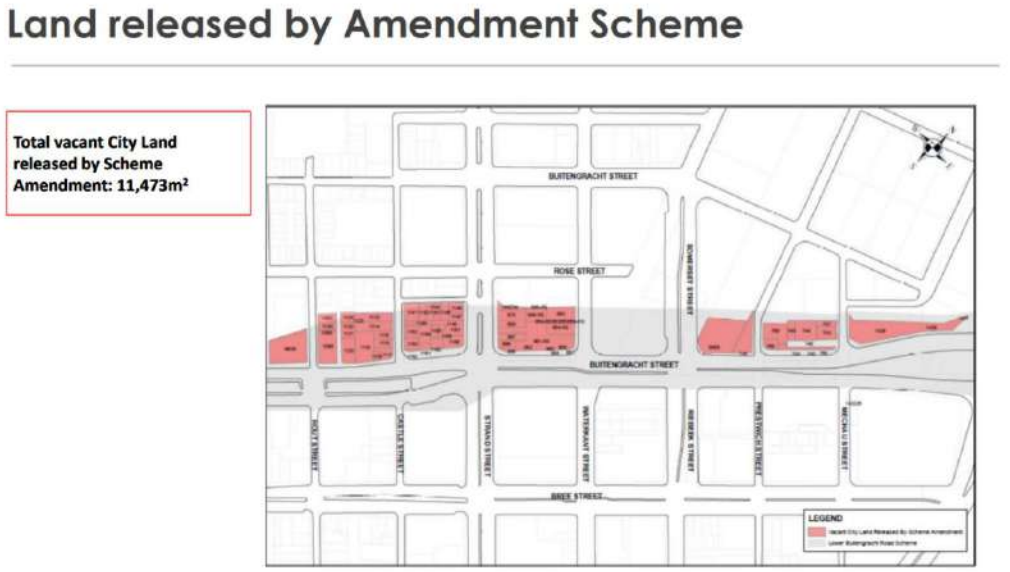
Context

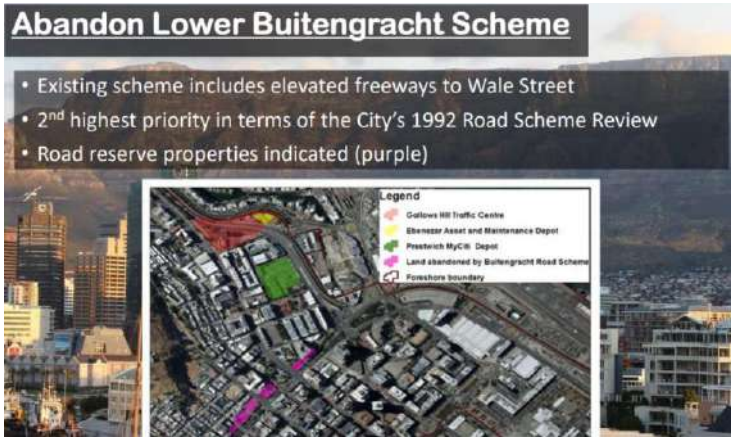
In my pursuit of exploring sustainable and innovative design solutions within an urban context, I set out to find an ideal location that would offer unique opportunities and challenges. With a focus on urban centres and their potential for self-sufficiency, I directed my attention to the (CBD) of Cape Town.

The CBD, with its mix of commercial, residential, and cultural activities, serves as a microcosm of urban life, making it an ideal setting to explore the integration of sustainable practices.

During my research, I came across the City of Cape Town Amendment Scheme. This scheme outlined the city's intention to release Multiple sites along Buitengracht Street, a prominent highway extension within the heart of the CBD. This discovery sparked my interest as it presented a promising opportunity to investigate and propose self-sufficient urban architectural solutions within a bustling urban environment.

The city suggests that the ideal uses cases for the sites are to unlock economic potential, to reduce congestion and to add affordable housing.



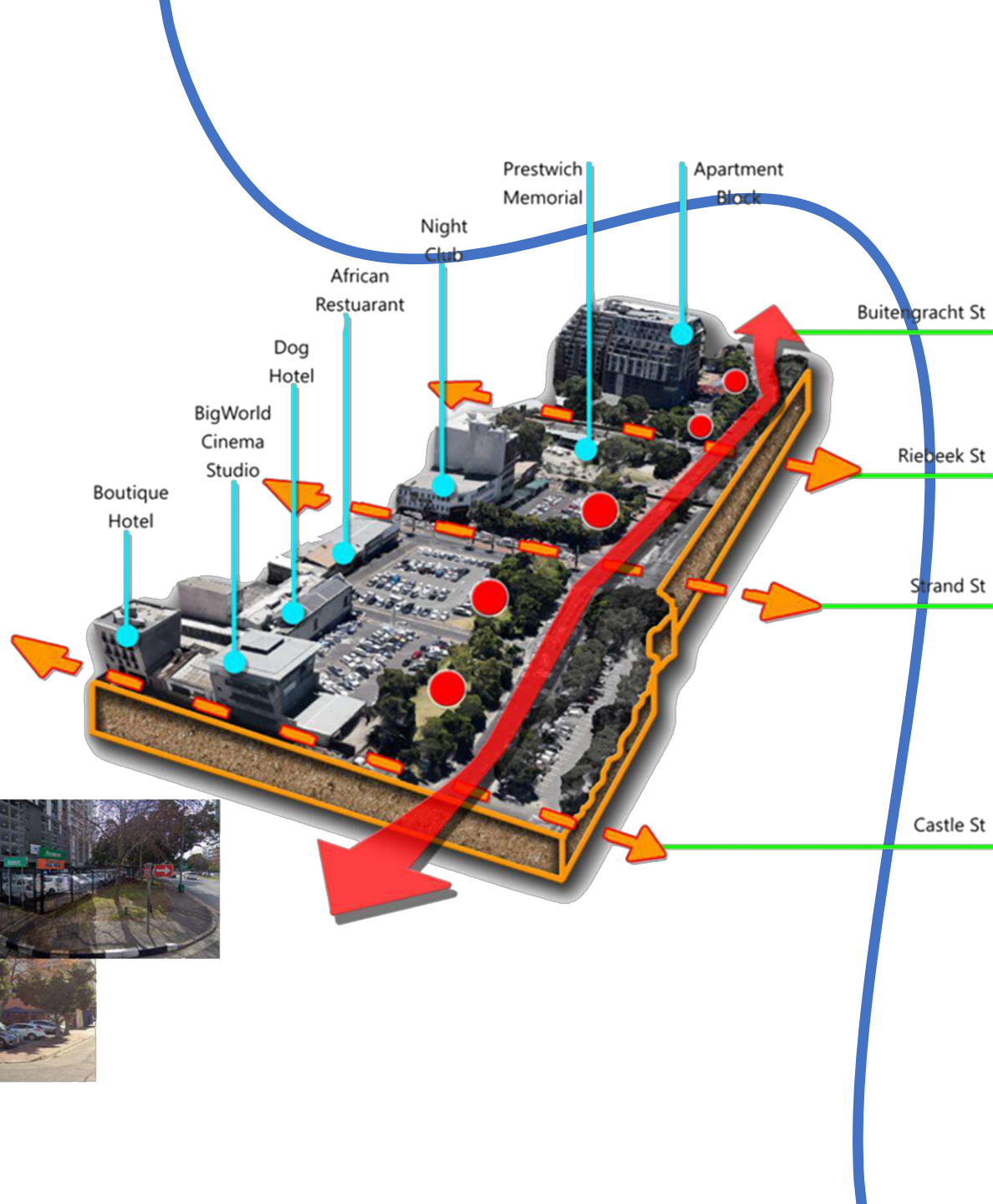


Location

This is a contextual look at the sites marked by red dots, which are identified by the City to be development sites.

These sites are currently being used as parking spaces for the various surrounding buildings, but the spaces offer diverse architectural possibilities within the urban landscape.

Being on the main street the sites serve as focal points where architecture can play a transformative role and create an entry points into the complex urban fabric of the city.

