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# Deluge [ proof ]: A Design Resilience Study

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# DELUGE
[ proof ]


# DELUGE PROOF
# A FLOOD RESILLIENCE STUDY

Approval of Thesis Research
Project Book is Presented to:

Professor Selen Okcu
and to the
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by
NIA MCGANN

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# DEDICATION

I extend my heartfelt gratitude to the God for His constant guidance and strength throughout this journey.

To my incredible parents, Morton McGann & Clovalyn McGann who made the move from Jamaica to America, to ensure my future. Your unwavering support and endless sacrifices have shaped me into the person I am today.

A huge thank you to my thesis advisor, Dr. Selen Okcu whose mentorship and encouragement have been invaluable. Your belief in my thesis has fueled my passion and nurtured my creativity.

This thesis booklet is a tribute to your unwavering faith in me. I dedicate it with profound gratitude for your love, support, and inspiration.

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# + ABSTRACT

Rising sea levels, a consequence of climate change, pose a significant and escalating threat to coastal communities worldwide. Projections indicate that by 2050, sea levels may rise by an estimated 1 to 2 feet, potentially affecting not only coastal but also inland communities. The ramifications of rising sea levels encompass heightened risks of flooding, erosion, and saltwater intrusion. These impacts have multifaceted consequences, ranging from evident transportation disruptions and damage to underground and ground-level structures to more subtle yet equally critical effects on infrastructure, ecosystems, potable water reservoirs, community displacement, and economic activities.

In response to this pressing challenge, a collective effort among scientists, architects, and engineers has been dedicated to exploring various solutions. These proposals encompass diverse strategies, including the concept of floating architecture, which envisions communities living on the water's surface. Another approach involves constructing resilient structures elevated on robust stilts in flood-prone regions. Additionally, there is a focus on preserving existing buildings through waterproofing techniques and the adaptive repurposing of vulnerable areas in flood-prone zones.

While these ideas exhibit creativity and thoughtful consideration, it is imperative to recognize that they may not exhaustively explore the full spectrum of possibilities and opportunities presented by this complex issue. One innovative avenue to address the challenges posed by rising sea levels is the development of hybrid marine urban communities. This approach entails updating existing structures to withstand erosion and saltwater intrusion while concurrently designing new architecture that harmonizes with the evolving environment. For instance, the rehabilitation of salvageable structures, particularly concrete buildings, could involve reinforcing their foundations with saltwater- and erosion-resistant concrete. Subsequently, the design process can transition to the creation of structures elevated above floodplains by means of being supported by elevated columns. In cases where stilt-based construction is no longer feasible due to environmental limitations, such as ocean depth, architects can explore the concept of floating architecture. This hybridized approach emphasizes the preservation of existing urban fabric while embracing innovation, resulting in a dynamic coexistence of old and new. By aligning design strategies with environmental change, this approach unlocks novel opportunities and expands the horizons of architectural possibilities.

FIGURE 1: MIAMI BIRDS EYE
(Cavalleri 2015)

# + DELUGE
# [ proof ]

## PROBLEM STATEMENT
Climate change is causing sea levels to rise at an alarming rate, posing a serious threat to coastal communities and infrastructure around the world. Traditional architecture is often not designed to withstand the impacts of rising sea levels, such as flooding and storm surges. This is a major problem, as it leaves coastal communities vulnerable to damage and displacement.

## LITERATURE REVIEW
There is a growing body of research on the development of climate-resilient architecture. However, there is still a need for more research on how to design and build buildings that can withstand the specific impacts of rising sea levels in different coastal regions.

## NATIONAL CRISIS
A study examines the impact of sea-level rise on coastal populations, utilizing two elevation models: SRTM and CoastalDEM, across different emissions scenarios. The findings reveal that over 70% of the global population residing in areas threatened by rising seas is concentrated in island nations (Scott, 2019). This puts the need for a universally applicable typology to be studied and distributed to both developed, undeveloped, large and small nations.

## THE EFFECT
The following are directly correlated to rising sea levels.

Short-term Effects: Variations of sea level on periods ranging from minutes to weeks that arise from processes like storms, astronomical tides and freshwater input.

Sterodynamic Variability: Sea level change that arises from variability in the ocean's circulation, temperature and saltiness. This all continues to change as global temperatures rise and glaciers melt.

Melting Glaciers: Glaciers outside of the ice sheets account for about 1% of total ice trapped on land.

Land Water Storage: Changes associated with the transfer of water between land and ocean.

Ice Sheets: The Greenland and Antarctic ice sheets contribute to global sea level rise, and these changes become experienced regionally through Gravitational and Rotational changes.

Subsidence: Movement of the land at the coast (could also be uplift) in response to a range of physical processes including groundwater and glacial adjustment.

FIGURE 2: MAN WALKING IN FLOOD
(Herald, 2022)

## + MIAMI 2023

FIGURE 3A: PRESENT DAY MIAMI
(Mondial, 2022)

## + MIAMI 2100

FIGURE 3B: FUTURE MIAMI FLOODED

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## HYBRID

Creating a hybrid architecture design in response to the increasing threat of rising sea levels offers several advantages over simply opting for floating architecture solutions. Firstly, hybrid designs facilitate the preservation of existing urban landscapes. By seamlessly integrating these designs into established coastal cities, they avoid the displacement of residents and businesses, thereby safeguarding the rich historical and cultural heritage many coastal cities possess.

Secondly, hybrid architecture demonstrates superior flexibility and adaptability. These designs can be tailored to address various levels of sea-level rise, such as elevating structures on stilts or constructing artificial islands. This adaptability ensures the sustainability of hybrid architecture over the long term. Moreover, hybrid designs tend to be more cost-effective. Unlike floating architecture, which relies on relatively new and potentially costly technologies, hybrid solutions can harness existing construction methods and materials. This affordability makes them more accessible to coastal cities facing budgetary constraints.

In addition to these advantages, hybrid architecture designs serve multiple additional purposes. They help protect coastal communities from flooding and storm surges, create new public spaces and amenities, stimulate the local economy, and enhance the city's distinctive character. The example of Miami demonstrates how this approach can effectively address the challenges posed by rising sea levels by seamlessly blending innovative elements with the city's historical and cultural fabric, resulting in a more resilient and livable environment. While hybrid architecture is a relatively novel concept, it holds significant potential for aiding coastal cities worldwide in adapting to the ongoing challenge of rising sea levels.

FIGURE 3B: ENGINEERS FIGHTING FLOODING
(Raedle, 2021)

## WHY HYBRID?

This blended approach places a strong emphasis on conserving the established urban landscape while embracing innovation, leading to a vibrant coexistence of old and new elements. By aligning design strategies with the challenges posed by environmental changes, this method opens new possibilities and broadens the scope of architectural potential, all while maintaining the unique character that Miami has cultivated over the years.

## CONSIDERATIONS

- Will be able to save historical Miami.
- New approach could be less expensive.
- Can be utilized across many coastal communities.
- Provides areas of refuge for floating communities.
- Works with existing marine life.
- Works with and adapts to the ocean
- Can keep road transportation.
- More cost beneficial in the long run.

## HOW HYBRID?

Hybrid is a completely new concept so all of it must be reimagined. Ultimately the pilotis will be on the coast where the depth is less than or equal to 1 meter while the floating architecture will begin at depths exceeding 1 meter, with taller and larger buildings needing more depth. It is also to be considered that the floating architecture inhabits a space on the site where the water is more static where water levels are predictable.

The addition of architecture on pilotis to the traditional floating architecture concept allows for a transitional zone between the main coastland and the new floating architecture typology by populating the areas too shallow for floating architecture. This space would not only operate as a physical transition space but also a social transition space where the boundaries of social spaces will be explored.

FIGURE 4: SITE IMAGE FROM SOUTHERN VIEW
(Salermo, 2010)

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# + RESCUING EXISTING

### WHAT CAN BE RESCUED?
Concrete Buildings and steel buildings

### HOW CAN IT BE RESCUED?
Protecting
Elevating
Floodproofing
Relocating Critical systems
Using Ecologies

### WHAT ARE MOST BUILDINGS MADE OF IN?
In Miami, the predominant building materials include concrete, favored for its durability and affordability in the region's hot and humid climate. Steel is also commonly used for structural support in large commercial buildings due to its strength and resistance to fire and corrosion. Additionally, glass is extensively employed for its aesthetic qualities and capacity to admit natural light, though impact-resistant glass is crucial to safeguard against hurricanes and extreme weather conditions .

### CURRENT PROTECTION METHODS
Currently residents in Miami employ two methods for safeguarding their homes against flooding: landscaping and sandbags.

Landscaping offers a multifaceted approach to flood protection. For instance, by planting trees and shrubs, homeowners can leverage the natural water-absorbing capabilities of vegetation and mitigating the flow of rainwater towards their homes. Additionally, the creation of swales—shallow trenches—serves to collect and channel rainwater away from the home. When it comes to driveways and walkways, using permeable materials like gravel or brick enables rainwater to infiltrate the ground instead of running toward the house (Gunderson, 2019).

In conjunction with landscaping, sandbags are an invaluable tool for immediate flood defense. Typically composed of materials like burlap or polypropylene and filled with sand, these sandbags can be strategically stacked to establish temporary barriers, effectively impeding the advance of floodwaters. Their effectiveness is maximized when integrated with other flood protection measures, such as landscaping and floodproofing. Sandbags can be used to seal gaps around doorways and windows or create a temporary protective perimeter around the entire residence (Gunderson, 2019).

It's important to note that while sandbags and landscaping are a short-term solution, they simply wont be able to withstand the projected flooding across Miami in the upcoming years (Gunderson, 2019).

FIGURE 5: SANDBAGS USED TO MITIGATE FLOOD WATERS
(Cardy, 2016)

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## PROTECTING

To safeguard steel structures from the corrosive effects of saltwater exposure, several protective measures are employed. One common method is galvanization, a process that entails applying a zinc coating to the steel. This zinc layer acts as a shield against corrosion, including the kind induced by saltwater. Additionally, steel buildings can be safeguarded through painting, but it's imperative to employ high-quality paints designed for marine environments to ensure effective protection. Another advanced technique is cathodic protection, which employs an electric current to shield metal from corrosion. This system finds utility in safeguarding steel constructions from the corrosive impact of saltwater intrusion, enhancing their longevity in coastal regions (Meguro, 2023).

When considering the protection of pre-existing steel buildings against saltwater exposure, it's essential to weigh the practicality of various methods. Galvanization, while highly effective, can be costly and time-intensive, potentially making it less suitable for already constructed steel structures. Painting, on the other hand, offers a more budget-friendly and quicker alternative, provided that marine-grade paint is utilized. Alternatively, cathodic protection presents a complex yet viable option for safeguarding existing steel buildings from saltwater intrusion, albeit necessitating ongoing maintenance. Determining the most appropriate method depends on factors such as the severity of saltwater exposure, budget constraints, and the desired lifespan of the building (Meguro, 2023).

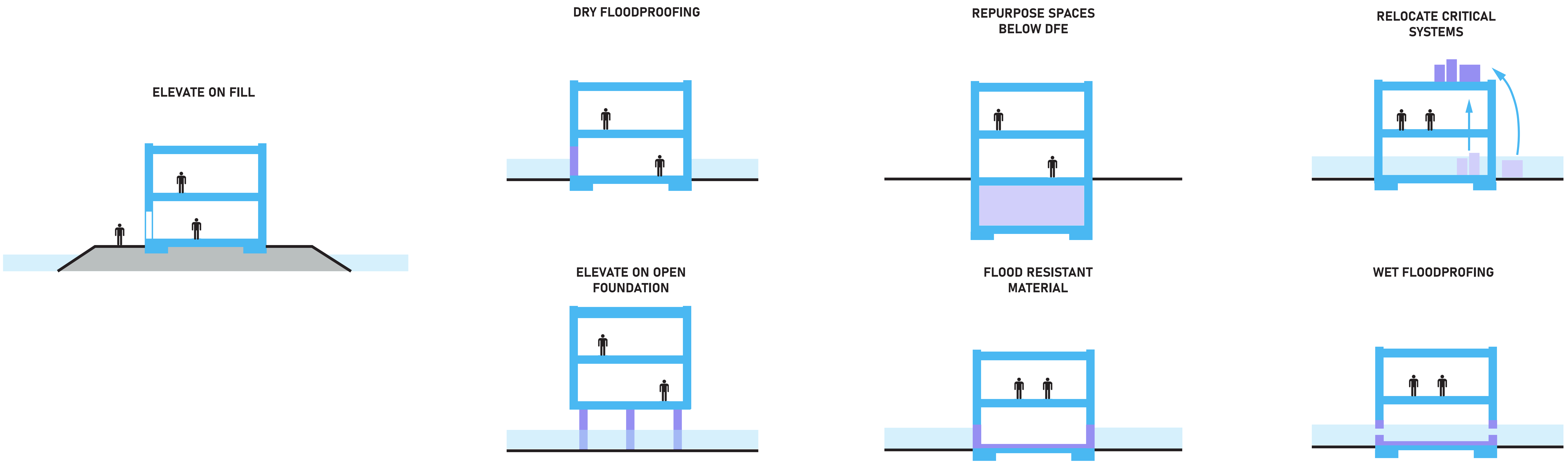


FIGURE 6.1-6.7: PROTECTIVE MEASURES

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## ELEVATING

There are two primary methods for elevating buildings in response to rising sea levels: elevating on an open foundation and elevating on fill. Elevating on an open foundation is a more straightforward option, particularly well-suited for new construction and low-rise buildings. Retrofitting existing large structures can be challenging, but two viable approaches exist: lifting the entire building and adding support columns or converting the ground floor to an open foundation, transforming it into a communal area or pass-through space (Meguro, 2023).

On the other hand, elevating on fill is a less practical choice for large or older buildings, where starting anew might be more viable. Concerns include potential pollution and mosquito infestations in unfilled areas. However, the permanent inundation of these areas by the ocean could lead to natural cleansing by ocean currents. Key considerations involve the quality and potential contamination of the fill material, which could impact floodwaters, as well as the risk of erosion leading to fill material ending up offshore. Proper coordination with existing street levels is essential for successful implementation in both methods. Each approach presents its unique set of challenges and considerations, necessitating careful evaluation based on specific building characteristics and project goals (Meguro, 2023).

Consider, "If you go to war with water, you will always lose." - an allusion to Caligula.

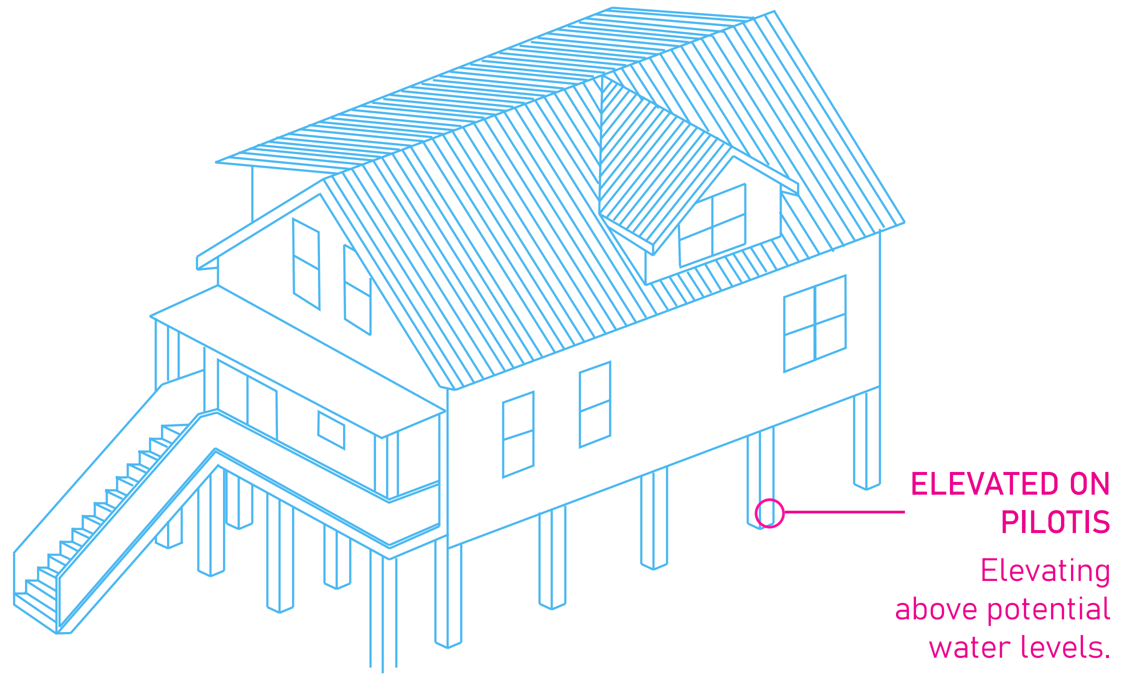


FIGURE 7: ELEVATED ON PILOTIS

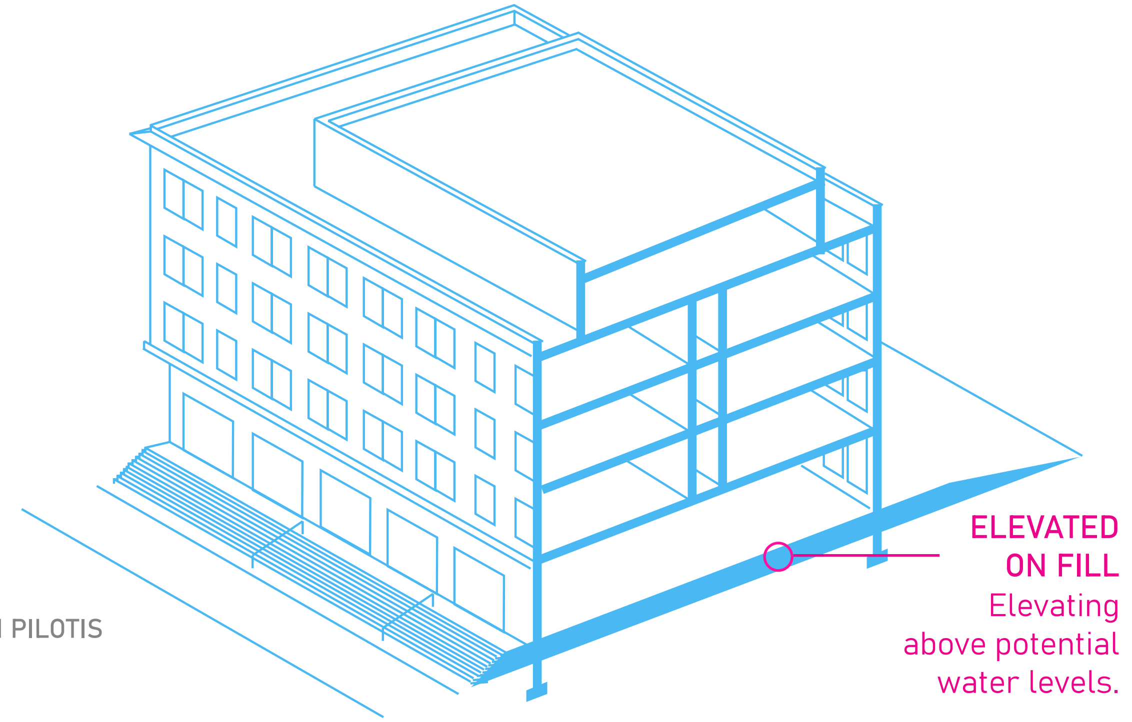


FIGURE 8: ELEVATED ON PILOTIS

## RELOCATING CRITICAL SYSTEMS

Relocating critical systems to higher levels is indeed a crucial strategy in addressing the impacts of rising sea levels, and it should be a top priority for both commercial and residential settings. This strategy ensures the continued functionality and safety of essential infrastructure (Meguro, 2023).

When considering this relocation, challenges may arise, particularly when dealing with large generators in basements. Structural limitations may prevent their placement on the roof, and adapting the second floor for such point loads can be complex, as it may not have been originally designed for this purpose. Furthermore, addressing the placement of fuel tanks for generators is essential to ensure accessibility for delivery services (Meguro, 2023).

One alternative solution worth exploring is the replacement of fuel tanks and generators with battery storage systems, which can be more adaptable to various locations and are environmentally friendly. However, transitioning to battery storage may come with its own set of technical and logistical considerations (Meguro, 2023).

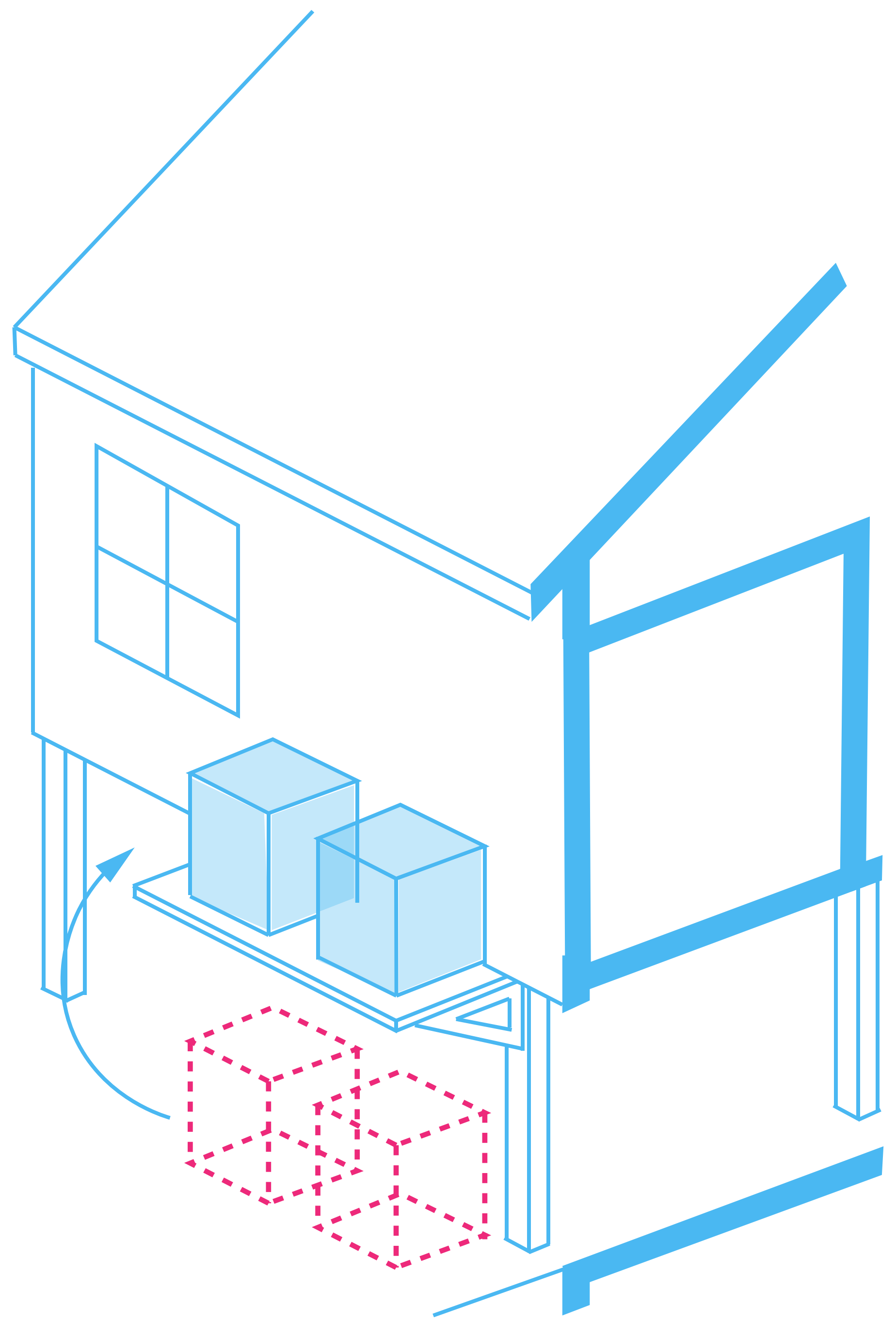

FIGURE 9: RELOCATING CRITICAL SYSTEMS

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## FLOODPROOFING

Dry Floodproofing is a temporary, established technology, but the temporary barriers won't hold the impact of a wave or strong current. There is a folly in thinking we can dry floodproof, which only protects from king tides, big rain events and slowly rising sea level when we will be hit by a big hurricane. This would not work with higher water (pressures); most structures probably aren't designed to handle this. This works great until it doesn't. Eventually you'll have to fill it. If elevators and electrical get flooded, it gets expensive to fix. This is a Temporary barrier for big rain events but a band-Aid for event-based flooding. Also, should this protection need to totally cover the building's circumference so Anything below DFE should not be critical for the facility (Meguro, 2023).

The wet floodproofing approach described appears to be one of the more practical and adaptable options available. It accommodates water flow with minimal damage to the building, making it cost-effective and physically less disruptive. This method serves as an interim solution, allowing for flexibility in addressing rising sea levels. By raising the floor of an 18-ft high lobby, for instance, the building can adapt as roads are elevated, transitioning the lower level into a floodable basement (Meguro, 2023).

It's crucial to consider the potential corrosion of rebar in concrete, which can fail within 20 years when exposed to water. For a 100-year lifecycle, stainless steel reinforcement may be necessary, albeit at a higher cost. Extensive research is needed to identify materials that can withstand full submersion or prevent water from seeping down and combining with rising groundwater tables, thereby saturating the foundation. This approach necessitates comprehensive encapsulation of both the interior and exterior to effectively address the challenges posed by rising sea levels (Meguro, 2023).

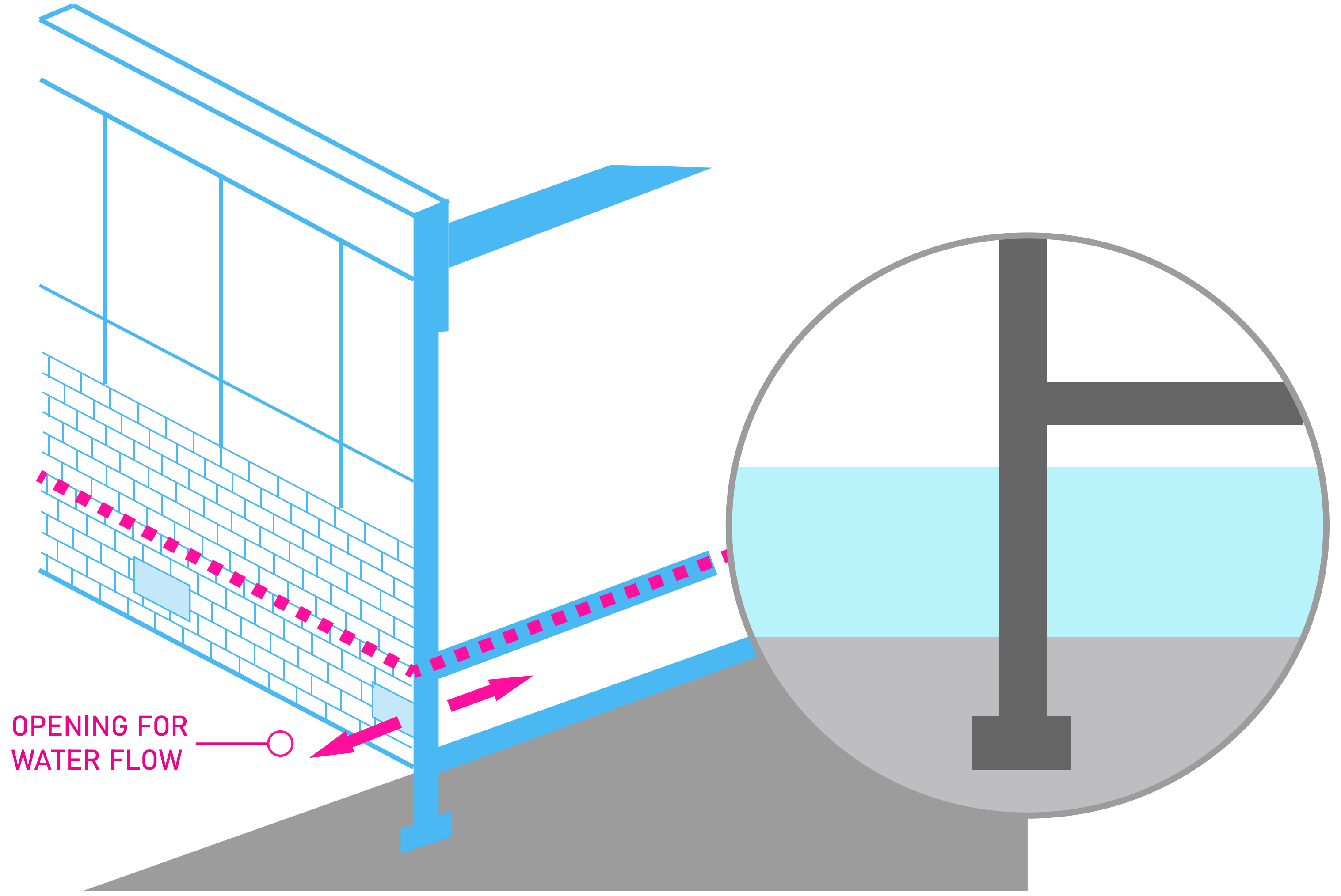


FIGURE 10: WET FLOODPROOFING

## USING ECOLOGIES

Turning existing green space into floodable usable space for rising sea levels is a promising approach to adapting to climate change. It involves designing and managing green spaces in a way that allows them to flood and drain safely, while still providing valuable benefits to people and wildlife (Meguro, 2023).

