REVISION OF SEYCHELLES'S FUTURE: AN ECO-TOURISM PROTOTYPE

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ABSTRACT

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The non-gradual and rapid increase of the effects of global climate change on small islands all over the world is very critical. Sea level rising has serious impacts on small islands such as Seychelles, Maldives, and the city of Venice. These islands have already started to drown making their near future obscure. Globally, the consequences of climate change are clear evidence that our cities and countries will not survive anymore. As we experience global climate change, do we adapt to new conditions or invent responses to prevent changes of our physical environment and affect our diverse cultural experiences? By considering island communities, we may better understand the consequence of climate change and discover opportunities for future strategies to enable island communities to thrive. To best understand how to construct these strategies, an early and mid-twentieth century urban utopia projects, such as the Metabolism Movement and the work of Richard Buckminster Fuller, are studied. These projects do not only respond to the future needs of cities and people, but also offer a framework to explore Seychelles Islands as a prototype for possible ideal and cultural societies to adapt to the effects of climate change.

Keywords

Climate Change, Sea Level, Renewable Energy, Metabolism, Megastructure, Capsules, Organism, Buckminster Fuller, Ephemeralization, Synergetics

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Chapter 1
Metabolism Movement

"I began to seriously consider methods that utilize natural resources without waste, that reuse materials by dismantlement and reassembly and allow for reconstruction. Metabolism was based on this idea."
(Kiyonori Kikutake, 'From Tradition to Utopia' 1997-p.10)

Introduction

Seychelles Islands are facing an increase in the intensity of extreme weather events. The great Indian Ocean Tsunami, December 2004, and Cyclone Bondo that hit Providence and Farqhuar Islands, December 2006, are just a few examples representing the consequences of global climate change that Seychelles Islands are suffering from. Generally, these natural disasters have massive impacts; first, on the social development on which the growth of the human population depends, and second, on the infrastructure on which a country's economy relies.

Global challenges, such as water crisis, food, insecurity, and health issues, are all tied to climate change making the idea of understanding that natural phenomena very challenging. However, nowadays many cities have future plans, either to mitigate climate change by reducing the greenhouse gas emissions or to adapt it to the current status, in which climate trends and variability are factored into the daily planning decisions. To reach this ideal condition in Seychelles Islands, this paper examines the possibilities of constructing an urban system that can be mapped out and measured using nature's geometry to adapt to environmental changes. This paper asks: How can an ideal society, adapting to the current and futuristic impacts of climate change, be established on Seychelles Islands with respect to its existing culture?

As we always imagine and dream of worlds free of conflict, unhappiness, poverty, hunger, and natural disasters, we always seek to find these perfect worlds –often characterized as *utopia*. No specific time or place can describe utopia, as it can be set at any point in the future, present, past, or even before time began. The first 'Utopia' was written by Sir Thomas More in 1516, the word 'Utopia' came from the Greek word '*ou-topos*' which means 'nowhere' or 'no place' indicating that, as ideal

as it could be, it is not realistically possible. However, '*eu-topos*', an almost identical Greek word, means 'good place', so there is a vital question at the heart of the word: Can an ideal, utopic, world ever exist?

The idea of utopia is to provide an escape from reality, it presents an ideal world, compared to the real one, just by highlighting the problems faced on the daily basis in life. This can help draw the attention to what has been changed or removed, as it also helps to better comprehend the reasons and the notions behind the revolution that led to reform a new world at that time. Therefore, we can understand the utopian world as a parallel world, as a reaction, to the real world or to a specific aspect of it. Generally, each utopian society is based on visions, and versions of traditions and social systems already existing in our world (such as law, economy, beliefs, values, and needs). In order to build this kind of ideal societies, Seychelles Islands are in need of a fixed adaption plan –a one that is capable of fitting with the current and predicted climate changes threatening their existence.

The first part of this paper considers a brief history of global climate change and its effects on the cultural, economical, and political environment of Japan as an example of the potential possibility for the future of Seychelles Islands. First, by examining the notion of sustainable architecture through studying the history of the Metabolism movement and its products such as terms, models, projects and buildings like the three proposals of the Marine City designed by Kiyonori Kikutake, and the Nakagin Capsule Tower designed by Kisho Kurokawa. Second, by defining and analyzing the main characters of the movement and the reasons for its failure.

The second chapter briefly introduces the economical, political, and environmental climate of Seychelles, displays the past,

current, and future impacts of climate change on the country, and examines the adaption and mitigation plan for the future.

The third chapter considers the vision of Richard Buckminster Fuller -one of the most known utopian futurists- and his design strategy that is based on the idea of doing more with less, in which he found a key to fix the world's problems, through highlighting some of his sustainable inventions.

A Brief History of Global Climate Change

Throughout history, the Earth's climate has varied. Seven cycles of glacial advance and retreat happened in the last 650,000 years. With an unexpected end of the last ice age, 7,000 years ago, the modern climate era and the human civilization began. These changes in climate resulted from small shifts in Earth's orbit, which altered the range of solar energy reaching the planet.

The current climate trend is a result of human activities, that started in the early 1800s with the beginning of the industrial revolution. When societies started to industrialize, gradually the nature of the atmosphere began to change. Over the years, introducing carbon emissions and other heat-trapping gases to the air in tremendous amounts, influenced the earth's global temperature that has always fluctuated at a stable rate throughout the years. These gases have played a big role in warming the atmosphere, which rapidly increased during the last couple of years and exceeded the sensible limits, precipitating the phenomenon of global warming.

Architecture from Rubble

One of the most dreadful consequences of global climate change is the Great East Japan Earthquake, of magnitude 9.0, that hit the Pacific coast of Tohoku, Japan on March 11th, 2011. It is was not only considered the most destructive earthquake to ever hit Japan but also the fifth most powerful earthquake in the whole world since 1900. It was the

reason for the radiation leak that happened in Fukushima Daiichi Nuclear Power Station. Hospitals, public temporary accommodations, and relatives' houses became the shelter for more than 250,000 people, because of the incident. A massive tsunami, following the incident, reached up to 40.5 meters and destroyed everything in the affected area. On March 10th, 2014, the official record showed 16,884 deaths with 2633 missing, and over 400,000 crashed buildings and residential houses. These series of natural disasters not only damaged the infrastructures of the impacted region but also the Japanese people's soul.

Confronting the wreckage of the repeatable incidents has promoted the Japanese to not only reconsider different strategies to reconstruct their lives and cities, but also to try to understand the complicated relationship between human and nature. This exceptional combination of man-made and natural disasters raised questions about the reliance on modernization and Japanese modernity. Toyo Ito, one of the Japanese architects said:

"The reported scene of a fishing village in Sanriku [northern coast of the Tohoku region facing the Pacific Ocean] devoured in seconds by the tsunami struck me and made me wonder what Japan's 60 years of modernization since the war was all about... I am amazed by the fragile state of things despite all the economic and technological 'strength' Japan has been so proud of... Was our achievement of the past several decades a house of cards?" (Koolhaas and Obrist, 'Project Japan: Metabolism Talks' 2011- p.697)

Japan was faced with finding another way of living, which led to problems with many fundamental features of its society. This was not the first time Japan faced this type of experience; the massive destruction of the atomic bomb in the Second World War did not just ruin towns and cities but also created a feeling of despondency

and emptiness. However, at the same time, it offered a magnificent opportunity to transform architectural practice and philosophy. The absence of control after the war, the need to reconstruct the devastated cities, and reinvigorate the Japanese economy required modern urban planning proposals and architectural methods. Japan, a defeated nation that lost its certainty, cultural strength and national identity, sought to rebuild its cities and recreate a new image of Japan

It was not until the beginning of the 1960s when the Metabolism movement came as a result of the collaborative work between seven Japanese architects, who were seeking to restore the lost identity. The modern architectural movement displayed a new conceptualization of architecture and the city's landscape embracing a utopian futurism. Metabolism did not just offer the opportunity to restore the lost image, but to also confirm the social role of the Japanese architects. The Metabolists followed the new utopian architectural assumptions and believed that architects have the ability to make people's and society's habits better.

Megastructure: The Age of Life

After the war, the Japanese were trying to find a position for themselves in the world, more influential and more independent. At the beginning of 1960, the "income-doubling plan" by the Prime Minister Hayato Ikeda played a major role in changing the political and economic situation in Japan. Focusing on very powerful industry policies and procedures, Japan scored a new record in the economic growth which later renowned as the Japanese Miracle. The plan encouraged individual spending, low-interest loan to economic sectors, more investment in transportation such as railways and highways, infrastructure, and port facilities. Also, the government created some incorporations with manufacturers and banks to operate resources efficiently and to organize

production, financing, and distribution process, to increase the competition in the international business market. As a result, from 1960 to 1970, the Japanese Gross National Product (GNP) increased by 420 percent.

While the economy was recovering and began to boom again, the Japanese population was growing exponentially at a higher rate, which created a critical concern for the architects. On one hand, Tokyo became a very congested city and began to expand into the countryside, this problem started to exacerbate due to the lack of the cohesive urban system. On the other hand, the fear of natural disasters played a big role in changing building codes and restricting the buildings' height limit to less than 31 meters, which led to a low-rise crowded city. Also, the old methods of the wooden construction were still commonly in use. All these issues resulted in an unplanned-Tokyo city that was not capable of keeping up with rapid development. Thus, the architectural conception of the Metabolism movement was based on a mega scale and the total city plan; in other words, the Metabolists sought to design the whole city with all necessary functions and systems rather than just designing a single or sets of buildings.

In the 1950s and the 1960s, they mainly relied on the concept of the 'megastructure', engaging with high-tech, futuristic, utopian architectural design and regulation systems of the total city. On one hand, they tried to establish democratic and egalitarian living environments for the people. They believed that creating innovative living spaces would be possible by mass production and systematic quality control of materials, through developing the architectural technology. On the other hand, the main control system of the megastructure essentially depends on centralization and planned control. While developing their theory, they attempted to promote the concept of a city that could be perceived as a supra-individual organism;

similarly to the ones of organismic development and natural processes.

In contrast to the architecture of the 20th century, 'the age of the machine' that has been often identified by Le Corbusier's declaration *'A house is a machine for living in' (1923)*, the Metabolists advocated 'the age of life'. Kisho Kurokawa, as one of the renowned Metabolists, said, *"Machines do not grow, change or metabolise of their own accord. 'Metabolism' was indeed an excellent choice for a key word to announce the beginning of 'the age of life'" (Kisho Kurokawa, 'The philosophy of Symbiosis' 1994-p.24).* The city was not seen as static and fixed arrays of material structure, but as an organic entity as any of the living things that are able to grow, develop and regenerate itself within the time to adjust to everchanging environments. Also, in the book *'Megastructure: Urban Futures of the Recent Past (1976)',* Reyner Banham imagined the megastructure as a single structural framework, containing various modular units, that is capable to change and extend at different rates to fit with the renewable needs of each unit.

Main Characteristics of the Metabolism Projects

The idea of the megastructure that consists of a main structural framework 'core' with attached units, cells or capsules 'jointed-together' is the fundamental concept of the Metabolism movement. The individual units can be 'plugged-in' to the prime core framework and 'plugged-out' of the core framework based on the need. At the same time, the units or the capsules must be standardized, and that makes it more convenient for the mass production and also helps economically by decreasing the unit cost.

The time factor is a very important aspect in the idea that the core must be more sustainable, stronger, and has a lifetime longer than the attached modules or units that can be replaced to fit with the need, and without major

construction. But also, the main framework must have a capacity to extend; in different words, it will never be completed, it will continuously grow and die.

The Metabolists tried to apply the idea of the core and units to their projects. However, because of the technological limitations and the declination of the economic growth during that time, most of the projects remained as proposals except a few buildings such as Kurokawa’s Nakagin Capsule Tower.

Case Studies

(Nakagin Capsule Tower by Kisho Kurokawa)

Figure 1 – The Nakagin Capsule Tower in 1972

The Nakagin Capsule Tower, designed by Kisho Kurokawa, in 1972, is an ideal example that represents the fundamentals of the capsule living concept. As one of the few built projects, it is considered as a significant architectural artifact that symbolizes the Metabolism era.

The structure system of the tower includes two reinforced concrete shafts, with a rigid frame made of steel, that act as the main cores of the tower. These two shafts provide plumbing, electricity, and circulation for 144 capsules (100 sq. ft. each) attached to them from the outside (Figure 3,4). The way that the capsules are linked to the cores is very flexible, as any capsule can be easily replaced or removed without affecting the neighboring ones (Figure 4). Each capsule measures 2.5 by 4.0 by 2.1 meters and functions as a small living room or an office space, they can be connected and combined together to create larger spaces. The capsules were constructed from prefabricated parts, and within inbuild appliances, they include the basic services such as bathroom and storage spaces. Every unit has a bed and a big circular window. Kurokawa imagined that the capsules would be updated occasionally with new technologies and replaced entirely every 25 years. However, the cost of doing

so is too high, and the building has fallen into disrepair ever since.

At that time, Kurokawa's idea of the capsule architecture comprised many futuristic concepts, his concept on how to make the most efficient use of living space to accommodate to the everyday essentials of a person. In his book *"Metabolism in Architecture" (1977),* he elucidated that his obsession came from three separate elements 'man, machine and space' connected together in order to create 'something' beyond each element individually –a 'new organic body'. He referred the word 'capsule' to the use of the three previous elements, similar imagery to 'medicine' and 'living quarters of an astronaut'. He believed that humans will become as 'cyborgs' by employing the new technological assistance that existed within the capsules.

Through the idea of the capsules, Kurokawa wanted to provide high-quality living units that can satisfy most of the people's daily needs. However, with the explosive development in every aspect of the Japanese society, people would not be satisfied with the standard design; and at the same time, it was impossible to do customized design for everyone. For that reason, Kurokawa tried to consider the mass customization in an affordable way. All of the furniture and appliances were box-based with different dimensions. This way, they could be re-arranged to adapt to people's different needs.

At that time the building was considered revolutionary. However, the design idea of the capsule is similar to the most traditional of Japanese design of a tea ceremony room. To help the capsules to be a meditative place like the tea ceremony room, the main elements of the design remained without any change such as the circular window and the focus on the experience and the individual (Figure 2). *"By examining spaces for individuals, we must seek new relations between the individual and the society" (Kisho Kurokawa, 'Metabolism in Architecture' 1977-p.36).* He desired that his capsule's

architecture would revive this design notion that was forgotten in the modernization of Japanese architecture.