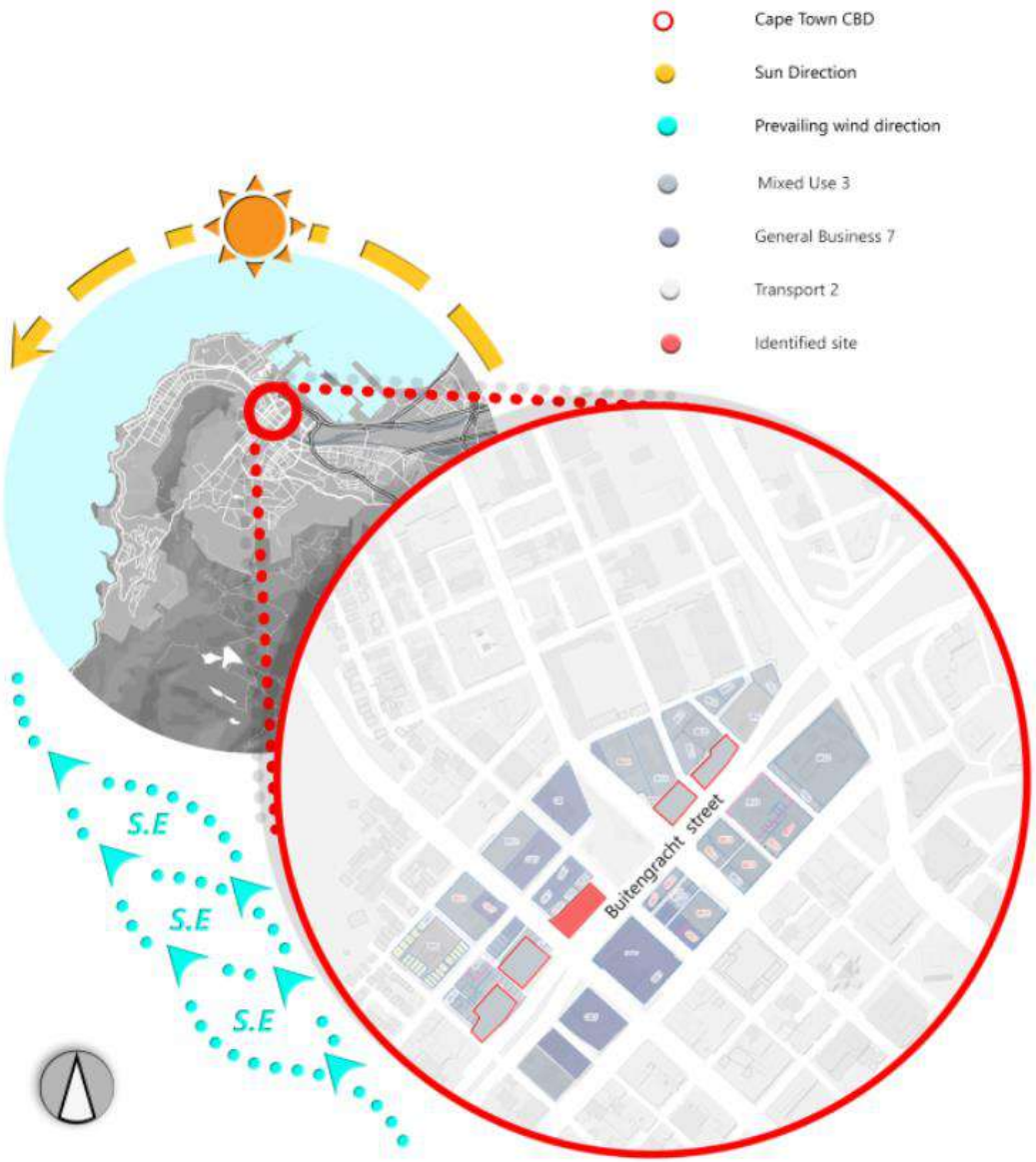


Mapping

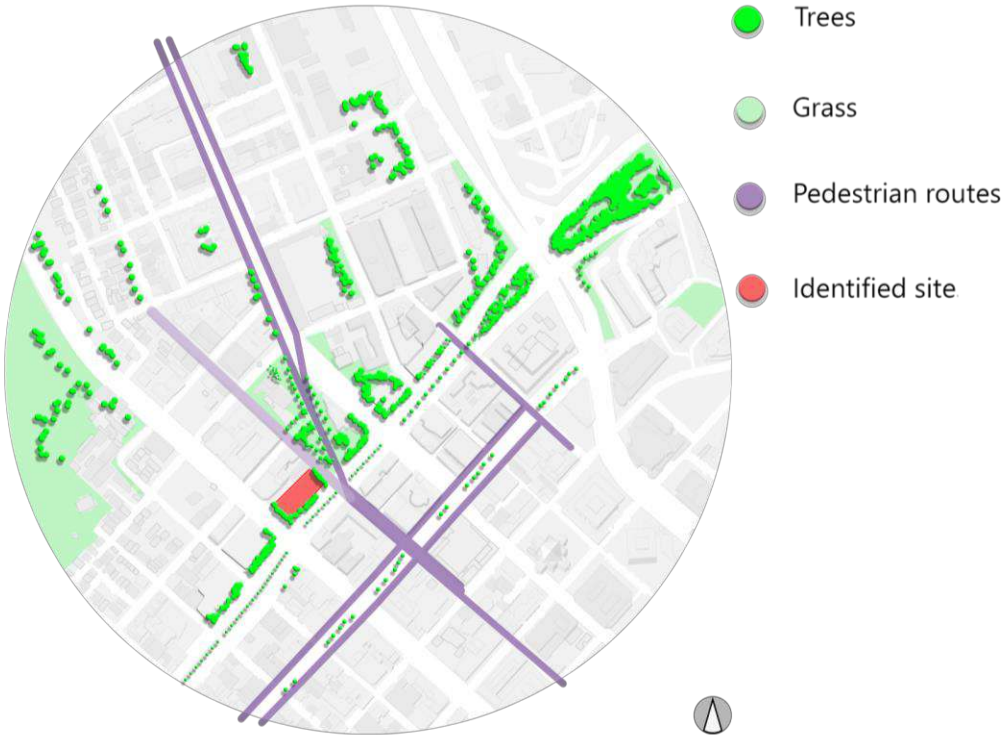
This map analysis helps us understand where our site is in Cape Town's CBD. It looks at important factors like how the sun shines and the typical wind direction, mainly coming from the southeast.

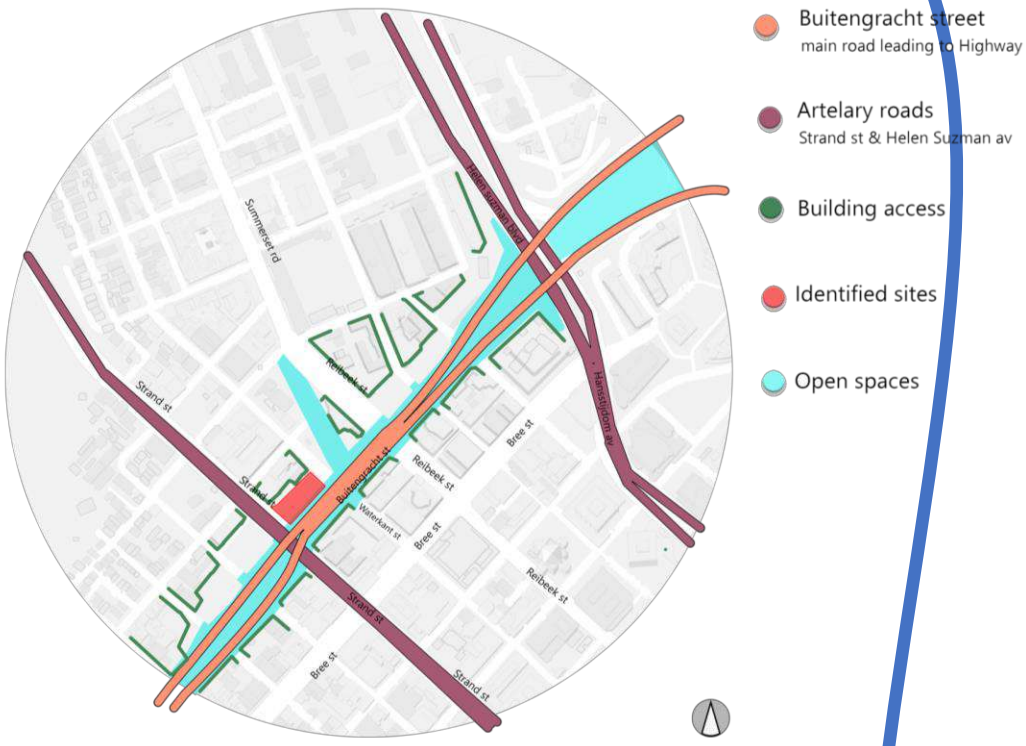
The bigger map emphasizes the main street, which is the backbone of this busy urban area. Most of the nearby buildings have different uses, Mixed use and general business, which shapes the overall architectural setting.

This map lays the groundwork for our design. It reminds us that our site is a key part of the city and should fit well with what's around it. It's like a crucial map that guides our architectural ideas in Cape Town's CBD.