There are many ways to design and manage floodable usable space. One common approach is to create multi-purpose spaces that can be used for both recreation and stormwater management. For example, a park could be designed with wetland areas that can store and filter stormwater during heavy rainfall. These wetland areas could also provide habitat for wildlife and improve air quality (Meguro, 2023).

In addition to the elevation of streets and buildings, the method introduces an innovative concept: a living seawall designed to counter the effects of rising waters. This seawall serves multiple functions, including preventing land from being submerged by rising waters, retaining stormwater, and absorbing the impacts of future storm surges and waves (Meguro, 2023).

The elevated buildings in this design accommodate floodable ground floors, providing a practical solution for managing increased water levels. Furthermore, elevated streets incorporate a network of new pipes designed to channel stormwater either to the bay or a designated park area. This holistic approach not only addresses the immediate challenges posed by rising sea levels but also embraces sustainable and adaptive strategies to create a more resilient and environmentally friendly urban landscape (Meguro, 2023).

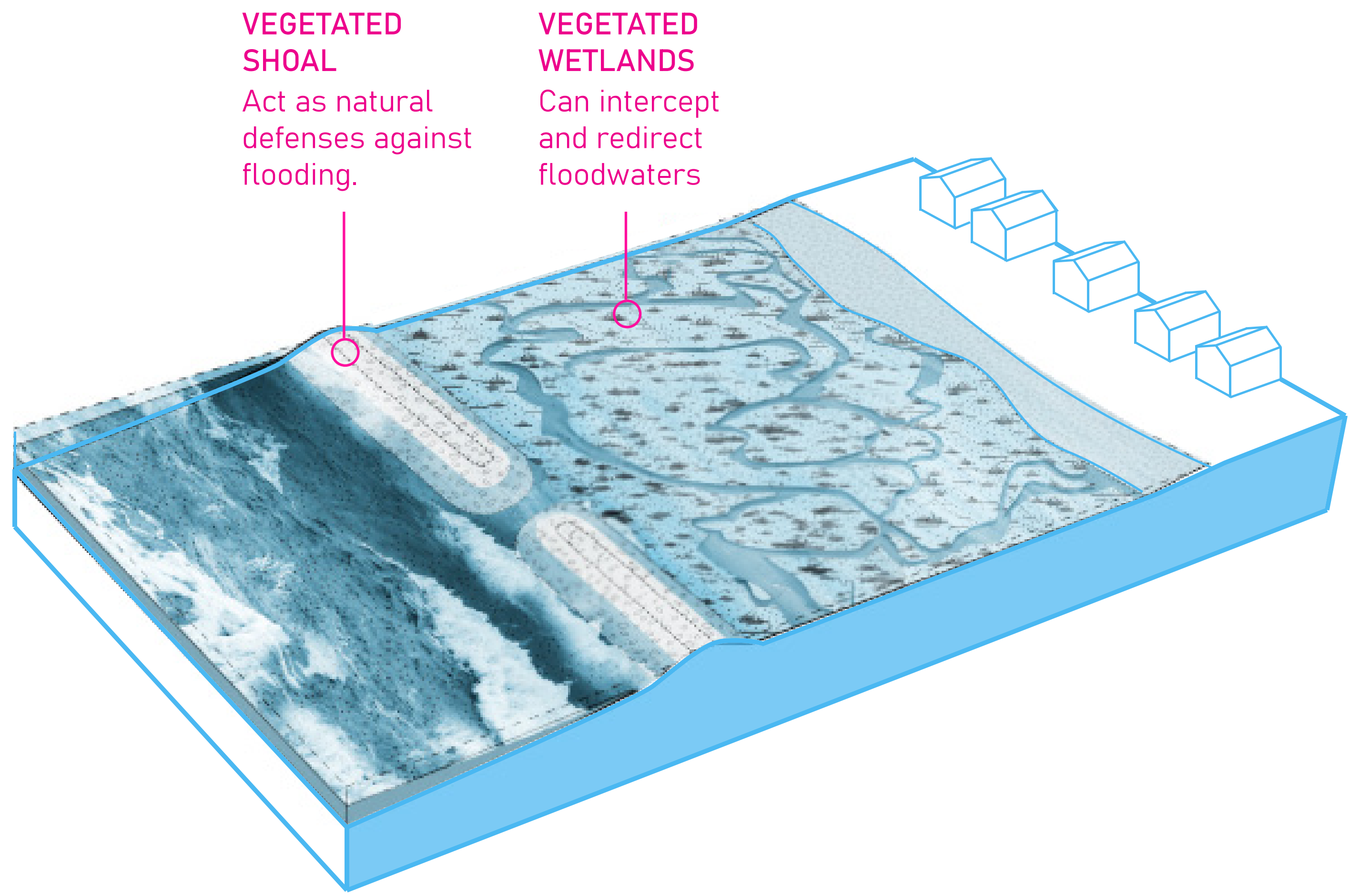


FIGURE 11: USING ECOLOGIES

# + FUTURE CONSTRUCTS

**WHAT MATERIALS ARE BEST TO USE?**
Concrete

**HOW CAN THESE STRUCTURES BE BUILT?**
On Pilotis
Floating

**HOW CAN THE CONCRETE BE PROTECTED?**
Paints
Additives - Calcilte

**HOW CAN WE ADDRESS SUSTAINABILITY?**
Algae

**THE RESPONSE**
Designing architectural structures on water, particularly as a response to flooding, introduces a distinctive set of prospects and challenges. These innovative approaches to flood-resistant and flood-resilient architecture aim to alleviate the impacts of flooding and adapt to evolving climate conditions.

**ADAPTIVE SOLUTIONS**
These innovative constructions are designed to adjust their height in accordance with fluctuating water levels, thereby enhancing resilience to flooding.

Floating residences, hotels, and offices are gaining prominence, offering occupants a unique water-centered lifestyle while bolstering flood resistance. Concurrently, some architectural approaches integrate elevated platforms and piers, elevating structures above anticipated flood levels. These versatile platforms serve a range of purposes, from providing parking spaces and communal areas to supporting green roofs, all the while safeguarding the core structure from inundation (Meguro, 2023).

Further enhancing flood resilience involves the incorporation of green infrastructure elements like floating gardens and wetland zones, adept at absorbing excess water during floods while augmenting the aesthetic appeal of the surroundings. Meanwhile, waterfront areas can be transformed into versatile mixed-use developments, housing a blend of commercial, residential, and communal spaces. These multifunctional settings promote the growth of resilient and adaptable communities, capable of thriving in the face of periodic flooding. By integrating these multifaceted opportunities into waterborne architecture, communities can enhance their preparedness and response to flooding while cultivating urban environments that are sustainable, resilient, and responsive to evolving challenges, such as climate change (Meguro, 2023).

FIGURE 11: ELEVATED HOMES ON SHORELINE
(WIlcox, 2020)

# + ELEVATE

## ON PILOTIS

There are several different ways of constructing in the water but the two that will be considered for the scope of this project are driven piles and cofferdams. Cofferdams are temporary enclosures that allow water to be pumped out, creating a dry environment for construction. As the name suggests, cofferdams work similarly to dams, preventing the flow of water from a particular area. A fully constructed cofferdam looks like a large, walled pit with water surrounding it (Huber, 2017).

When building foundational elements underwater, driven piles enable crews to create sturdy structures without having to remove any water at all. Piles, which look like long, vertical columns, can be driven into the ground using a powerful hammer, creating a stable foundation for underwater or overwater structures. In underwater construction, piles are most often made of steel, though they have a partially hollow interior. After the piles are placed, a tube is used to fill the inside of the pile with concrete, which displaces the water that was previously inside the pile. Concrete can set even when surrounded by water, and what remains at the end of this process is a steel-reinforced concrete pillar with no water inside of it. Driven piles are one of the most cost-effective ways to build foundational elements of underwater buildings, which need to be securely attached in place to prevent moving with the water's current.

FIGURE 12: STEEL BRIDGE OVER OCEAN
(SIM, 2020)

## GALVANDIZED STEEL PILE

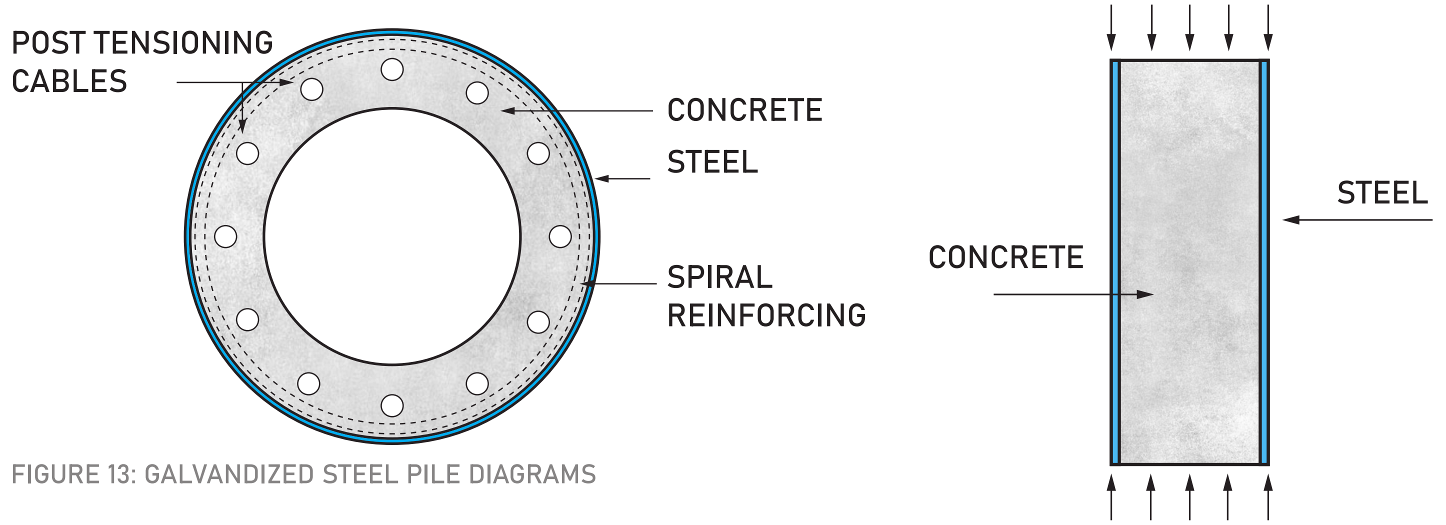


FIGURE 13: GALVANDIZED STEEL PILE DIAGRAMS

## WATER ANALYSIS:
### HOT TIDAL CREEK

| Cations – | Anions – |
|---|---|
| Calcium 1,200 | Bicarbonate 200 |
| Magnesium 3,800 | Sulphate 7,200 |
| Sodium/potassium 29,400 | Chloride 53,000 |

Originally built in 1962, the Caltite protected support chairs remain in excellent condition today.

## MATERIALS

The root cause of chloride induced concrete corrosion is the fact that all normal concrete is very absorptive, and the speed of absorption is rapid. Under conditions of wetting and drying it relentlessly sucks in and absorbs water, moisture and contained salts (Huber, 2017).

Everdure Caltite introduces a revolutionary ingredient to enhance the durability of concrete, much like the addition of carbon to iron creates the robust material known as steel. Cast iron, once avoided in modern construction due to its brittleness, becomes steel with the infusion of a small amount of carbon, offering high tensile strength. The inclusion of chrome further refines this alloy into the corrosion-resistant "stainless" steel. In a similar vein, Everdure Caltite revolutionizes concrete by serving as a hydrophobic and pore-blocking liquid ingredient with a built-in corrosion inhibitor. When incorporated into the concrete mix, it reverses the usual capillary action, resulting in ultra-low absorption concrete (Cemetaid, 2019).

Typically, standard high-quality concrete is ill-suited for marine structures, as it naturally absorbs water, moisture, and potentially harmful salts, thus creating the electrolytic connection between the anodic and cathodic regions of the reinforcement. However, the addition of Everdure Caltite effectively transforms traditional concrete, bestowing upon it a range of advantageous properties with significant technical, commercial, and environmental benefits (Cemetaid, 2019).

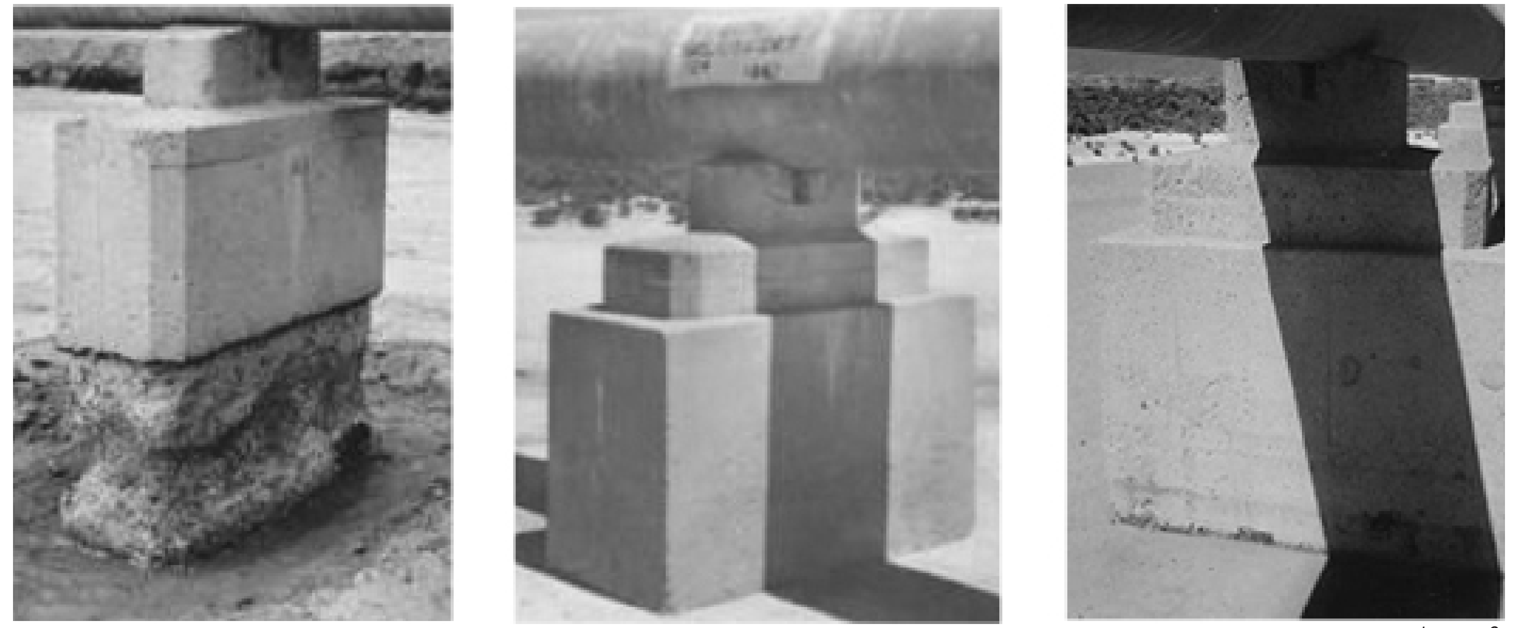

Image8

20 year old traditional concrete | Lightly reinforced calcite concrete | Same calcite concrete after 50 years

## INGRESS OF SALT INTO PORUS CONCRETE

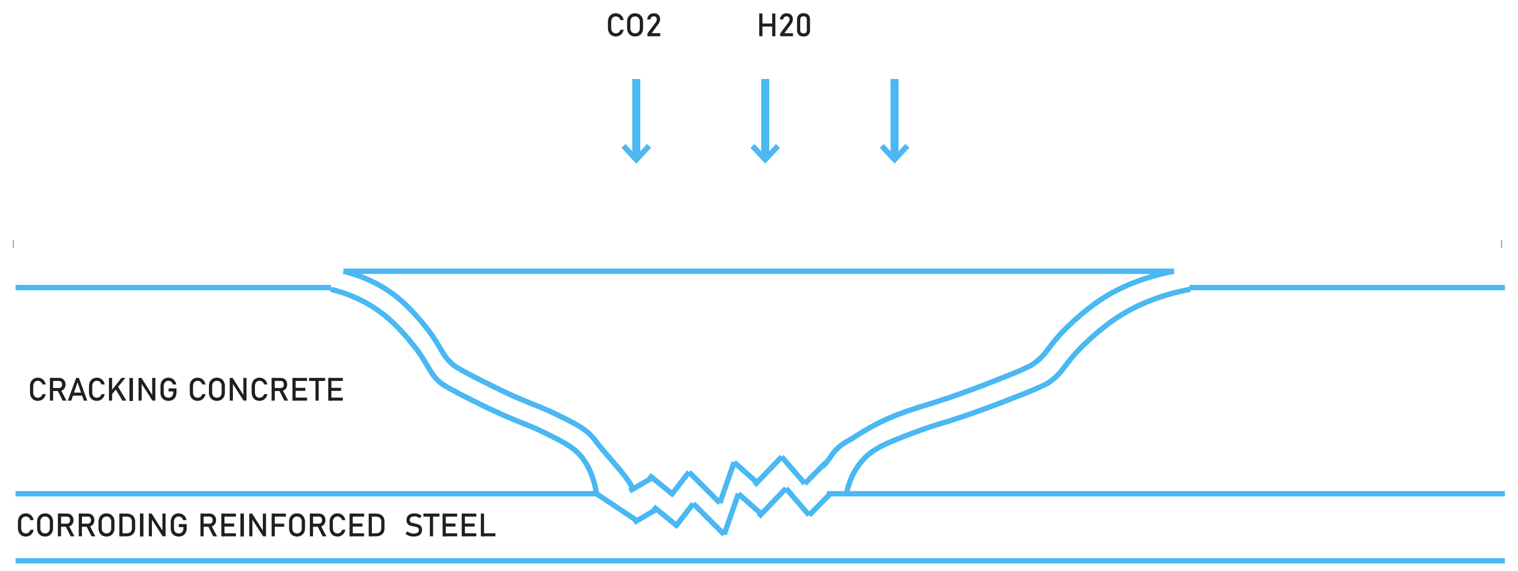


FIGURE 14: CALCITE CONCRETE CASE STUDY
(Cementaid 2019)

# + FLOAT

## FLOATING ARCHITECTURE

The concept of floating architecture, as emphasized by Shahryar Habibi in his article "Floating Building Opportunities for Future Sustainable Development and Energy Efficiency Gains," he underscores the significance of incorporating environmental sustainability indicators into the analysis and design of floating buildings to advance sustainable development. To achieve this, several key principles must be considered in the environmental design process for floating structures:

Access: Accessibility is paramount for a floating building, ensuring easy and convenient access to and from the shore to accommodate its occupants.

Flotation System: A robust flotation system is essential, capable of withstanding the most challenging combinations of loads it may encounter. It should maintain a suitable level of stability in alignment with the building's intended use and remain resilient against minor impacts.

Water Depth: To prevent grounding, a floating building must always have a sufficient water depth beneath it.

Materials: The selection of materials, including those related to fastening, must align with the environmental conditions they will face.

Mooring Lines: Mooring lines, connecting the floating building to deck fittings and other supporting structures, must be robust and capable of withstanding lateral pressures resulting from various forces that may act on the floating structure, including those from attached vessels or mooring piles (Czapiewska, 2014).

FIGURE 15.1: GROWTH PROPOSAL 2020-2030
(Czapiewska, 2014).

## WHY FLOATING?

Floating buildings and houses offer several distinct advantages over traditional structures, making them increasingly popular in various contexts. Here are some of the key benefits associated with floating buildings:

Minimal Environmental Impact: Floating buildings can have a lower ecological footprint as they minimize disturbance to natural ecosystems. They are particularly eco-friendly in areas prone to flooding, where traditional construction can disrupt wetlands and wildlife habitats.

Efficient Construction: Floating buildings often employ prefabricated materials and components, leading to faster and quieter construction processes. This reduces disruption to surrounding areas and communities.

Adaptability: Floating structures can be relocated easily, making them suitable for areas with changing water levels or evolving needs. This adaptability can be advantageous in response to climate change and shifting population dynamics.

Reduced Flooding Risk: Floating buildings are inherently designed to handle water, reducing the risk of flood damage to the structure itself. This can be particularly valuable in flood-prone regions.

Sustainable: By being on the water, opportunities arise for the use of biofuels and more innovation regarding food source (Czapiewska, 2014).

FIGURE 15.2: GROWTH PROPOSAL 2040-2050
(Czapiewska, 2014)

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## DESIGN OBJECTIVES

This section elaborates on the design objectives. The six most important objectives are: movability, dynamic geography, growth, seakeeping, safety, and water experience. Each objective will be discussed, including how the objective will influence the design of the floating city.

## MOVABILITY

The mobility of a floating community, crucial for relocating when its current site is no longer viable, is intricately linked to its capacity to move. Larger structures typically employ straightforward mooring systems, facilitating quicker relocation. Conversely, smaller floating structures often exhibit more connections to city elements and the ocean floor. While relocations are generally infrequent, if they occur at all, in specific regions, the ability to move away from hurricanes or cyclones would confer a significant advantage (Czapiewska, 2014).

## DYNAMIC GEOGRAPHY

A seastead holds the promise of expanding freedom on the levels of cities, communities, and individuals, offering diverse spatial configurations. Notably, two well-suited options are islands and branches, each featuring a restricted number of residences. Islands are connected by bridges or jetties, while branches interconnect via a flexible hinge, facilitating easy disconnection. Both designs cater to individuals, families, and, in the case of branches, small family communities. This adaptability empowers people to relocate to various places, enriching the concept of dynamic geography (Czapiewska, 2014).

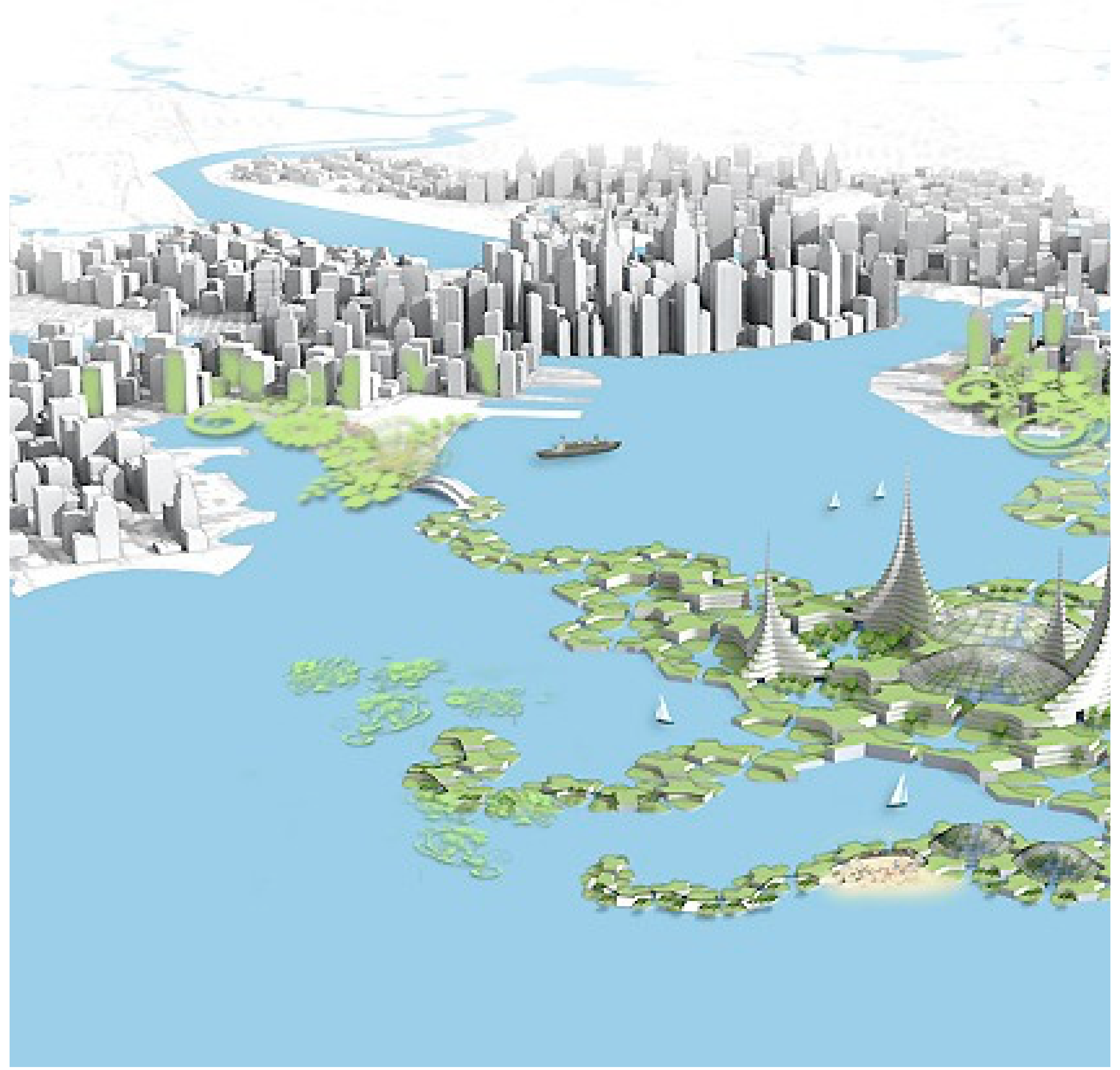

FIGURE 15.3: FLOATING ARCHITECTURE PROPOSAL
(Czapiewska, 2014).

## SAFETY

Seakeeping involves two aspects: surviving harsh conditions in a protected bay and adapting for survival on the open sea, which includes dealing with issues like water depth, large waves, and storms. These challenges affect mooring, wave management, and comfort.