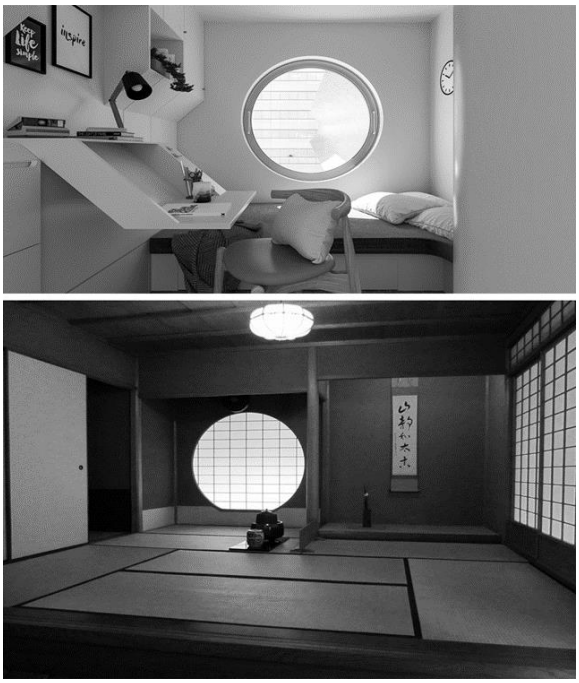


Figure 2 – Circular Window in a Capsule and Tea Ceremony Room

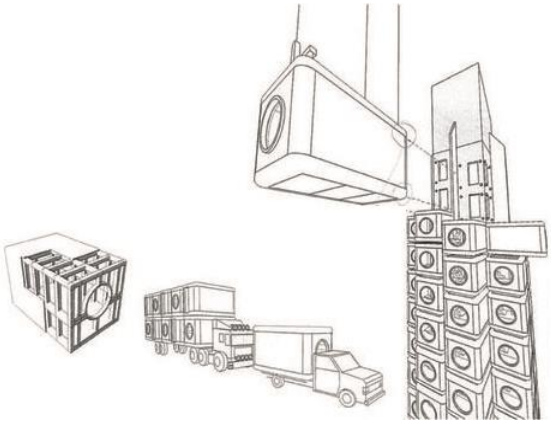


Figure 3 – Adding or Removing Capsules

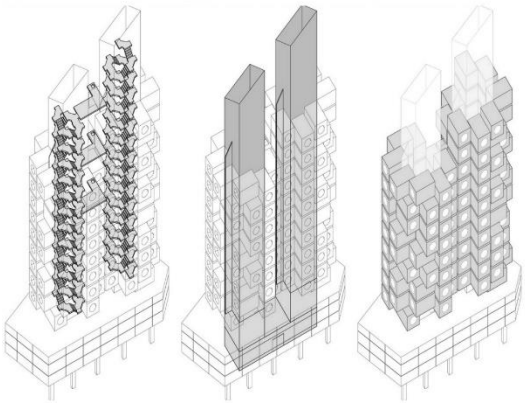


Figure 4 – Circulation into Two Shafts

(Marine City Projects by Kiyonori Kikutake)

The Metabolists also had many ideas of living under or above the sea and considering the ocean as a possible escape space from the increasable threats of the environmental changes and the possible overpopulation on land. The marine city projects designed by Kiyonori Kikutake are ones of the most initial and influential proposals to establish megastructure into the sea. It holds the concept of the city as a process, artificial land, and the distinction between the minor and the major structure. Designing an entire city separated from any other, capable to float freely on the sea, using new technologies that

allow the mass production of prefabrication elements to emerge with the time. Being fearless of war or even problems of societies were the essential notions of the proposal. According to Kikutake, the idea of 'Marine City' came as a result of the limitation of land, it is a solution to the reduction of the living levels and the insecure social and political situation of Japan. In this part of the case studies, three different proposals of the marine city (Marine City Project 1958, and another two proposals of Marine City in 1960 and 1963) are analyzed and compared together in order to display the relation between the 'Floating Platforms' and other parts of the building, such as the spatial and the structural elements; in addition to the relation between the structural system and the functional program, relating to the expanding pattern of the city.

(Structural System)

In (Figure 5) Kiyonori Kikutake provided five different structural systems for the 'Floating Platforms' that differ in the technique of balancing weight and buoyancy. The five systems can be classified into two types. The first type depends on hexagonal or triangular prisms joint together and oriented in a vertical or a horizontal way (i, iv). This orientation allows either the sides of the prisms or the horizontal plates that are supported by the prisms, to form the 'Floating Platforms'. The second type depends on large volumes like spheres, and vertical and horizontal cylinders to be the buoys (ii, iii, v) while supporting the 'Floating Platform'. The space inside the large volumes are prepared to contain buildings and services. In (ii) the 'Floating Platform' is represented by a horizontal plate floating on the sea. Part of it is supported by the floating large volumes (spheres and cylinders) which are attached to each other under the sea to form a spiral, or triangular, grid. The other part is supported by buoyancy and tension created by seawater on the surface of the sphere. In (iii) the horizontal plate

is surrounded by a circle made of horizontal cylinders. The horizontal plate is supported by a large watertight chamber and is floated on the water surface by small spherical buoys underneath it. Whereas, in (v) the large floating buoys are separated from each other, are more independent, and contain vertical shafts inside of them to help support the horizontal plates above the water surface.

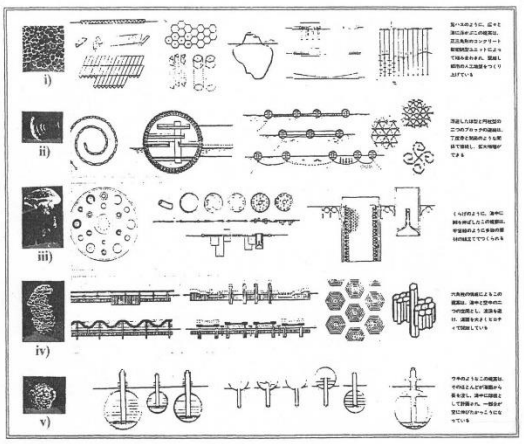


Figure 5 – Five Structural Systems of 'Floating Platforms'

(Marine City Project of 1958)

The Floating City "Marine City", designed by Kiyonori Kikutake in 1958, has a circular shape with a diameter of four kilometers. On the outer edge, it contains a group of twelve spherical industrial facilities, with a total area of 1,000,000 m^2. Six concrete cylindrical cores of 300 meters tall, extended into the sea, are specified for transportation and public services. The cylindrical cores are connected to each other by a curved horizontal tube (ii) which is used for circulation. These cores are floating, and they work as vertical buoys to support the horizontal plate above them. Residential units, for 50,000 people, are located on the inner edge of the concrete cores under the sea. At the center, there is a vertical shaft (Figure 7). On the surface of the horizontal platform, there is an open space for the human community to thrive, which also works as a connection between the spherical industrial facilities, the cylindrical cores for the residential units, and the vertical shaft. The aerial perspective of the project shows many Marine Cities separated from each other. However, the proposal does not have any access to the city or any specific description of the expanding process of the city.

Figure 6 – Marine City Project 1958

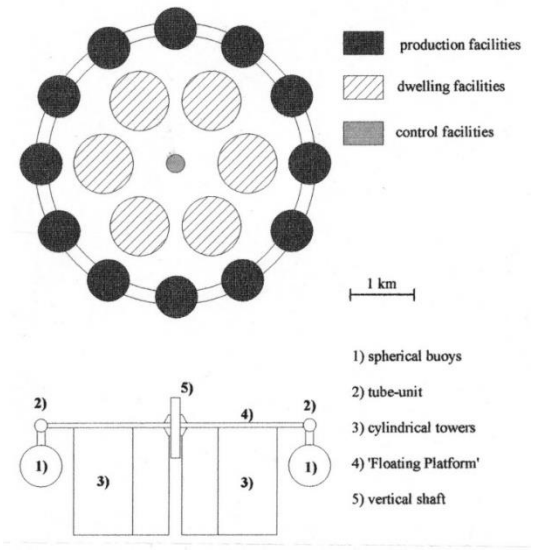


Figure 7 – Plan Marine City 1958

(Marine City Project of 1960)

The Marine City of 1960 has two 'Floating Platforms' that have an irregular shape, and a surrounding zone, 500 meters wide, that protects from the sea waves. (Figure 9) The outer zone contains production sectors, and horizontal plates of the outer zone are supported by wells. While the inner zone contains residential blocks. The structure of the residential blocks is based on hyperbolic paraboloid shells and has a shape of concrete ships with a massive mast as a core at the center. The central core supports three corridors that provide service for the living units on every floor. The lower part of the residential blocks which is under the water includes urban public spaces and common facilities. The outer and the inner zone are separated from each other by sea water which is considered as a buffer zone and is also specified for the cultivation of marine products. However, the two zones are connected together at one point by the administration block. At the center of the inner zone, there are two control towers of 500 meters tall above the sea level and 1000 meters tall under the sea level. The two towers, with

an artificial sun above them, also work as energy centers for the city.

Clarifications for (Figure 10): the control tower (white dot), the residential zone (dotted line), the industrial zone (double line), and the administration block (black dot). Kiyonori explained the growth process of the city in a similar way to biological cell division. The control tower, counted as the main energy source for the entire city, is equal to the nucleolus, the main part of the nucleus in cells that curls and duplicates the chromosomes. In (a, b), the division started from inside the cell. In (a), a new administration block, born on the opposite side of the inner zone, caused the residential zone to expand and touch the industrial zone, while the control tower is duplicated. After that, as the two administration blocks moved towards each other, and with the expansion of the two zones, a new city is born. In (b), the residential zone started to divide with an administration block containing a new control tower. While in (c), the duplication started from outside the cell, the industrial zone started to duplicate around the administration block.

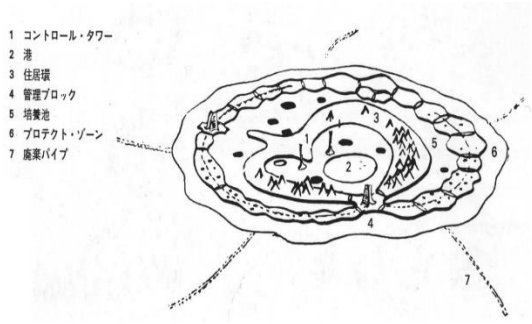


Figure 8 – Marine City Project 1960

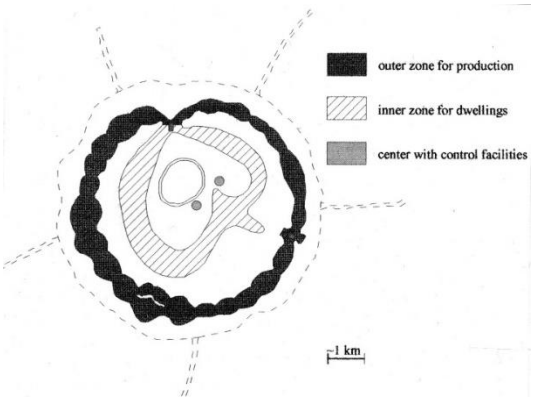


Figure 9 – Plan Marine City 1960

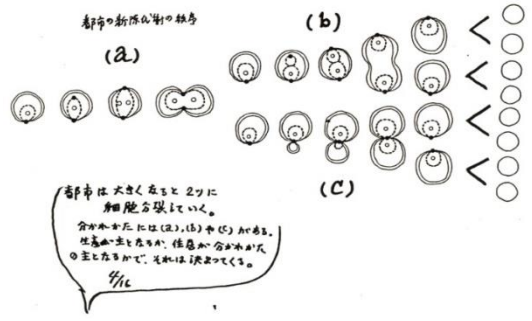


Figure 10 – Growth Process of Marine City 1960

(Marine City Project of 1963)

In (Figure 12) the Marine City of 1963 contained six large separate

islands to accommodate industrial facilities, these islands are coordinated in a circular way. Small islands, accommodating residential facilities, are located around the large islands. Each one of the small islands contained cylindrical towers, each tower is based on a double-wall structure that included circulation in-between to form the central core. The living units are cantilevered outwards from the exterior wall. The way that the islands are supported is not clearly described. However, the 'Floating Platforms' might be supported by the towers and with the assistance of underwater buoys, similar to (v). The small islands are linked together and to the large island, that they are gathering around, by some bridges to create a community block. Each community block has an administration block as an individual center. There is one central island, containing the control facilities, located close to the center of the entire composition.

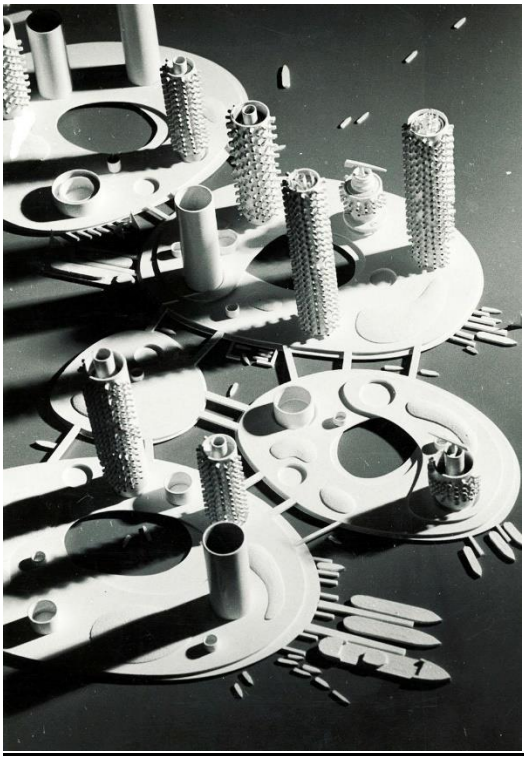


Figure 11 – Marine City Project 1963

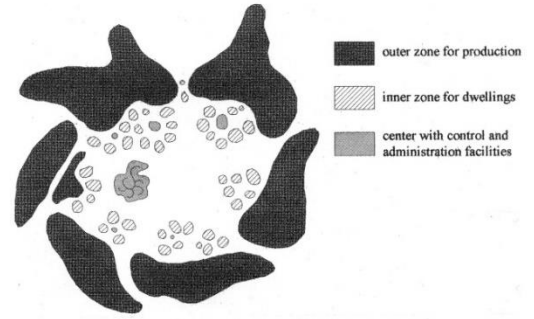


Figure 12 – Plan Marine City 1963

The Relation Between the Three 'Marine City' Proposals

In 1978, Kikutake published a diagram that summarized the interrelations among the three different proposals of 'Marine City'. In (Figure 13) he showed that the Marine City Project of 1958 is the archetype of 'Marine City' that slowly transformed into other 'Marine City' projects. The physical shape of the 'Floating Platforms' was a circular plate in Marine City Project of 1958; however, it changed to be concentric rings in Marine City Project of 1960 and became to be separate units of 'Floating Platforms' in Marine City Project of 1963 later on. This chronological order of the evolution of the physical form is linked to the enlargement of scale. (Figure 13) shows how Kikutake shifted his approach from the structural creation of the floating platforms as 'artificial land' in Marine City Project of 1958, designed for 50,000 people, to the technique of organic growth of the floating platforms in Marine City Project of 1960 and 1963, proposed for 500,000 people.