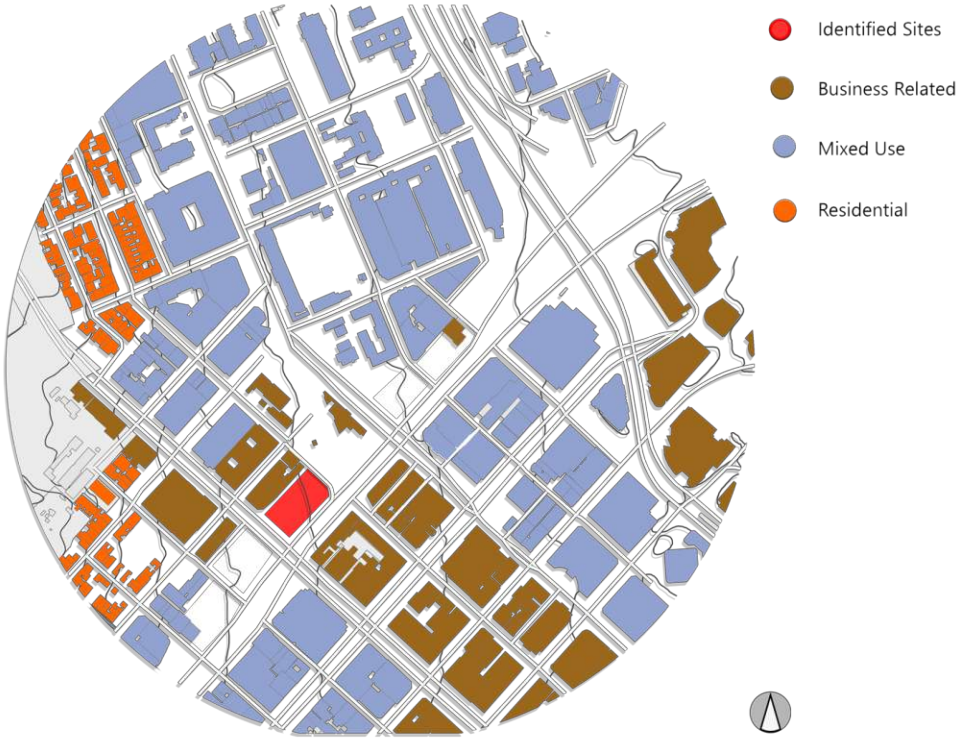


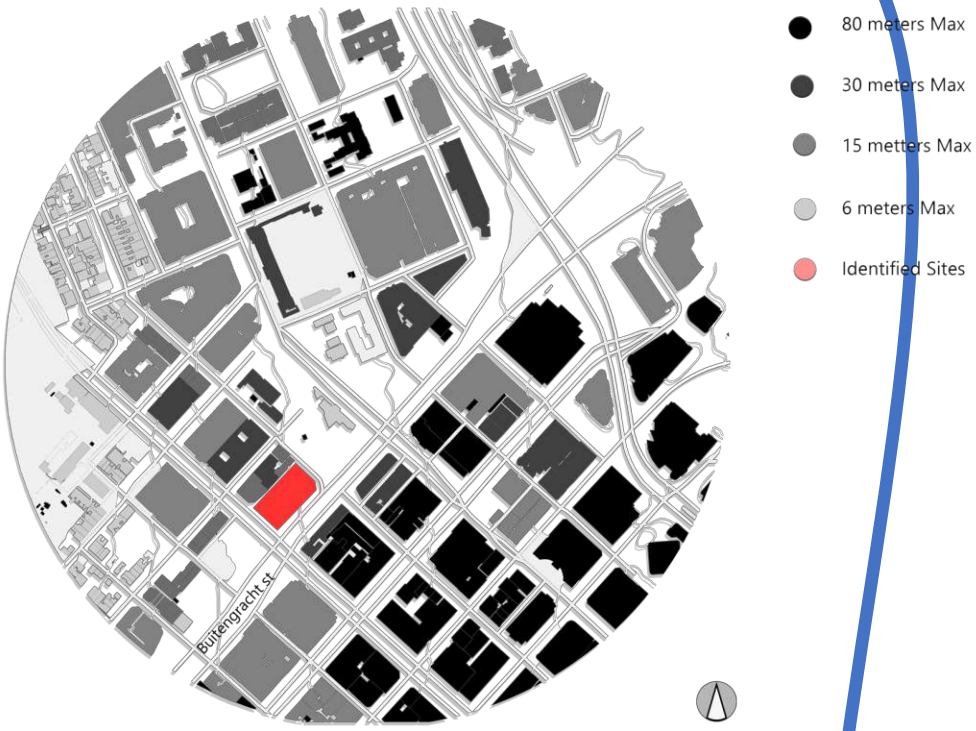
Mapping


Trees
Grass
Pedestrian routes
Identified site

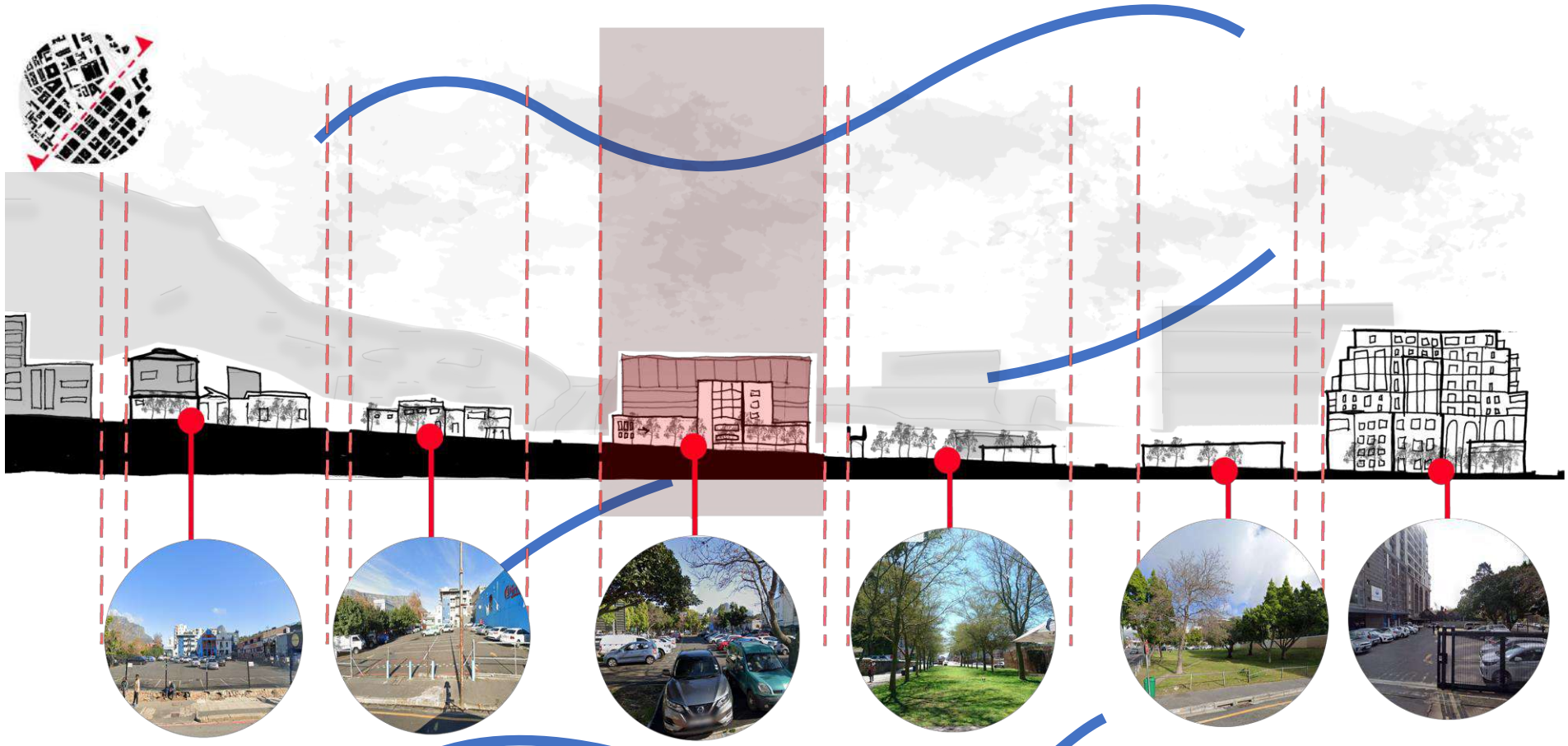

Buitengracht street
main road leading to Highway
Artelary roads
Strand st & Helen Suzman av
Building access
Identified sites
Open spaces
Summerset rd
Strand st
Buitengracht st
Reitbeek st
Bree st
Waterkant st
Hansstroom av

Mapping


Identified Sites
Business Related
Mixed Use
Residential

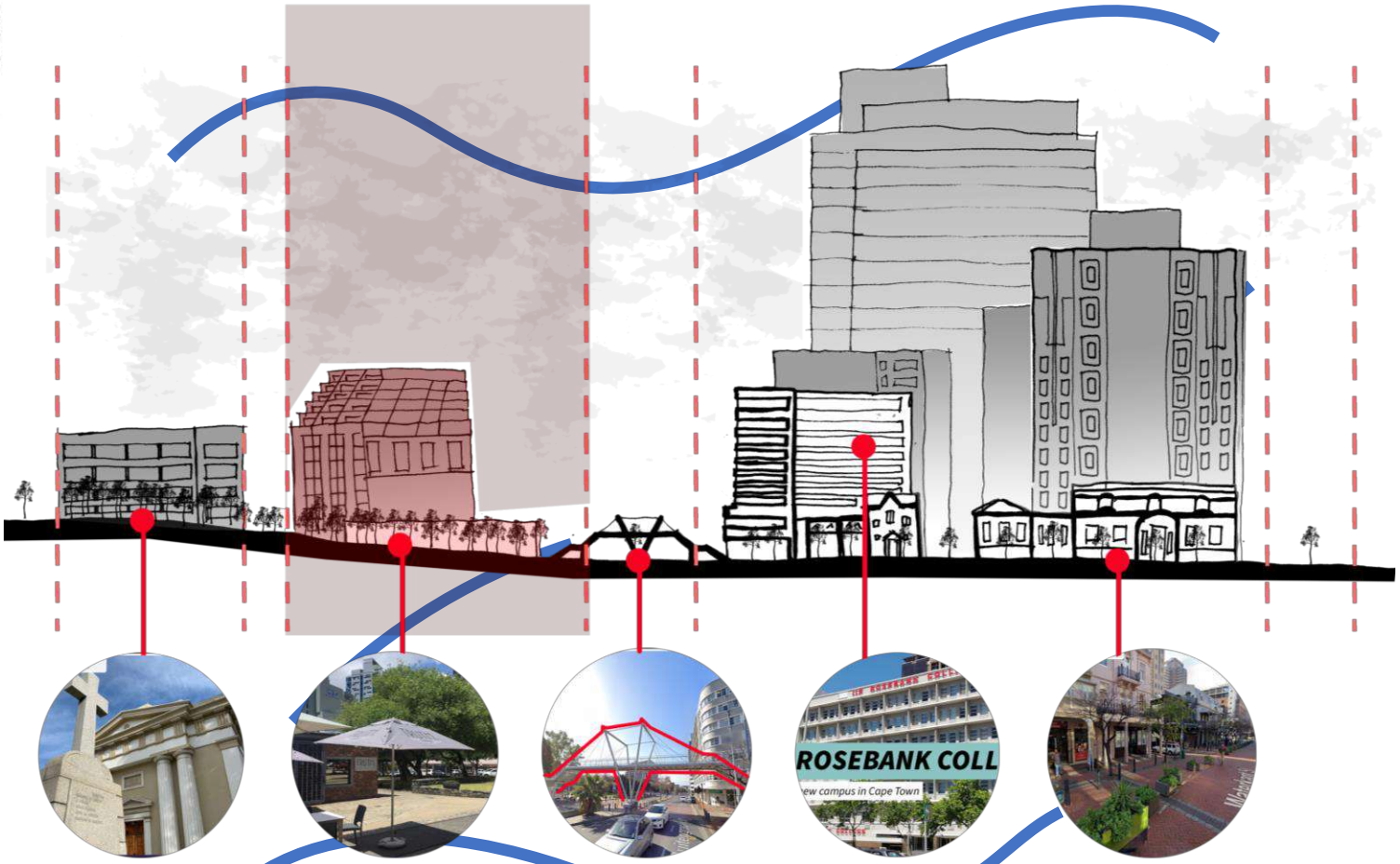

80 meters Max
30 meters Max
15 metters Max
6 meters Max
Identified Sites
Buitengracht st

Buitengracht street Section

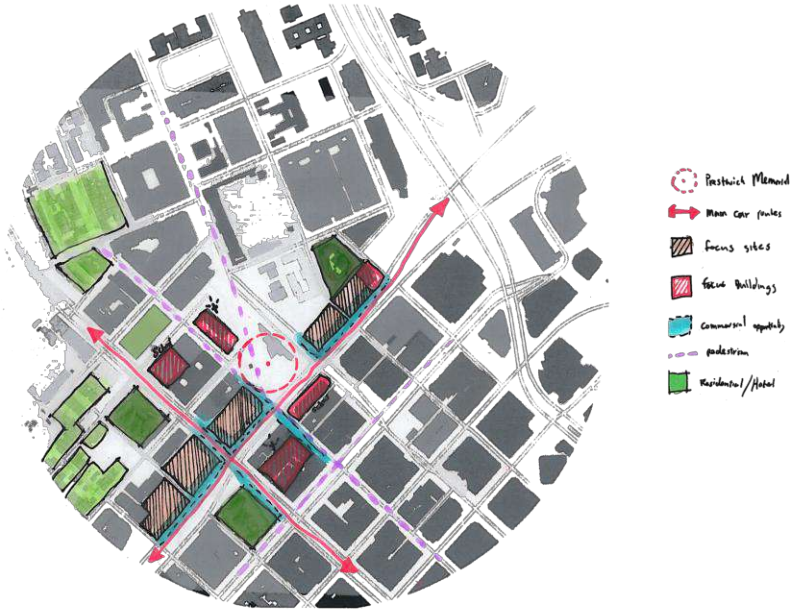


This is a sketch section through the main street. This sketch focuses on the area where I plan to design the building and the empty spots nearby. The highlighted spot is essential in the city and our architectural project can make a big impact here, adding to the city's biophilic story.