The cruise ship and submerged options are considered unsuitable for providing citizen comfort. Cruise ships experience excessive swell, while the submerged option lacks direct access to fresh air and sunlight. Therefore, the most appropriate choices for ensuring seakeeping comfort are the oilrig and the breakwater structure, offering better stability and comfort for long-term habitation in challenging maritime environments.
(Czapiewska, 2014)

## WATER EXPERIENCE

The concept of water experience within a seastead can be divided into two categories: visual and physical. Visual experience pertains to residents' ability to see the water, while physical experience encompasses activities like swimming, sailing, diving, aquaculture, and surfing (Czapiewska, 2014).

Living in a waterfront neighborhood is favored over residing on an oil rig or a cruise ship, where the connection to the water is purely visual and distant. In this case, smaller platforms provide a more immersive water experience. An island and branch option housing arrangement would offer the best water experience, as they minimize the distance to the water, ensuring that all houses have direct contact with it (Blue 21, 2014).

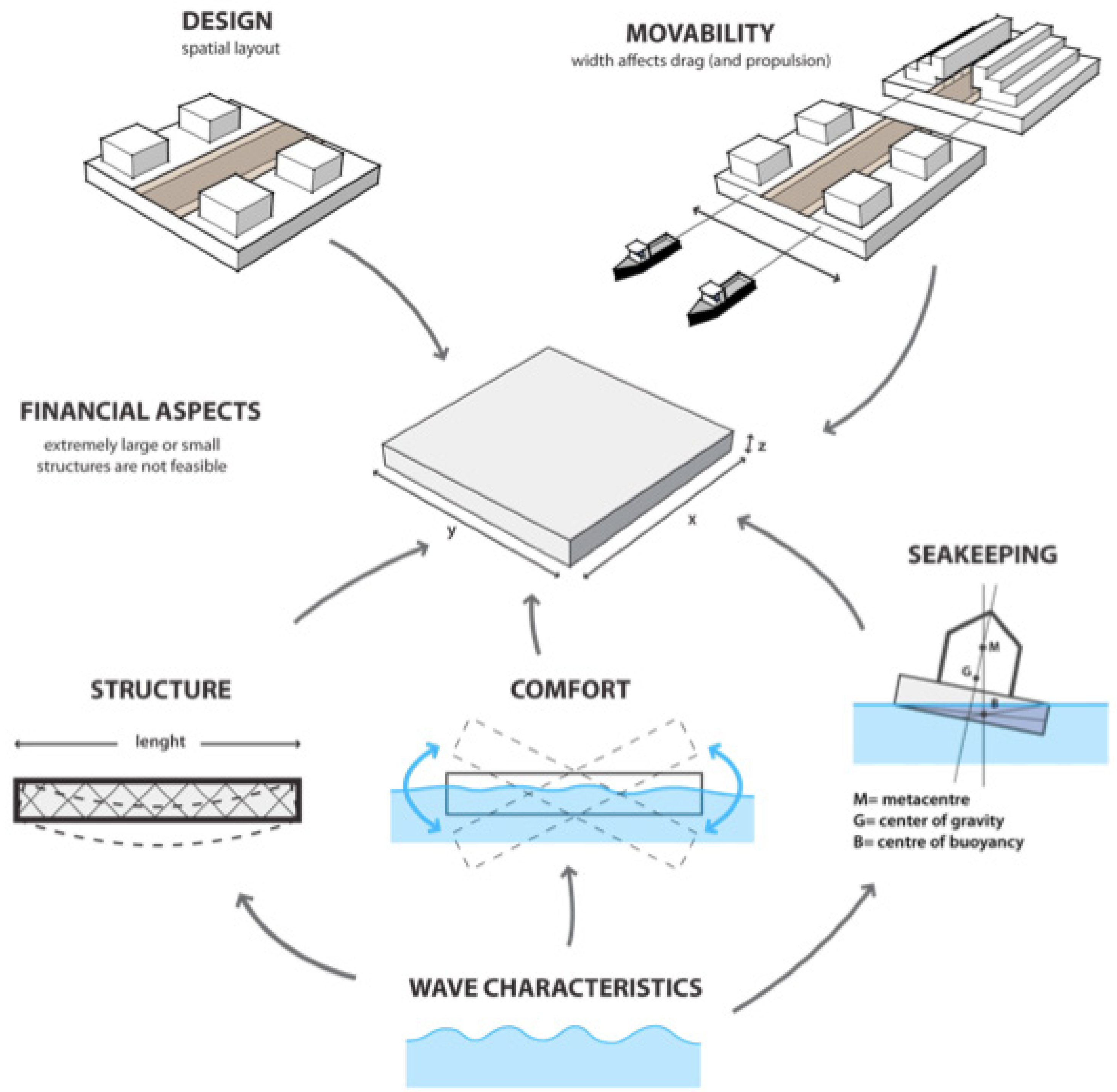


FIGURE 15.4: FLOATING ARCHITECTURE PROPOSAL
(Czapiewska, 2014)

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## PLATFORM

### WAVES

Understanding wave characteristics is crucial as they directly impact the size and design of the platform. The wave characteristics in the chosen locations for the initial phase of the seastead, which are likely to be bays or gulfs, are expected to be significantly more favorable than the challenging conditions experienced on the high seas (Blue 21, 2013).

### WIND

Wind blowing on the water is the primary cause of wave formation. The size of the wave depends on the strength and duration of the wind, as well as the water depth. Large waves formed in open seas can continue traveling for long distances after the wind has stopped blowing. As these waves travel, they are influenced by tides, winds from other directions, and the shape of the shoreline. Therefore, it is important to have data on wind speed and direction for specific locations. In a bay, for example, wind waves can be predicted by knowing the fetch and the wind speed. This allows wave protection to be applied specifically in the areas where it is needed (Czapiewska, 2013).

### CONNECTIONS

Connections, both to the ocean floor and in between different platforms are vital to the feasibility of a seasteading community. Mooring connections will keep the community stationary. In between the platforms there will be several types of connections: structural connections, utility connections and bridges. In order to enable emergency relocation, these connections not only need to be strong and flexible, but also easily disconnected (Blue 21, 2013).

## PLATFORM COMPOSITION

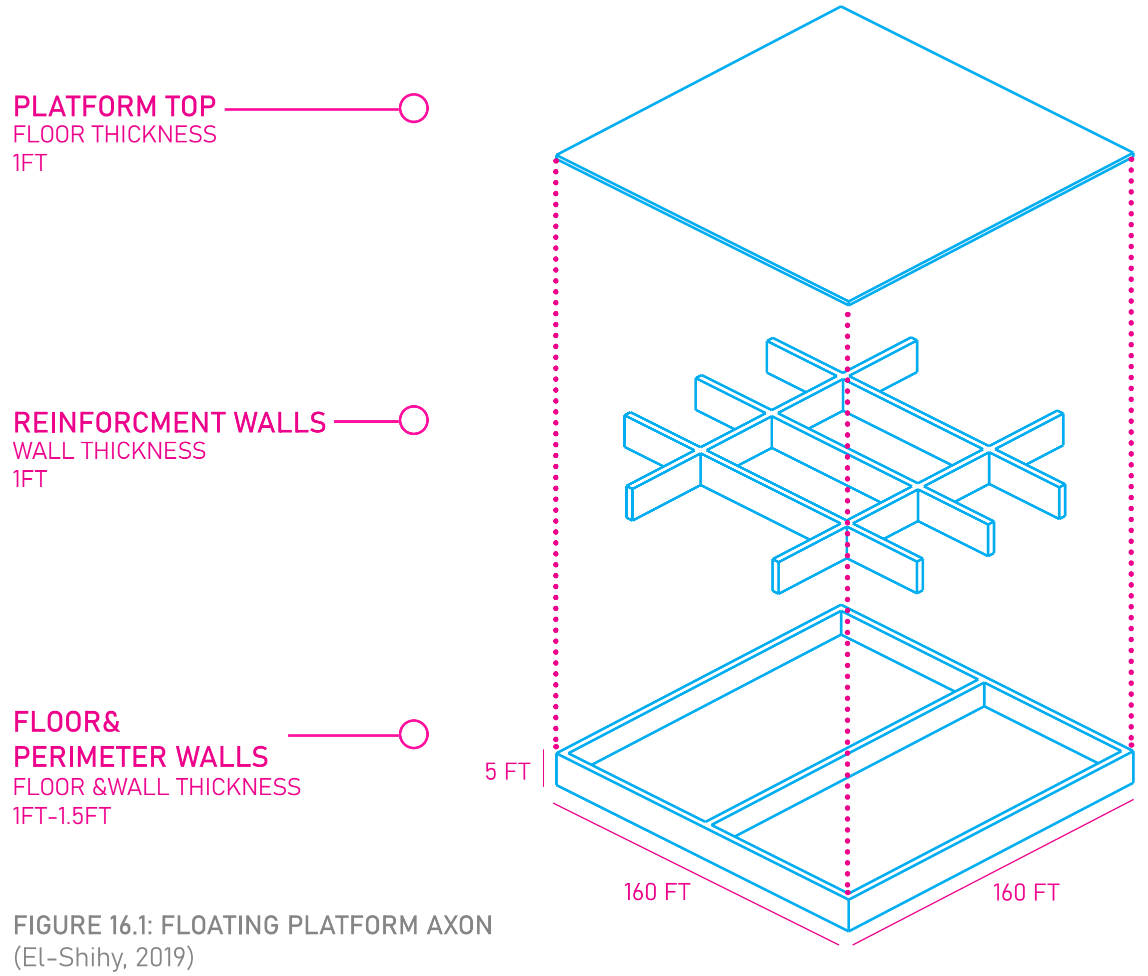



FIGURE 16.1: FLOATING PLATFORM AXON
(El-Shihy, 2019)

## WAVES

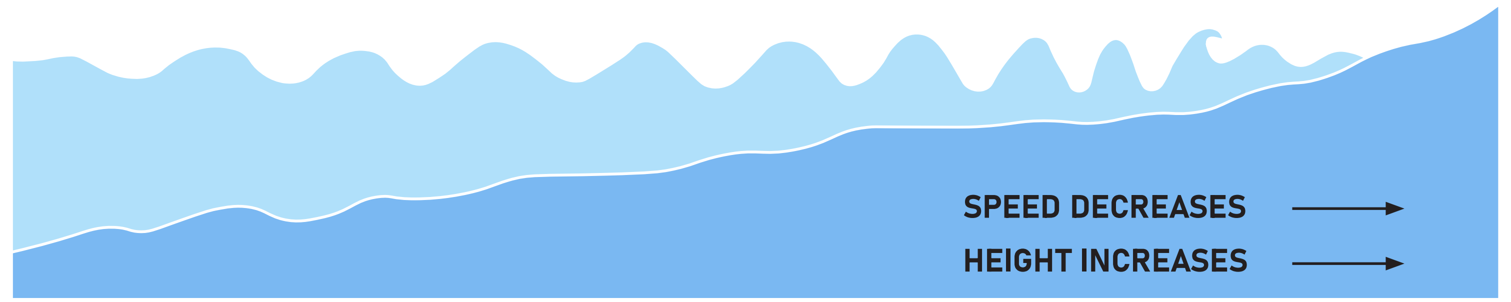



FIGURE 15.4: WAVE CONDITIONS
(Czapiewska, 2014).

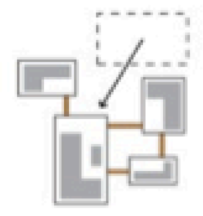
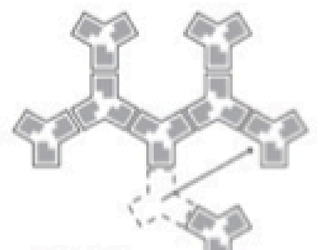
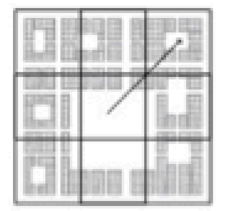
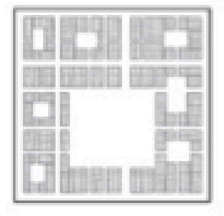
| TYPE | DESCRIPTION | PROS | CONS | PROS | CONS |
|---|---|---|---|---|---|
|  ISLANDS | Every building is located on its own platform (or hull). This enables maximum freedom of movement. Structures are connected with hinged joints. | - Optimal dynamic geography. | - Large number of connections.<br>- Large number of moorings is needed.<br>- Large swell. | - Maximum water experience. | - Less stability.<br>- Needs protection by breakwater, which may obstruct ocean view. |
|  BRANCH | The floating structures consist of several houses or other buildings. The structures can be connected with hinged or rigid joints. | - Easy to move away.<br>- Less swell than 'islands'. | - No possibility to move a single house<br>- Structures need to be uniform to be able to fit together.<br>- Large number of mooring constructions are needed | - Very good water experience.<br>- Intermediate stability. | - Needs protection by breakwater, which may obstruct ocean view. |
|  COMPOSITE STRUCTURE | Semi large structures are connected to each other until they form one larger structure. Connections are rigid. | - Fewer moorings needed.<br>- Little swell. | - Not easy to disconnect<br>- When rearranging, adjacent structures also need to be moved. | - Nice bay-like experience.<br>- Very stable. | - Many different platform types.<br>- Many rigid connections needed. |
|  SINGLE LARGE STRUCTURE | Using a large structure such as a (cruise)ship or oil platform as one unit. | - Fewer moorings needed.<br>- Little swell. | - Rearrangement not possible. | - Building shapes not limited by platform<br>- Very stable | - Little water experience, except from the edges.<br>- Even the edge has less optimal water experience, because exposed to waves. |

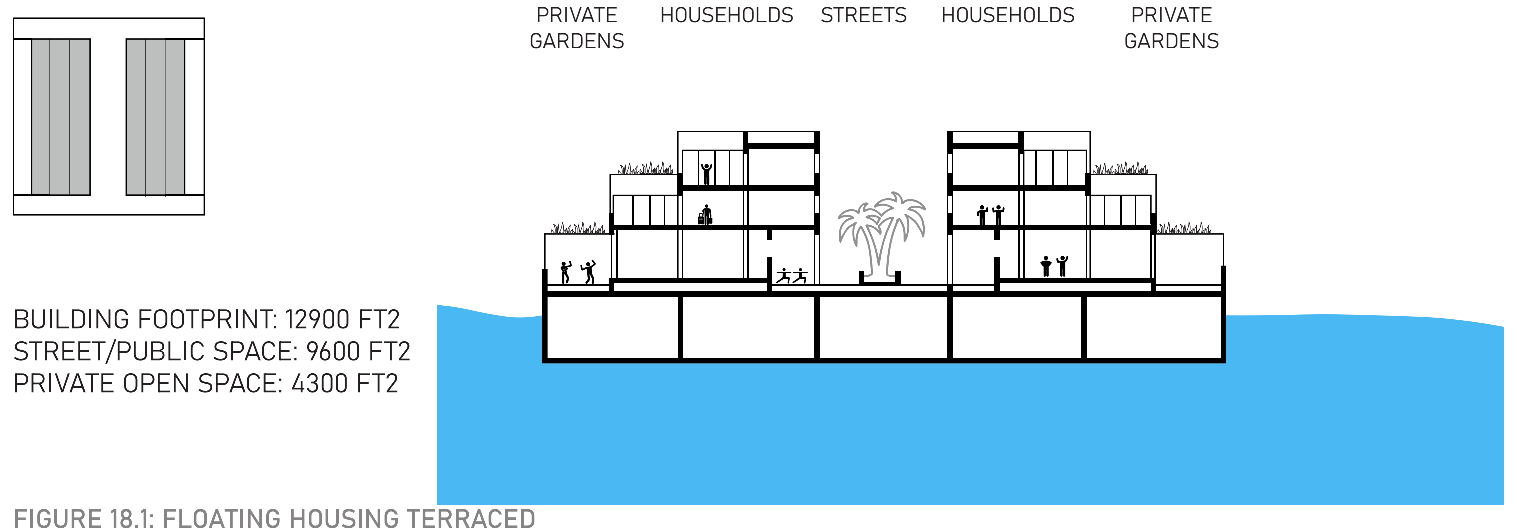
FIGURE 17: FLOATING PLATFORM STYLES
(Czapiewska, 2014)

## HOUSING TYPOLOGY

Three different housing typologies were studied for the square platform. The first typology includes 3-floor apartment blocks with large terraces oriented towards the water. On the platform, two of those buildings are constructed and the space between them is used for the street and the public green space. The edges of the platform include private open spaces owned by apartments on the ground floor. Facades on the street can include arcades that provide covered public space and protect inhabitants during rains. Ground floor space can be used for apartments, small offices and shops. Such buildings on one platform are suitable for approximately 30 inhabitants (Czapiewska, 2013).

When buildings, roads and green areas are constructed together on one platform, it is important to keep the ground floor of the buildings higher than the space outside, in order to prevent rainwater and dirt from streets and gardens to flow inside. Extensive green on the platform roof for example, can have a total height of 2-3ft, including soil, drainage layer, membranes and floor gradient. This means that building floors need to be raised some tens of centimeters in order to be higher than the exterior space. For the floating platform, two options are available. The first option is to raise the areas of the platform roof where the buildings are going to be constructed. The second option is to build one flat platform roof and raise the ground floor of the buildings enough to keep water and dirt away (Blue 21, 2013).

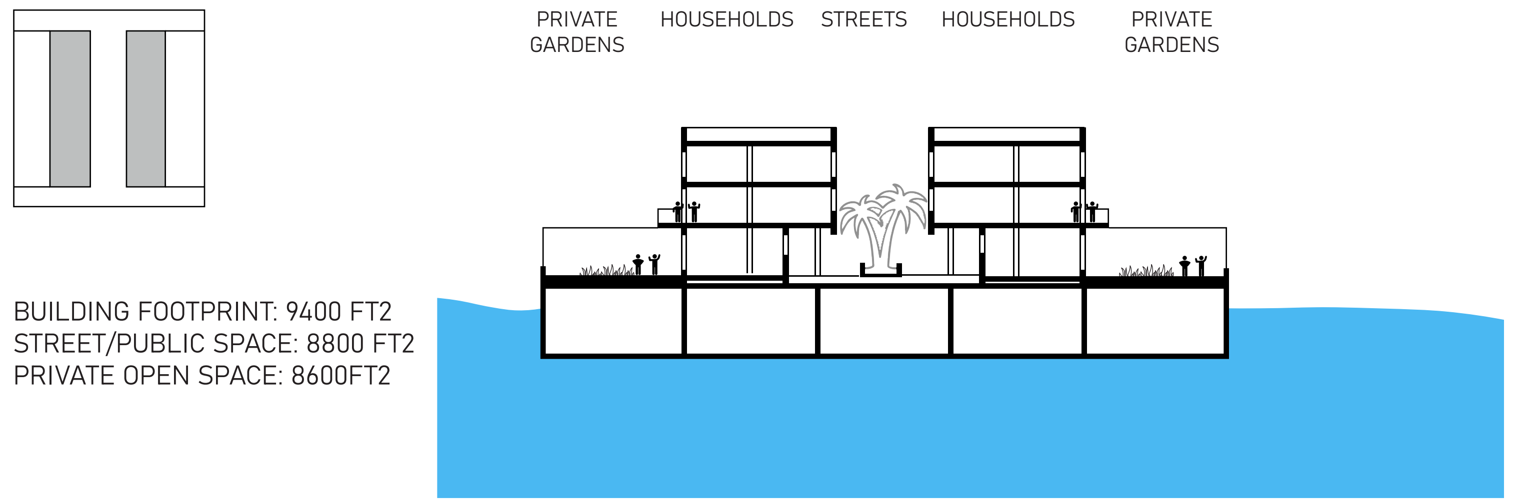
## TERRACED HOUSING BLOCK




BUILDING FOOTPRINT: 12900 FT2
STREET/PUBLIC SPACE: 9600 FT2
PRIVATE OPEN SPACE: 4300 FT2

FIGURE 18.1: FLOATING HOUSING TERRACED
(Czapiewska, 2014)

## APARTMENT BLOCK




BUILDING FOOTPRINT: 9400 FT2
STREET/PUBLIC SPACE: 8800 FT2
PRIVATE OPEN SPACE: 8600FT2

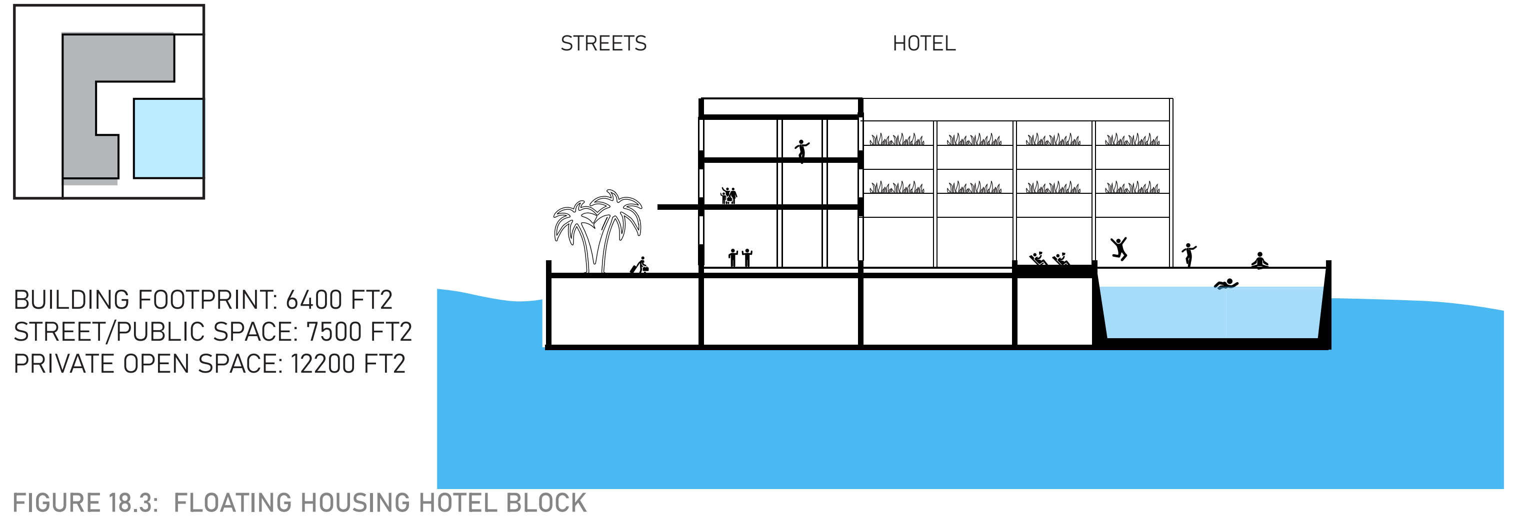
FIGURE 18.2: FLOATING HOUSING APARTMENT BLOCK
(Czapiewska, 2014)

## COMMERCIAL TYPOLOGY

In addition to residential typologies, the inclusion of a block for hotel and office space further enriches the functionality of the platform. By integrating commercial and hospitality functions, the design creates opportunities for economic activity and cultural exchange within the floating community. The hotel and office block can be strategically positioned to optimize views and accessibility, enhancing the overall appeal and livability of the waterfront environment. Additionally, incorporating sustainable design features such as green roofs and energy-efficient systems can contribute to the long-term viability and resilience of the development (Czapiewska, 2013).

Overall, the exploration of housing typologies and mixed-use blocks underscores the importance of thoughtful planning and integration of diverse elements to create vibrant and sustainable floating communities. By prioritizing functionality, adaptability, and environmental stewardship, such designs can offer innovative solutions for urban living in coastal areas (Czapiewska, 2013).

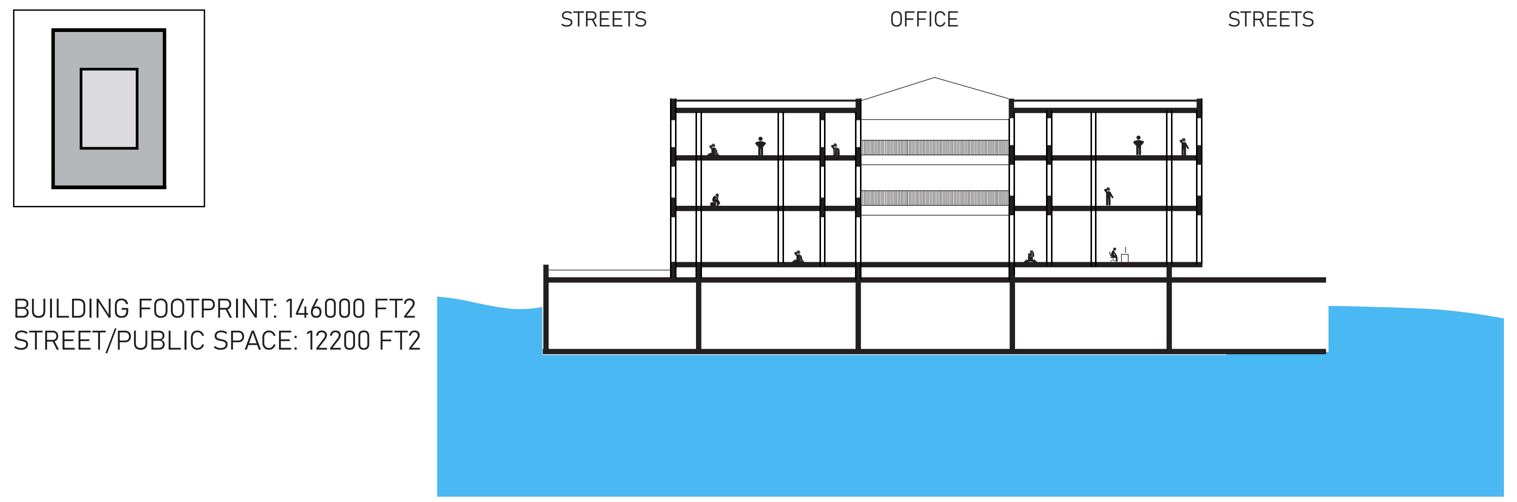
## HOTEL BLOCK




BUILDING FOOTPRINT: 6400 FT2
STREET/PUBLIC SPACE: 7500 FT2
PRIVATE OPEN SPACE: 12200 FT2

FIGURE 18.3: FLOATING HOUSING HOTEL BLOCK
(Czapiewska, 2014)

## OFFICE SPACE BLOCK




BUILDING FOOTPRINT: 146000 FT2
STREET/PUBLIC SPACE: 12200 FT2

FIGURE 18.4: FLOATING HOUSING OFFICE BLOCK
(Czapiewska, 2014)

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# + SUSTAIN

## ALGAE

Waste could be used as inputs by floating cities to grow algae and produce food and biofuels (Blue Revolution). Biofuel can be produced on the water, 10 to 20 times more efficiently than crops and without competing for scarce agricultural land. Biofuel production from microalgae has a lipid content of around 40%, giving biodiesel yields of 40 to 50 tons per ha per year. This means that a floating city could be able to produce energy through the reuse of waste products as wastewater and CO2. Another benefit is the positive impact that floating cities will have on the ecosystems. By extracting nutrients and CO2, water quality of aquatic ecosystems can be significantly improved (Czapiewska, 2013).

Floating algae and seaweed farms could be constructed within the seastead. An innovative system to grow algae on the sea is the OMEGA (Offshore Membrane Enclosure for Growing Algae), developed at NASA by Jonathan Trent. OMEGA is a collection of closed photo-bioreactors constructed out of flexible plastic that can be filled with treated municipal or agricultural wastewater that would normally be discharged into the ocean. The modules float on the sea surface, maintaining the algae in ample sunlight. Forward osmosis membranes allow clean water to diffuse out of the bioreactors, leaving inside an algal paste, which can be easily harvested and processed into biofuels, animal feed, fertilizer, and other bio- products (NASA, 2012).