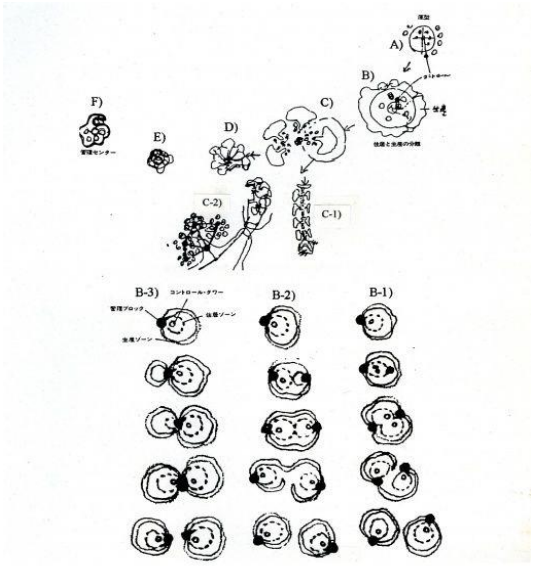


Figure 13 – Relation Between the Three Marine City Proposals

Analyzing of the Main Characteristics

(Prefabrication)

The concept of the modularity and prefabrication, that was adopted by the Metabolism movement, is applicable and appropriate to our current ecological crisis in many ways. First, prefabrication of building parts in industrial manufactures provides less construction waste and possibilities to redesign the entire or parts of the capsules for reusable purposes (Figure 14). There is also a

possibility for regionalizing the capsules with, produced and renewable, locally-available materials. This approach would help to overcome the effect of the mass production and would also minimize the carbon footprint of buildings. In the modular buildings, the essential accessibility of individual parts enhances the ability to commission and control building systems.

Second, the prefabrication process optimizes the quality control. In order to build sustainably, energy usage in buildings has become a focus of concern. The quality control that is provided by the prefabrication became more attractive. Quality is optimized in manufactures due to the controlling of the environment, enhanced automation, supervision, and focus on particular jobs.

(Affordability)

Regarding the construction cost, the prefabricated units are more efficient economically than the site-built construction. However, the Metabolism buildings were not economy-friendly, in 2008 the cost of the 100 sq. ft. capsule in the Nakagin Capsule Tower, designed by Kurokawa, was 6 million yen each (approximately 66,000 USD). Assuming there is an economy in numbers, we can expect a capsule of 100 sq. ft. to cost around 10,000 – 15,000 USD. The capsule of Kurokawa's tower should cost extremely less. In addition to that, the cost of the central core, which provides the structural support and consists of the circulation and utilities of the tower.

(Recycled Building Materials)

The revival of the world's interest in recycled components and materials has driven to reuse shipping containers as actual building blocks. It might be interesting to share that the capsules of the Nakagin Tower, despite the fact that they were not recycled, were constructed by a manufacturer of a shipping containers company (Urban Space Management Ltd).

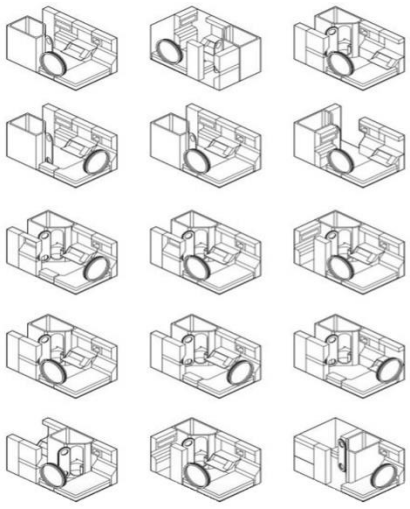
"Devised by Urban Space Management Ltd, Container City™

is an innovative and highly versatile system that provides stylish and affordable accommodation for a range of uses". They attach the shipping containers together to supply greater strength, and they use preconstructed steel modules, that can be joined together, to create plenty of building shapes to meet the user's needs. This technology allows decreasing the construction's pace and costs by half of the traditional building methods'. It is also considered more ecology-friendly.

(Modular Systems)

The Modular system can be organized into three categories. The closed system method confirms the economy and is more reasonable; however, its ability to expand and change its parts is limited. Once the layout is set up, the preconstructed parts are interlinked into a fixed core. The open system method provides an open framework that gives a possibility to add and remove units. The mixed system is the same system that was used in the Nakagin Tower by Kisho Kurokawa. This method contains fixed components such as circulation and utilities core with mobile units attached to it.

Most of the Metabolism projects used the mixed system method. On one hand, the main core is an extension of the urban system, and the attached units give the freedom to change. On the other hand, the closed system, similar to the one in the Marine City of 1958, would be better for the economy. However, it could not offer the ability of the organic growth and that made it inappropriate for the Metabolism concept.



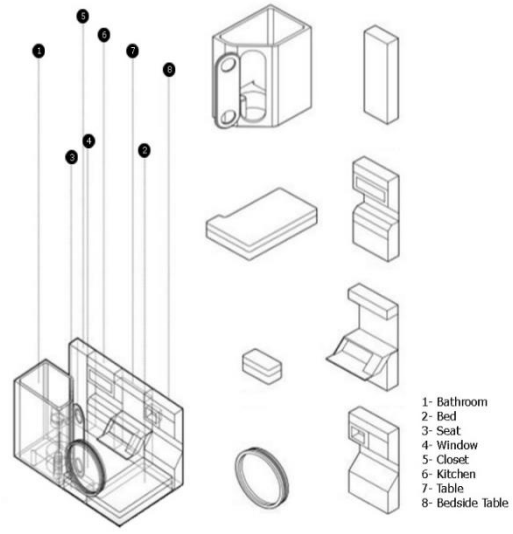


Figure 14 – Prefabricated Elements of the Nakagin Capsule Tower

The Paradox of the Utopian City

The fundamental premise of the Metabolists is the solid belief that modern architecture, through modern technology and design, could change and enhance the qualities of people's daily life and societies, and open up the new model of utopian human life. They believed that in the utopian future city, the communal spaces would provide greater autonomy support for the people and establish democratic relationships as well. For them, the communal space was represented as 'artificial land', the megastructure on 'artificial land' contains the individual units. As described before, the mass production of the individual units required standardization of prefabricated elements and components. However, the Metabolists insisted that the prefabricated components/units should provide a various-combinations subject to the inhabitants' styles, tastes, and necessities, rather than impact the inhabitants' individuality. They also thought that increasing the mobility and the repeatable change of the future city will weaken the ties between the inhabitants and a particular land or place. Since they believed that being free from the land would lead to a greater freedom and mobility for people, they claimed that the land must be regulated and owned by a public institution, not by individuals. Also, the city's system must be governed and controlled by a central administration.

In this sense, despite the basic philosophy of the Metabolism movement –which is based on the progressive human development

and the autonomy for people– what they planned to do was in danger of turning into the opposite. Here, we can see the primary contradiction between the practical design of the city and the philosophical conception of the Metabolism movement. On one side, they promised democracy and freedom in the daily life; on the other side, they imagined life in the future city to be ruled and controlled by a centralized system. They confirmed that the architects should have the power to rule, because designing the physical layout of the city can determine and control people's lives and practices in the society that they live in.

The Descent of the Metabolism Movement

The Metabolism movement started to decline in the middle of the 1970s, because of the changing economic climate. The business competition and the expansion of the investors' financial capacities, along with the change of the consumer culture, imposed the Metabolism projects to become more involved with commercial interests. The 1970 Osaka Expo was assumed to be a great opportunity for the Metabolists to present their architecture and their imaginary ideas of the ideal future city. Based on the modern architectural technology and the aim to represent a new image of Japan, their pavilions were supposed to display their utopian city concepts. However, their designs impressed the commercial sponsors and met their interests. By giving place to politics and industrialists, the Metabolism almost lost its autonomy and became driven by the commercialism, gradually they shifted their philosophical view from utopian modernism to neoliberal capitalism. Another reason was the economic regression after the oil crisis, 1973, when the Japanese economy depended on importing the oil from the Middle East. Many aspects of the Japanese economy had to be reviewed due to the increase of instability of the architectural

industry and the drop of the economic growth. Hence, the mega-scale of the urban system became problematic.

Arata Isozaki argued about the Metabolist's linear view of the constant development of the city. The Metabolists saw that the city development emerged to be an organic system which could be controllable and predictable. While for Isozaki, *"the city is formless and accidental" (Koolhaas and Obrist, 'Project Japan: Metabolism Talks' 2011-p.37),* it confronts unforeseeable disastrous destruction. He debated that in nature, as well as the city, the organic metabolism is always emerging, immeasurable and unplannable.

Japan has faced war destruction such as the atomic bomb and various critical natural disasters such as the Kanto Great Earthquake that burned and ruined most of Tokyo, in 1923, and the Fukushima tsunami and nuclear radiation leakage in 2011. These series of events provide a clear evidence which supports Isozaki's assumption that the development of the city could be disrupted by catastrophic accidents and therefore, could not be considered as linear.

Conclusion

The Metabolists saw that people's lives and societies change in a dramatic way and they needed to express their feelings architecturally. They tried to have architecture follow and accommodate to the situation of Japan during that time. They showed that architecture had no ability to impact, but it can convert itself to adapt to the new pattern of life. Architecture, as they proposed should be seen as one component of a huge natural and organic system. The call for more efficient and environment-friendly structures and construction methods have brought the idea of the modularity and prefabrication to the forefront. The architecture of the metabolism challenged the machine age. The mechanical model of the modern architecture

was substituted by a biological and more dynamic one, in which its elements –like the living capsules– could come to live and die while the whole body goes on living.

The Metabolists emphasized not only on the entity, but also on the existence of individuals. They displayed the relationship between cities and natural systems, buildings and cities, and building components and buildings –which were all linked and separated at once. From the idea of the autonomy of the individuals, they came up with the concept of capsules architecture in which each one of the capsules has its own identity. The concept of the living capsules was based on the notions of division, expansion, evolution, deconstruction, the autonomy of individuals, and recycling. The capsule architecture was purposed as deconstructed architecture instead of mass production. However, the modularity of the capsules ended itself to prefabrication.

The Metabolists dedicated a valuable deal of energy to the topic of human beings and technology. The new technologies, that the metabolism offered, made the occupation of new spaces such as the ocean and the sky possible. However, they actually never accomplished the flexibility that was the notion of their entire concept. Their movement was limited to a few projects, the movement failed not because of the lack of its members' ability, but because of the lack of the economic, social, and political support, where the technological growth alone could not assist the ambitious movement.

Chapter 2
Seychelles Islands and Climate Change

Seychelles Islands

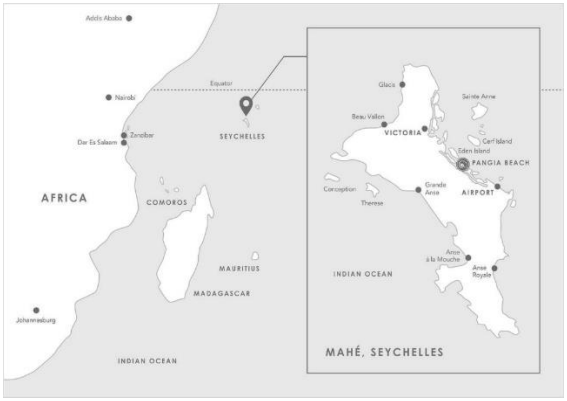


Figure 15 – Seychelles Islands

Seychelles, officially the Republic of Seychelles, is an archipelago with a total area of 455.3 km2 located in the Indian Ocean in Southeast Africa. Seychelles consists of over 115 islands, 40 of the islands are granitic, and the rest are coral. Mahé, the biggest island in Seychelles, is home of the capital Victoria, Mahé is also considered as one of the four main inhabited islands, in addition to Praslin, Silhouette and La Digue. Seychelles was first settled in 1771, with an initial population of 28 persons. The population has subsequently grown to its present population, estimated at 86,000 in 2008, and projected to reach 100,000 by 2020 (NSB, 2008). The current total human population is about 95,100. The capital Victoria, which is the largest city in the archipelago, has attracted about 25% of them. Because of the steep land conditions that made the region unsuitable for infrastructure, the majority of people and economic activities centered on the narrow coastal plateau of Mahé.

Politically, the system of socialist multi-party, the Parti Lepep "People's Party", governs the island's state, and it had replaced The Democratic Party that governed from the first year of independence in 1976 to 1977. Administratively, the country is divided into 25 districts and each has a District Administrator, who is responsible for its well-being.

Economically, the geographical nature of Seychelles, where the forest or vegetation covers over 80% of its land area, played into the flourishing of agriculture for a while, but the need for continued adjustment to changing circumstances led Seychelles away from food production into a cash crop economy. So, since

Independence in 1976, Seychelles has developed from an agricultural-based economy into tourism and fisheries-based economy.

Currently, the farms, dispersed throughout Mahé, Praslin and La Digue, employ around 3,800 persons and the agricultural sector contributes to about 3.8% GDP. While tourism is the main service activity. Although it has been influenced by many historical changes such as the Gulf war in 1990, an upward trend of tourism sector has been noted since 2005 and is expected to be incremented with upcoming new projects. The same is true for the fisheries sector, which has been affected by increased shipping costs following the piracy attacks in the Indian Ocean (1992). However, nowadays, it plays a crucial role on Seychelle’s economy and on the country's commercial balance. It employs 17% of the total population, its annual contribution to GDP is up to 20%, and the value of the fish exports constituted 93% of the total value of domestic exports.