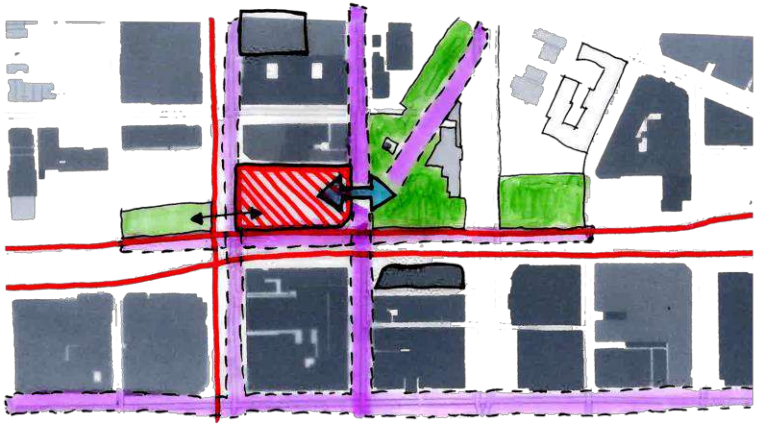
Waterkant street Section



This Section through Waterkant street focuses on the area where we plan to design building. What is significant with this drawing is that it highlights some of the reasons for the high amount pedestrian foot traffic. We have a church, a memorial and green park, a college and local stores on this road.

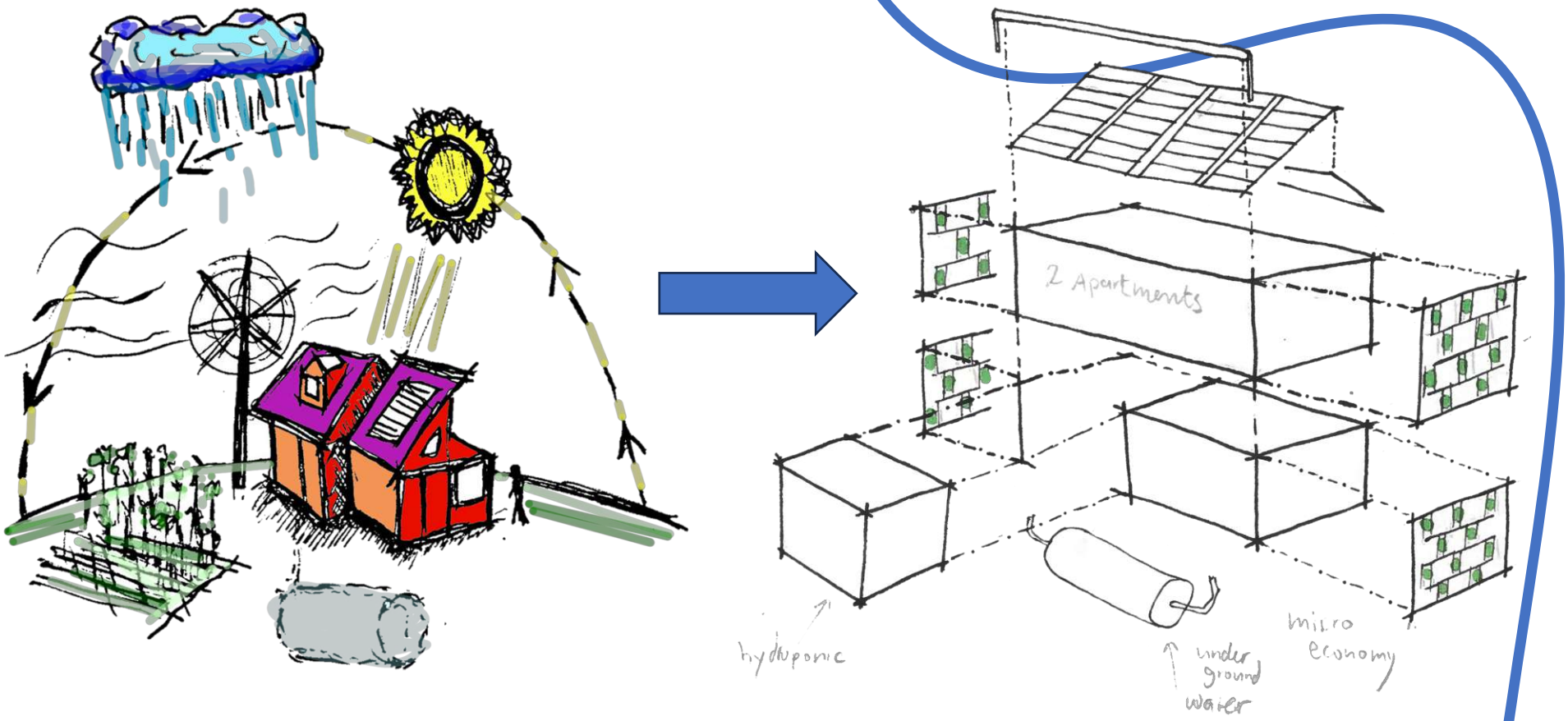


In this map analysis I was identifying significant points that can inform my proposed program and architectural design of my building. Looking at the green spaces, pedestrian routes, busy vehicle routes and residential buildings.

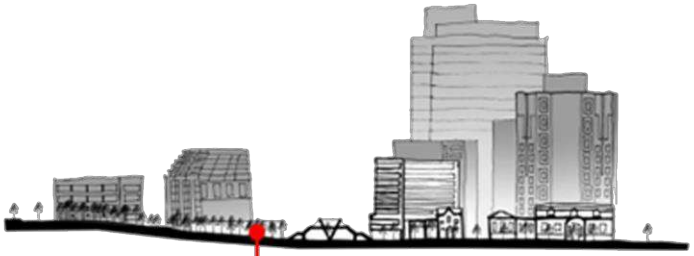


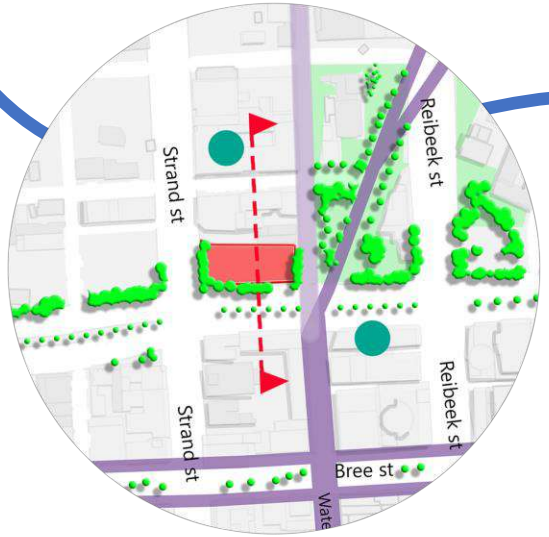
In this map analysis signifies my decision to focus on this site due to its adjacency to a prominent pedestrian route and its proximity to a green and open space. It also highlights the connection I wanted to implement between the sites.

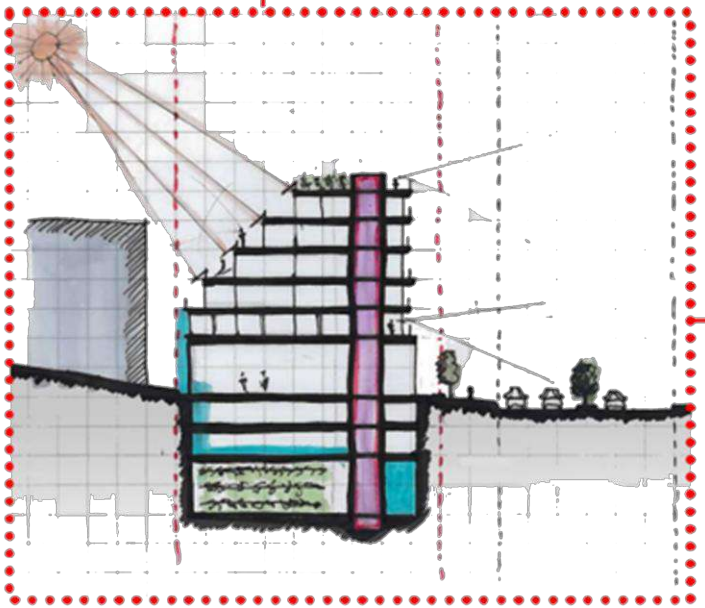
Concept & Process

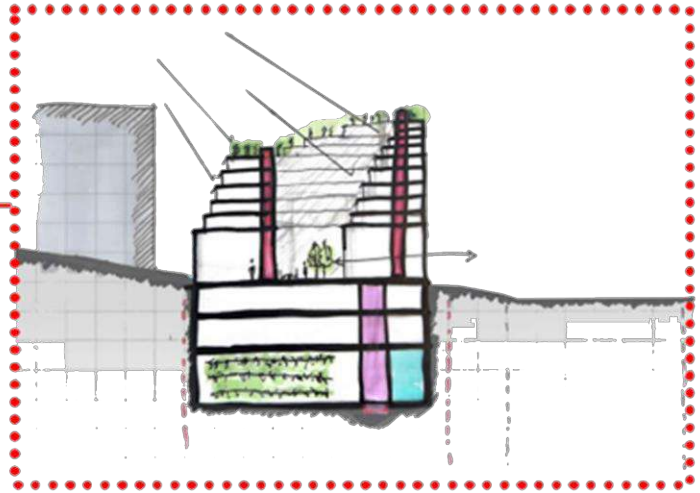


These sketches depict my initial thinking regarding taking off the grid aspects and modernizing them for an urban context, also depicted in the small model
Urban agriculture, water harvesting system, living space, solar power and micro economy.