FIGURE 19: ALGAE BLOOM
(McNeil, 2017)

## FOOD PRODUCTION

In combination with algae culture, food production can be realized in floating cities. There are multiple concepts and technologies available for water-based food production. Local food production is fundamental for some products, fresh vegetables in particular, which would be more difficult to keep fresh while being shipped from the land to the floating city (Czapiewska, 2013).

On the seastead, the cultivation of fresh vegetables is made possible through aquaponics, a self-contained ecosystem that merges aquaculture and hydroponics. Hydroponics involves growing plants in a nutrient-rich liquid solution, utilizing water and essential nutrients. Plants and bacteria play a dual role in water purification, utilizing the nutrients produced by fish. This method significantly reduces water usage for crop cultivation, cutting down to one-tenth of conventional vegetable farming, and minimizes water consumption in single-use fish farming by 95% or more (Czapiewska, 2013).

The aquaponic system is versatile, supporting the growth of tomatoes, bell peppers, cucumbers, herbs, lettuce, spinach, chives, watercress, and other plants alongside tilapia, trout, perch, arctic char, and bass in freshwater environments. Additionally, for saltwater fish, an integrated multi-trophic aquaculture (IMTA) system aligns with the concept of circular metabolism. IMTA efficiently recycles leftover feed, waste, nutrients, and by-products of one species, converting them into fertilizer, feed, and energy to support the growth of other species. This sustainable approach combines fish with "extractive" species that derive nutrients from the environment (Blue 21, 2013).

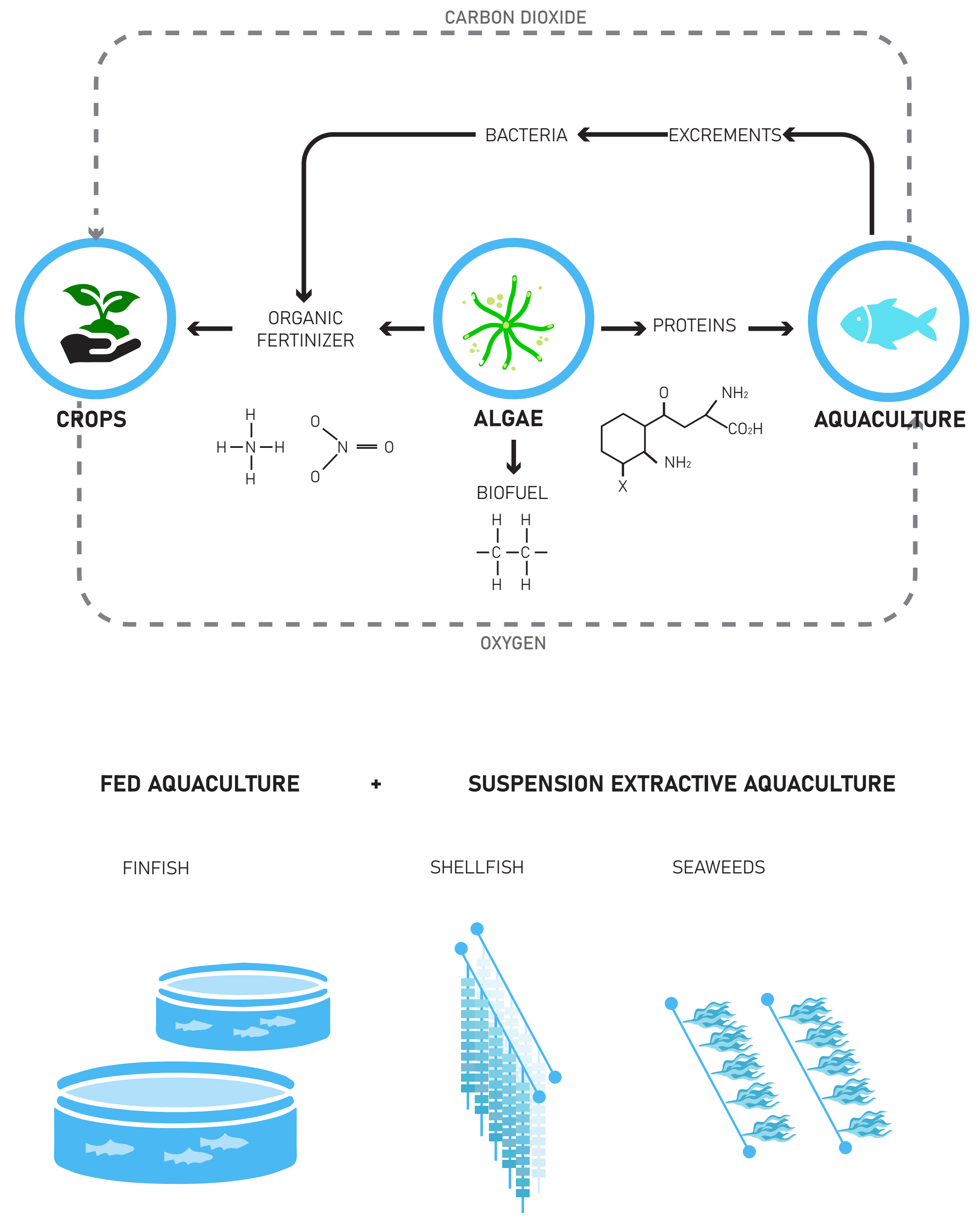


FIGURE 20: WASTE UPCYCLING DIAGRAM INSPIRED BY BLUE 21
(Czapiewska, 2014)

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## SUSTAINABLE SYSTEM

Cities use clean water as an input and produce wastewater as an output. Rainwater is a resource that is not often utilized. However, rainwater can be applied for many purposes. On a seastead in particular, rainwater could be an important resource of freshwater. If rainwater will not be collected, fresh water would need to be imported or produced locally from desalination of seawater (Czapiewska, 2013).

For these reasons, rainwater collection and storage should be provided on the seastead. In warm-humid climates, dry and rainy periods usually alternate. To ensure the use of rainwater during dry months, adequate rainwater storage needs to be provided. On the seastead, precipitation can be collected using buildings' roofs and the floating platforms, and stored in flexible tanks. Rainwater can be treated and used for cooking, drinking, showering and bathing. After use, water could be collected in another tank for grey water. Grey water is not suitable for drinking use but, with adequate treatment, can be used for washing machines and toilets. While water used for the washing machine goes back to the grey water tank, wastewater from toilets could be used as a free source of nutrients for algae. When wastewater is pumped in OMEGA floating bioreactors, algae extract nutrients and clean water is slowly released in the sea (Czapiewska, 2013).

## SUSTAINABLE ENERGY

One of the anticipations of The Seasteading Institute is to settle in tropical climate zones. One of the benefits of these regions is the availability of a vast amount of solar power. Solar panels generate electrical power by converting solar radiation into direct current electricity with semiconductors.

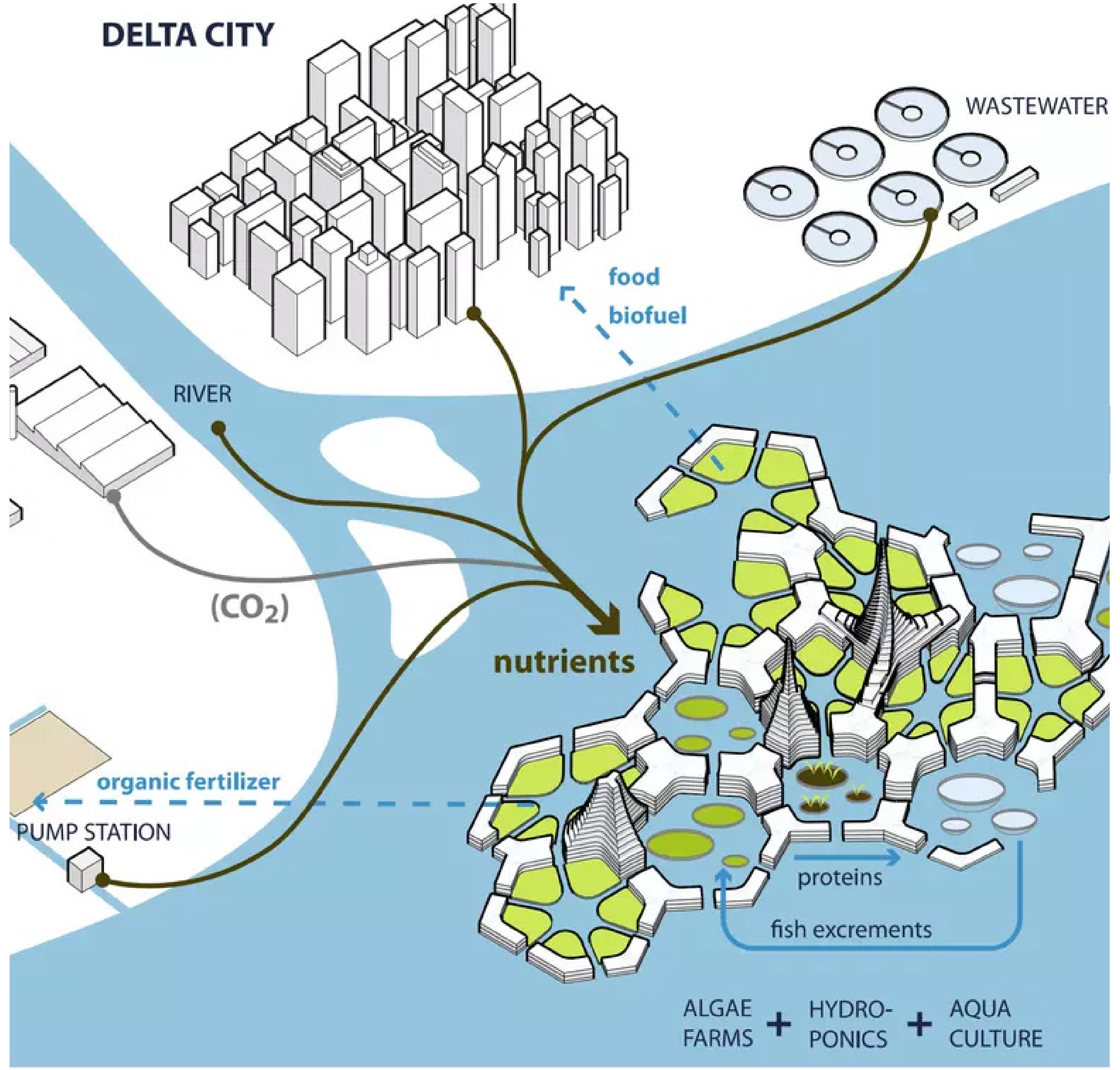


FIGURE 21: BLUE 21 SUSTAINABLE DIAGRAM
(Czapiewska, 2014)

## CONNECTION TO COAST

The combination of the initial small scale of the seastead and the continuity of the economic processes would be easier with a large coastal city nearby. In the past, settlements that developed into cities were usually built as trading centers or as fortifications to defend strategic locations. For this reason, most major cities are located along rivers or harbors, or at the junction of important overland trade routes. This new city should consider this. The general observation from studying the growth of cities is that three major influences are responsible: economic growth, natural increase and rural-urban migration. The most significant reason to move into a city is economic opportunity. Important pull factors are expectations of jobs and comfort, while the main push factors are adverse circumstances in the countryside (Czapiewska, 2013).

While experimentation with rules and new forms of government is the highest priority for the seastead, economic influences cannot be ignored. This means the city should be attractive for a diverse array of manufacturing and service-based companies. Also, sufficient incentives should be developed for companies and entrepreneurs to move to the seastead. Such incentives should include clear and simple legislation, low taxes, lower office rents than in the city center, a diverse and well-educated workforce, access to knowledge, technology and innovation, good (public) transport connections to the wider metropolitan area, especially when the city is small at the beginning. Another important asset is access to global markets through connections to an airport and seaport. The first floating city in the world will also attract many tourists to create opportunities for recreational businesses like hotels and restaurants (Czapiewska, 2013).

FIGURE 22: BLUE 21 SUSTAINABLE RENDER
(Czapiewska, 2014)

# + SOCIODEZIGN

## SOCIAL SPACE

A social space is a physical or virtual space where people gather and interact. It can be a public space, such as a park or plaza, or a private space, such as a home or office. Social spaces are important for fostering a sense of community, promoting social cohesion, and providing opportunities for interaction and engagement. When designed and managed well, social spaces are valuable to urban settings (Pacheco, 2017).

## PUBLIC SPACE

A public space, as mentioned before, is a form of social space. It is an area open to the public. People come together to socialize, relax, and enjoy their surroundings (Pacheco, 2017). Public spaces can be found in both urban and rural settings, and they take many forms such as:

- Parks
- Plazas
- Ampitheatre's
- Beaches
- Shorelines
- Walkways
- Communal Gardens
- Retail
- Theatres
- Atriums

Characteristics of well designed public spaces include the following key characteristics:

- Accessibility
- Safety
- Functionality
- Aesthetics
- Welcoming
- Vibrant
- Meaningful

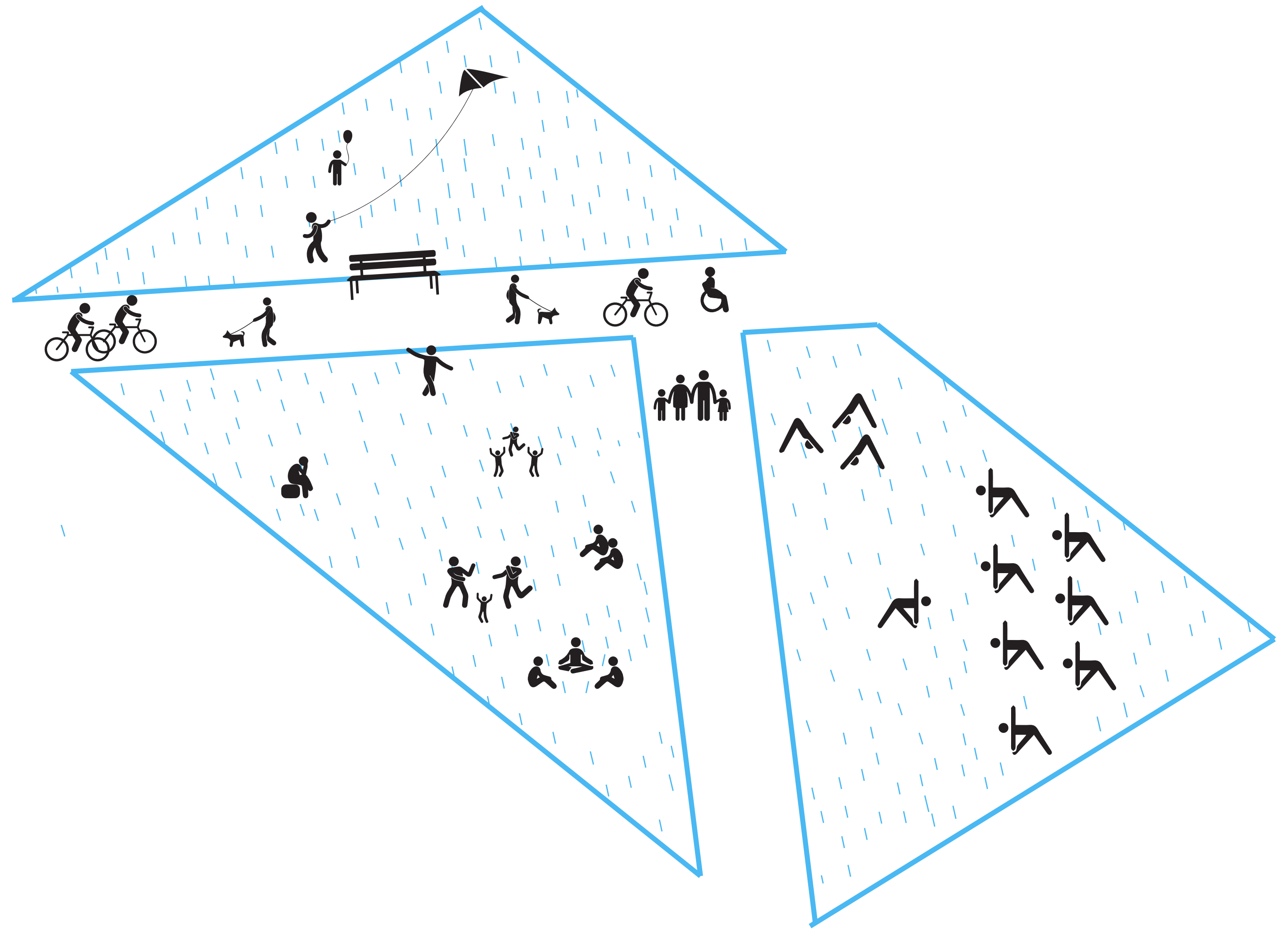

FIGURE 23.1: PUBLIC PARK

### ROOFTOP

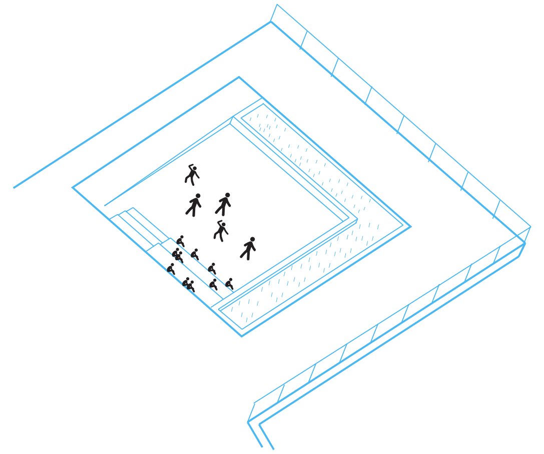

FIGURE 23.2: ROOFTOP

### ATRIUM

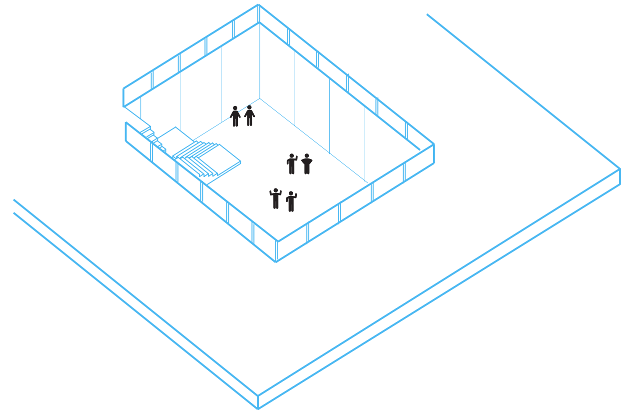

FIGURE 23.3: ATRIUM

### RIVERWALK

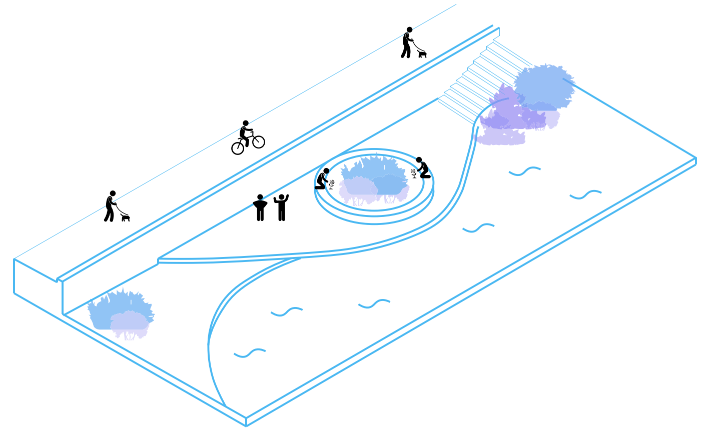

FIGURE 23.4: RIVERWALK

### RECREATION

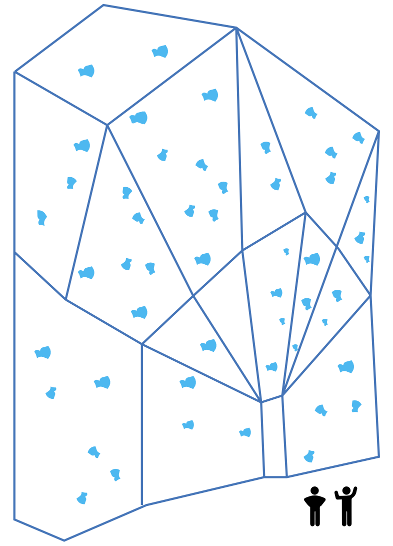

FIGURE 23.5: BEACH

### BEACH

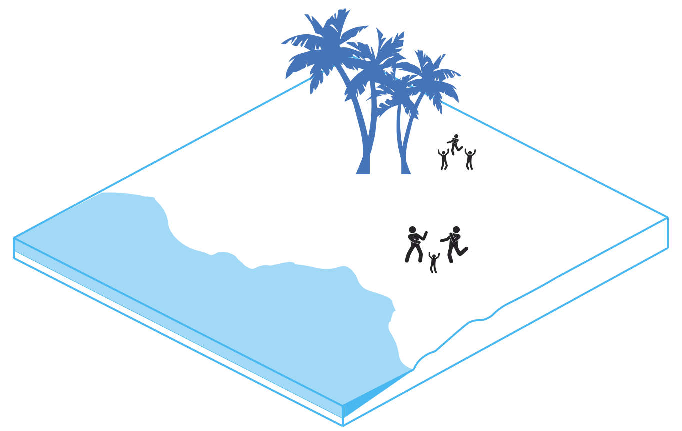

FIGURE 23.6: PARKS

### PARKS

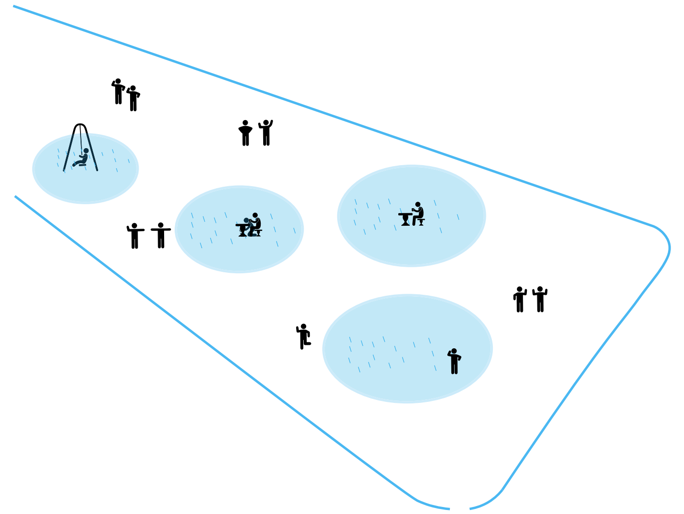

FIGURE 23.7: RECREATION

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## ADAPTABILITY

Traditional infrastructure in the United States has not typically been designed with the public in mind; instead, it has been imposed on cities from the outside, often with negative consequences for the urban experience. This proposal combines the need for protective infrastructure with a commitment to involving the community in the planning process. It suggests that flood protection shouldn't be an unusable space that separates the community from the waterfront. Instead, the structures on the floodplain should blend with the natural elements and become attractive hubs for social and recreational activities that enhance the city .

## BENEFITS

- Fostering Community and Social Cohesion
- Enhancing Mobility and Accessibility
- Promoting Urban Vitality and Vibrancy
- Preserving Cultural Heritage and Identity
- Promoting Economic Vitality
- Enhancing Health and Well-being
- Connectivity

FIGURE 24.1: ADAPTABLE PUBLIC SPACE (Ingels, 2021)

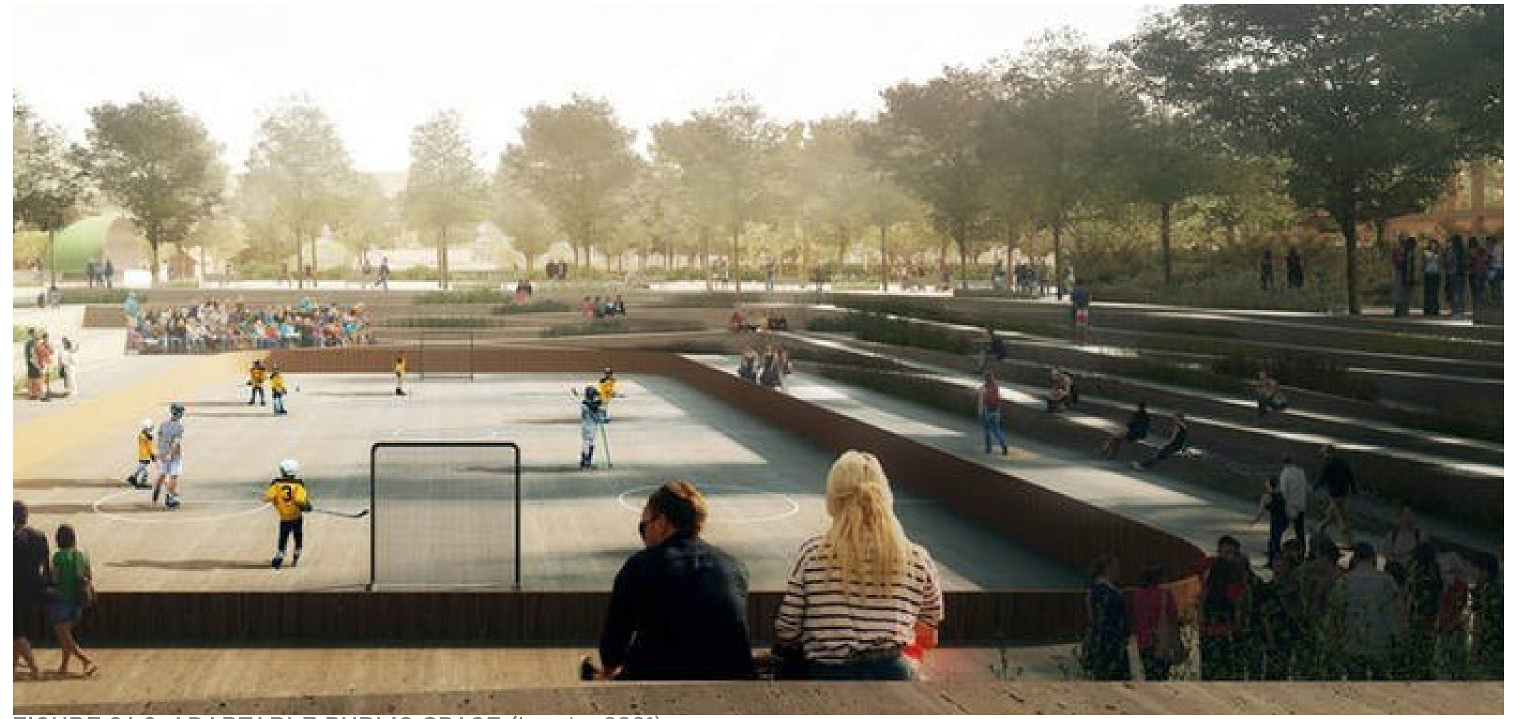

FIGURE 24.2: ADAPTABLE PUBLIC SPACE (Ingels, 2021)

FIGURE 24.1A: ADAPTABLE PUBLIC SPACE (Ingels, 2021)

FIGURE 24.2B: ADAPTABLE PUBLIC SPACE (Ingels, 2021)

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## MODULARITY

Modularity is a design approach that emphasizes the use of standardized, interchangeable components. This allows for greater flexibility, adaptability, and scalability in design and construction.