In 2008, Seychelles faced a critical economic situation, due to the recent economic expansion that has led to a rapid growth in fuel consumption coupled with rising in oil prices, where Seychelles depends on imported oil products for its energy needs. Seychelles works to reduce this dependency by increasing energy efficiency and promoting renewable energy, which is virtually non-existent, except for solar water heaters. In the coming years, the energy sector is expecting an excessive growth, because Seychelles set ambitious targets to provide large-scale renewable energy plants (large scale solar PV plants, large-scale offshore wind farm, marine renewable energy, and biomass plants) that will create a lot of job opportunities and will drive local industries and investment through a competitive process.

The Climate of Seychelles and the Main Considerations

Climate Change will have notable consequences on Seychelles in the short, medium and the longer term. Its direct and indirect influences will be clear on the demographic structures, the infrastructure, and the economy of Seychelles. So, researches are needed to better understand changes in cyclone patterns, ocean and air currents, and the interaction between the climate change and other climate phenomena such as El Niño.

Seychelles: Major Natural Disasters

Year	Disaster type	Number of people affected	Estimated economic damage (in percent of GDP)
1997	Flood	1,237	0.5
2004	Tsunami	4,830	3.6
2013	Tropical storm	3,000	0.7

Source: EM-DAT

Recent studies carried out by researchers from Japan and Cuba highlighted that much of the human activity is concentrated around the low-lying, coastal areas which are at the highest risk of flooding from heavy rainfall, storm surges, and sea level rise over the longer term.

Generally, Seychelles is outside of the hurricanes zone, but its topography makes it vulnerable to the climate changes, such as tsunamis, strong winds, severe rainfall, flooding, rockslides, landslides, and forest fires.

Since 1862 and up to now, 92 significant disasters affected Seychelles that are classified into different categories as it is shown in the table below:

Events	Number
Tsunami	2
Storm / Strong winds / Cyclone	19
Drought	6
Heavy rainfall	21
Flood (due to heavy rainfall)	14
Landslide / Rock fall / Mud flow (due to heavy rainfall)	14
Forest fire	13

The global climate changes will increase Seychelles' economic concerns. As the sea's temperature rises, the water expands causing an increase in sea levels, which will not only threaten the tourism sector but will also have a devastating effect on the marine ecosystems. This gradual increase in sea temperature will kill the coral reefs and fishes will either die

or migrate. Also, for example, the tuna fish will shift their patterns and migrate out of territorial waters reducing national income. The extreme rainfall affects the crop and causes a fish loss, and sea-level rise leads to the coastal erosion, salinization, and consequent losses to tourism, food, and water security. For instance, the heavy rainfalls, El Nino, between 1997 and 1998, and La Nina, between 1998 and 2000, hit Seychelles hard bleaching 90% of coral reefs in the archipelago as deep as 23 meters. Extensive flooding caused serious economic losses, which included the fisheries by 45%, agriculture (28%), industry and constructions (12%), tourism (12%), and forestry (3%). This phenomenon occurs every two to seven years and always has far-reaching consequences. The last El Nino, in 2016, resulted in reducing the coral reefs coverage from 5%-50%. Again, in September 2002, a wind gusts up to 130 km/h hit Praslin, followed by a heavy rainfall, that reported 327.1 mm in a 24-hour period, which destroyed terrestrial and marine biodiversity as well as physical infrastructure. The total losses were estimated at USD 86.7 million.

Specifically, Seychelles climate is equatorial with an average annual rainfall of 2,200 mm. The mean annual rainfall decreases from the north-eastern to the south-western islands. Rainfall can be as high as 5,000 mm per year on the top of Morne Seychellois (905m) on Mahé, and as low as 867 mm on the coralline island of Assumption. High-intensity rainfall, with occasional heavy rains (up to 250 mm/day) may occur from December to March. The sea surface temperature in Mahé reached a maximum temperature of 30.1C and had a minimum temperature of 24.9 C. Dr. Denis Chang Seng a professional UN Science Program Specialist (Ocean Observation & Services Section /Tsunami Unit) in The Intergovernmental Oceanographic Commission of UNESCO emphasized that, from 1961 to 1993, the local sea level trends were consistent with the sea level

rise of an average rate of +1.8 mm (1.3 to 2.3 mm) per year. While the rate rapidly changed from 1993 to 2003, around +3.1 mm (2.4 to 3.8 mm) per year. Chang Seng also said that it is not clear if the reason behind this change is related to an increase in the long-term trend or not.

The Future Impacts of Climate Change on Seychelles

The short-term effects of the climate change on infrastructure, agriculture, fisheries, tourism, energy and water security, biodiversity, waste management, and on human health and well-being could be considered as a clear evidence to possible climate change consequences of the long-term.

Genetic Resources estimates Seychelles' dependence on the plant resources is about 85%. If we took into consideration the recent world food crisis, which may continue in the future, we can confirm that the climate change will have a serious impact on the agriculture in many ways. The increase of the sea level will cause salinization in the soil because of seawater. Also, the coastal flooding and the extreme rainfall will cause serious losses to crop.

Although the extreme rainfall that recorded an average of 2,200mm/year, the main islands have faced water rationing. Water supply in Seychelles is from river sources, coupled with groundwater extraction and desalination plants. Whilst river water is abundant, the steep topography and low retention of soil and rock cause the flow to become inconsistent and fall to very low values during the dry season from June to September. In the narrow coastal plateau, groundwater extractions have not been successful. Desalination plants have been installed to meet a shortfall in demand during the dry season. Despite these efforts, Seychelles will face serious water shortages in the near future, water resources are likely to be seriously compromised and the ration will worsen both in duration and severity, leading to a negative

impact on economic activities and more public health problem.

Furthermore, changes in long-term rainfall patterns, as well as temperature, will exacerbate the water supply problem on Mahé, Praslin, and La Digue, because the scarcity of the rainfall and the increases in the surface air temperatures, which will increase the rates of evapotranspiration, will decrease the stream flow and reduce the groundwater recharge. Even the increases in the rainfall intensity, which may result in a greater surface runoff, will not necessarily translate into a greater availability of water because of greater variation in stream flows.

Long-Term Vision

Seychelles' long-term vision is to minimize the impact of climate change, especially in critical sectors (water, food and energy security, and disaster management), to encourage technology development, and transfer to it cleaner one.

(Adaption Plan for Climate Change)

The Government of Seychelles considers adaptation to climate change as a high priority to overcome the country's economic vulnerability.

The food security has been recognized by the Government as a critical issue, and it agreed that there are clear linkages between water, food, ecosystem health and well-being of the people. Seychelles is in the manner of achieving an ecosystem-based strategy for watershed management and its entanglements for foods supply and water security.

The case of fisheries & agriculture could be a good illustration. The Seychelles National Investment Plan provides plans that aim to make the sector more resilient and plans for adaptation measures through the climate-smart agriculture that could boost agricultural productivity, increase climate resilience, and lower greenhouse gas emissions.

It also aims to put in place such programs that improve port infrastructure to support sustainable, industrial and artisanal, fisheries and mariculture. Such programs could also promote home gardening and reduce illegal, unreported and unregulated activities.

Seychelles now looks for a proactive strategy to adapt the blue economy to climate change, through structuring its resilience by strengthening the management of fisheries and marine ecosystems and extending the coverage of marine protected areas.

The water security, the storage, and the distribution problems require instant attention and it needs to take into consideration the projected population growth, while reducing the increasing demands on the treated water. There is an urgent need for using more rainwater, enhancing the efficiency of the distribution system, and improving water storage capacity. The increase in water demand from the residential, commercial, agriculture, and tourism sectors is due to the changes in rainfall patterns and a limited water storage capacity.

Adaptation is not just a matter of investment spending; updating the Seychelles Strategic Land Use Plan to adequately address sea-level rise, and storm surges, is needed as an important tool for adaptation to climate change. For instance, the current moratorium on building big new hotels is intended to protect sustainability in the face of coastal erosion and pressure on energy, food, and water. This strategy does not adequately address sea-level rise and storm surges, which are the two main climate change impacts on infrastructure.

Another essential component is setting plans for critical infrastructure, particularly roads, ports, government buildings, energy generation, and water and sewerage management systems.

(Mitigation of Greenhouse Gases in Seychelles)

The oil-based power supply is the major economic burden on Seychelles' economy and the main risk to its future economic and social development. The sole dependence on crude oil products to generate electricity has resulted in rising electricity bills, for both families and private companies, as well as a massive depletion of hard currency from Seychelles' economy.

Seychelles enjoy two domestic energy resources, the wind and the solar energy, which are hardly used so far. These renewable resources could make up for very attractive economic conditions for the production of renewable energy-based electricity.

According to a study, done by Prof. Dr. Olav Hohmeyer from Europa-Universität Flensburg -Center for Sustainable Energy Systems (CSES), Energy and Environmental Management, a 100% renewable power supply is technically feasible for Mahé. The study is based on an annual total electricity demand (including system losses) for Mahé of 320 GWh and a scenario with 50 MW of installed wind power capacity, 125 MW of installed solar energy (PV) capacity, biodiesel and a pump storage hydro plant with a storage volume of 1 GWh. This proves that Mahé can easily be provided with electricity from renewable energy sources every hour of the year. This transition of the energy system can boost the economy, as it saves the hard currency and increases the spending power of the citizens. When this transition is done, it is possible to expand the system to create adequate amounts of renewable electricity to stimulate all cars, small trucks and busses, assuming the present fleet is evenly exchanged with electrical vehicles.

In 2013, Seychelles' first wind farm, was achieved by MASDAR in cooperation with the Seychelles Public Utilities Company (PUC) and Seychelles Energy Commission (SEC). The plant that covers a land

area of 27.2 hectares is located off the East coast of Mahé and consists of eight wind turbines. The integration of the clean sustainable wind energy will help Seychelles to address its long-term energy security besides decreasing the power outages and reducing the carbon footprint. It will also decrease the amount of imported fuel by 1.5 million liters per year. The project is planned to produce about 7GWh of clean energy annually, which could power more than 2200 house with the advantage of displacing about 10,000 tons of CO2. Seychelles is aiming to produce 15% of electricity generation from renewable energy sources by 2030.

In 2013, the Government of Seychelles also implemented a Project “Promoting Grid Connected Rooftop Photovoltaic systems in Seychelles” to increase the use of grid-connected photovoltaic (PV) systems as a sustainable means of generating electricity.

The Government of Seychelles is conducting feasibility studies to look at the possibility to turn waste into energy through a facility that would take the form of a biogas plant. This strategy could be useful not only to increase the renewable energy but to reduce the waste that is expected to increase by 40% in the next 10 years. Solid waste management is a growing problem for Seychelles’ inhabitants and tourists, who generate about 65,000 tons/per year of waste on an upward trend. Landfilling produces negative environmental externalities; besides the problems of greenhouse gases and leachate, the landfills are located in the limited coastal area on all three main islands that lack the capacity to deal with wastes.

Seychelle' government is still investigating new technologies for renewable energies. Lately, it started new negotiation to take advantages of Carnegie's CETO to harnesses the enormous renewable energy present in the waves and to convert it into two of the most valuable energy; zero-emission electricity and desalinated water. The submerged CETO buoys drive

generators, and pumps, to deliver the power through undersea cables either to power desalination plants or to export it into the grid. This technology could be a big plus for Seychelles from an environmental side and an independence aspect as well.

Conclusion

Seychelles needs to pursue the target of a 100% renewable power supply rather than importing expensive fossil fuels as a major part of its adaption plan for the future as soon as possible. In order to achieve the sustainable level of adaption, some essentials need to be taken into considerations: First, on the urban level, Seychelles needs to update the land use plan as well as the transportation systems to fit the predictableconsequences of climate change. It is also important to improve the high voltage grid, in order to cover the entire island of Mahé, and to establish a solid grid infrastructure that acts as backbone of the future development of a 100% renewable power. Selecting a proper location for the pump storage plant, considering its high value in the future as a main source of energy, would supply the entire island.

Seychelles, experiencing the effects of climate change, is seeking a way that can allow the country to grow as a part of the whole natural system. Its plan for the future reflects its need to reform the existing cultural environment to what can adapt the potential requirements in the future.

Chapter 3
Richard Buckminster Fuller

"You never change things by fighting the existing reality. To change something, build a new model that makes the existing model obsolete."
(Richard Buckminster Fuller)

Adaptable Architecture

The idea of adaptable architecture was generated from realizing that a traditional-design-based, fixed building composition cannot meet the needs and demands of today's lifestyle, which is changeable and flexible –contrarily to the buildings. New strategies and a high-level flexibility are needed to manage everyday's life and handle the rapid change. The advent of modern technologies provides the needed flexibility to create new possibilities in the space's mobility and transformability. It, also, provides the ability to change a design's functions and configuration. Whereas, static solutions can no longer respond to the various requirements of the modern society (social and demographic needs, economic fluctuation, and environmental changes), nor are they able to deal with the serious crisis facing our coexistence in this world –or 'Spaceship Earth' as Buckminster likes to call it.

The development of the human life requires flexibility to ensure an ever-lasting adaption capable of adjusting itself, infinitely, to meet new daily challenges. Applying this model allows the investigation of many points: At which level is adaptability a subject of the sustainable model? How can we apply concepts such as variation, and adaptation, to construction dilemmas and concerns? What are the consequences of applying the idea of "a progressive process" when dealing with a design? How to deal with the demands for flexibility with build solutions? And, ultimately, how to apply architecture to provide a flexible environment and allow a constant change of use?

"People often tell me I am an optimist, and I say, I am a very hard realist. I know we have the option to make it, and that's very different from being an optimist." (R. B. Fuller 1980)

Buckminster, strongly confident, believes that technology is a solution for man to reshape the

environment to best suit his needs. Fuller considered to replace politics with design science revolution in order to fully advance planetary resources to benefit all people; he called it the "shift from weaponry to livingry". Fuller made a proposal of efficiency in economy, in 'Utopia or Oblivion', which is visible in the science and design in the existence of humanity.

"There is only one revolution tolerable to all men, all societies, all political systems: revolution by design and invention." (R. B. Fuller 'Utopia or Oblivion' 1973-p.205)

According to Fuller, technological utopia, through ephemeralization, would ensure the survival of the Earth planet and the human species. Ephemeralization is the concept of doing more with less. His state of utopia is based on optimizing ephemeralization's technological capacity. All desires are satisfied in this setting, except for war and politics where abundance becomes dead and useless. When Utopia is not present, oblivion takes over; a world based on politics and military is self-destructive.