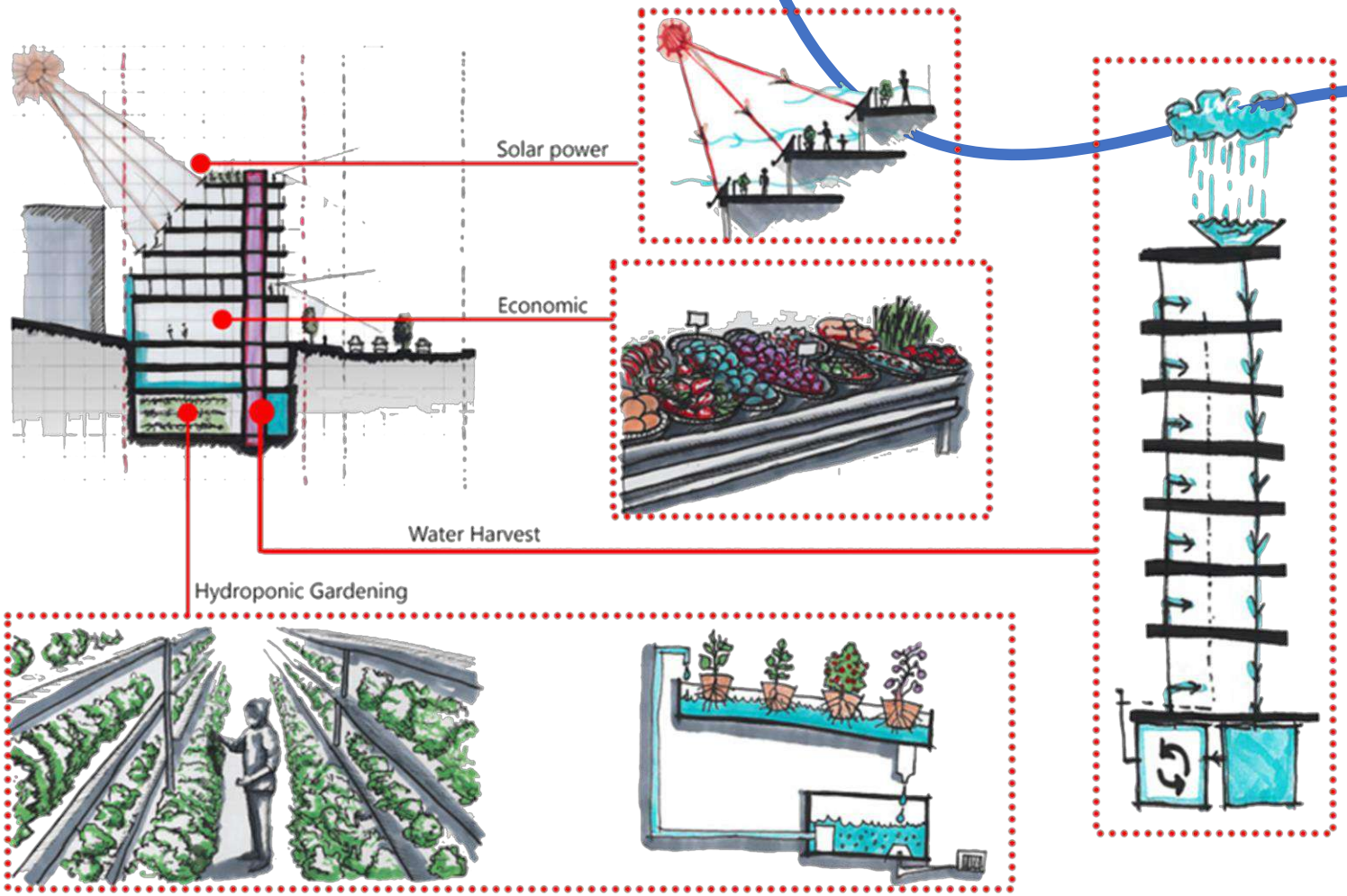




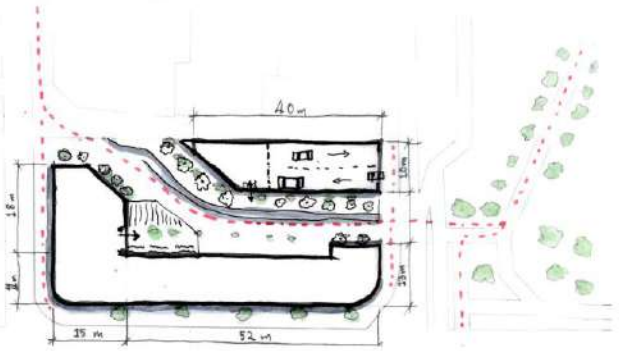


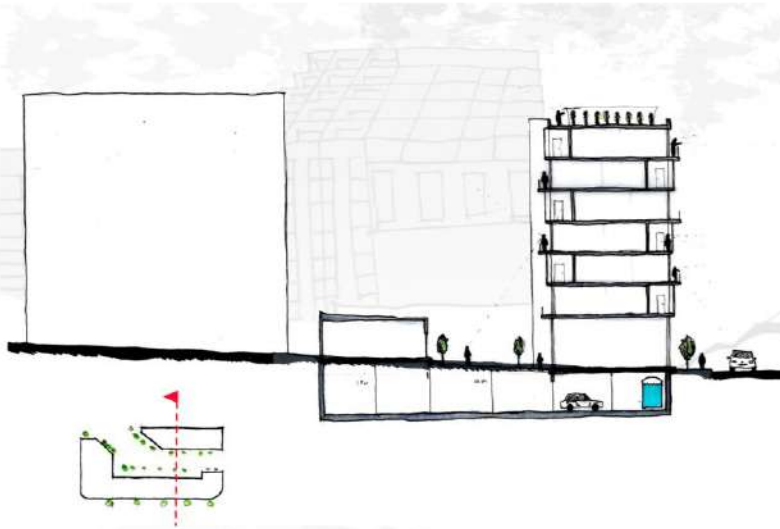


The sectional drawing serves as a design investigation, considering optimal spatial arrangements while carefully factoring in solar angles and orientations.

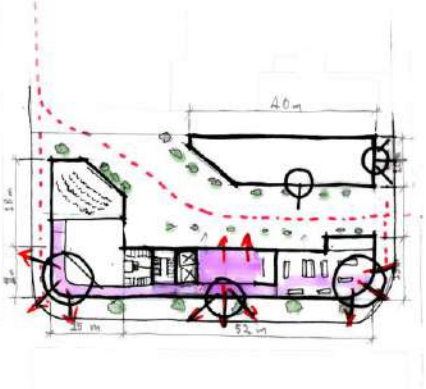


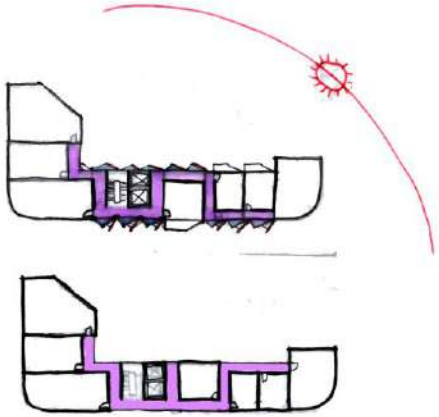
This sectional analysis marks conceptual exploration that addresses both programmatic considerations and the integration of technologies within the building. It provides a glimpse into the strategic design approach, functional aspects and technological innovations. A highlight is the hydroponic gardening aspect where no pesticides are used in the farming process to ensure food security for the building occupants.

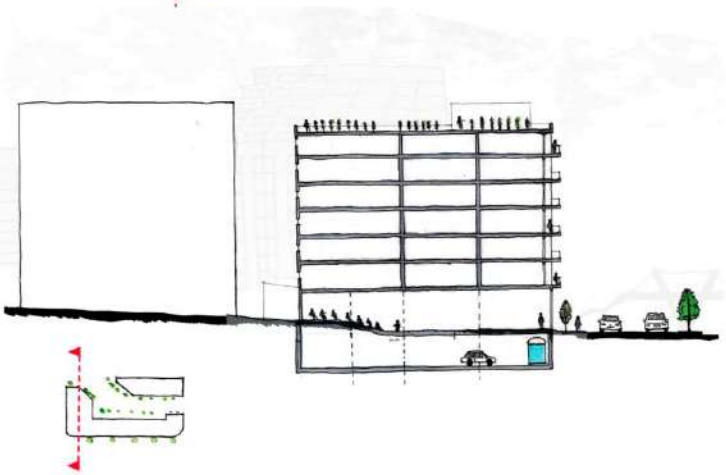




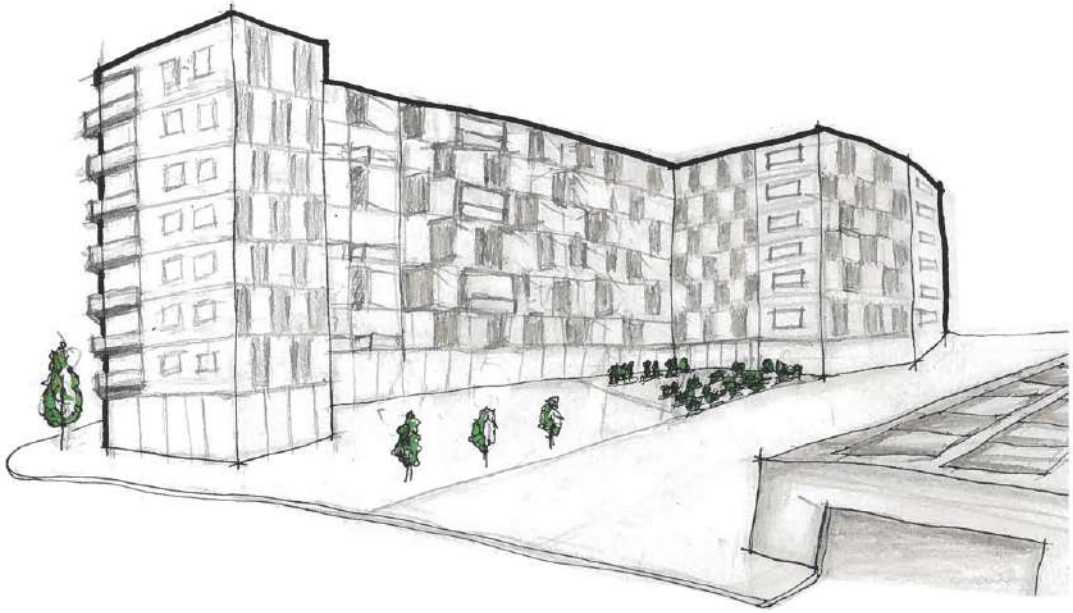
Site Plan







This design iteration has played a pivotal role in shaping the ultimate architectural solution. Key features of this version encompass a ground floor characterized by a welcoming public interface, a seamless connection to the adjacent site, a distinctive and expressive facade, and a careful regard for solar orientation and prevailing wind patterns.