## BENEFITS

>Ease of Assembly
> Resilience to Damage
> Cost-Effective Construction:
> Reduced Site Disruption
> Incremental Expansion
> Flexibility and Adaptability

A modular approach to floating architecture allows for the creation of adaptable and scalable structures that can respond to changes in water levels, environmental conditions, or the need for additional space.

Modularity in design is a strategic approach that harnesses the power of standardized, interchangeable components, offering a myriad of benefits that revolutionize the landscape of construction and architecture (Wang 2019)..

Ease of assembly stands out as a primary advantage of modularity. By utilizing standardized components, construction processes become streamlined and simplified, leading to faster build times and reduced labor costs. This efficiency not only expedites project completion but also minimizes the potential for errors or inconsistencies during assembly.

Moreover, the resilience to damage inherent in modular construction is remarkable. In the event of damage to a specific component, it can be easily replaced or repaired without necessitating extensive alterations to the entire structure. This resilience enhances the longevity and durability of modular buildings, ensuring they remain functional and aesthetically pleasing for years to come (Wang, 2019).

## BASE UNITS

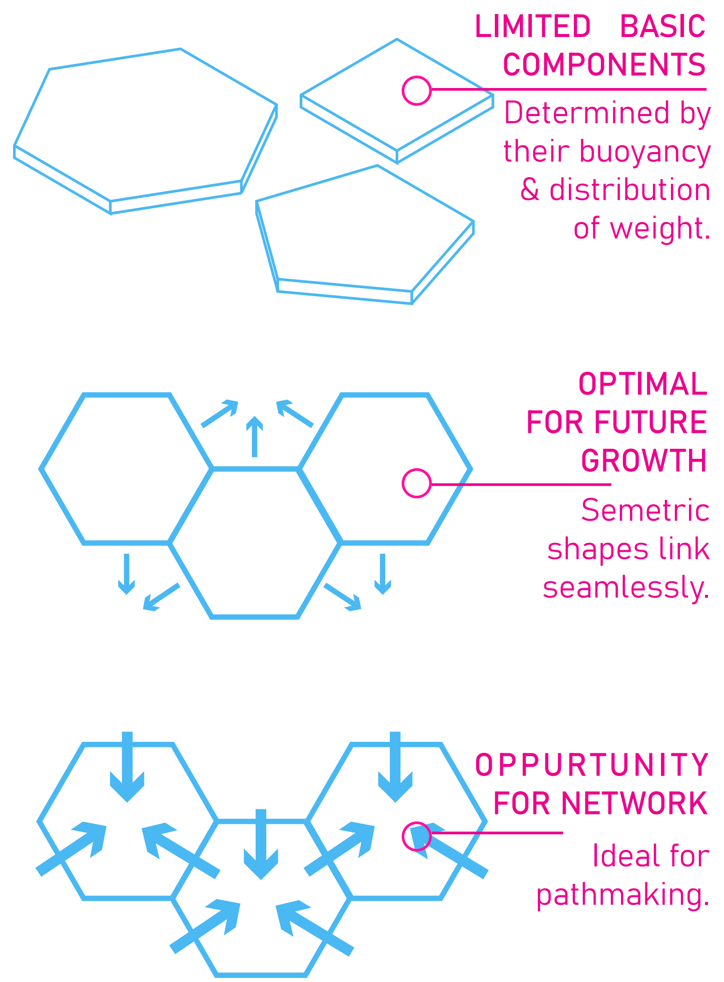


FIGURE 25.1: BASE UNITS INSPIRED BY BLUE 21
(Czapiewska, 2014)

## UNIT VARIATIONS

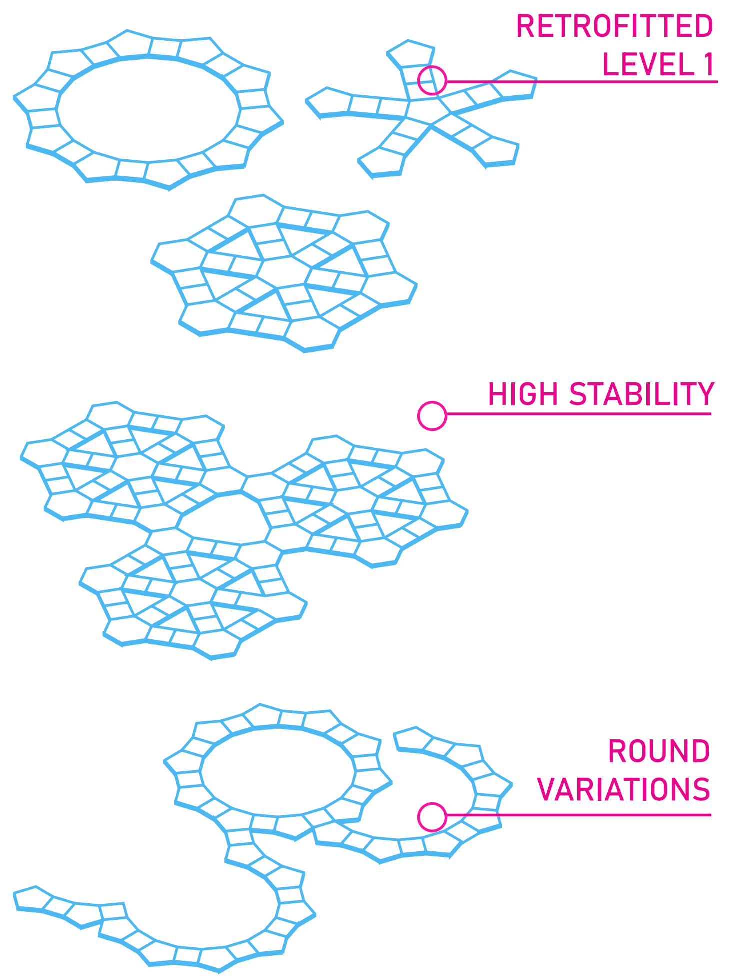


FIGURE 25.2: UNIT VARIATIONS INSPIRED BY BLUE 21
(Czapiewska, 2014)

## MODULAR SPACES

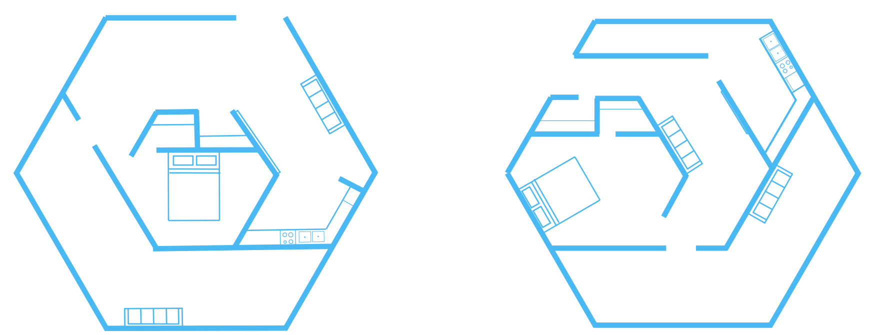

FIGURE 25.3: MODULAR SPACES INSPIRED BY BLUE 21
(Czapiewska, 2014)

## GROWTH

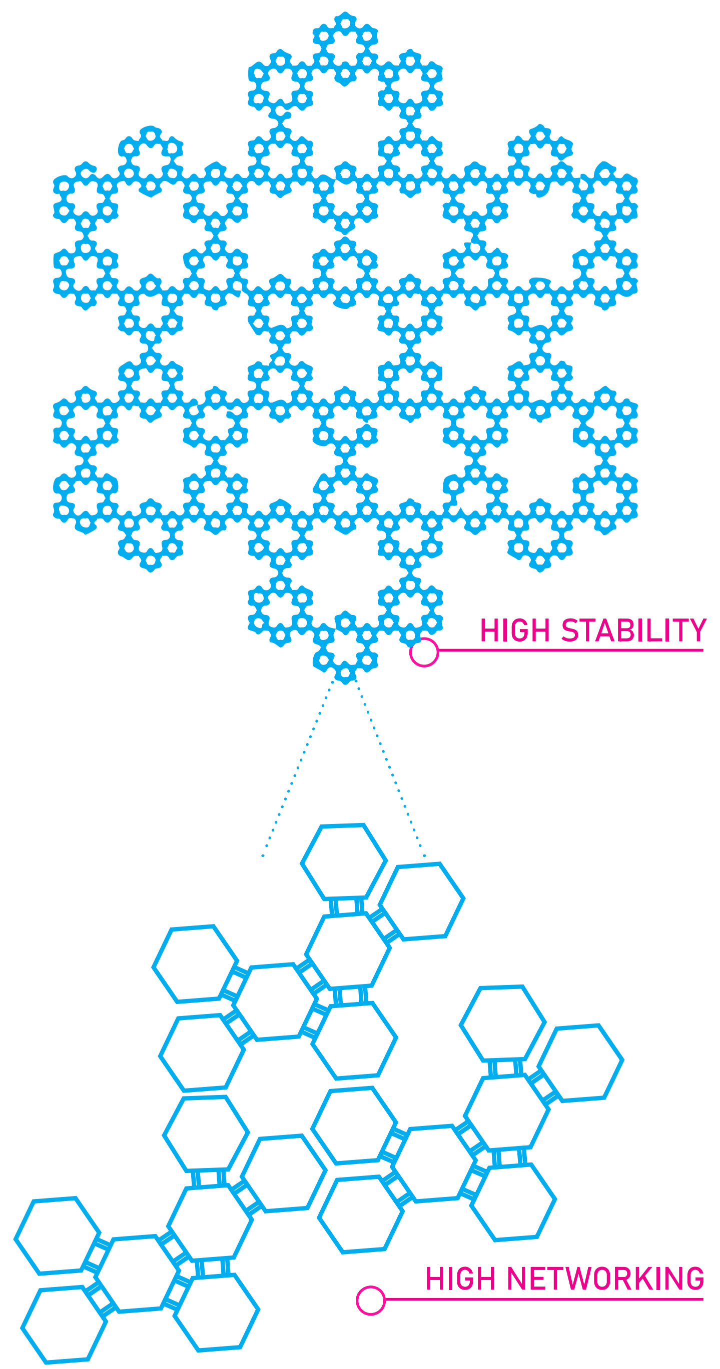


FIGURE 25.4: GROWTH INSPIRED BY BLUE 21
(Czapiewska, 2014)

## FUNCTIONALITY

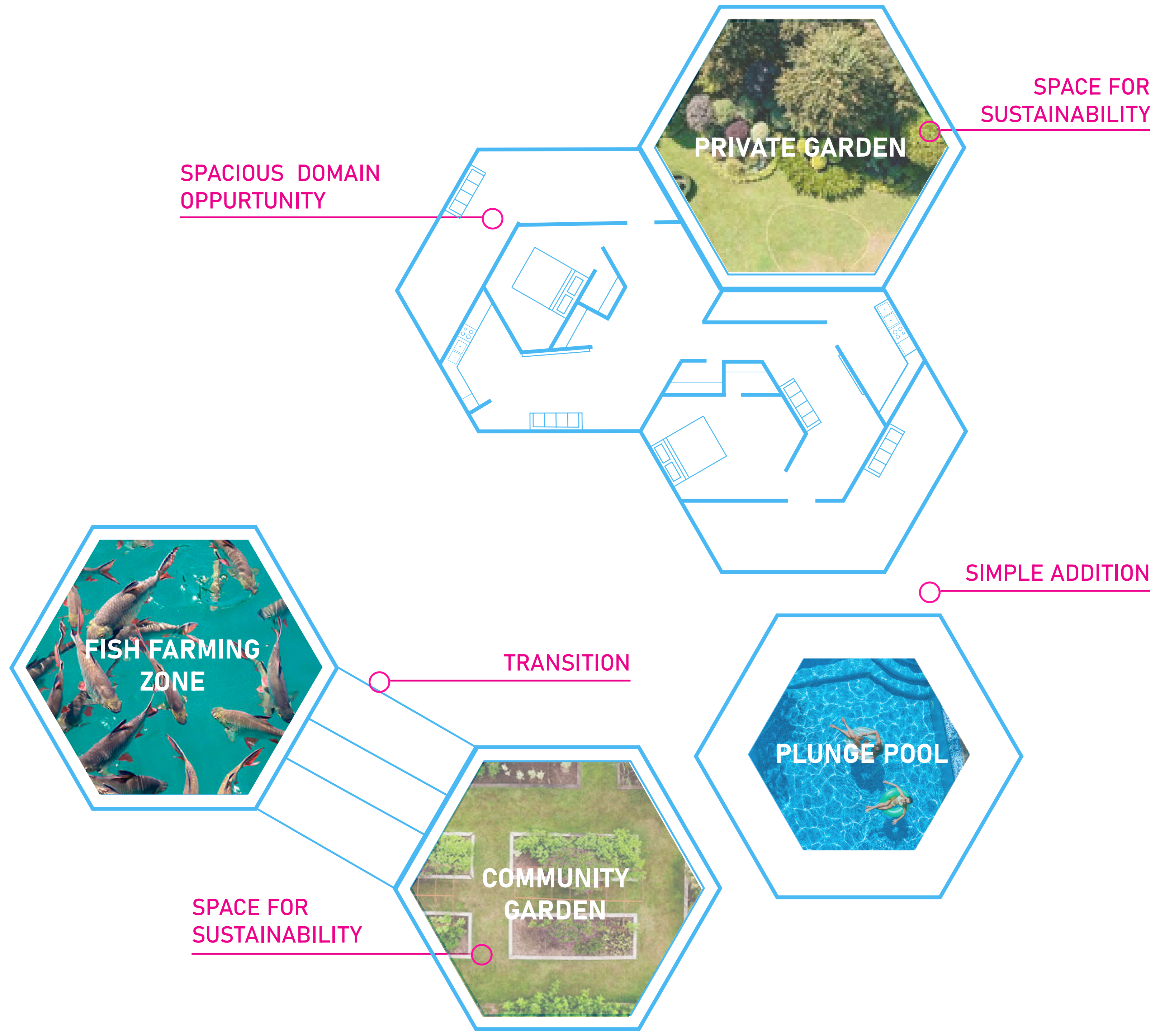


FIGURE 25.5: FUNCTIONALITY INSPIRED BY BLUE 21
(Czapiewska, 2014)

# + DESIGN PRAXIS

**WHAT HAS BEEN DONE?**
Research.

**WHAT ARE THE DESIGN PRINCIPLES?**
Designing with the water.
Designing for the future.
Retrofitting.

**ECOLOGICAL IMPLICATIONS?**
Goal is to not disruptthe ecosystem.

**HOW DO WE ACTIVATE THE WATER?**
Dual public space, water activities.

**PRESENT DAY**
In the present day, architects and urban planners are increasingly focused on designing resilient and adaptive structures that respond to the growing threat of rising sea levels caused by climate change. This involves several key strategies, including the development of flood-resistant building materials and innovative construction techniques, the creation of elevated or floating structures that can withstand inundation, and the integration of sustainable urban planning to mitigate flooding through green infrastructure and improved drainage systems.

Moreover, architects are working hand-in-hand with environmental scientists to ensure that their designs not only address immediate challenges but also anticipate long-term sea-level rise projections, fostering sustainable and aesthetically pleasing urban environments that can thrive despite the changing climate. As of the present day, it's important to note that a significant portion of architectural projects aimed at responding to rising sea levels remain in the research and development phase. While there is a growing awareness of the urgent need for such adaptations, many designs are still undergoing feasibility studies, testing of novel construction materials, and simulations to assess their effectiveness.

Architects and engineers are collaborating closely with scientists, climate experts, and environmental researchers to refine and optimize these innovative solutions. In the midst of ongoing research, the architectural community is also exploring funding mechanisms, regulatory frameworks, and policy support to translate these innovative concepts into practical, scalable, and sustainable architectural solutions for coastal regions vulnerable to sea-level rise. The exploration of uncharted territory in architectural responses to climate change necessitates continued investigation and innovation to ensure the long-term resilience of coastal communities.

FIGURE 26: ADAPTABLE PUBLIC SPACE
(Kamp, 2015)

## THE KENTISH CLASSIC

The D*Haus Company clinched the top spot in a competition focused on designing the urban homes of tomorrow with their innovative proposal tailored for London, a city susceptible to urban flooding. Their winning concept presents vernacular-styled townhouses elevated above rising water levels on 3D-printed concrete platforms. These prefabricated timber homes pay homage to the timeless elegance of Georgian-style architecture, seamlessly blending into London's historic urban fabric.

By combining classic design motifs with cutting-edge technology, these dwellings epitomize a harmonious fusion of tradition and innovation. The utilization of 3D-printed concrete platforms not only safeguards against flooding but also underscores a commitment to sustainability and structural resilience, marking a forward-looking approach to urban planning.

Dubbed "The Kenlish Classic," the design draws inspiration from London's vibrant architectural palette, celebrating its cultural heritage while adapting to climate change. It envisions a future where the essence of the past is preserved alongside advancements in urban living.

Beyond mere housing, "The Kenlish Classic" encapsulates a vision of resilience, ingenuity, and cultural continuity amid the urban challenges of the future.


FIGURE 27.1: KENTISH CLASSIC CONCEPT DIAGRAM 1
(Siufan, 2019)

## MY KENLISH CLASSIC

In my floating architecture project, I envision incorporating elements inspired by "The Kenlish Classic" to enhance both its resilience and cultural significance. Just as the prefabricated timber homes in "The Kenlish Classic" are elevated above rising water levels, I plan to retrofit existing buildings and design new structures to be adaptable to flood-prone areas. By utilizing innovative elevation techniques, such as 3D-printed concrete platforms or adjustable foundation systems, I aim to ensure structural integrity while mitigating the risks posed by heavy urban flooding.

Moreover, like "The Kenlish Classic," my project will celebrate the vibrant colors and cultural identity of its surroundings. Whether through colorful facades, artistic murals, or vibrant landscaping, I intend to infuse the floating architecture with the dynamic spirit of its location, fostering a strong sense of place and community.

In essence, by connecting the concepts of retrofitting, elevation, and cultural heritage inspired by "The Kenlish Classic," my floating architecture project will embody a vision of resilience, creativity, and cultural continuity in the face of urban challenges. Through thoughtful design and innovative solutions, I aim to create a dynamic and sustainable urban environment that embraces both the past and the future.

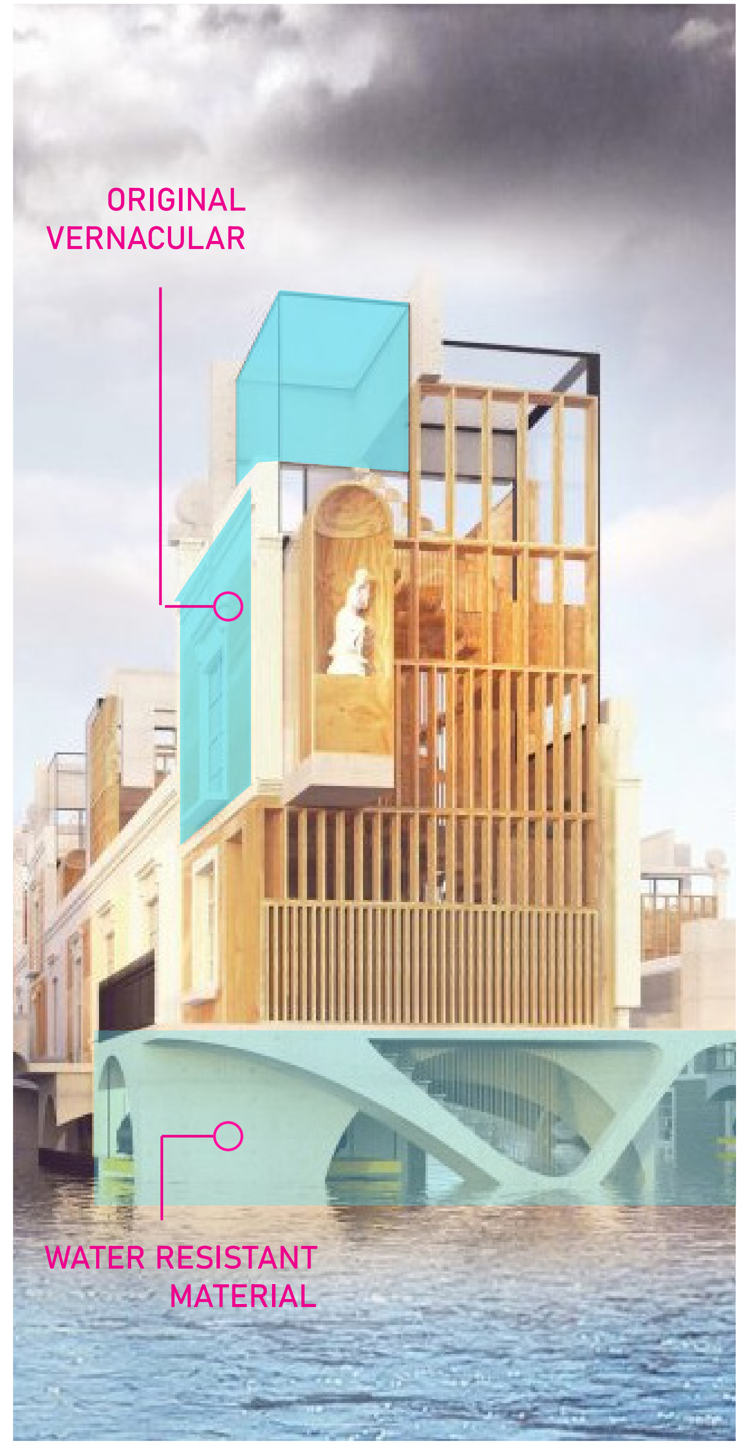


FIGURE 27.2: KENTISH CLASSIC CONCEPT DIAGRAM 2
(Siufan, 2019)


FIGURE 27.3: KENTISH CLASSIC CONCEPT DIAGRAM 3
(Siufan, 2019)

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## SEA2CITY VANCOUVER

MVRDV put forth a vision for the Sea2City Vancouver Waterfront and Infrastructure development by reimagining existing buildings and spaces, alongside creating new structures that are both sustainable and enjoyable, while also considering the challenges of rising sea levels. This initiative was in response to the Sea2City Design Challenge, which aimed to explore the future of False Creek, a significant water body in Vancouver.

At the heart of the team's ideas lies the recognition that traditional approaches to waterfront urban development, which primarily involve building rigid infrastructure to combat water, are increasingly inadequate given the realities of climate change. Instead, the proposals emphasize fostering a balanced relationship between the city and the water, departing from conventional norms to create a more resilient and adaptable urban environment. (MVRDV, 2022).

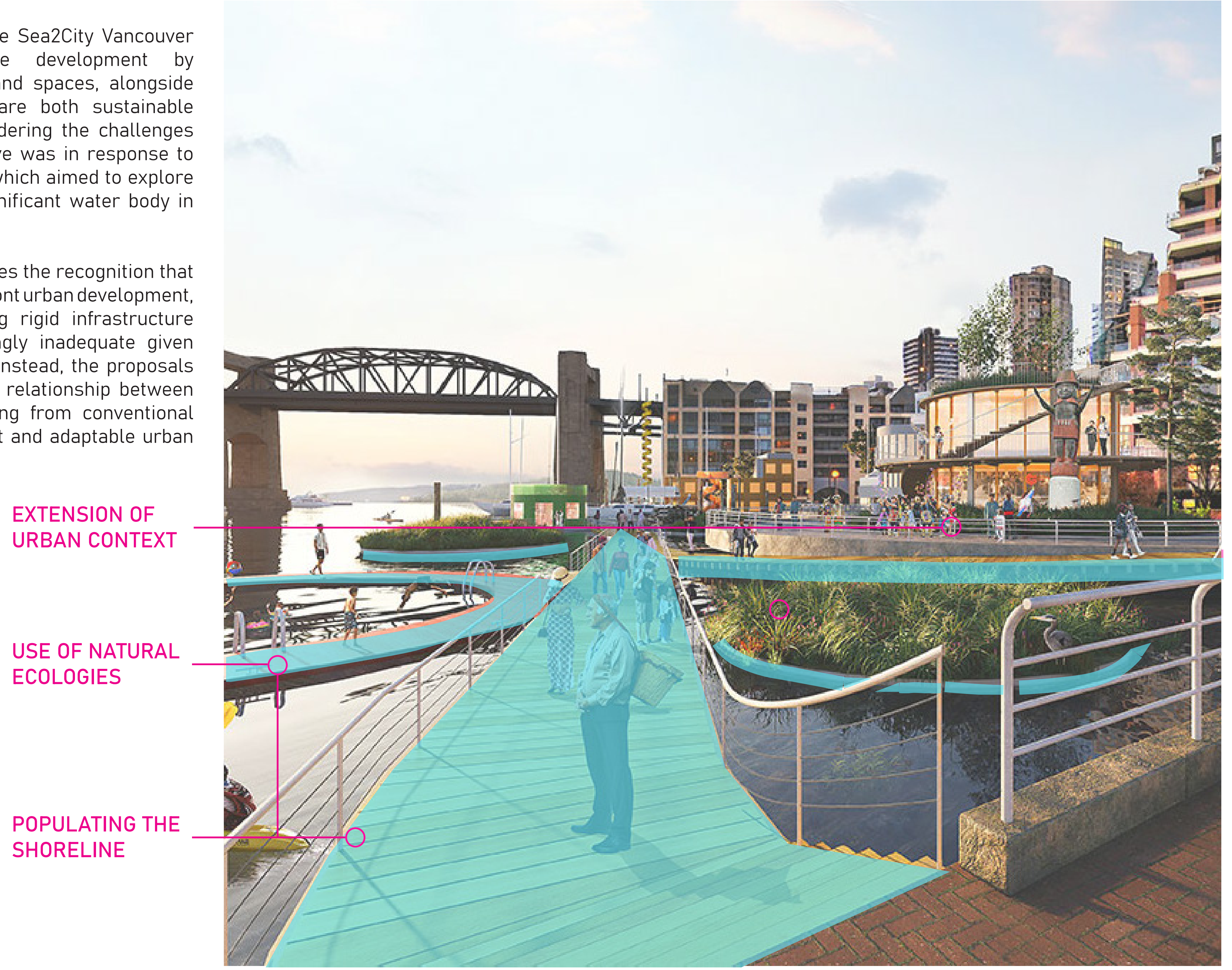


FIGURE 28.1: SEA2CITY CONCEPT DIAGRAM 1
(MVRDV, 2022)

## MY SEA2CITY

Incorporating the strategies outlined into my design involves a comprehensive approach to urban planning and architectural innovation. Repurposing underground structures for flood-proof uses presents an opportunity to maximize space efficiency and resilience. I plan to explore creative solutions for adapting these spaces to serve as functional amenities or storage areas, contributing to the overall adaptability and sustainability of the design.

Additionally, lifting the ground floor of buildings will be a key strategy to mitigate flood risk and enhance resilience. By incorporating elevated plinths or raised platforms, I aim to create a barrier against inundation while providing a seamless transition between indoor and outdoor spaces.

Moreover, the development of raised walkways to connect structures will ensure safe and accessible mobility during high water levels. These elevated pathways will not only facilitate circulation but also serve as dynamic public spaces, fostering connectivity and social interaction within the waterfront environment.