Comprehensive Anticipatory Design Revolution

"Comprehensive anticipatory design science demands maximum overall efficiency with the least cost to society and ecology. Being comprehensive is a direction (Bucky called it 'comprehensive prospecting') that implies extensive, omnidisciplinary research, a task recently made easier by the Internet. The goal is to optimise, rather than to compromise. … A well-designed product represents thousands of years of refined human experience. Nature is not to be conquered or opposed, but she is to be regarded as a model of applied principles: Nature always does things in the most efficient and economic way. We need to learn how nature makes design decisions. …To be in tune with Universe, our designs should be regenerative. The current, overworked word 'sustainable' comes close" (J. Baldwin, 'BuckyWorks: Buckminster Fuller's Ideas for

Today' 1996-p.63).

R. Buckminster Fuller used the expression "Comprehensive anticipatory design revolution" to communicate his objectives and goals of his designs, which are to reform the environment and to ease the process of human success. It is similar to the concept emphasizing life-support in the practice of war-era design. However, it does not include the concept of violence, nor does it have a ruling authority, of war.

Total human success

Fuller was determined to study all aspects of society; its various fields and scales. He thought that the people are equally important to the community's function and to making the planet a responsibility for future generations. He also believed that the existing morals of people are beneficial and can help humanity evolve; however, that is only possible if the role of politics is changed.

The current human knowledge and inventory of materials is adequate to support the entire humanity with high standards of living –higher than the current ones. For so many years, people have been living with a survival-of-the-fittest instinct; the Malthusian-Darwinian assumption. However, the idea of us-versus-them has been now outmoded, since the new technological efforts' goal is livingry, instead of killingry.

Fuller explains why there will not be enough food supply for the entire population, because the population is growing at a higher rate than that of productions, which supports Thomas Robert Malthus' discovery in the 19th century.

Later, Charles Darwin, in his book '*The Origins of Species*', stated that natural selection is a main concept of evolution. Natural selection is based on many mechanisms, one is the "survival of the fittest" mechanism which is a term invented by Harbert Spencer. Both scientists provided many evidence that the sustenance is not enough for the whole population, but only for the "fittest".

Coming next was Karl Marx who divided society into two categories, the ruling class and the working class. In his opinion, the working class was the "fittest" for they worked in the production of food and other necessities for survival. Whereas, the ruling class had to vanish. Combining the work of Malthus, Darwin and now Marx, a new understanding of the world is developed: In a world with inadequate sustenance, only the fittest survives, while the two categories of society fight for the right of survival.

"Capitalism and socialism are mutually extinct. Why? Because science now finds there can be ample for all, but only if the sovereign fences are completely removed. The basic you-or-me-not-enough-for-both-ergo, someone-must-die-tenets of the class warfaring are extinct."(R. B, Fuller 'Operating Manual for Spaceship Earth' 1970-p.48)

No more Social Reform

"Don't attempt to reform man. An adequately organized environment will permit humanity's original, innate capabilities to become successful... Politics and conventionalized education have sought erroneously to mold or reform humanity." (R. B. Fuller 'Utopia or Oblivion' 1973-p. 366)

A revolution of the comprehensive anticipatory design is completely different from social modification. Fuller believes that telling people what actions to take, in order to make the necessary changes in world, is useless. Instead, he believes that letting people adapt to an environment, that is already designed, is more sensible. *"We must design our way to positive effectiveness, and not just be negative about politicians and what they are doing" (R. B. Fuller 'Ideas and Integrities' 1963-p.398)*

'Revolution' would be out-of-context if it was used in this text, due to the fact that our relations with the phenomenon often suggest unorganized savage riots and overtaking the current power structure. The comprehensive anticipatory design revolution is a

peaceful revolution, it aims to co-build a sustainable was of living, deliberately, without the use of violent.

The politicians-preoccupied conflict between capitalists and socialist is not the best way to deal with the humanity's problems; politics is built based on age-torn, useless ideas. Comprehensive Anticipatory Design Revolution is to grow the non-political, innovative, ambition and environment-reform design for the human success.

Aside from social-reform, Buckminster saw utopia, as free and self-sufficient, through technology. He proved that the power of technology can be liberating and used in a positive way. Fuller calls the 'Spaceship Earth' as a capsule; a home for humanity to survive and thrive. He believes that humans can use technology for their benefits, instead of being imprisoned by it. He also mentioned that the technology needed is already available, yet people do not know how to benefit from it.

Ephemeralization

Ephemeralization is the main principle of design for the total human success. Buckminster Fuller used this word to describe the progressive work of technological advancement; "do more with less". Getting better at using materials more efficiently means that less materials, quantity wise, are required. As our minds continue to grow, technologically and scientifically, and new principles are generated, the "do more with less" concept expands. He considered Henry Ford's assembly line, as a model of ephemeralization, in which design is used to enhance production.

Fuller made this concept as a reaction to Thomas Malthus' philosophy. Malthus saw that the increasing human population will use up the fixed resources on the planet and will eventually run out of resources. However, Buckminster disagreed for he believed that improved technology, design and engineering would enhance the efficiency of people's

ability to use existing resources. Thus, greater output with decreased input.

The rate of efficiency and "doing more with less" is accelerating. This increase will eventually result in doing *everything* with *nothing*. Buckminster provided an example of ephemeralization using the revolution of ship: In 1520, it took Magellan 2 years to travel around the world in a wooden ship. 350 years later it only took 2 months for a steel steamship to travel the same distance. It took a metal-alloys-made plane only 2 weeks to fly around the planet, 75 years later. A space capsule, made of exotic metals, took only 1 hour to do the same –that was only 35 years later. Continuously the materials became more efficient by getting lighter, stronger and more flexible.

Fuller's Inventions

In order for Fuller's perspectives to be accomplished and taken seriously, he needs to make inventions to clearly display his position, both philosophically and intellectually. Social reform is outmoded, and the scientists of comprehensive anticipatory design are able to mold the environments in a way that ensures the total human success

(Geodesic Dome of 1952)

The geodesic dome is probably one of the most famous examples, that Buckminster used to show his philosophy and attitude. They are ephemeralization's most available practical example with an estimate of 100,000 geodesic domes in use. Their geometric structures display efficiency and beauty; symmetrical triangulation are not only the most rigid structures but also enclose large volumes with only a dash of materials.

A geodesic dome is made of a fixed pattern; the sphere's, or icosahedron (20-sided shape), surface is divided into adjacent triangles. All the dome's nodes are found on the sphere's surface, they connect all the individual bars making the dome, which makes its structure smoother. The design is

super precise, like a mathematical equation, is calculate perfectly so that the structural stress is distributed equally in the sphere. The shape makes it possible to enclose large volumes with a little amount of materials. Buckminster, because of this genius invention, believed that all of his inventions should start as whole pieces, rather than multiple components.

The principle of geodesic domes shed the light on several questions for Fuller: How can we produce a supportive structure in an industrial way, that is time-efficient and easy for installations, uses minimum weight, whose structure does not require support, is economically producible, can be modified and put in position, is re-usable and reserved, can be transported and weather-resisting?

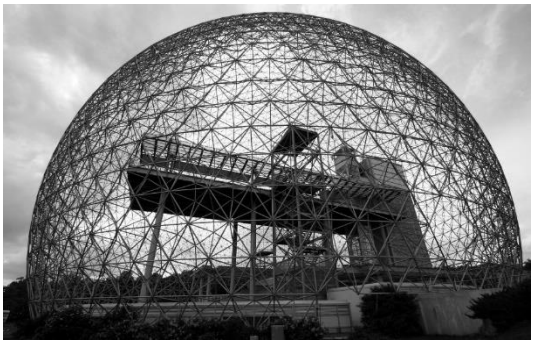


Figure 16 – Biosphere of Montreal 1967

(Climate Dome of 1960)

Fuller's visions led to even greater ambitions. In 1960, he proposed the idea of having a 'Climate Dome' installed over the midtown of Manhattan. The 'Climate Dome' is a huge geodesic dome that enclose large areas of the peninsula. This can also be a solution to the weather and air pollution issues in New York, the dome would shelter people from heavy snowfalls and provide an appropriate temperature throughout the year –all without using air condition and heating.

Alden Hatch described it *"Its skin would consist of wire-reinforced, one-way vision, shatterproof glass, mist-plated with aluminum to cut*

sun glare while admitting light. From the outside, it would look like a great glittering hemispheric mirror, while from the inside its structural elements would be an invisble as the wires of a screened porch, and it would appear as a translucent film through which the sky, clouds and stars would appear." (R. B. Fuller 'At home in the universe' 1974-p.230)

Instead of making the sky and clouds disappear, Buckminster thought of them as the new home for people and society; an airborne habitat. Due to a small increase in temperature, their lightness and aerodynamic design, the houses would be able to float. Buckminster and his partner, the architect Shoji Sadao, created a photo presenting the floating structures in 1960 – they called it 'Cloud Nine'.

This scenario is not more likely to happen, not because the current technology lacks the ability, but due to the fact that the conditions, economically and socially, of living in a floating structure needs to be thoroughly investigated.

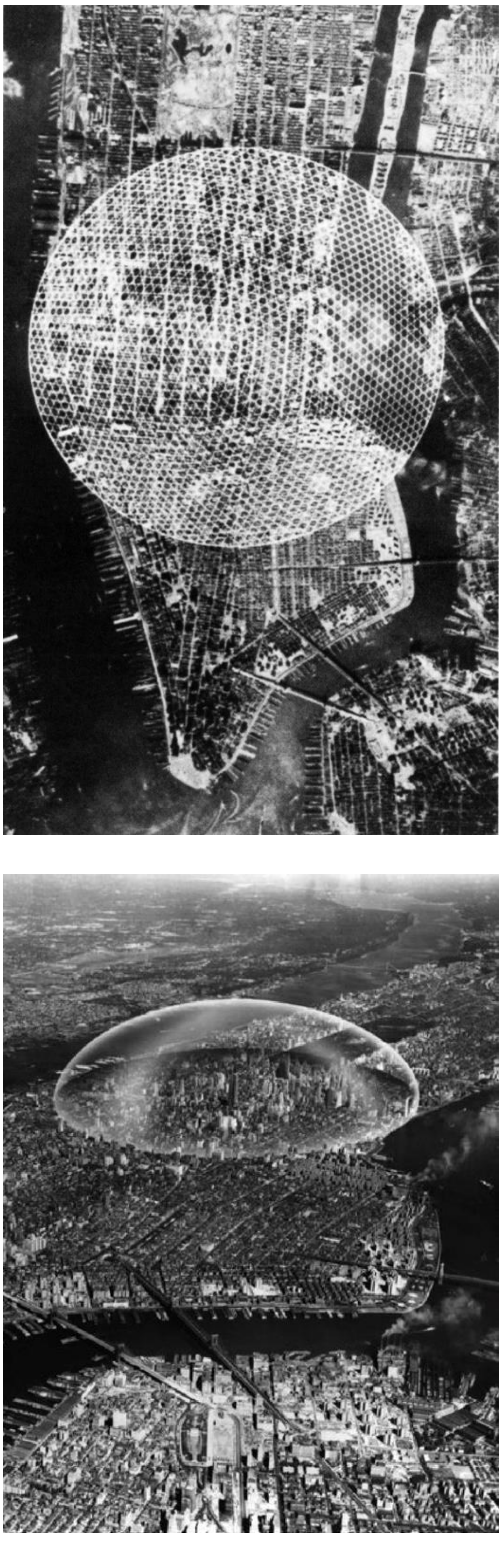


Figure 17 – Manhattan Climate Dome 1960

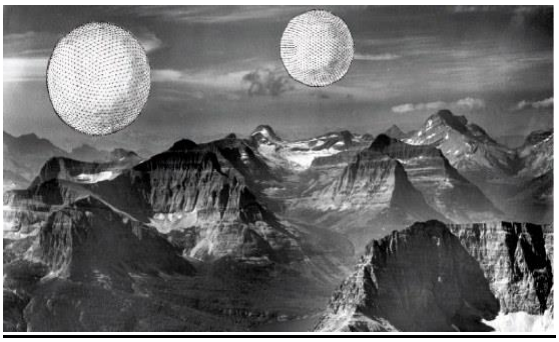


Figure 18 – Cloud Nine 1960

Other Inventions and Initiatives

(Renewable Energy)

Although geodesic domes contribute to the structural and architectural aspects of society, Fuller did not consider himself an architect. His worked covered various disciplines and concepts, his research made him an advocate of sustainable design and renewable energy.

Fuller was a renewable-energy-sources enthusiast, he incorporated the winds wave energy into his designs. He claimed, *"there is no energy crisis, only a crisis of ignorance."* His research indicated that humans can satisfy %100 of their energy needs, while eliminating the use of fossil fuels and atomic energy. For example, he proved that a wind power generator can generate power three-and-a-half times greater than of the country's output, that is only if the tower is connected to every high-voltage transmission tower in the U.S.A. In the early 1930s, he designed a car that is not only gas efficient, aerodynamic and sustainable, but can also fit 11 people –he called it 'Dymaxion Car'.

Again, his extensive research proved that enough energy can be produced for everyone in the world to use, while eliminating the use of fossil fuels and atomic energy. In his book 'Critical Path', he mentioned his encounter with a 12-year-old, who asked him about what he would do to save the world. Fuller said to the child, "unite the electric grids!", his explanation was:

"There is no want of energy in the world, only a want of vision. The sun is pouring billions of kilowatts of power on the Earth every second. Then there is hydro, geo-thermal, bio-mass, wind, ocean

differential and other sources of clean renewable power. About half of the grids that exist in the world today are connected and one-half remain unconnected. The latter are in the developing world. Link up all the electric grids and you would have a continuous source of abundant and clean renewable energy immediately available throughout the planet. The immense benefits of unlimited energy for all is immediately apparent. First, you protect the environment. No need to cut down the rain forests or pollute the ground and oceans with oil, coal and radio-activity from nuclear plants. Then when everyone has sufficient energy, birthrate decreases at exactly the same rate that the per capita consumption of inanimate electrical energy increases. Living standards rise as population declines especially in the developing countries. In short, the world's population will stop increasing when and if the integrated world electrical grid is realized. With everyone sufficient in energy needs, poverty disappears, greed, crime, strife is reduced to zero. Wars become unnecessary and therefore obsolete. Peace reigns on Earth." (R. B. Fuller)

(Dymaxion House - Synergy and Synergetics)

Considering Buckminster's design of the 1930s, Dymaxion House, is necessary when understanding the role of industrial designers and how should architects design sustainably for future uses.