Precedents

Stefano Boeri – Vertical Forrest

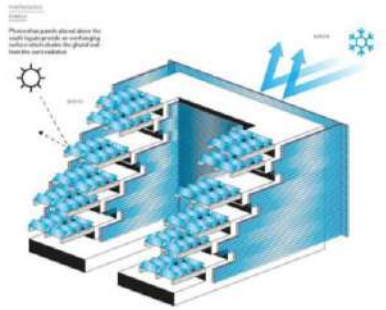
(Vertical Forest) in Milan, consists of two residential towers covered in trees and plants on each balcony. These buildings are not only aesthetically striking but also environmentally friendly, promoting urban greenery and biodiversity while mitigating pollution and energy consumption.

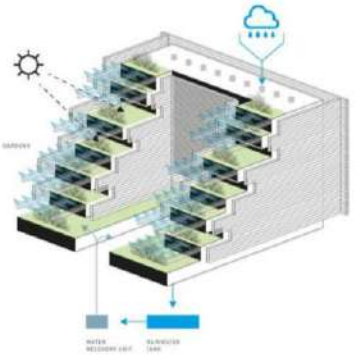
Inspired by such visionary concepts, my own design proposal advances the idea further. Instead of ornamental trees, I advocate for the cultivation of edible plant life, thus harmonizing aesthetics with sustenance and self-sufficiency living.

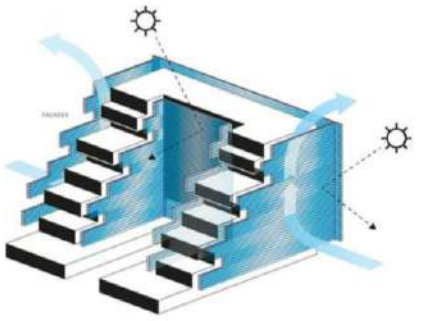
Mario Cucinella – SIEEB

Located in Beijing, China. This innovative building serves as a symbol of environmental responsibility and energy efficiency. It incorporates advanced green design principles, utilizing features like natural ventilation, rainwater harvesting, and solar panels to reduce its environmental impact.

The stepped building resembles a terraced landscape and evokes a profound connection to nature. The designs is both visually stunning and the reasoning behind it environmentally responsible. The interplay of form and function in this building serves as inspiration.



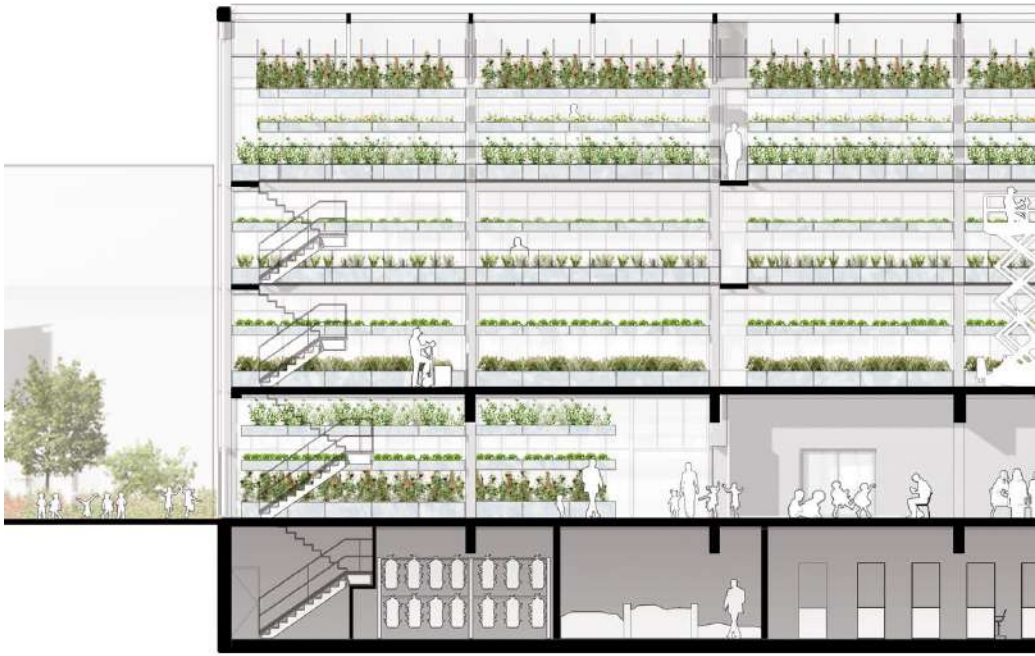




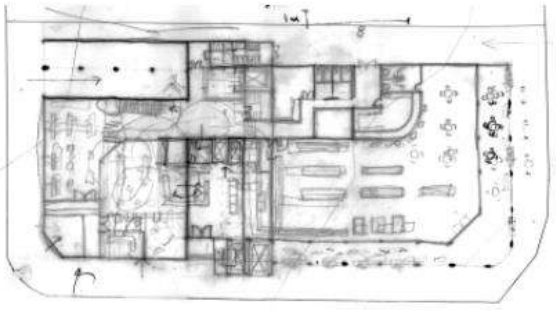
ilimelgo Architects - Vertical Urban Farm

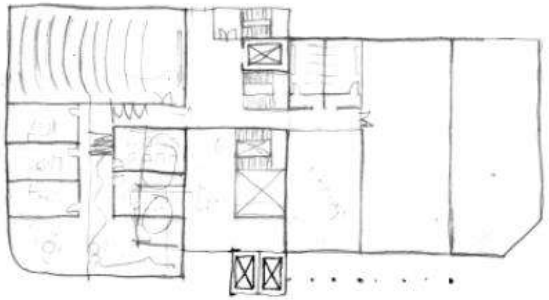
This building is dedicated to urban agriculture in a truly groundbreaking form. Its the first building of its kind to provide sustainable urban farming in France, offering fresh, low carbon footprint year round produces while creating local job opportunities.

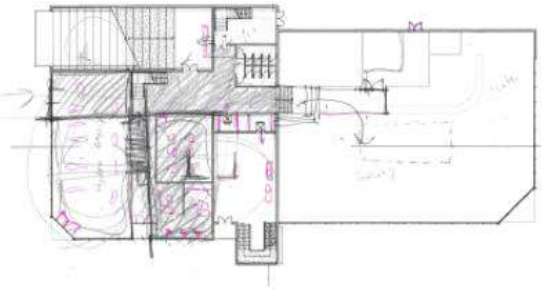
The way this building treats its façade and the ergonomics of the indoor farming spaces serve as an inspiration to my design



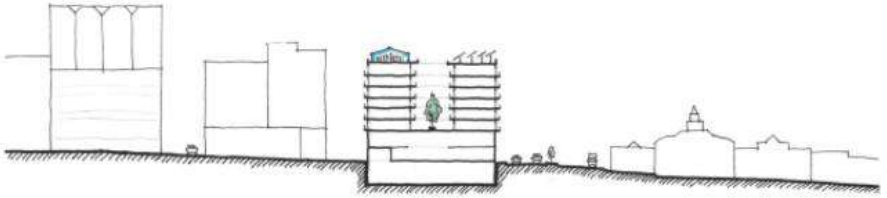
Final Design Iteration

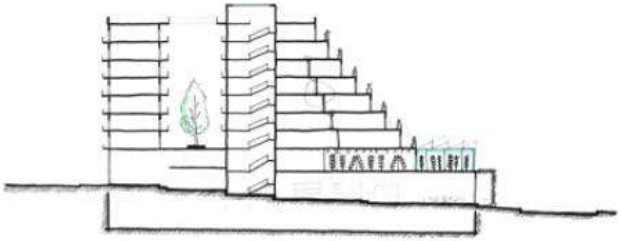


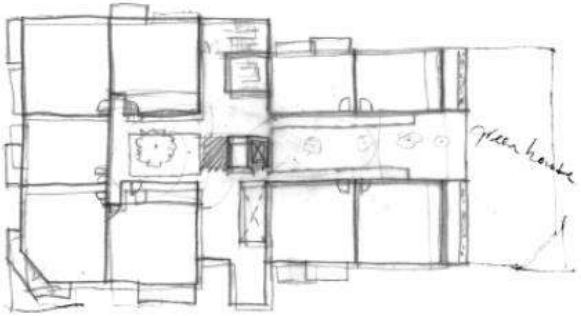


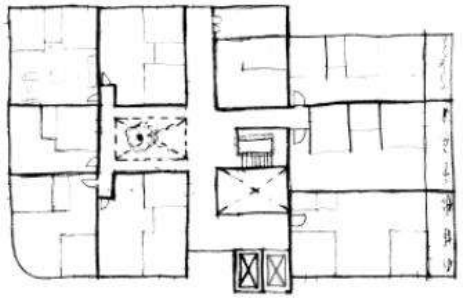


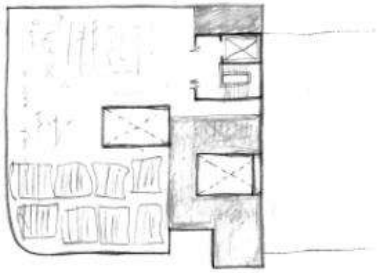
These sketches and drawings are the blueprint of the creative journey. They consider every aspect of the building's purpose and design, giving life to the vision and architectural innovation. Throughout this process, I balance form and function, crafting a space that is both beautiful and purposeful.