FIGURE 28.2: SEA2CITY CONCEPT DIAGRAM 2
(MVRDV, 2022)

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## PIERESCAPE

The 'Pierescape' proposal, shortlisted for the Navy Pier competition, is a collaborative effort by Davis Brody Bond, Aedas, Martha Schwartz Partners, Halcrow Yolles, Marshall Brown Projects, and Solomon Cordwell Buenz. It presents a masterplan that expands public landscapes in Chicago's lakefront area, aligning with the city's commitment to an open and accessible waterfront. Building upon Daniel Burnham's original concepts, the design aims to enhance connectivity between existing buildings and public spaces while returning the landmark to everyday use. Key features include the Gateway Plaza, 'Scoop' Wetland Park, South Dock Porch, smaller boat piers, floating parks, and pool zones. The proposal also includes four new boat docks with ticketing pavilions, floating parks with seasonal activities, and areas for shelter and recreation, catering to visitors year-round. The design's undulating surfaces offer opportunities for activities like skateboarding in summer and snowboarding in winter, ensuring vibrant engagement with the pier throughout the year. (Grieco ,2012).

FIGURE 29.1: PIERESCAPE CONCEPT DIAGRAM 1 (Aedas and Martha Schwartz, 2022)


FIGURE 29.2: PIERESCAPE CONCEPT DIAGRAM 2(Aedas and Martha Schwartz, 2022)

## MY PIERESCAPE

Incorporating ideas from the 'Pierescape' design into my own project is an exciting opportunity to infuse my vision with innovative urban planning and landscape architecture strategies. Studying the elements that resonate with my objectives allows me to adapt and integrate them into my design, enhancing its functionality, aesthetics, and overall impact.

For instance, I'm drawn to the emphasis on creating vibrant public spaces that promote interaction and engagement, such as the Gateway Plaza and floating parks. By incorporating similar features into my design, I aim to create inviting gathering spaces that cater to diverse activities and interests, fostering a sense of community and vitality within my project.

Moreover, I'm inspired by the emphasis on sustainability and environmental stewardship evident in the 'Scoop' Wetland Park and the integration of green infrastructure throughout the design. I plan to incorporate sustainable design principles such as green roofs, rain gardens, or renewable energy systems to enhance the ecological performance of my project while contributing to the well-being of its users and the surrounding environment.

In summary, by studying and integrating ideas from the 'Pierescape' design into my own project, I'm confident that I can enrich its design language, functionality, and sustainability while paying homage to innovative approaches in urban design and placemaking.

FIGURE 29.3: PIERESCAPE CONCEPT DIAGRAM 3 (Aedas and Martha Schwartz, 2022)


FIGURE 29.4: PIERESCAPE CONCEPT DIAGRAM 4 (Aedas and Martha Schwartz, 2022)

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## “LAND ON WATER” PROJECT

Danish Maritime Architecture Studio MAST has developed the “Land on Water” project, a system that provides an adaptable solution to building almost anything on the water: floating homes, campsites, even small parks, and community centers. The project represents a response to the acknowledgment of raising sea levels and increased risks of urban flooding, which has led to a growing interest in adapting architecture to be built on water. The “Land on Water” proposes a flexible and sustainable solution, a departure point from previous solutions, which are proven to be difficult to adapt, transport and are often using unsustainable materials such as polystyrene-filled concrete foundations or plastic pontoons. The project is developed with the support of Hubert Rhomberg & venture studio FRAGILE. (MAST 2021)

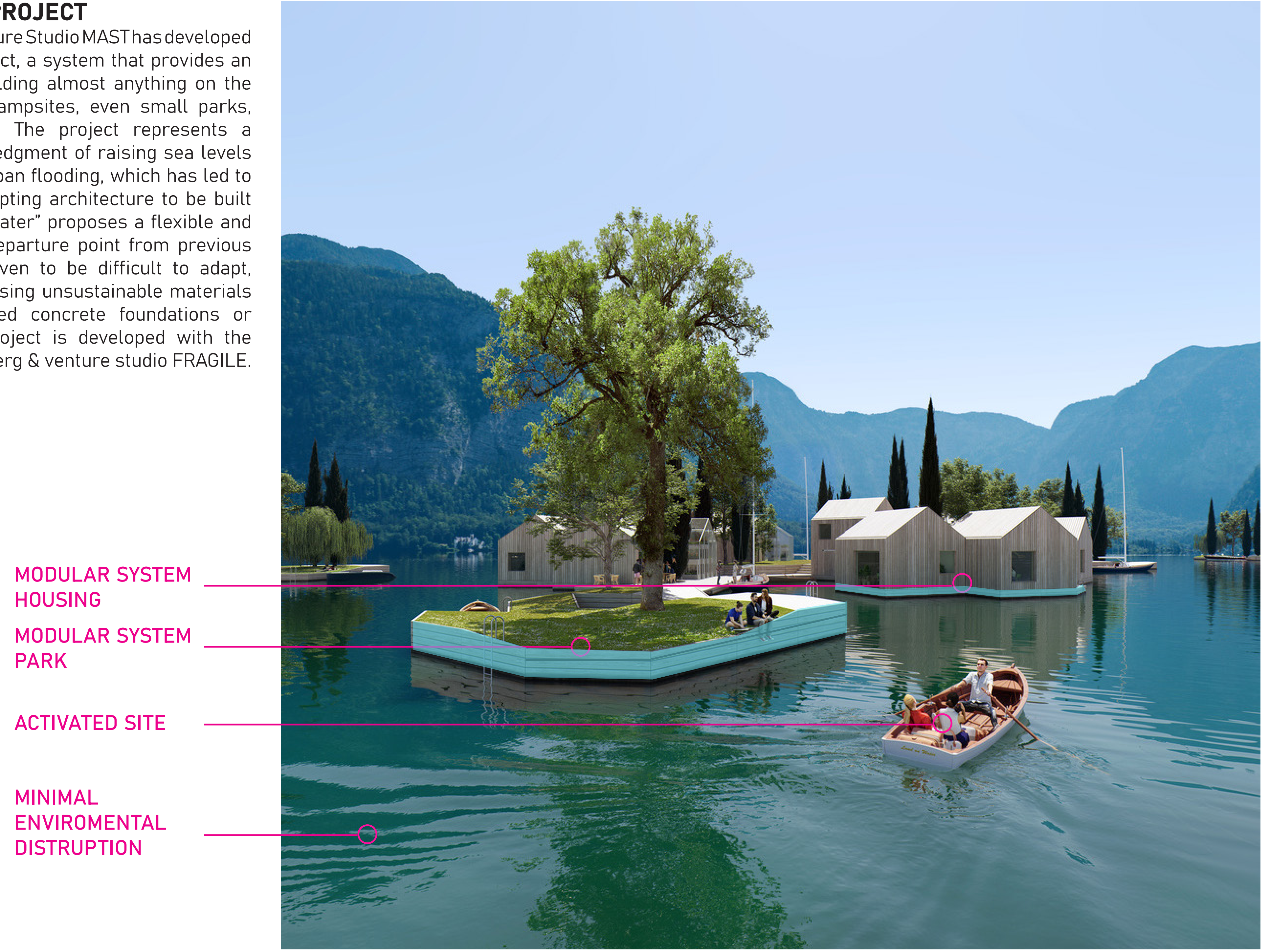


FIGURE 30.1: LAND ON WATER CONCEPT DIAGRAM 1
(MAST, 2024)

## MY “LAND ON WATER” PROJECT

The “Land on Water” project serves as a significant source of inspiration for my design of an elevated public space on the water. Drawing upon the innovative solutions proposed by Danish Maritime Architecture Studio MAST, my design integrates adaptable and sustainable principles to create a dynamic waterfront environment.

Inspired by the flexible and sustainable approach of the “Land on Water” project, I envision my elevated public space as a multifunctional platform that can accommodate various activities and amenities. Similar to the modular system proposed by “Land on Water,” my design incorporates adaptable features such as movable furniture, removable partitions, and flexible layouts, allowing the space to be easily reconfigured to meet changing needs and preferences.

The use of sustainable materials and construction techniques, as advocated by the “Land on Water” project, informs my design choices for the elevated public space. I prioritize the use of eco-friendly materials, such as reclaimed wood, recycled plastics, and renewable composites, to minimize environmental impact and promote resource efficiency. This project's emphasis on resilience and adaptation to rising sea levels inspires the elevation strategy of my design. By raising the public space above potential flood levels, I aim to ensure its continued functionality and accessibility in the face of changing environmental conditions.

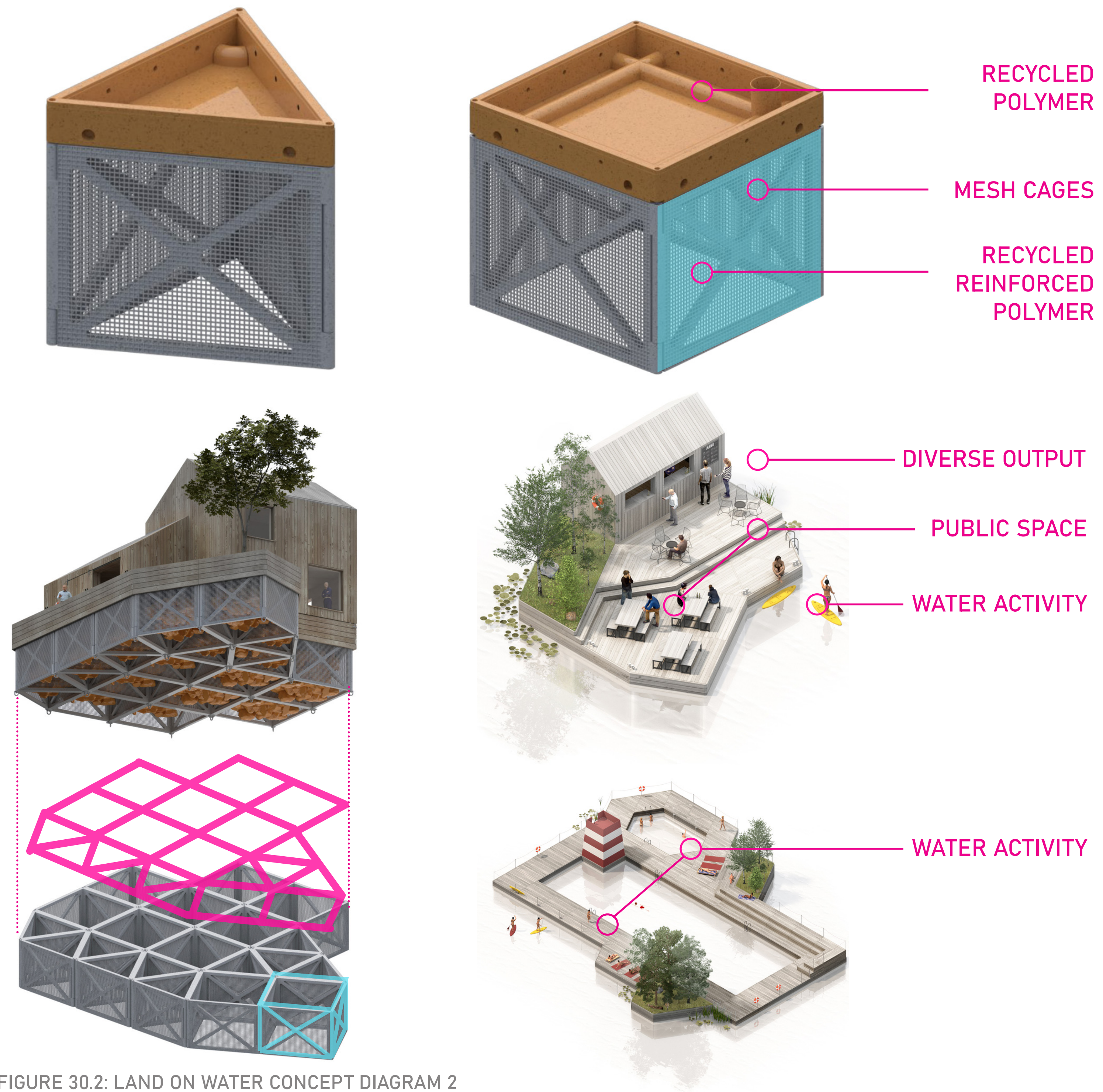


FIGURE 30.2: LAND ON WATER CONCEPT DIAGRAM 2
(MAST, 2024)

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## OCEANIX

Oceanix Busan, the inaugural prototype of a resilient and sustainable floating community, pioneers solutions for coastal cities grappling with the threats of rising sea levels. Spanning 6.3 hectares (15.5 acres), the interconnected neighborhoods cater to 12,000 residents, each designated for specific purposes such as living, research, and lodging. With 30,000 to 40,000 square meters of mixed-use programs per neighborhood, the floating platforms link to the port through link-span bridges, enclosing a sheltered blue lagoon housing recreational, artistic, and performance outposts.

Characterized by low-rise buildings featuring soft lines and terraces for indoor-outdoor living, these platforms activate a vibrant network of public spaces. OCEANIX Busan is designed for organic transformation and adaptation, commencing as a community with 3 platforms accommodating 12,000 individuals and evolving to a potential expansion for over 100,000 residents. Accompanying the floating platforms are numerous productive outposts equipped with photovoltaic panels and greenhouses that can dynamically adjust based on the evolving needs of Busan (BIG 2022).


FIGURE 31.1: OCEANIX CONCEPT DIAGRAM 1
(Ingles, 2021)

## MY OCEANIX

Like Oceanix Busan, my design will prioritize mixed-use programs and interconnected neighborhoods to foster a vibrant and diverse community atmosphere. By integrating different functions and amenities within the floating platform, I aim to create a dynamic environment that caters to the needs of residents while promoting interaction and engagement.

Furthermore, Oceanix Busan's focus on organic transformation and adaptation has inspired my approach to design evolution. Just as Oceanix Busan can expand to accommodate over 100,000 residents, my project will be designed with scalability in mind, allowing for future growth and development as needed. This flexibility ensures that the design can respond to changing conditions and evolving needs over time.

Additionally, I am inspired by Oceanix Busan's integration of productive outposts equipped with renewable energy sources and greenhouses. In my design, I plan to incorporate similar features to promote sustainability and self-sufficiency within the floating community. By harnessing renewable energy and utilizing green technologies, I aim to minimize environmental impact and enhance the resilience of the project.


Image 36

FIGURE 31.2: OCEANIX CONCEPT DIAGRAM 2
(Ingles, 2021)


# + SITE ANALYSIS

**WHAT IS THE DESIRED OUTCOME?**
Urbanscape Reimagined

**WHAT IS THE PERFECT SITE?**
A site with an existing culture to preserve.

**WHAT IS THE BENEFIT OF THE CHOSEN SITE?**
Rich in culture, rich in oppurtunity

## THE SITE

This research project is driven by a set of overarching objectives focused on the development and implementation of hybrid architectural designs in coastal communities. The primary goal is to create a pioneering prototype, a first-of-its-kind model that showcases the potential of these innovative architectural solutions. This prototype is more than just a concept; it serves as a practical demonstration of what future coastal communities could look like, emphasizing resilience in the face of environmental challenges.

Furthermore, the project aims to make these hybrid designs adaptable and scalable, with a particular emphasis on their suitability for small island settings.

Small islands face unique challenges in terms of climate change and sea-level rise, making it critical to tailor architectural solutions to their specific needs. Therefore, selecting the right site for this research is crucial, as it should meet specific criteria to ensure the project's success.

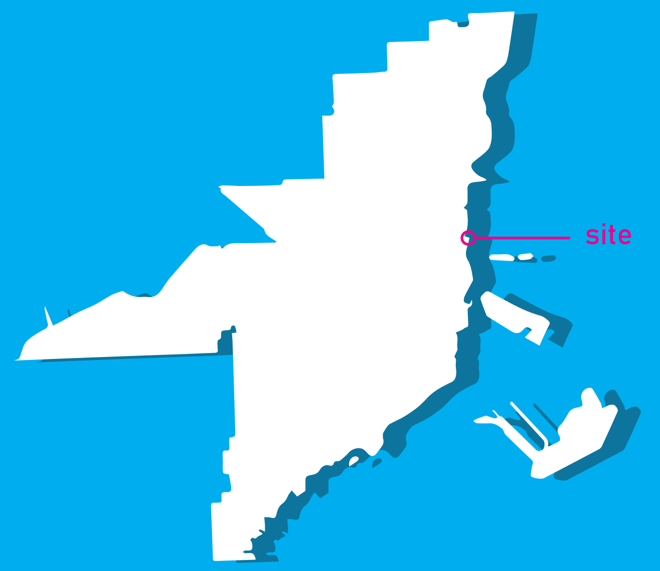
Key criteria for site selection include the presence of a vibrant cultural heritage that must be preserved and celebrated, existing popularity and tourism, which can boost the economic and social sustainability of the project, and, perhaps most importantly, direct access to water, which forms the cornerstone of the aquatic architectural concept. By aligning these goals with the chosen site, this research project aims to create not only a prototype but also a replicable model for sustainable coastal development. This model harmoniously combines culture, tourism, and innovative architectural solutions, serving as a blueprint for future coastal communities.

FIGURE 32: SITE IMAGE LOOKING WEST
(GOOGLE IMAGE)

# + SITE

## OPTION 1

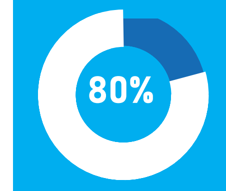
**2047 N BAYSHORE DRIVE**
**MIAMI, FLORIDA**



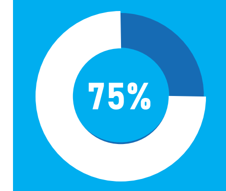

### VALUE

This location is surrounded by commercial spaces and high end residential spaces. It it adjacent to a popular public park with attatch recreation facilities.

### TOP VALUES




**EXISTING CONTEXT**
The existing context allows for the oppurtunity to evaluate retrofitting options.




**WATER LOCATION**
The location on the water is perfectly nestled in a man made bay between commercial and residential zones with a public green space.

## OPTION 2

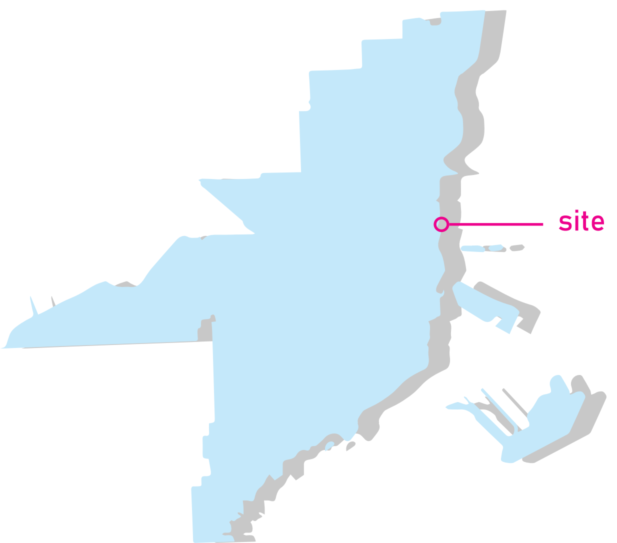
CHANTILLY SAVANNA LA MAR
WESTMORELAND, JAMAICA


### VALUE

This location is on the coast of Savanna La Mar Jamaica. The context of the site is a very underdeveloped which rose a level of concern. Smaller islands are the most at risk due to lack of funding for research.

## OPTION 3

498 NE 28TH STREET
MIAMI, FLORIDA




### VALUE

This location is in a less developed portion of Miami. This allows for potential to develope the area versus updating (saving) existing structures. This site is also larger in comparison with much more open space.

### THE DECISION

A Miami site combining commercial, residential, and a substantial green space presents an ideal canvas for the development of an aquatic architectural urban fabric for several compelling reasons. Miami's coastal location and susceptibility to rising sea levels make it a prime candidate for innovative architectural responses to climate change. Integrating aquatic architecture into this context not only addresses immediate challenges but also aligns with the city's vibrant coastal lifestyle and culture. The juxtaposition of commercial and residential structures with aquatic features can offer residents and visitors unique waterfront experiences, fostering a stronger connection to the water and a heightened awareness of sea-level rise. The inclusion of a large green space within this urban fabric not only enhances the quality of life but also serves as a buffer against flooding and promotes sustainable, resilient urban development. Such a multifaceted approach not only ensures the city's adaptability in the face of climate change but also contributes to Miami's reputation as a pioneering hub for innovative architectural and urban solutions.

### EXISTING SITE CONDITIONS

When walking toward the south of the proposed site, there already is a strip of parks in high rise residential spaces. The area is heavily activated and used by residents nearby. This site was specifically chosen because of these adjacencies. The current unused water space acts as the perfect site as it is bare, and not very activated in comparison to the nearby park. Considerations were made to build directly on the edge of the park, but this would likely receive community backlash as the park is

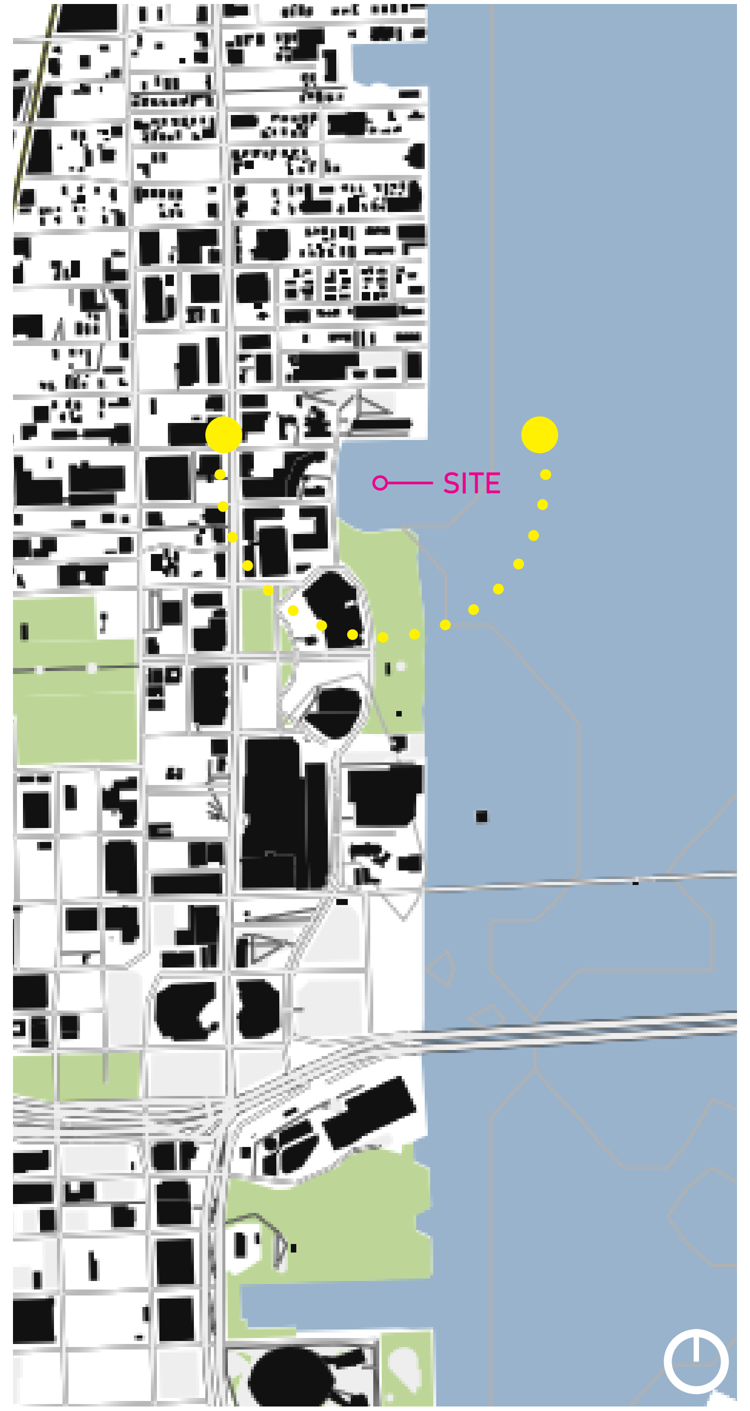



FIGURE 33: SITE PLAN
(Schwarz, 2022)