Fuller focused on sheltering 100% of humanity with a design that is cheap, acceptable and sustainable. He imagined it to be easy to adapt and mobile. His image was to convert the traditional house into an accessible, industrially-made, machine. He analyzed housing in three categories: simplicity, uniformity, and automatization. He also searched for materials that would ensure efficiency and obtain a minimum weight.

Buckminster based all of his findings on natural systems and linked the laws of nature more accurately, this process was crucial

to that notion. He thought that each structure should revolve around one point –similarly to the Sun and universe– and achieve strength by including the use of triangles and hexagons in construction. This is called 'Synergetic'; the relation between geometry and mathematics.

"Going from micro to macro, each more inclusive aspect of Universe is unpredicted by any of its respective subparts taken separately. Universe is a synergy of synergies. It is a corollary of synergy that the known behavior of wholes plus the known behavior of a few of their parts enables discovery of other parts and their behavioral characteristics. In order to really understand what is going on, we have to abandon starting with parts, and we must work instead from the whole to the particulars." (R. B. Fuller)

'Synergy' means that the behavior of the whole, such as a system, cannot be predicted just by simply analyzing the behavior of its components. He used the term 'Synergetics' to clarify how design science can wealthy income; for example, how "energy income" can be collected for the environment. His argument was that if humans were able to survive, then the nature's powerful order should guide human designs.

"The Dark Ages still reign over all humanity, and the depth and persistence of this domination are only now becoming clear. This prison has no steel bars, chains, or locks. Instead, it is locked by misorientation and built of misinformation. We are powerfully imprisoned ... by the terms in which we have been conditioned to think." (R. B. Fuller)

This idea might be difficult to apply into the practice of design, because it indicated an all-inclusive assessment of total systems. Fuller stressed the significance of synergy in design by stating, *"because the meaning of design Is that all the parts are inter considerately arranged in respect to one another" (R. B. Fuller 'And It Came to Pass – Not to Stay' 1976-p. 122).*

Figure 19 – Dymaxion Car

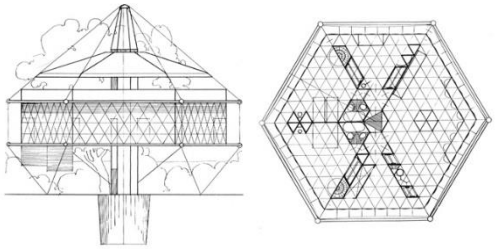


Figure 20 – Dymaxion House

Conclusion

Fuller's utopia is a kind of futurology, embedded so firmly in the present, he visualized as an existing reality extended into the future. As a well-known futurist, Fuller fought for innovative solutions to humanity's problems, such as the idea of "doing more with less" as the key solution to any problem. Through his ideas and visions, he demonstrated the importance of targeting the future and providing new answers. Fuller was a proponent of, what he called "comprehensive anticipatory design science", a method of design rooted in ethics, as he stated, "make the world work for 100% of humanity, in the shortest possible time, without ecological offense or the disadvantage of anyone." It was a global perspective. Buckminster Fuller should be the role model for every sustainable engineer, designer and architect, ecologist, environmentalist or anyone who is thinking of how to an environment, capable of serving everyone.

In the end, if there is still time to save humanity from self-destruction, creating a utopia from the catastrophic society, that we live in, is so challenging. The more catastrophic the society we live in is, the more we need a utopian vision. However, through the need to build an environment, in symbiosis with the planet's natural systems, that can adapt to the effects of climate change, it might be possible –through technology– to build cities that can grow in symbiosis with man, machine, and nature in the future

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ADDENDUM

MICHEL AL NAJM

Miami University

Witten Thesis to Design Approach

We always dream and imagine worlds those are free of conflict, poverty, madness, and natural disasters. We always seek to find these ideal utopian worlds, that are in our real life, will never exist.

Seychelles Island as any other island is suffering from climate change, the consequences of global climate change are very massive. However, the most concern that threats Seychelles's future is the sea level rise, not just because it has negative effects on the physical shape of the island, but also because it has huge impacts on the economy of the country as well as the people's life. In addition to the issue of sea level rise, Seychelles has a very unique physical land condition. 75% of the island is uninhabitable because of the steep land condition that makes the whole area unsuitable for infrastructure. While the rest 25% of the island, where most of the people live and buildings are located, is projected to disappear within the next 250 to 300 years due to the sea level rise.

Hence, the thesis question is *"How can an ideal society, adapting to the current and futuristic impacts if climate change, be established on Seychelles Islands with respect to its existing culture?"*

During the summer of 2018, the design research was mainly focused on the site analysis. To better understand the environment of the island regarding sea level rise, measurements that show the effects of sea level rise on the island have been conducted on 4 phases. Each phase has been measured on a different level above the sea surface displaying the different effects on the economy. As an example, phase 1 is measured at 1.5 meters above the sea level, showing that 60% of tourism and 15% of agriculture surfaces will be affected by the sea level rise.

Measuring the effects of the sea level rise on the economy helped to select the required functions of the proposal. However, applying the

different functions (residential, tourism, and agriculture) at the same time is not that simple. Here many questions have been raised such as, what kind of tourism is required for the next 200 years? Can Seychelles play a global role in the food production? Considering that climate change has negative impacts on the food production, not just on Seychelles, but also on the whole world.

Focusing on one function as a main source of the economy, either tourism or agriculture, was totally incorrect idea. Therefore, finding a strategy that can provide a merged relationship between both of the functions, in a way that supports the economy of the country within the era of climate change, was the next step.

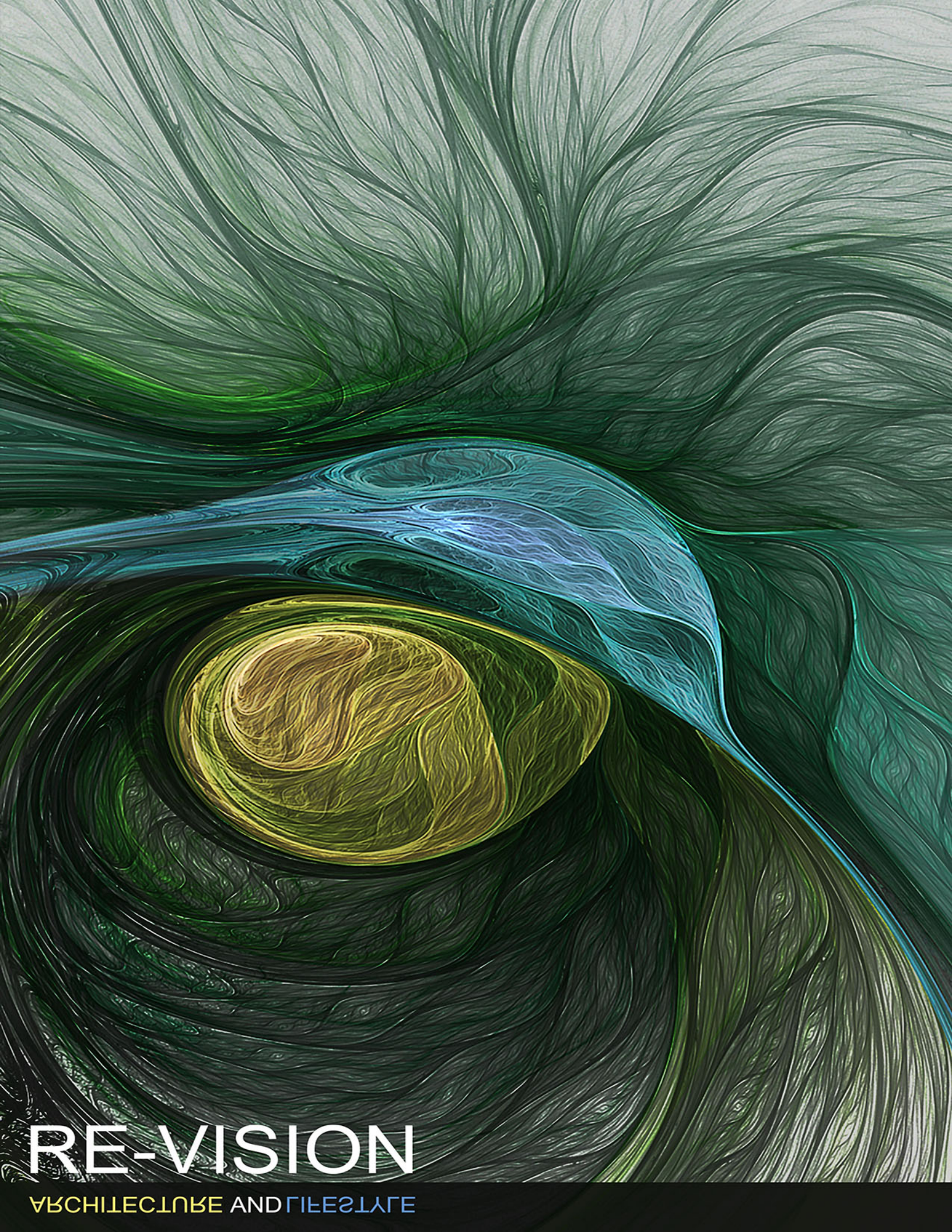
Here the required strategy goes beyond any idea of adaption or mitigation plan which are very essential aspects to be considered in the final application, but they cannot be the main core that the final application will be set based on. The main element that is missing here is the symbiosis relationship between nature and built form.

Design Methodology

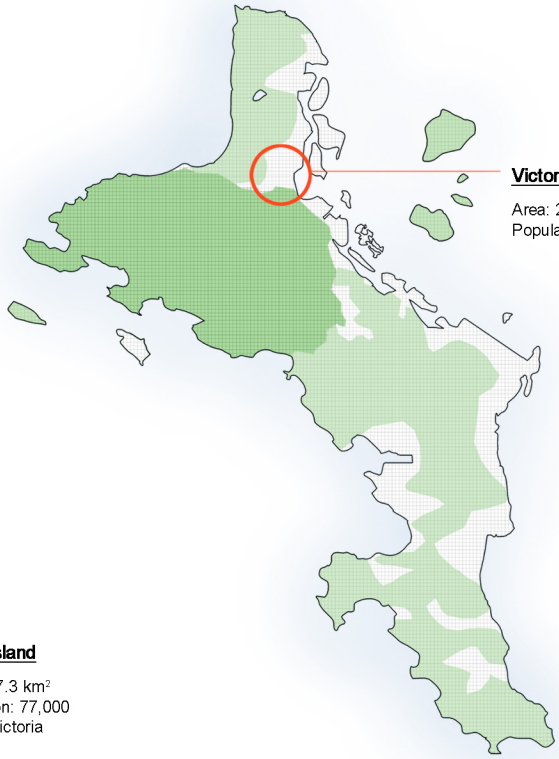
How can we change our way of life to come to terms with the transformed natural systems and processes? How can we be a part of the natural system? How can an urban system be subtracted from a natural system?

At this point, understanding the essence of the natural systems, requires analyses of natural geometries, such as branching methods, fractal systems, and Voronoi geometries, and at the end Voronoi geometry has been used in the final proposal. Grasshopper was used to subtract Voronoi analysis from the natural system that Seychelles Island has, and the result was a cohesive diagram that includes the three different functions (residential, tourism, and agriculture) in different ratio regarding topography, percentage of the effected functions and the remaining functions, and areas that are applicable to build on. Then, 16 geometries have been selected to apply the required functions, considering the subtracted Voronoi diagram and other factors such as views and topography.

Design Process


RE-VISION
ARCHITECTURE AND LIFESTYLE

Seychelles Islands

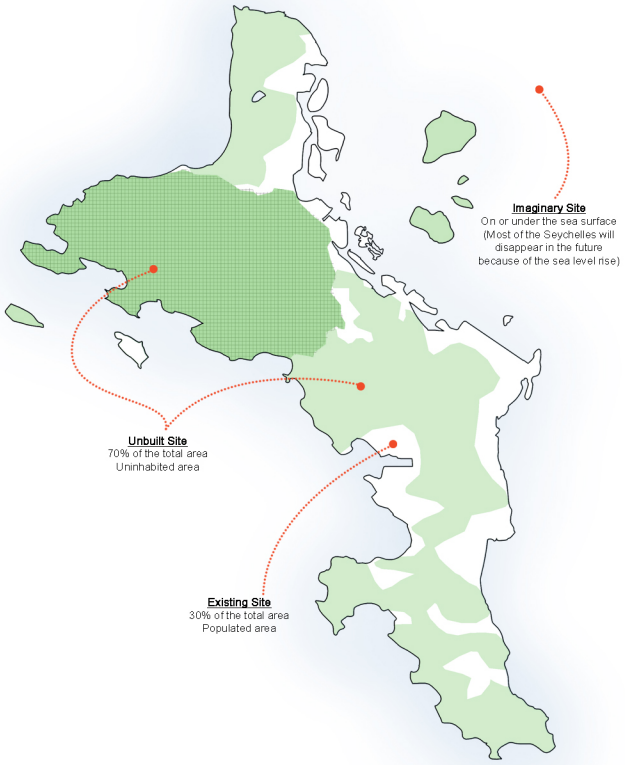


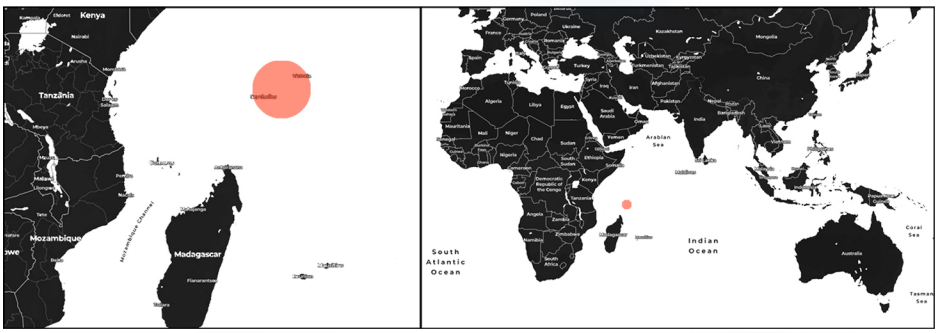
Victoria

Area: 21.1 km²
Population: 26,500 (25% of total population)