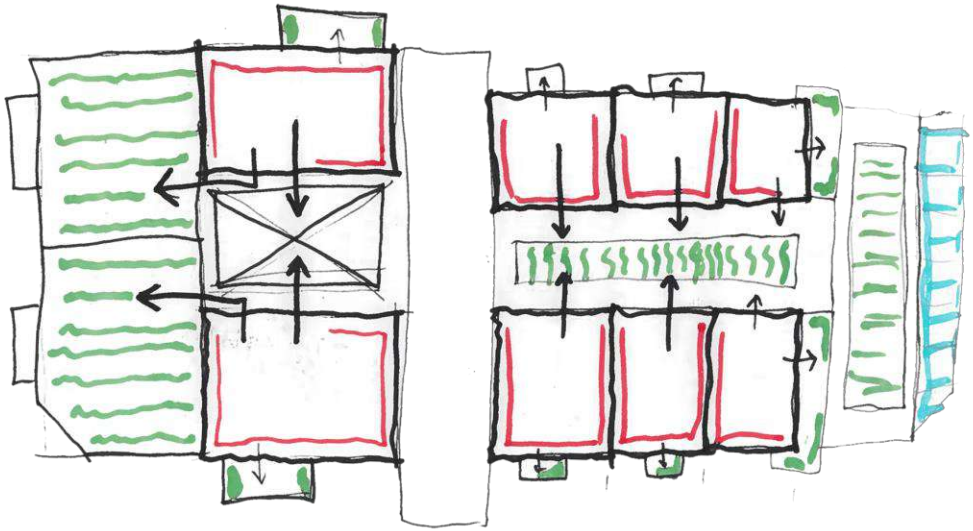




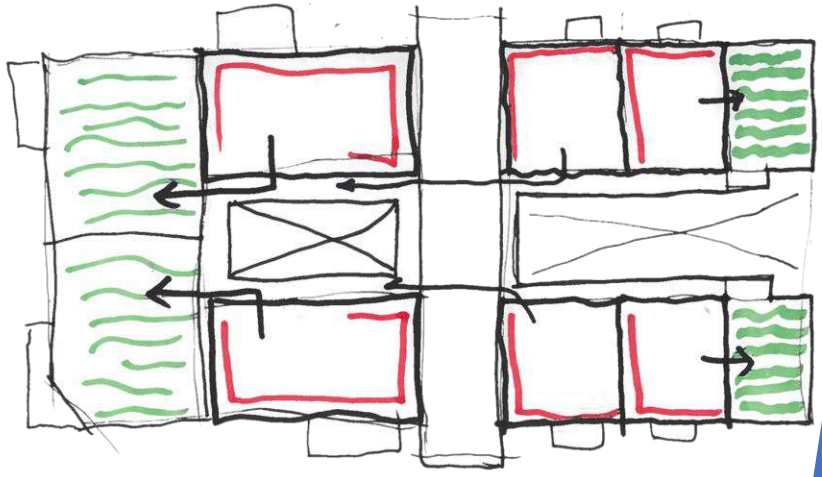




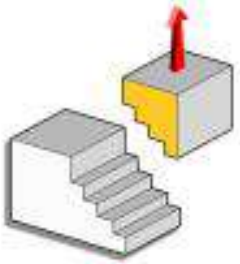




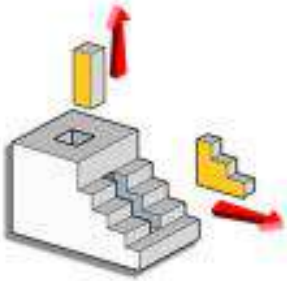
Residential Floor 1



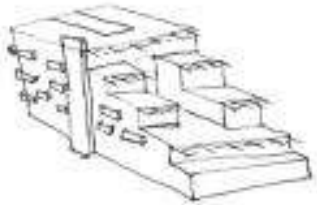
Residential Floor 2

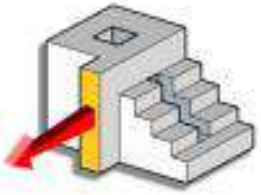


Step 1, we lay the architectural foundation by starting with a basic box structure. By removing strategic sections, we initiate the evolution towards a stepped building design.

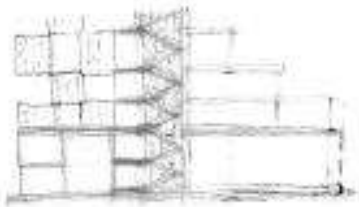


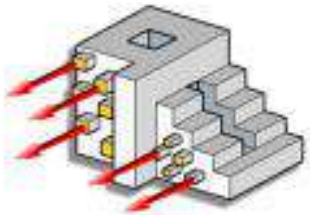
Step 2, we craft two purposeful openings within our building's form. These carefully designed atriums invite the play of natural light and ventilation, breathing life into the space. Here, architecture and environment unite as we take a step closer to a harmonious, sustainable design.





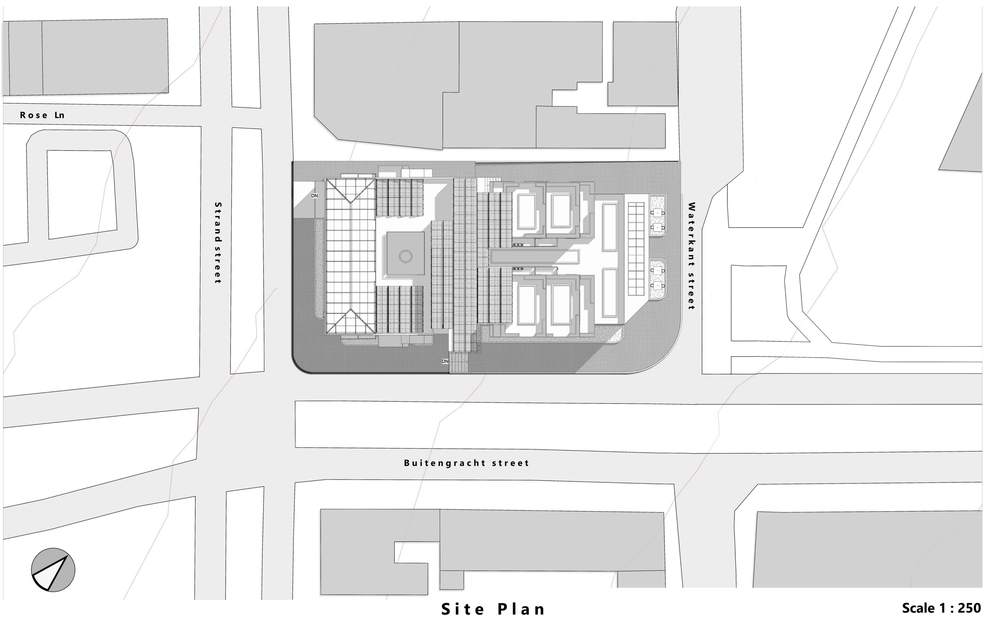
Step 3, we assert a pivotal element within the building's structure. By extending the central section, we decisively define the circulation core. This gesture not only enhances functionality but also forms a distinct focal point.





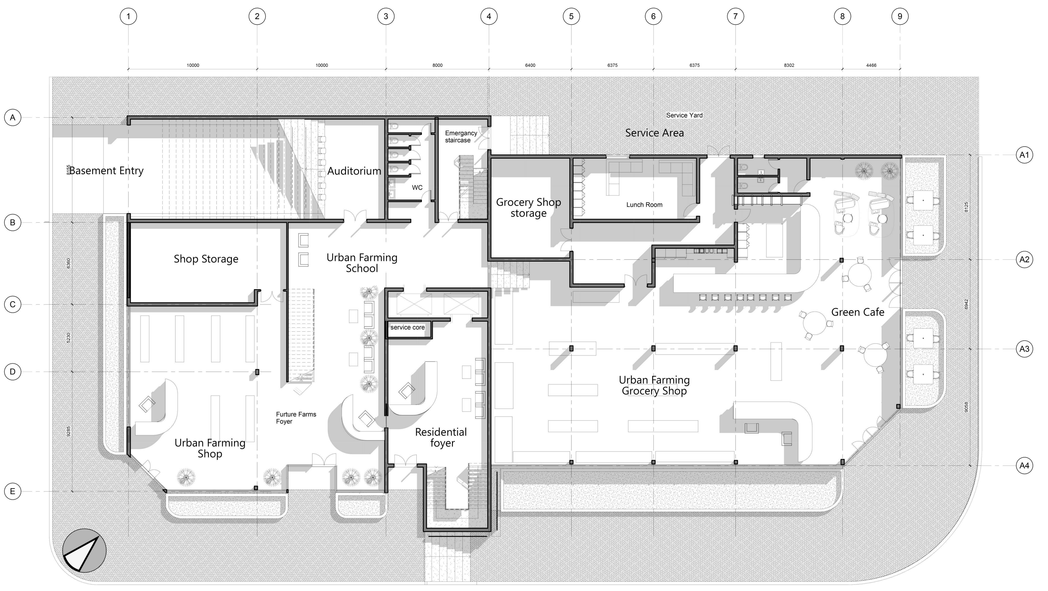
Step 4, we protrude residential balconies, transforming them into productive urban agricultural spaces. Here, residents have the opportunity to cultivate their own food, fostering a sustainable and communal urban environment.