### SITE EXPLODED AXON

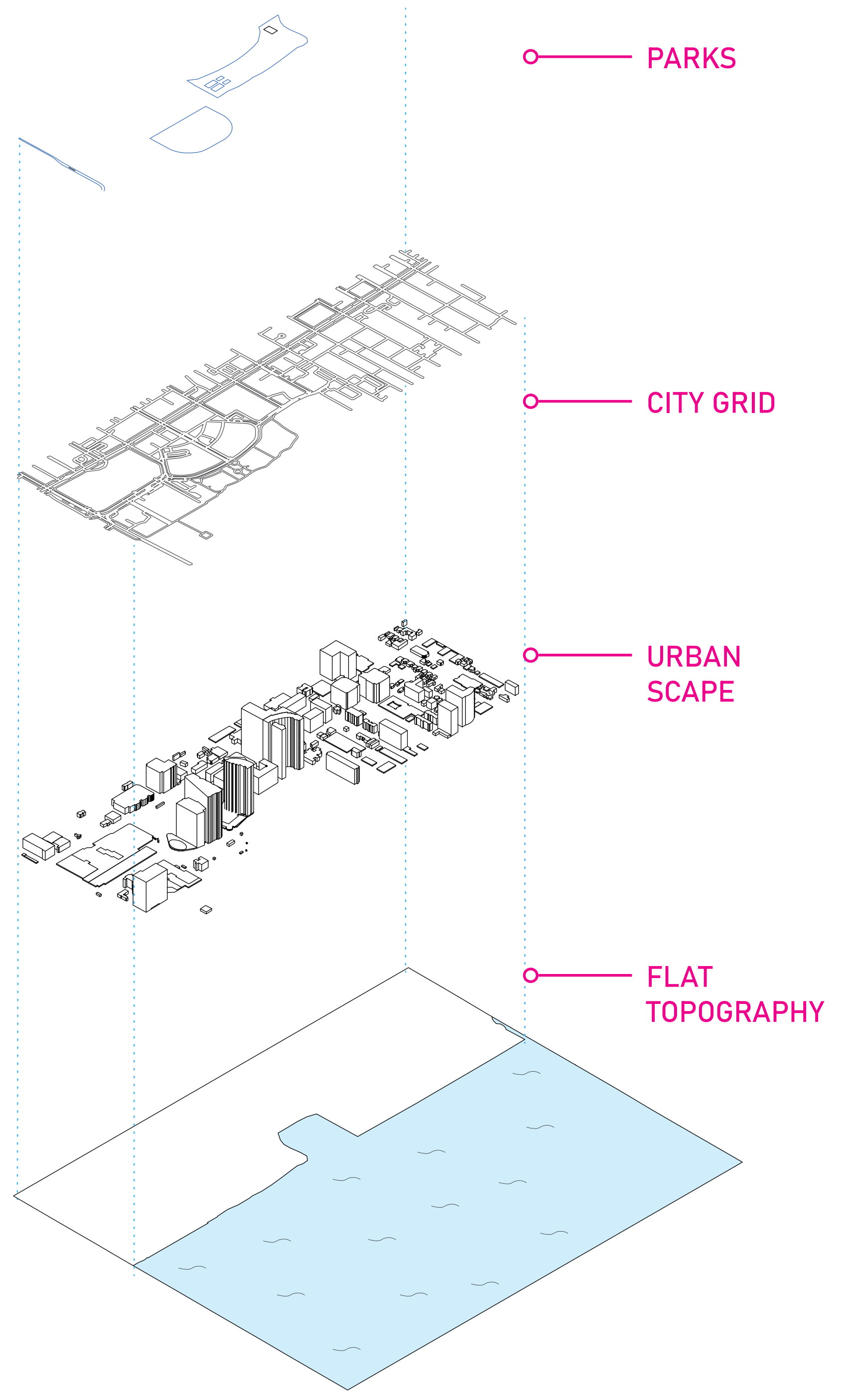



FIGURE 34: SITE AXON

# + PROGRAM

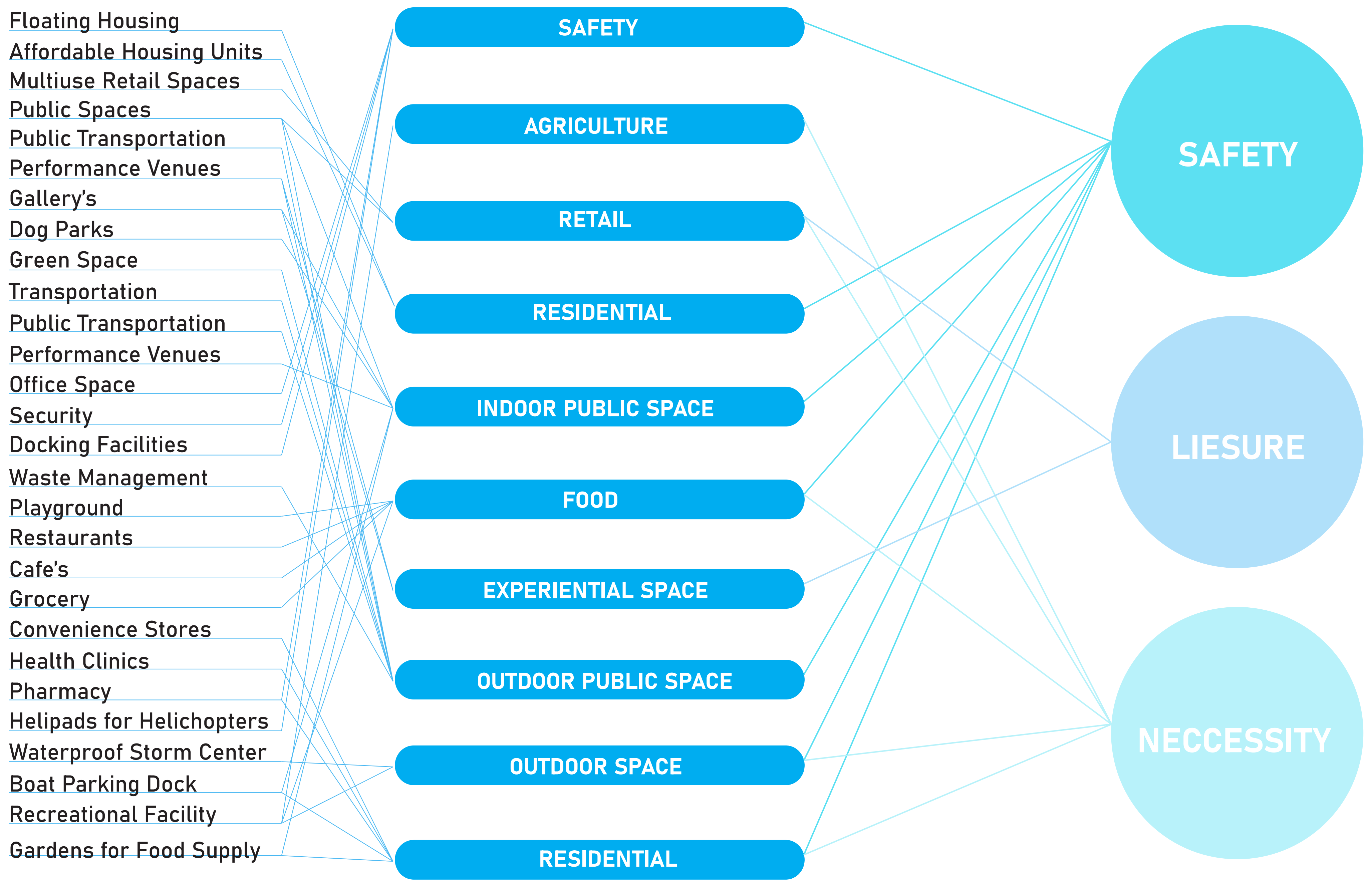



FIGURE 35: PROGRAM MARIX

## ITERATION 1

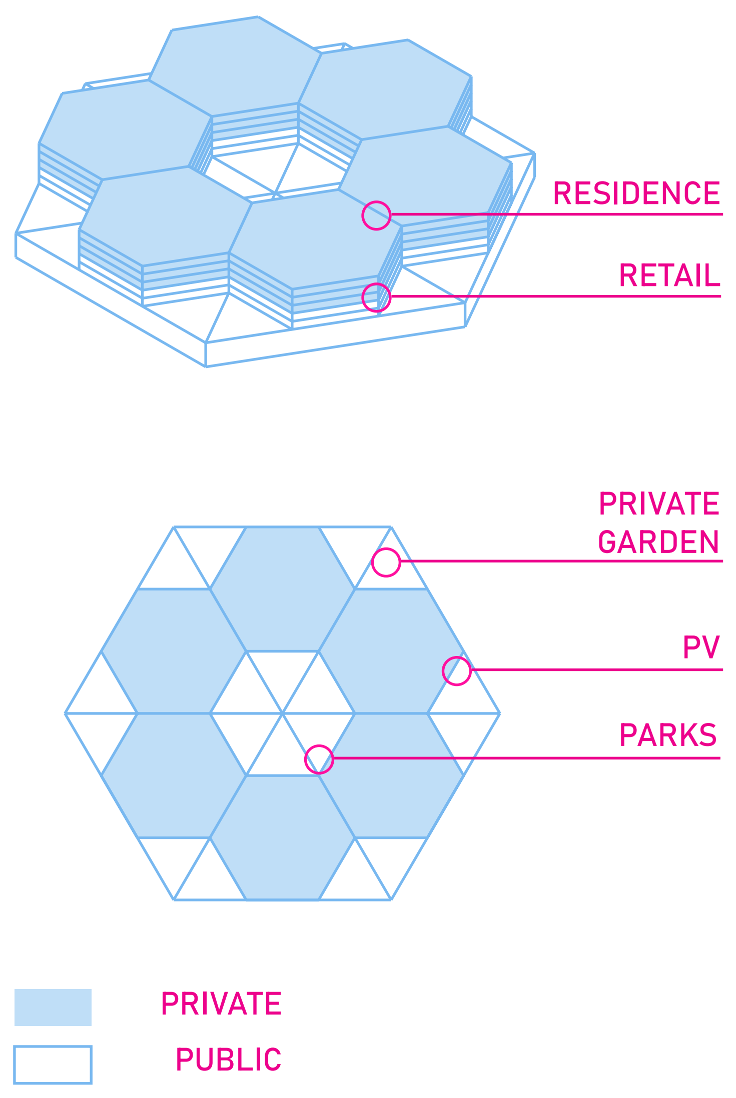



FIGURE 36.1: PROGRAM ITERATION 1

## ITERATION 2

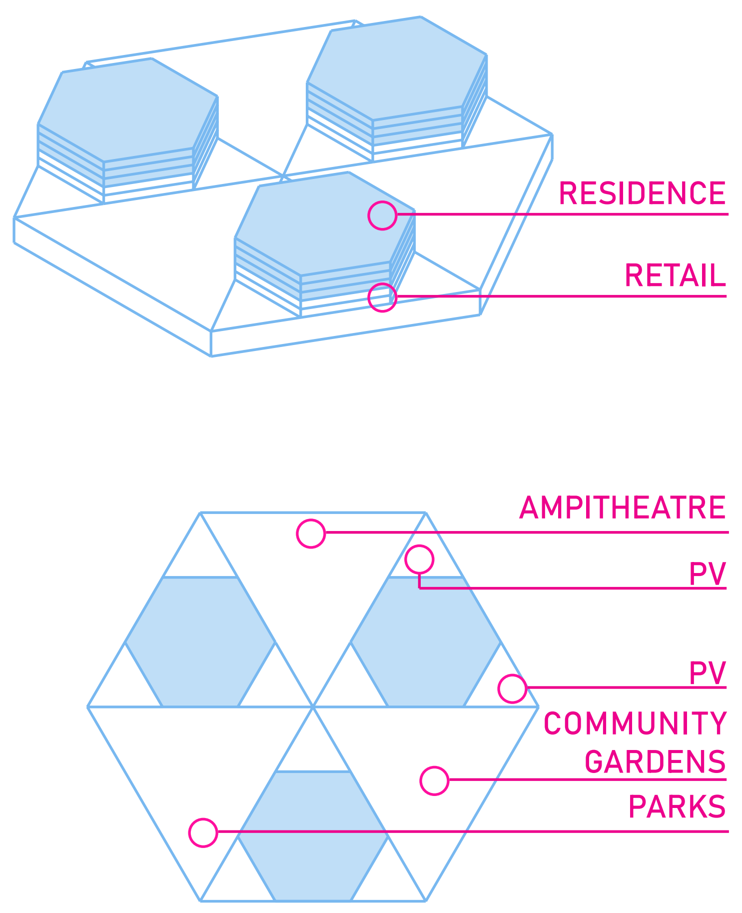



FIGURE 36.2: PROGRAM ITERATION 2

## ITERATION 3

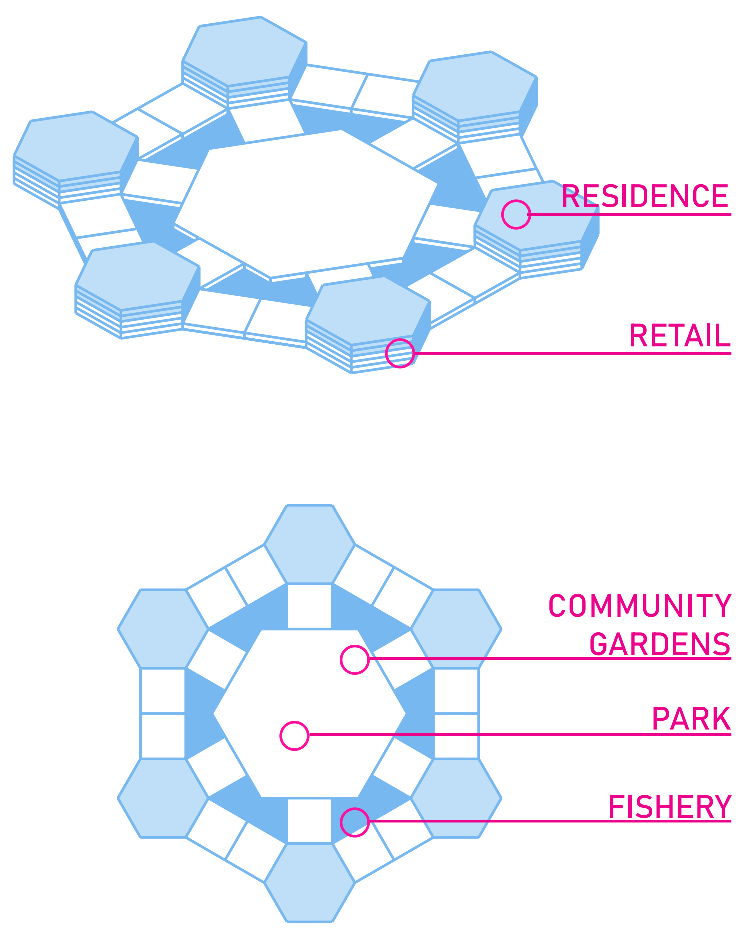



FIGURE 36.3: PROGRAM ITERATION 3

# + DESIGN THEOREM

**WHAT KINDS OF PUBLIC SPACES WILL BE INCLUDED?**
Beaches, seating space, retail space, bars, recreation center, parks, rock climbing wall etc.

**HOW WILL THIS BE ADAPTABLE?**
A site with an existing culture to preserve.

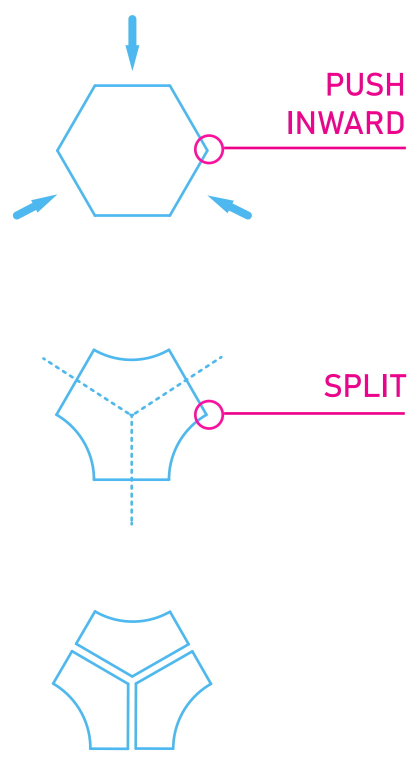
## THE SITE

The design theorem serves as the guiding principle and philosophical foundation underlying the conceptualization and execution of architectural vision. It encapsulates core principles, values, and aspirations that drive the design process and inform every decision made throughout the project. At its essence, the design theorem is a manifesto of innovation, resilience, and sustainability. It emphasizes the importance of pushing boundaries, challenging conventions, and exploring new possibilities in architectural design. It embraces the imperative of adaptability, recognizing the dynamic nature of the built environment and the need to create spaces that can evolve and respond to changing conditions over time. Furthermore, the design theorem places strong emphasis on functionality and user experience. It prioritizes needs and preferences of inhabitants, seeking to create environments that are not only aesthetically pleasing but also practical, comfortable, and enriching to live in. It recognizes the symbiotic relationship between form and function, striving to achieve harmonious balance between architectural expression and human well-being. Moreover, the design theorem embodies a commitment to sustainability and environmental stewardship. It champions use of innovative materials, technologies, and construction techniques that minimize ecological footprint and maximize resource efficiency. It advocates for designs that respect and integrate with natural landscape, fostering harmony between built and natural environments. In summary, the design theorem is a manifesto of innovation, resilience, sustainability, and human-centric design. It encapsulates ethos as an architect and serves as guiding light that illuminates path toward creating spaces that inspire, delight, and endure for generations to come.

FIGURE 37: PROGRAM SPATIAL ANALYSIS

# + PLATFORM DEVELOPMENT

**STEP 1**
DEVELOPE THE BASE MODULE

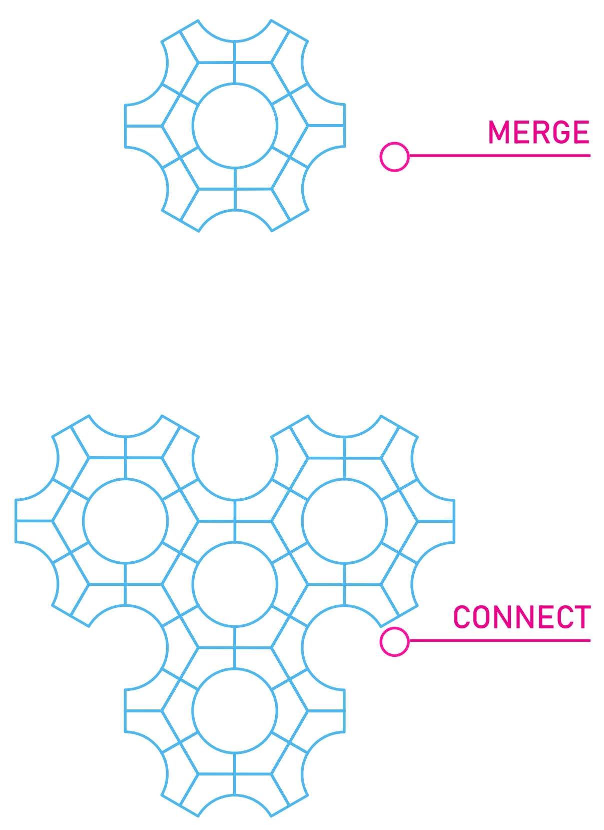



## HEXAGONAL BASE

Hexagons were chosen for their inherent balance between geometric symmetry and organic appeal, owing to their interconnected nature and flexibility in arrangement. By arranging these hexagons in patterns reminiscent of natural formations or organic growth, I established a visually captivating base.

FIGURE 38: HEXAGONAL BASE

**STEP 1**
DEVELOPE THE CLUSTER MODULE

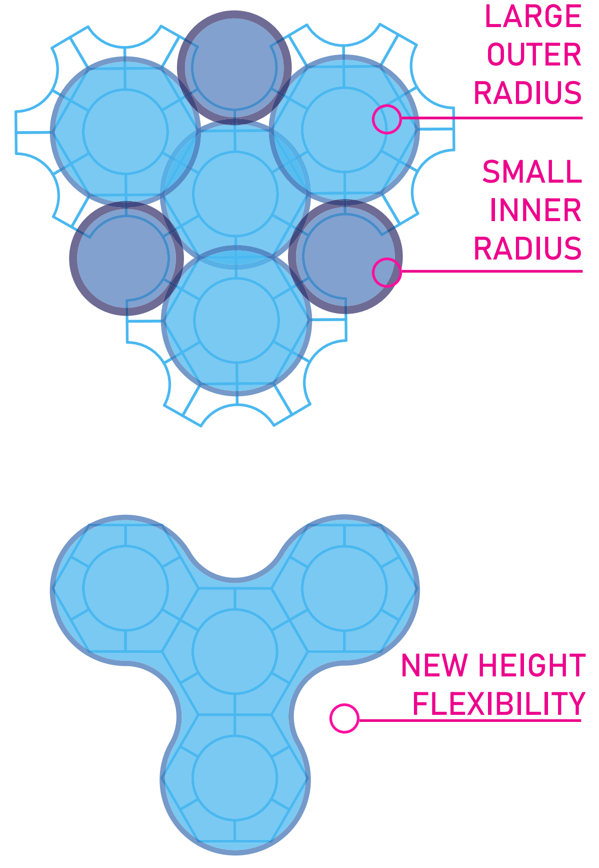



## HEXAGONAL CLUSTER

After the hexagons shape was adjusted, each shape was put together to create the cluster module. This cluster allows for flexibility when designing the elevated public space platform.

FIGURE 39: HEXAGONAL CLUSTER

**STEP 2**
DEVELOPE ELEVATED PLATFORM

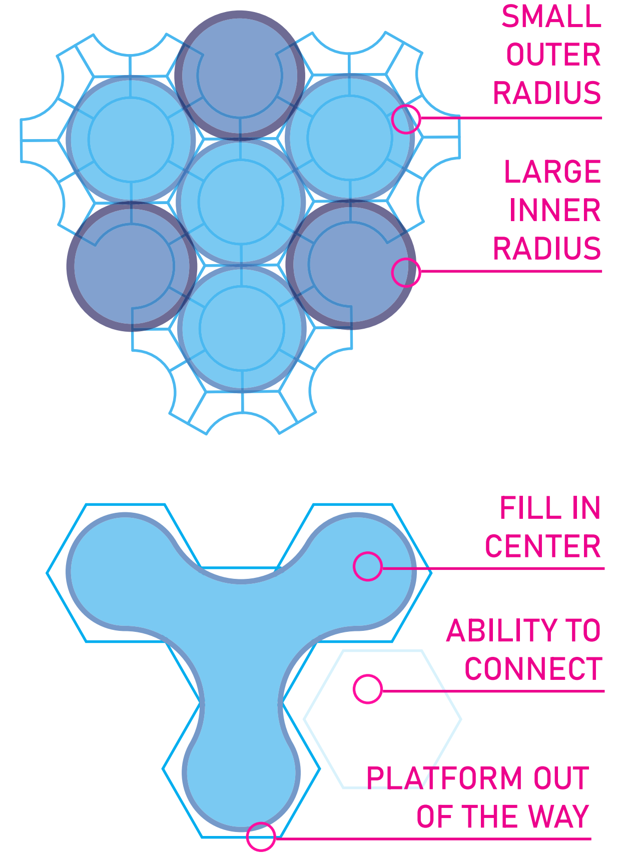



## ELEVATED PLATFORM

Platform forms outside of the Hexagonal base to allow for variation of height amoung platform modules. This innovative approach not only enhances visual interest but also facilitates practical benefits such as optimized views, increased sunlight exposure, and the ability to address site-specific challenges.

FIGURE 40: ELEVATED PLATFORM

**STEP 3**
DEVELOPE FLOATING MODULE

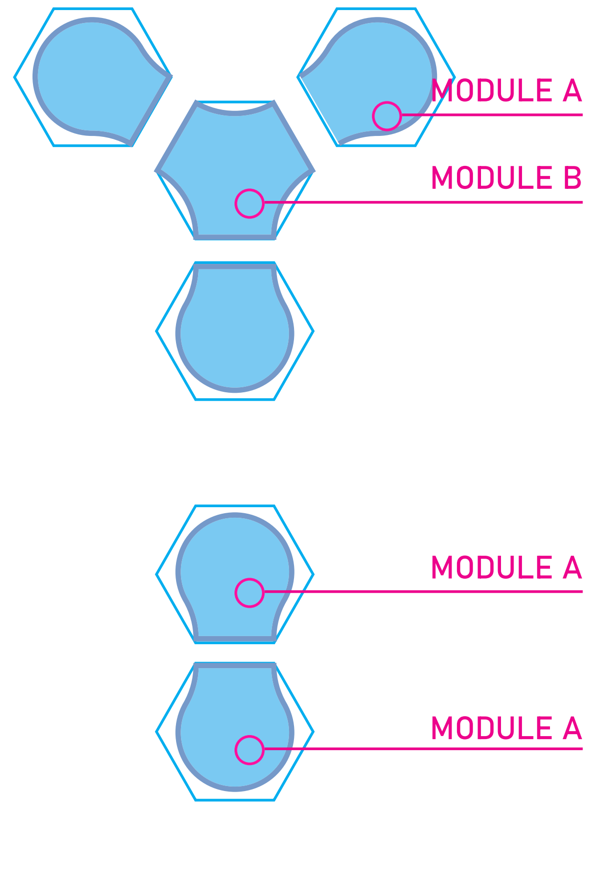



## FLOATING PLATFORM

Introducing platform forms within the hexagonal base facilitates the interlocking of modules beneath the water level, enhancing both structural stability and functional versatility. This innovative design feature enables seamless connections between adjacent modules, creating a cohesive framework that withstands the challenges of fluctuating water levels. By leveraging the hexagonal shape, these interlocking platforms ensure efficient use of space and resources while promoting modular expansion and adaptation to evolving needs.

FIGURE 41: FLOATING PLATFORM

**STEP 4**
MODULIZE THE SYSTEM

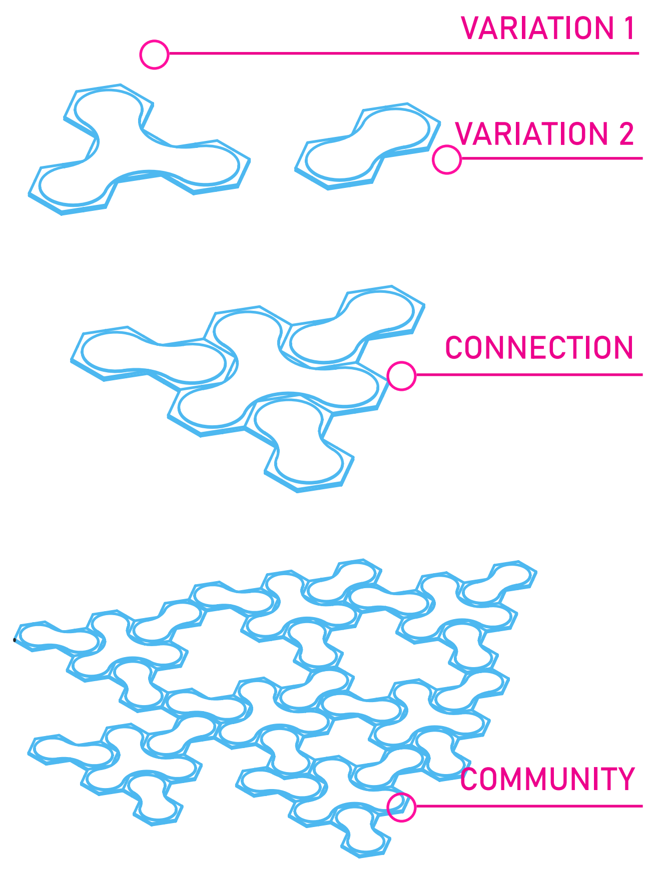



## MODULIZED MODULE

Modularizing the platforms within the hexagonal base marks a strategic advancement in the design, heralding a paradigm shift in adaptability and efficiency. By breaking down the structure into interchangeable modules, each platform becomes a versatile building block capable of accommodating diverse functions and configurations. This modular approach not only streamlines construction processes but also fosters scalability and resilience in the face of changing environmental conditions.

FIGURE 42: MODULIZE MODULE

**STEP 5**
REGULATE THE SYSTEM




## GROWTH

The design's capacity for modular growth and linkage represents a transformative leap in adaptability and connectivity within the floating community. Each module is conceived not only as a standalone entity but also as a potential node in a dynamic network of interlinked structures. This inherent modularity allows for seamless expansion and reconfiguration, enabling the community to organically evolve in response to changing needs and circumstances.

FIGURE 43: GROWTH

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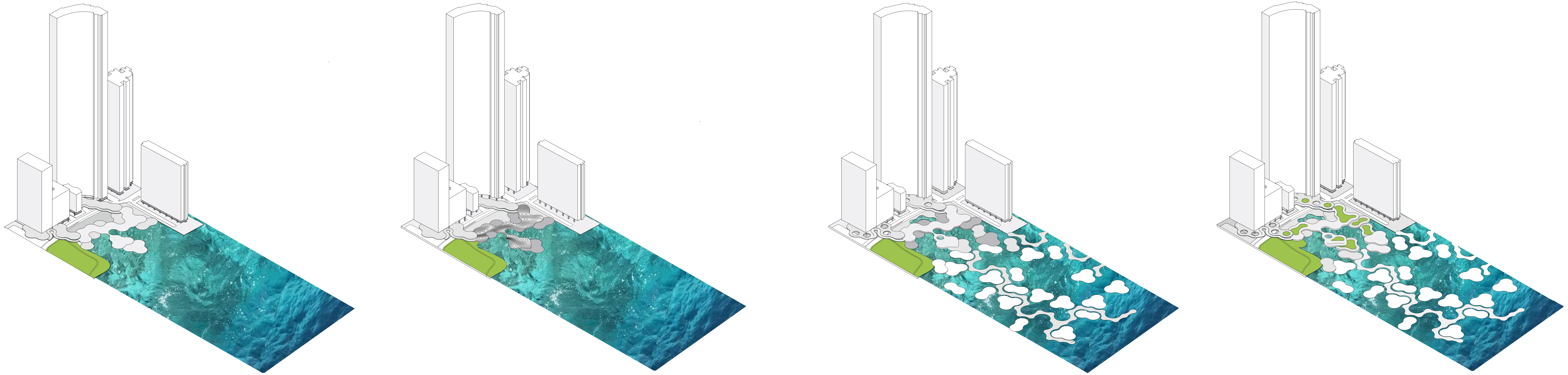
# + DESIGN DEVELOPMENT



1 FOUNDATIONAL DESIGN

2 ONGULATING PUBLIC PLAZA

3 FLOATING ARCHITECTURE

4 GREEN SPACE INTRODUCTION

FIGURE 44: DESIGN DEVELOPMENT

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# PHASE 3 MASTERPLAN


FIGURE 52: RESIDENTIAL BIRD EYE VIEW RENDER

# + MASTER PROGRAMMING

## PHASES

**BEACH:** The beach offers a natural setting for relaxation and recreation, attracting both residents and visitors.
**RESIDENCES:** This provides housing within the masterplan, fostering a sense of community and ensuring residents can easily access the amenities.
**REC CENTER:** Serving as a hub for indoor activities, the recreation center promotes physical fitness and social interaction among community members.
**RETAIL:** With retail outlets available, essential goods and services become easily accessible to residents, enhancing convenience and vitality.
**PARKS:** Green spaces throughout the masterplan provide opportunities for outdoor activities, relaxation, and connection with nature.
**WATER FEATURES:** Incorporating water features adds aesthetic appeal and creates tranquil spaces for contemplation and relaxation.
**ATRIUM:** The atrium serves as a central gathering place for under water exhibitions.
**BAR:** Providing a social venue, the bar allows residents to unwind and socialize within the masterplan.
Greenspace: These areas offer opportunities for outdoor recreation and contribute to the overall health and well-being of the community.
**DOG PARK:** Catering to pet owners, the dog park provides a designated area for dogs to exercise and socialize, fostering community among pet owners.
**BOATING DOCK:** For those near water, the boating dock expands recreational opportunities, allowing residents to engage in various water activities.
**AMPITHEATRE:** Hosting cultural events and performances, the amphitheatre adds entertainment options and brings the community together.
**COASTAL CROSSING:** Offering scenic views and opportunities for exercise, the walk path along the ocean connects different parts of the masterplan and enhances its appeal.