Mahe Island

Area: 157.3 km²
Population: 77,000
Capial: Victoria





3 Sites - 3 Conditions
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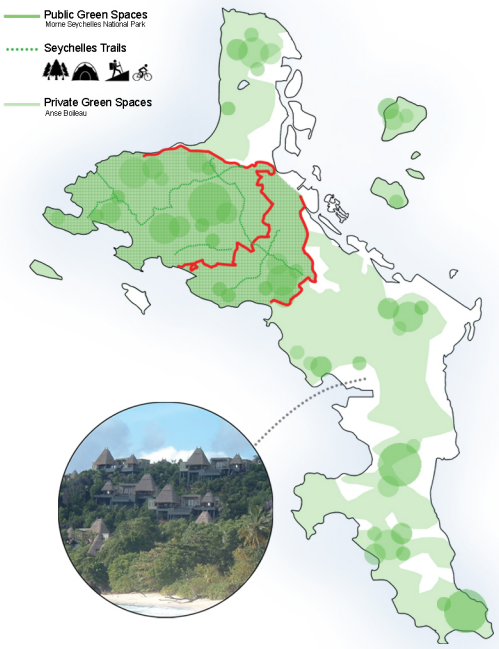
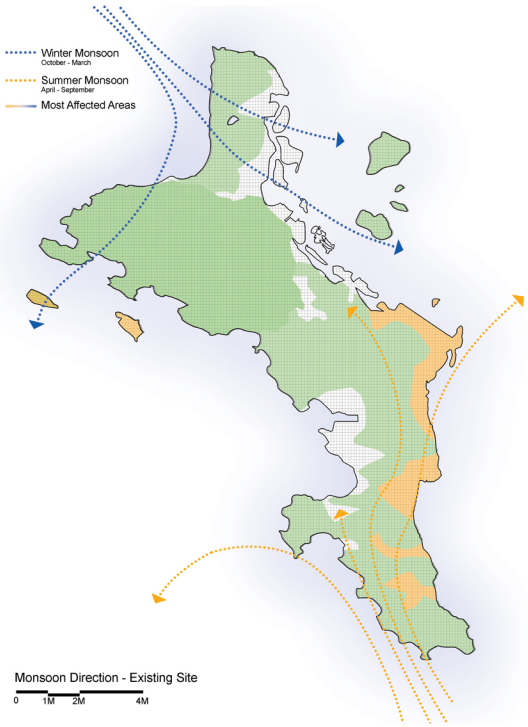


Green Area (Existing and Unbuilt Site)
0 1M 2M 4M

Valuable Views
0 1M 2M 4M

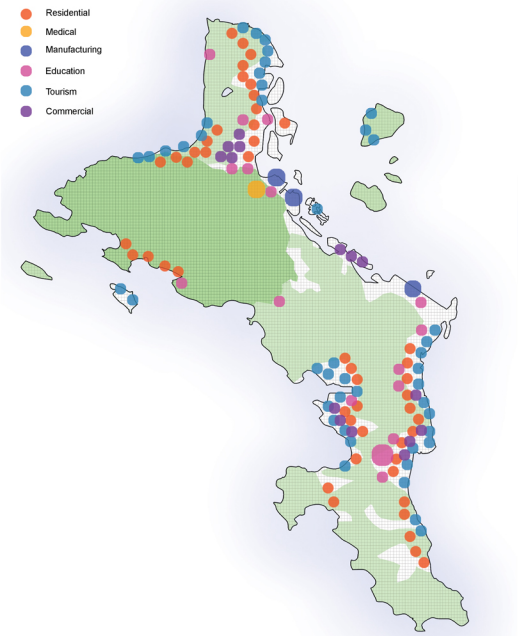
Populated and Uninhabited Area
0 1M 2M 4M

I- Site Analysis - General Info



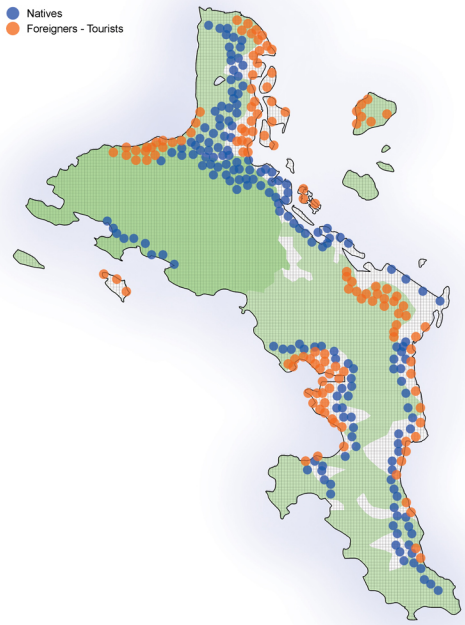
Monsoon Direction - Existing Site

0 1M 2M 4M



Land-Use - Exisitng Site

0 1M 2M 4M



Population - Existing Site

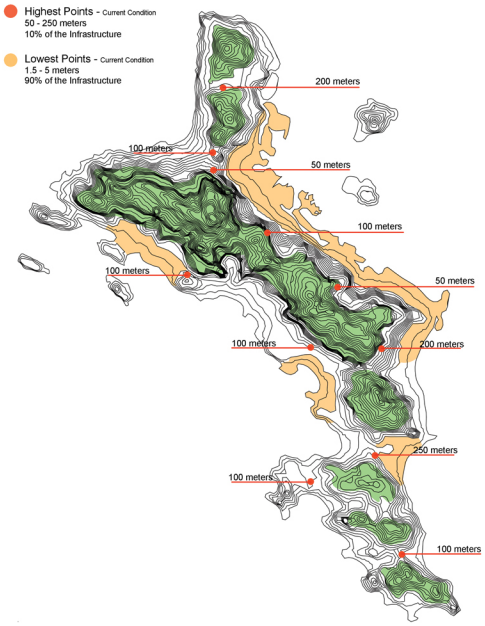
0 1M 2M 4M

Air & Land Transportation - Existing Site

0 1M 2M 4M

Architectural Development - Existing Site

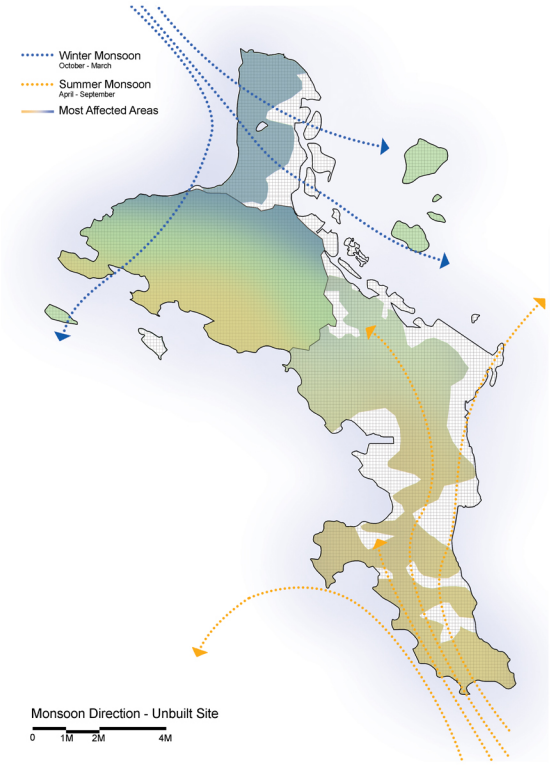
0 1M 2M 4M

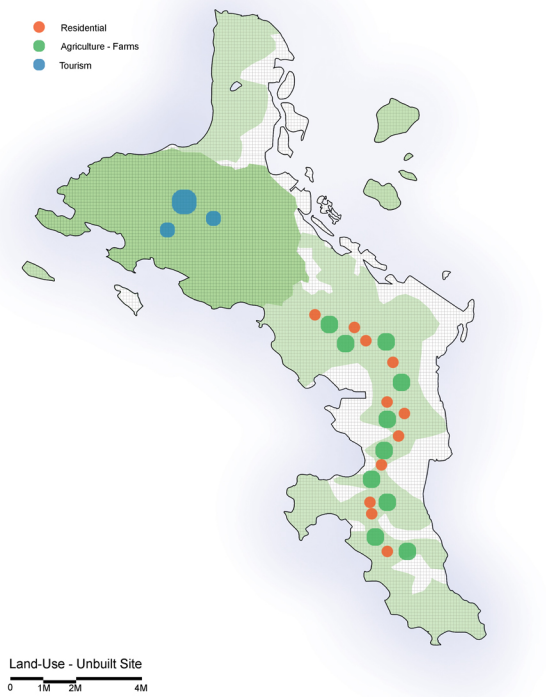


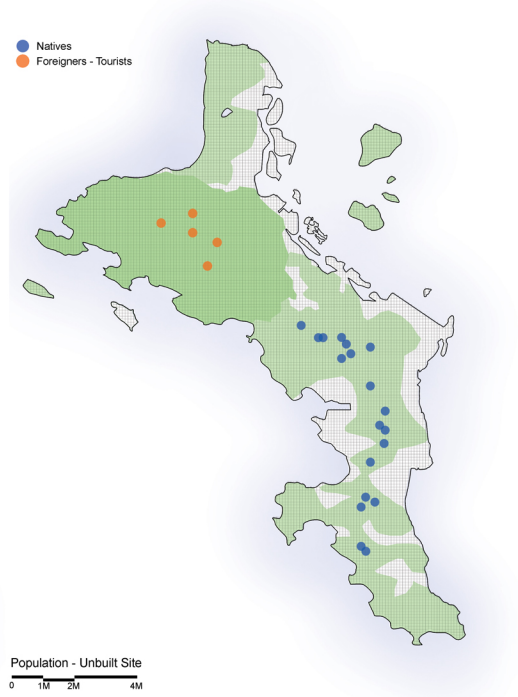
Topography - Existing Site

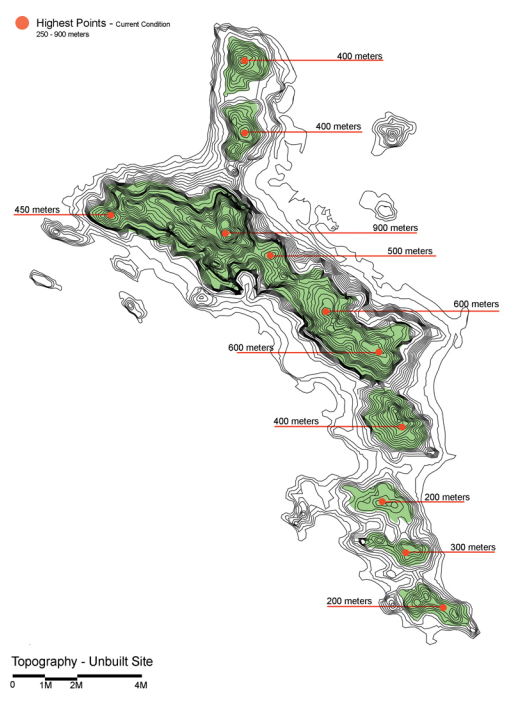
0 1M 2M 4M

I- Site Analysis - Existing Site

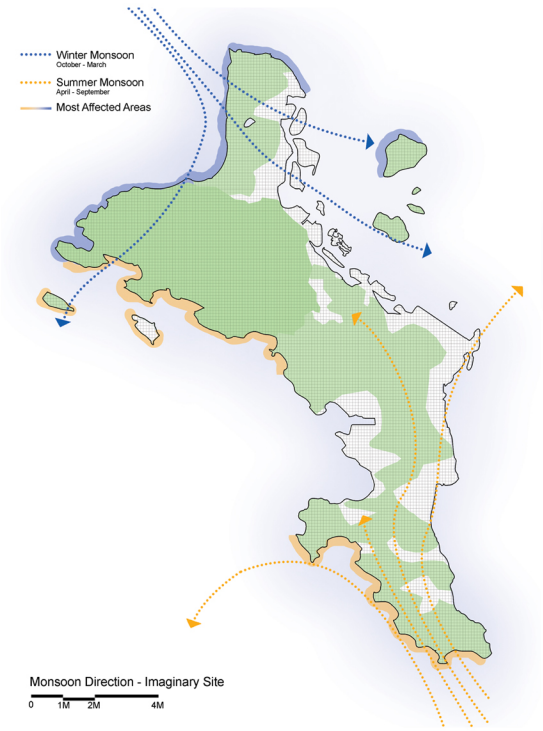






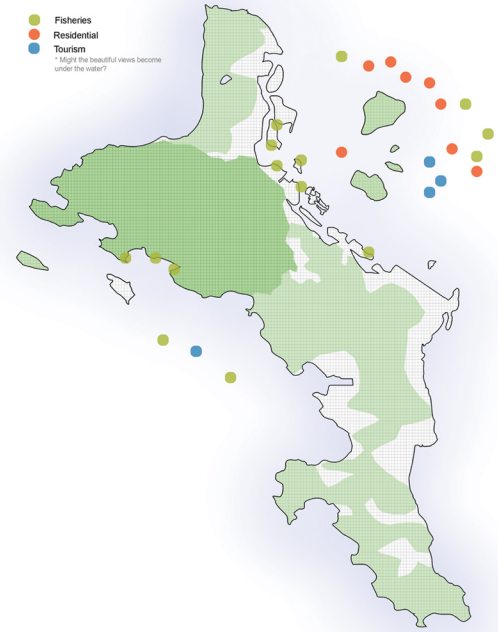


I- Site Analysis - Unbuilt Site



Monsoon Direction - Imaginary Site

0 1M 2M 4M

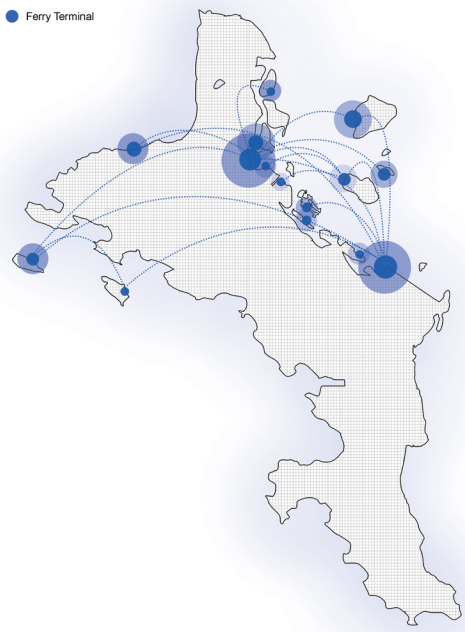


Land-Use - Imaginary Site

0 1M 2M 4M

Valuable Views - Imaginary Site

0 1M 2M 4M



Sea Transportation - Imaginary Site

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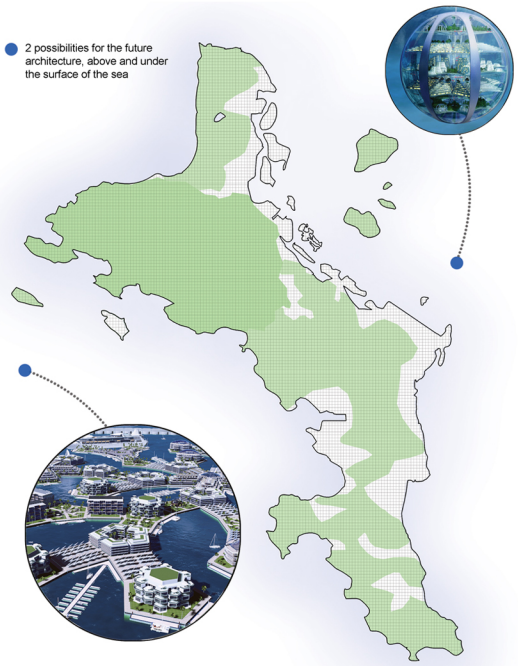
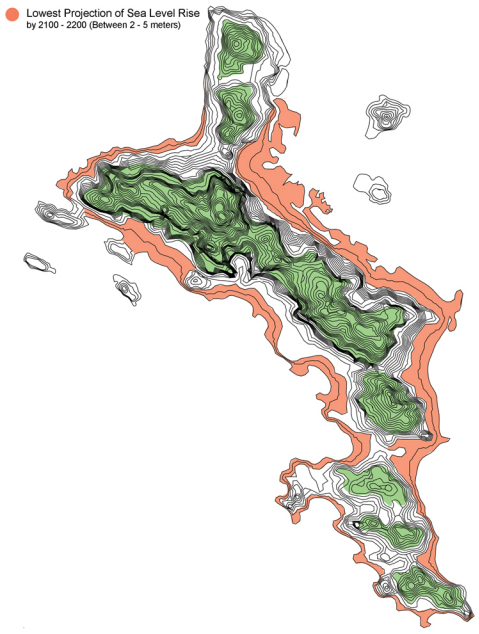