Plans
Section
Elevations



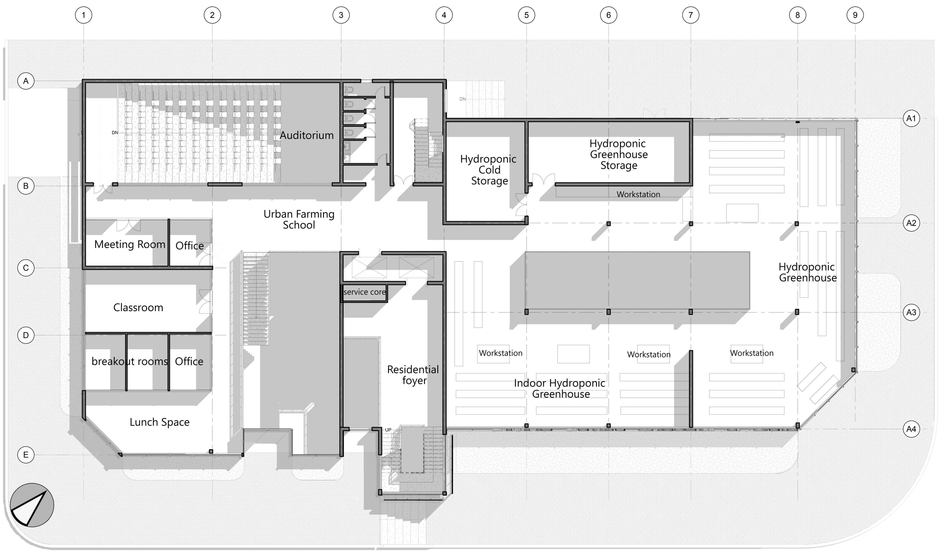
Site Plan

Scale 1 : 250



Ground Floor Plan

Scale 1 : 100



First Floor Plan

Scale 1 : 100

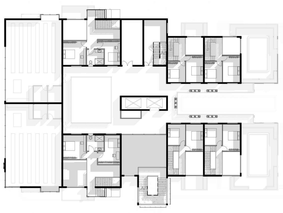
Second Floor Plan

Scale 1 : 100

Sections

Second floor mezzanine Scale 1 : 250

Third floor Plan Scale 1 : 250



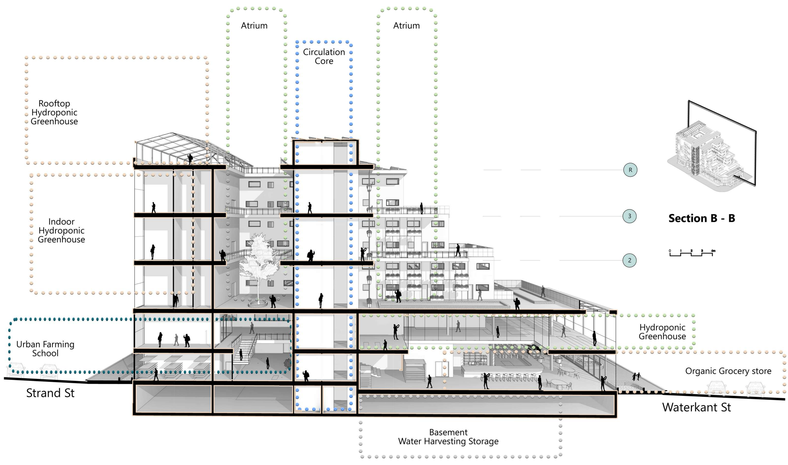
Third floor Mezzanine Scale 1 : 250

Fourth Floor Plan Scale 1 : 250

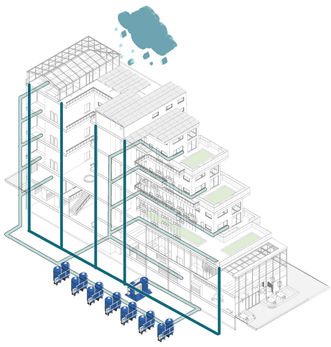
Fourth floor mezzanine Scale 1 : 250

Roof Floor Plan Scale 1 : 250

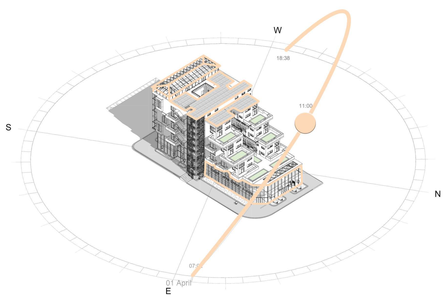
Section A - A



Section B - B



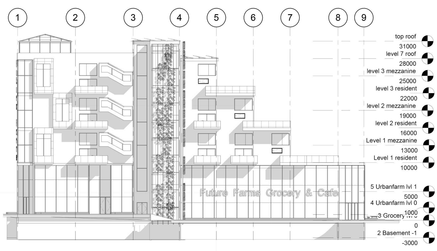
Basement
Water Harvesting Storage



Transparent
Solar Panels Glazing

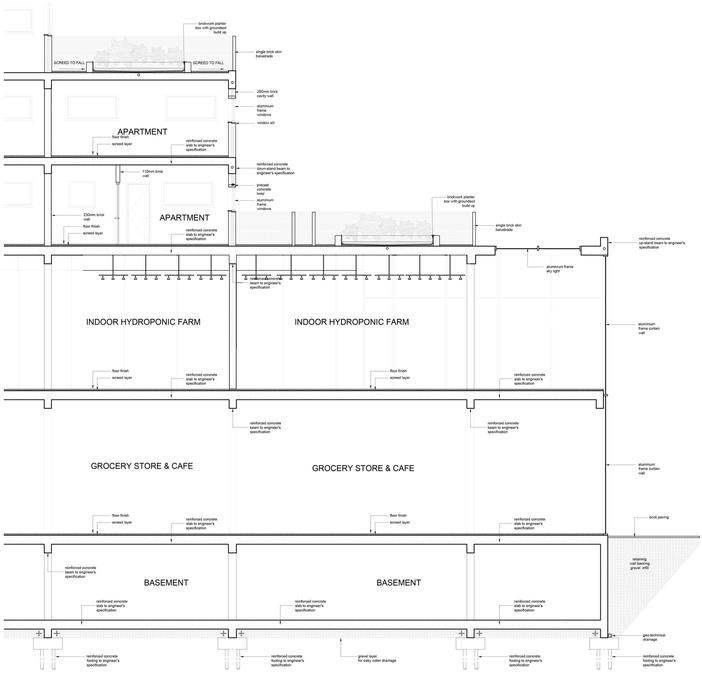
Elevations

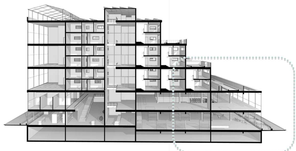
Scale 1 : 250



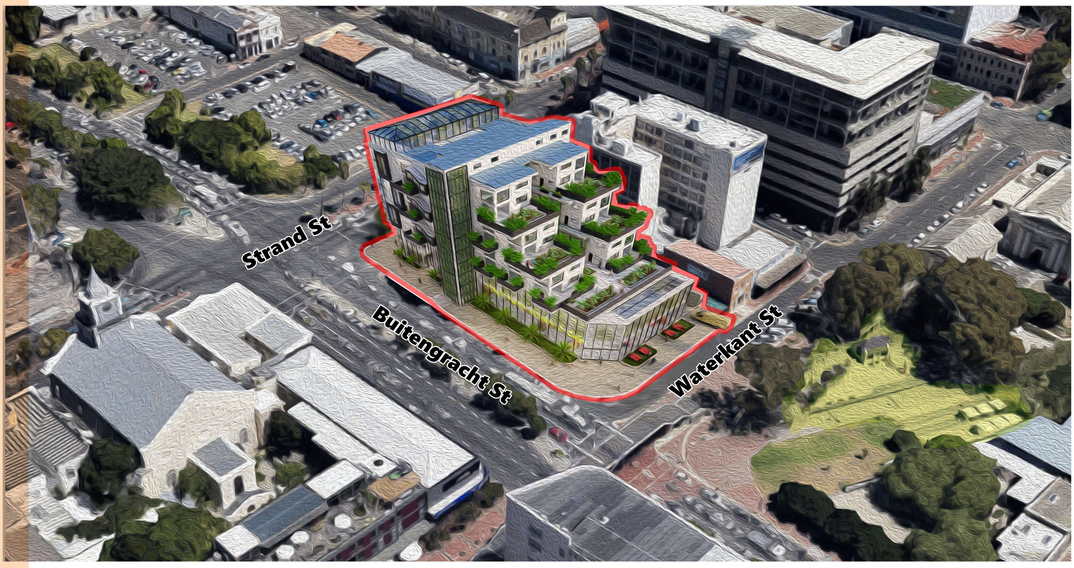
Scale 1 : 250

Technical Section

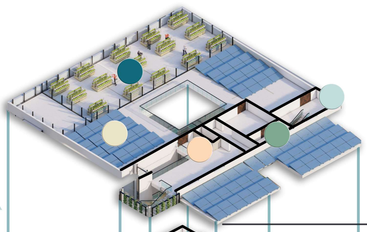




Scale 1 : 50



R



- Roof Greenhouse
- Solarpower Service Room
- Solar Panels
- Circulation Core
- Emergency Stairs

Roof Floor

4

- Indoor Hydroponic Farm
- Duplex Apartments
- Circulation Core
- Soil Based planter

Fourth Floor

3

- Indoor Hydroponic Farm
- Circulation Core
- Duplex Apartments
- Soil Based planter

Third Floor

2

- Indoor Hydroponic Farm
- Circulation Core
- Duplex Apartments
- Soil Based planter

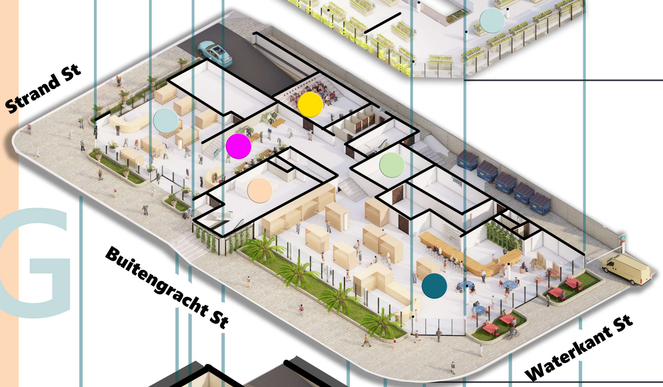
Second Floor

1

- Auditorium
- Office & Learning
- Indoor Hydroponic Farm
- Storage space

First Floor

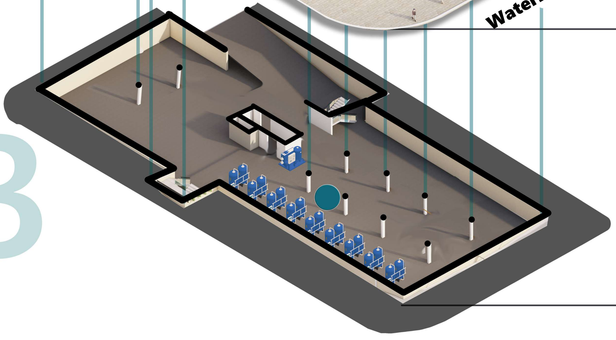
G



- Auditorium
- Urban Farming Equiptment Store
- Residential Foyer
- Urban farming learning
- Grocery Store & Cafe
- Storage Space

Ground Floor

B



- Water Harvesting System

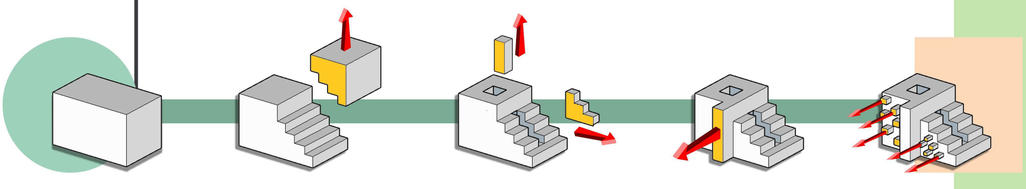
BasementFloor


Future Farms


Future Farms Grocery & Cafe


Future Farms Grocery & Cafe


Future Farms



Interior Spaces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