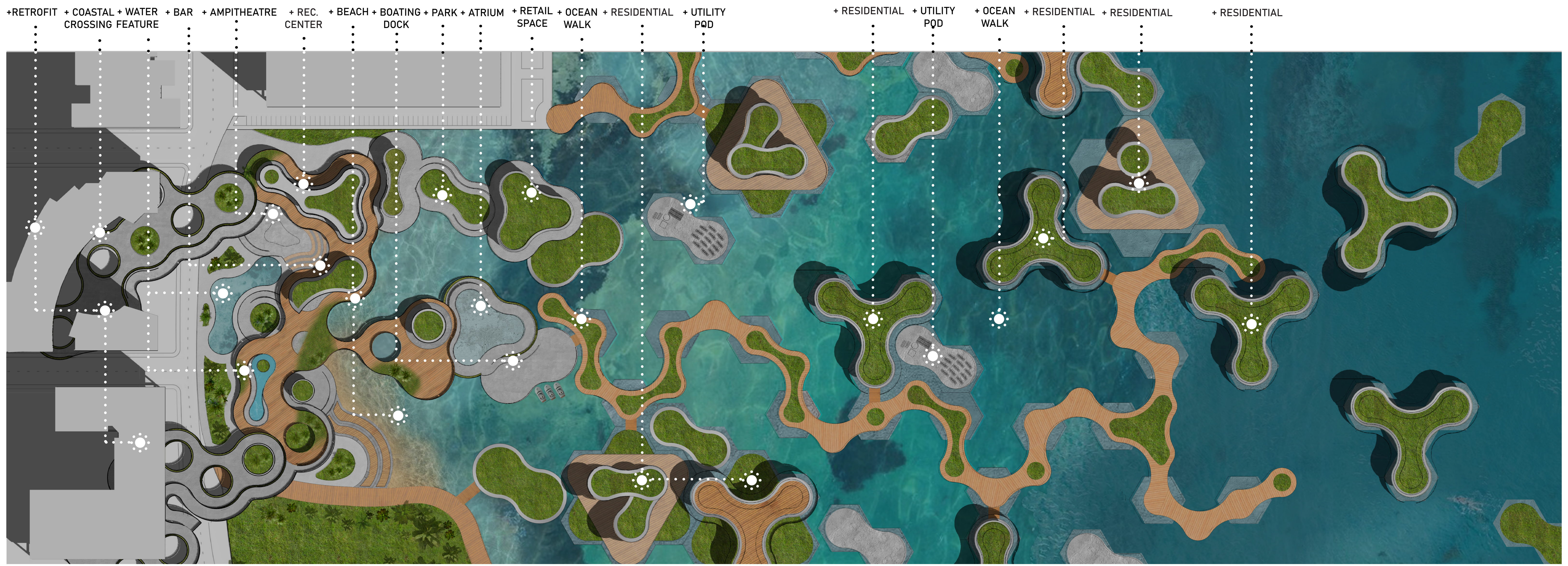

FIGURE 46.1: MASTERPROGRAMMING

### BEACH


FIGURE 47.2: PUBLIC BEACH RENDER

### RESIDENTIAL


FIGURE 47.1: RESIDENTIAL SPACE RENDER

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# SECTION PERSPECTIVE


FIGURE 48: SECTION PERSPECTIVE

# + DESIGN PHASES

**PHASES**
In the progressive design phases of the project, the evolution unfolds in distinct stages, each contributing to the overarching vision of the organic platform.

**PHASE ONE** initiates with the terraced organic forms, laying the groundwork for the entire structure. This phase focuses on shaping the foundational elements, primarily utilizing terraced arrangements to mimic natural landscapes.

**PHASE TWO** the design introduces the organic walkway leading to floating housing units. Here, the focus shifts towards connectivity and functionality. The organic walkway seamlessly integrates with the terraced forms, guiding inhabitants through the space while maintaining the organic aesthetic. Floating housing units emerge as focal points, offering unique living spaces suspended above the ground.

**PHASE THREE** marks the culmination of the design journey, introducing an upper level for circulation and public space, with retail amenities integrated into retrofitted residential apartments. In this phase, the platform reaches its full potential as a multifunctional hub. The upper level expands the spatial experience, providing elevated vantage points and opportunities for social interaction. Retrofitted residential apartments serve as adaptable spaces, seamlessly blending residential and commercial functions.

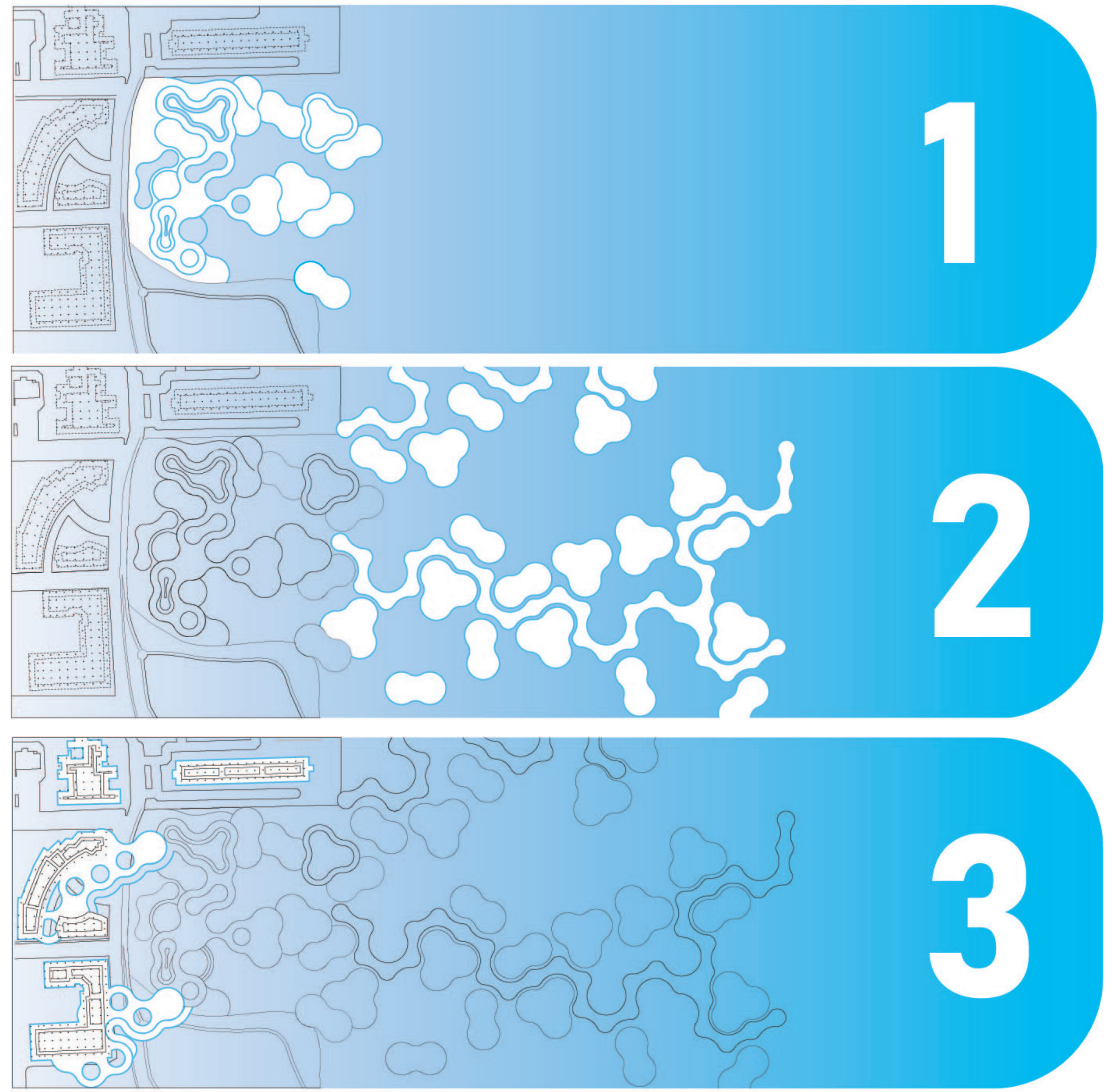



FIGURE 49.1: DESIGN PHASE 1 -3

FIGURE 50: PUBLIC SPACE RENDER

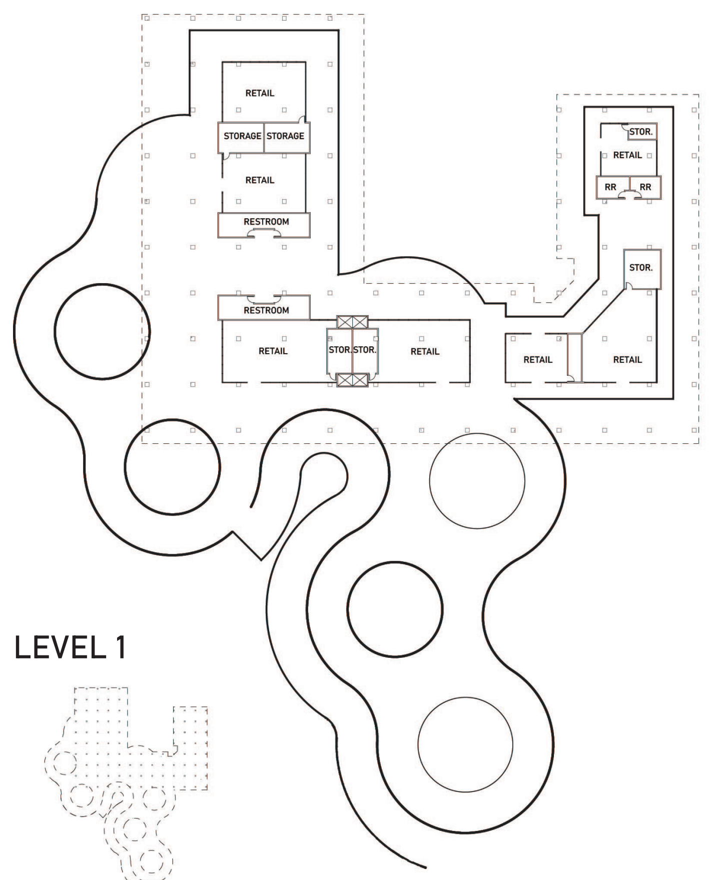
# + RETROFITTED

## EXISTING STRUCTURES

In this research project, the main goal was to retrofit existing coastal buildings to address the looming threat of future flooding. With a focus on resilience and sustainability, the study aimed to develop a comprehensive strategy that ensures both functionality and economic viability.One of the key aspects of this strategy was the adaptation of ground-level spaces into flexible retail areas capable of adjusting to fluctuating water levels during floods. This adaptability was achieved through the incorporation of versatile features and flood-resistant materials, allowing these spaces to transition between regular commercial use and flood-responsive modes seamlessly. Additionally, the research emphasized the importance of establishing permanent commercial spaces on the second level, protected from flooding risks, to sustain long-term economic activity and community resilience.

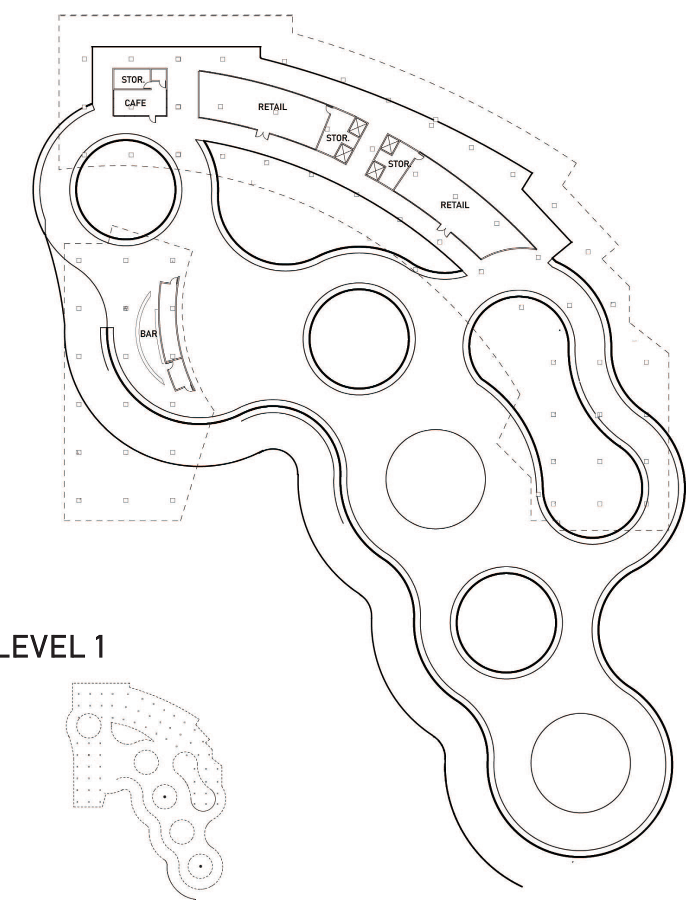
The decision to incorporate both light wells and to set the original floor plate back 15 feet around the perimeter of the building was a strategic move aimed at ensuring the functional adequacy of the flexible and adaptable retail space on the ground level, particularly in terms of daylight provision. Light wells serve as architectural features designed to introduce natural light into spaces that are otherwise constrained by building structures or lack direct access to exterior walls. By integrating light wells into the building design, natural light can penetrate deeper into the interior spaces, enhancing visibility and creating a more inviting environment for occupants.

LEVEL 2 BUILDING A



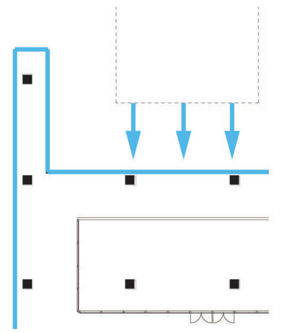
LEVEL 1

LEVEL 2 BUILDING B



LEVEL 1

SET BACK



LIGHTWELLS

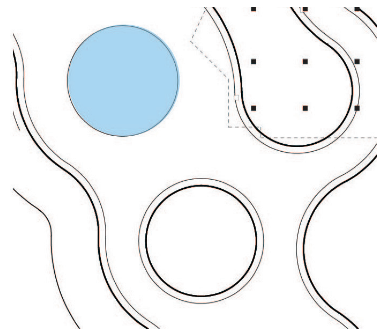


FIGURE 49.1: DESIGN PHASE 1 -3

FIGURE 51: RETROFITTED RENDER

# + ELEVATED

## PUBLIC SPACE

The designed public space, elevated on a platform constructed from steel and mesh steel combined with polycarbonate materials, represents a conscientious effort towards sustainable and environmentally friendly urban development. This choice of materials not only ensures structural integrity but also minimizes environmental impact through their recyclability and durability. The elevated platform serves as a multifunctional hub catering to various recreational, social, and commercial activities, enriching the community experience within the coastal environment.

At the heart of this elevated public space lies a diverse array of amenities aimed at promoting health, leisure, and community engagement. A designated dog park offers a safe and enjoyable space for residents and their furry companions to exercise and socialize. Adjacent jogging trails wind through lush greenery, providing opportunities for outdoor fitness and leisurely strolls amidst the coastal landscape. A recreational center offers indoor facilities for sports and leisure activities, catering to diverse interests and age groups within the community.

Furthermore, the inclusion of a bar, beach area, parks, and shops enhances the social and recreational offerings of the public space, creating vibrant gathering spots for residents and visitors alike. Ample seating areas scattered throughout the space encourage relaxation and social interaction, fostering a sense of community and connection among users. The integration of abundant greenery and landscaping enhances the aesthetics of the space while promoting biodiversity and environmental sustainability.

## LEVEL 2 BUILDING A


FIGURE 49: PUBLIC SPACE MASTERPLAN

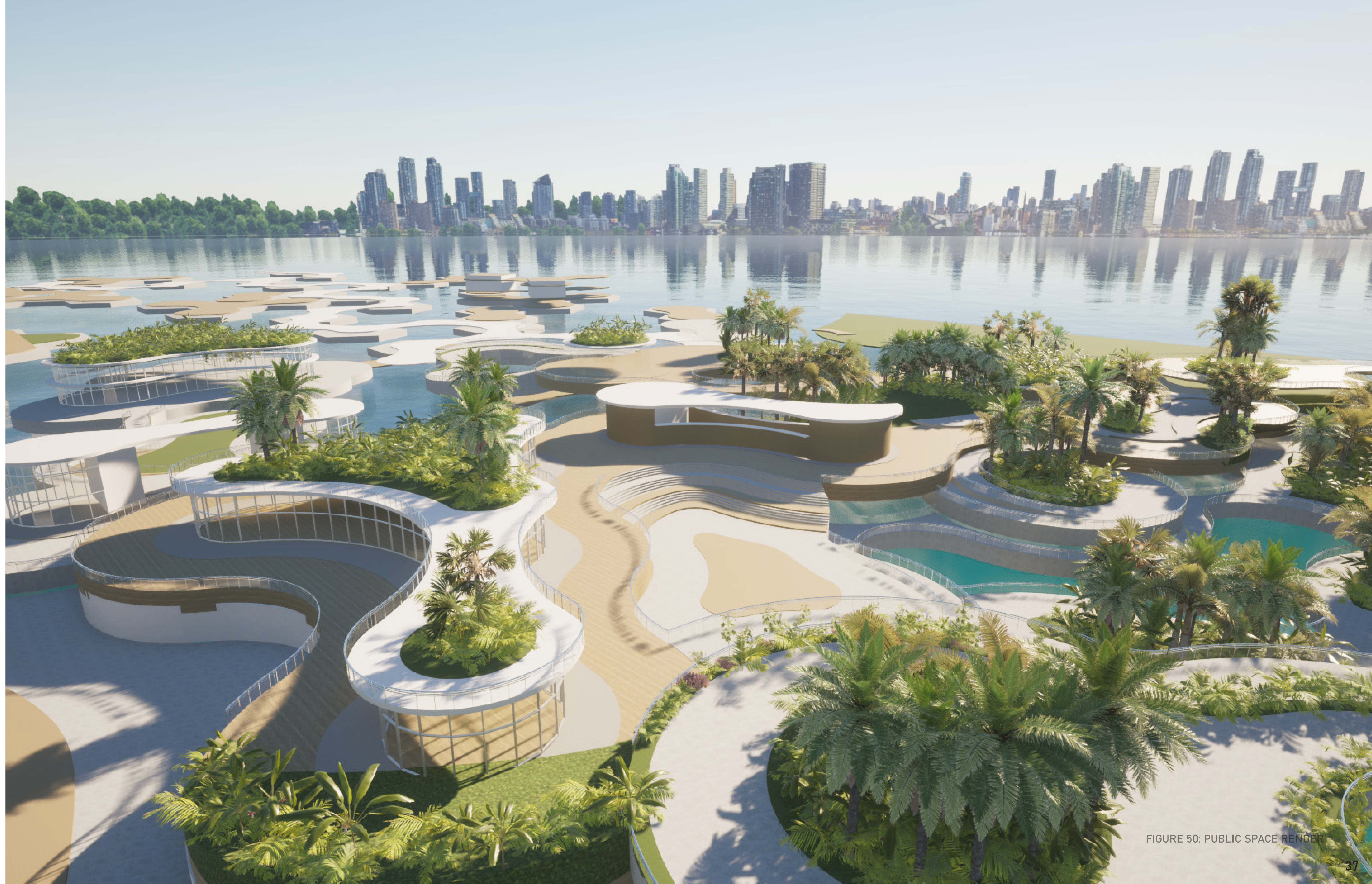


FIGURE 50: PUBLIC SPACE RENDER

# + FLOATING

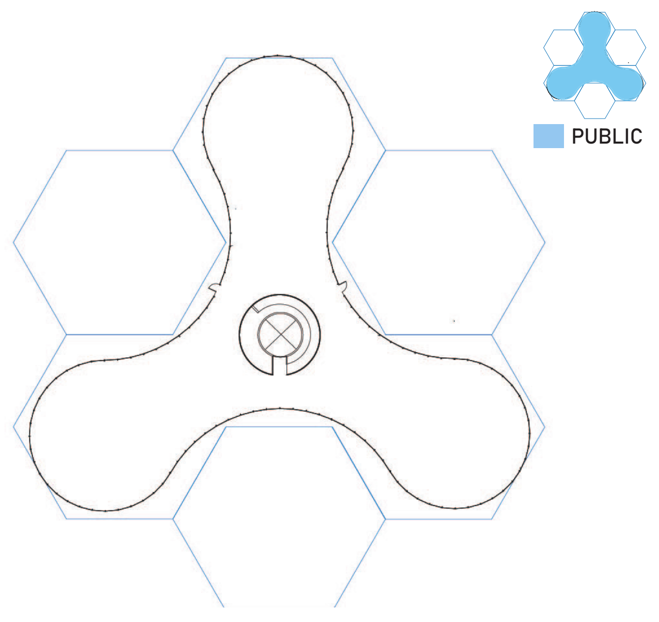
## RESIDENTIAL

Incorporating floating residential units with public spaces on the first level and private living spaces on the second level presents an innovative approach to coastal architecture. By integrating communal amenities at the lower level and individual residences above, a balanced environment is created, fostering both social interaction and personal privacy within the floating community. The decision to utilize a hexagonal base for the floating units is strategic, allowing for structural stability and facilitating easy linkage between neighboring residences. This modular design promotes community cohesion while maximizing space efficiency and minimizing environmental impact.

Positioning the floating units just below the water surface, with the more radial platform situated above, results in a visually captivating aesthetic that harmonizes with the coastal environment. This configuration not only ensures stability but also enhances the modern and futuristic appeal of the floating community. The interplay between submerged and elevated components adds depth and dimension to the design, evoking a sense of tranquility and innovation that complements the coastal surroundings.

Overall, the integration of floating residential units with public and private spaces, alongside the utilization of hexagonal modules and innovative aesthetic elements, represents a bold and forward-thinking approach to coastal development. This approach prioritizes functionality and aesthetics, envisioning a waterfront community that adapts to rising sea levels while fostering a strong sense of community and connection among its residents.

**LEVEL 1**
PUBLIC LEVEL




**LEVEL 2**
PRIVATE LEVEL

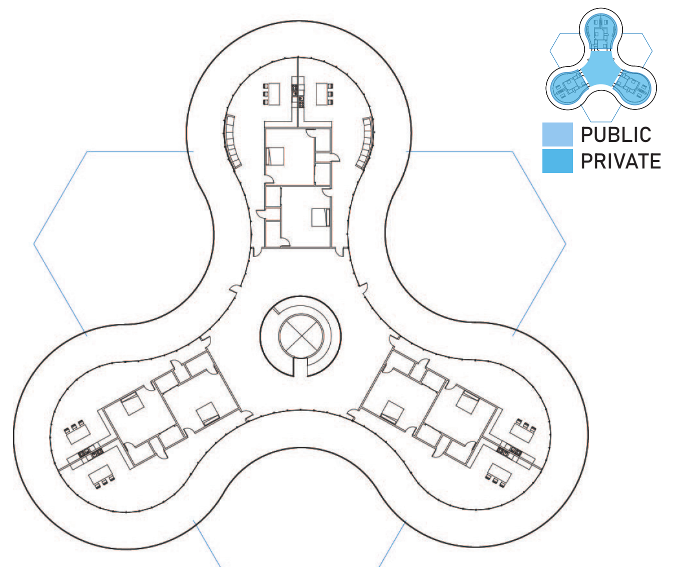



FIGURE 51: RESIDENTIAL FLOORPLANS

**EXPLODED RESDIENCES AXON**

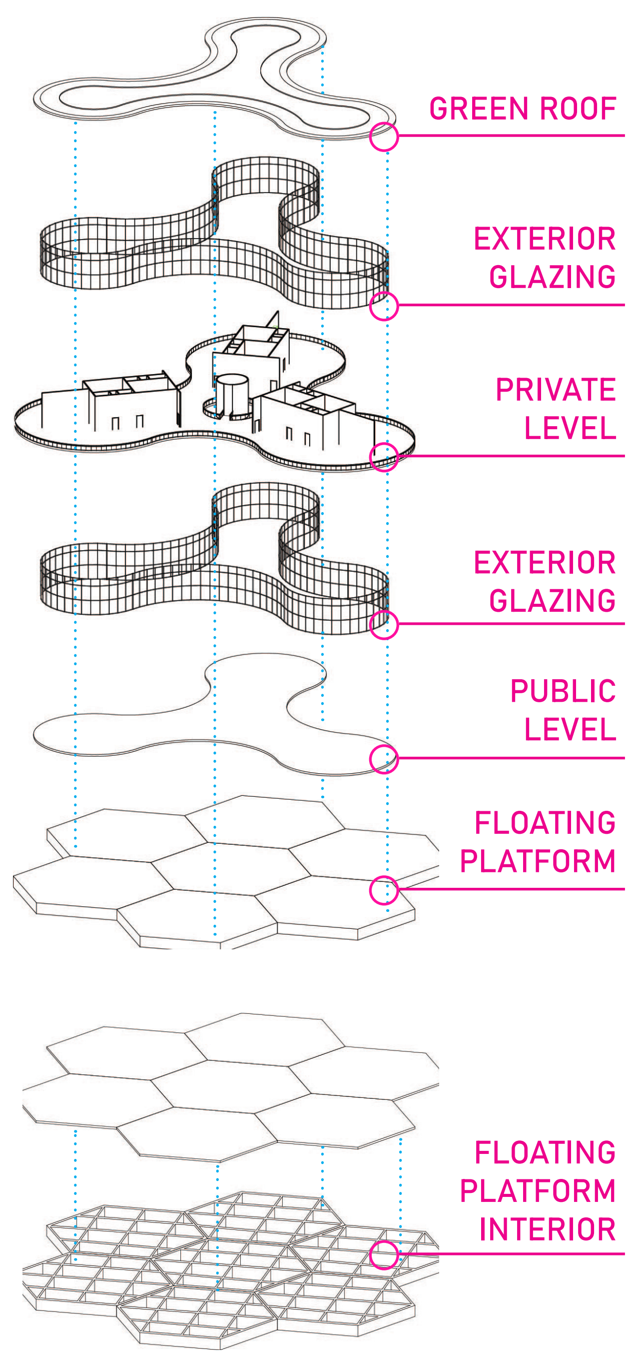



FIGURE 52: RESIDENTIAL AXON

FIGURE 5[illegible] RESIDENTIAL BIRD EYE VIEW RENDER

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