Architectural Development - Imaginary Site

0 1M 2M 4M



Topography - Imaginary Site

0 1M 2M 4M

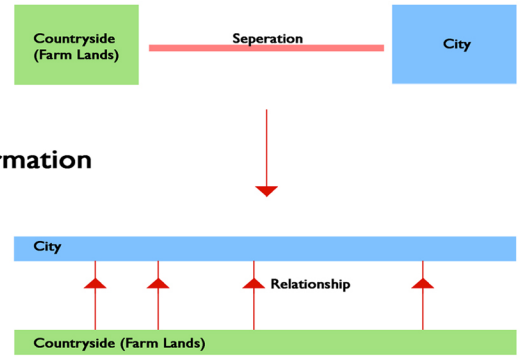
I- Site Analysis - Imaginary Site

Agriculture City - 1960 Kisho Kurokawa

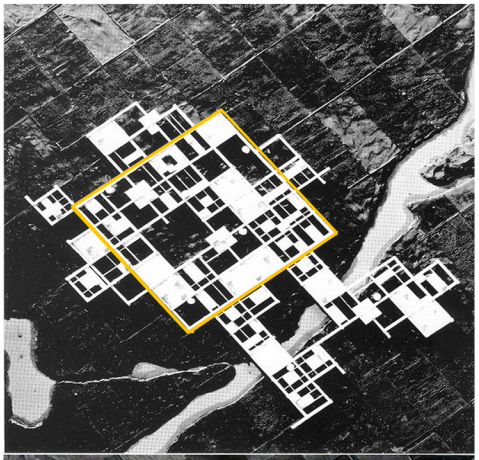
The proposal sought to resolve the contradiction between city and countryside. It was Intended for the replacement of the agricultural towns in Aichi destroyed by the Ise Bay Typhoon in 1959, the accommodation was to be raised above the ground to deal with future Flooding.

The majority of the flooded towns were located in very compact areas so Kurokawa has proposed a grid of 500 x 500 m, elevated 4 m high from the agricultural area by pilotis, organized around temple or a grade school, where all the installations and circulations meet. This earth is then free for agriculture use while the private dwellings are above the installations so as to protect them from floods.

The 500 m x 500 m frame consists of 25 (100 m x 100m) blocks for 200 people. The basic housing unit is in the shape of a mushroom, one to three floors structures with a wooden frame aluminium cap meant to overcome the concepts of walls and roof and opened to the sky through a skylight. The mushroom shaped house has a concrete facility shaft to which living units and other facilities are attached. The equipment shaft is the center of the mushroom structure as well as the equipment base which includes bathrooms, kitchen, washbasins etc.



First Version



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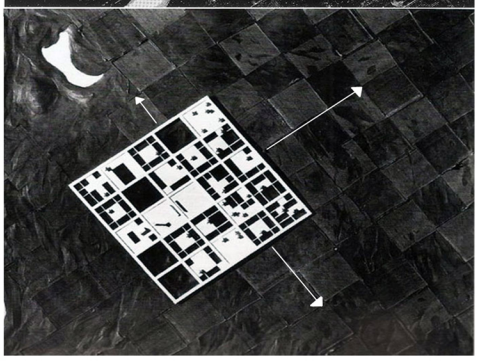
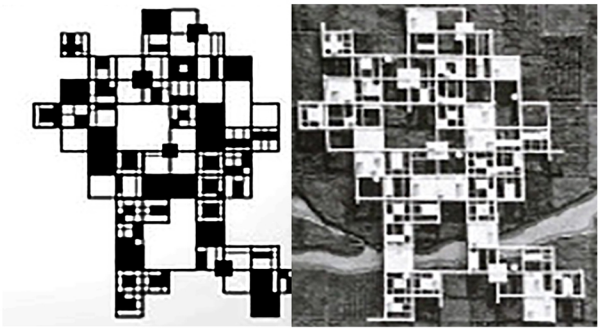
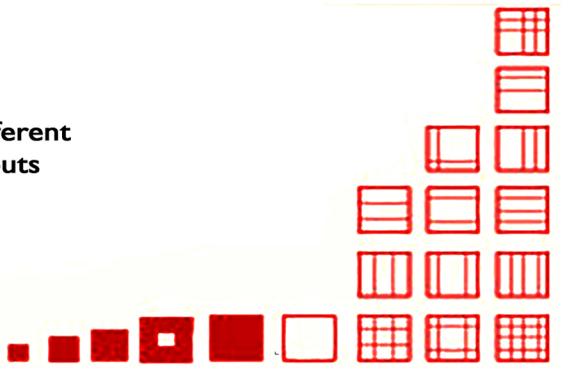
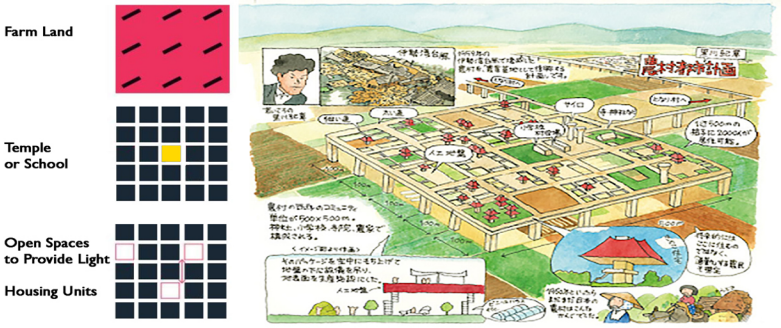


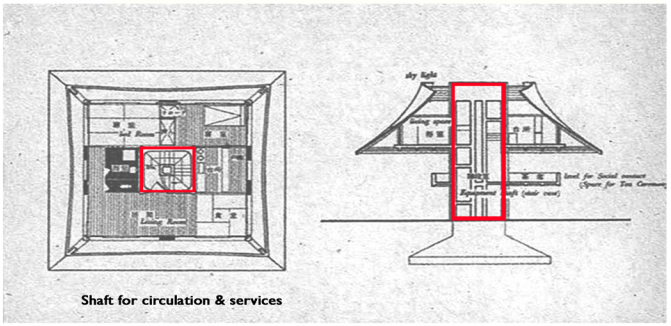
Solid & Void

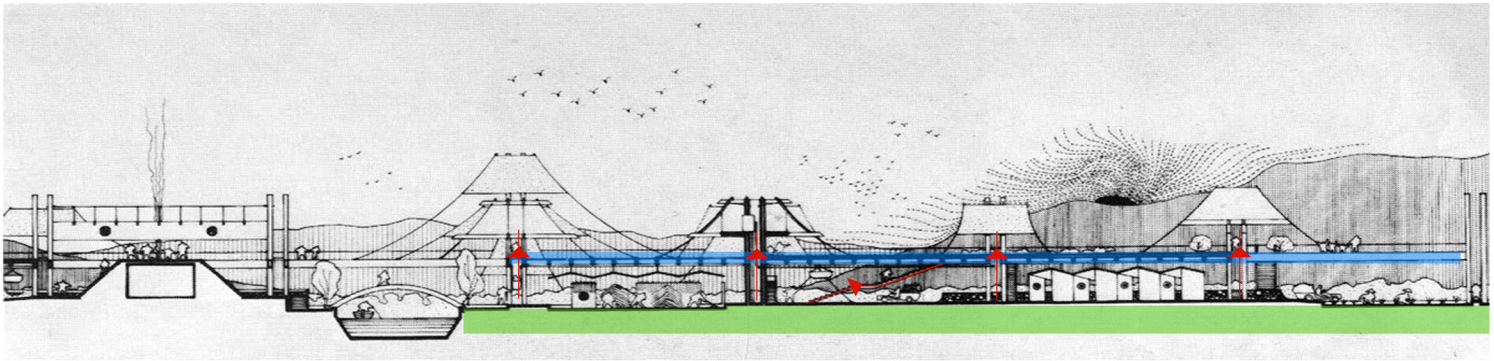


19 Different Layouts









2- Case Study - #1

Tokyo Bay - 1960 Kenzo Tange

In 1958 the Tokyo Regional Plan was released which proposed a series of satellite cities and general decentralization as the solution to Tokyo's rapid population boom (rising from 3.5 million in 1945 to 10 million in 1960).

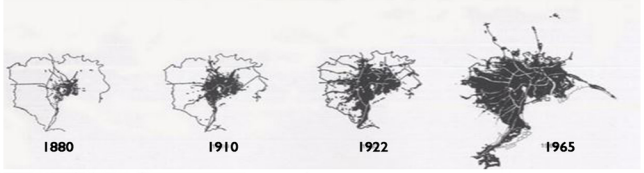
The plan proposed a linear organized matrix for Tokyo Bay, which was to be an extension of the uncontrolled expansion of the city proper.

The transformation from a centralized city into a liner city as in Kenzo Tange's project where communities and smaller towns would settle along a main axis appears as a very obvious and useful solution for Tokyo. Unlike in the virtual world, in our physical world distance matters and many common services such as food supplies have no replacement in virtuallity. Therefore, to think about the Tokyo of tomorrow as a linear system with many smaller centers and people living along the axis working for decentralized firms without loosing the opportunity for physical interaction is a very reasonable conclusion to the problem. Tokyo is lucky to be located next to a bay that allows for a linear expansion.

Four major ideas:

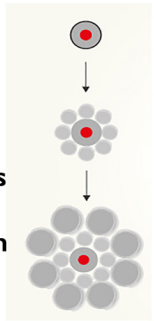
1) The connection between Tokyo and the proposed linear expansion.
2) The traffic circulation along the civic axis.
3) The two main shapes of business buildings.
4) The perpendicular organic growth of the residential area.

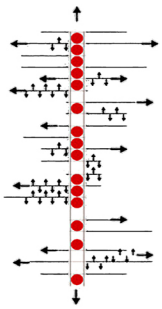
Growth of Tokyo



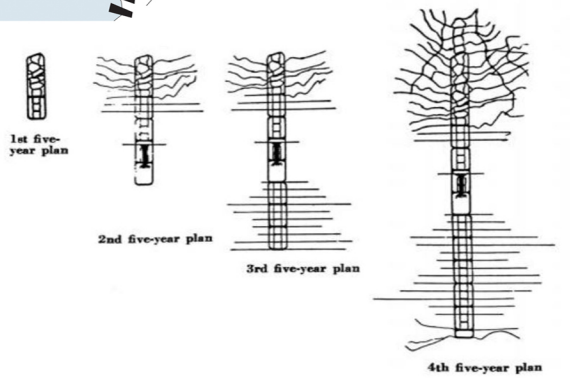
Tokyo Bay 1960

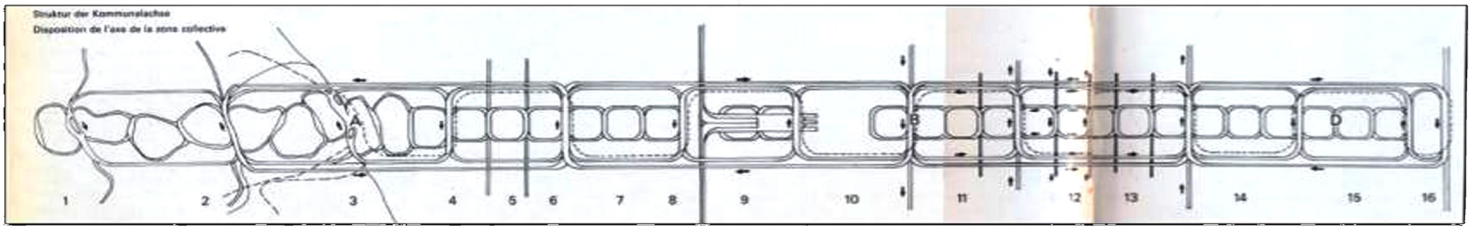
Process of Growth



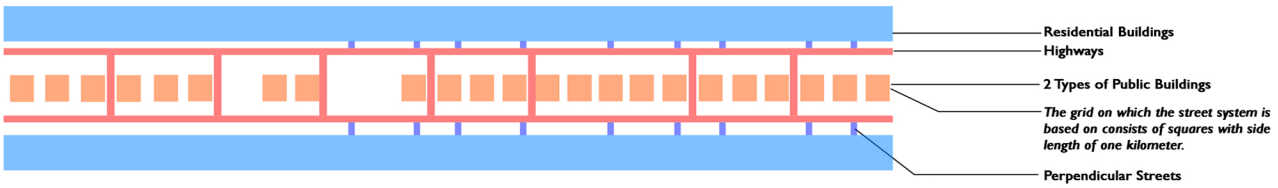


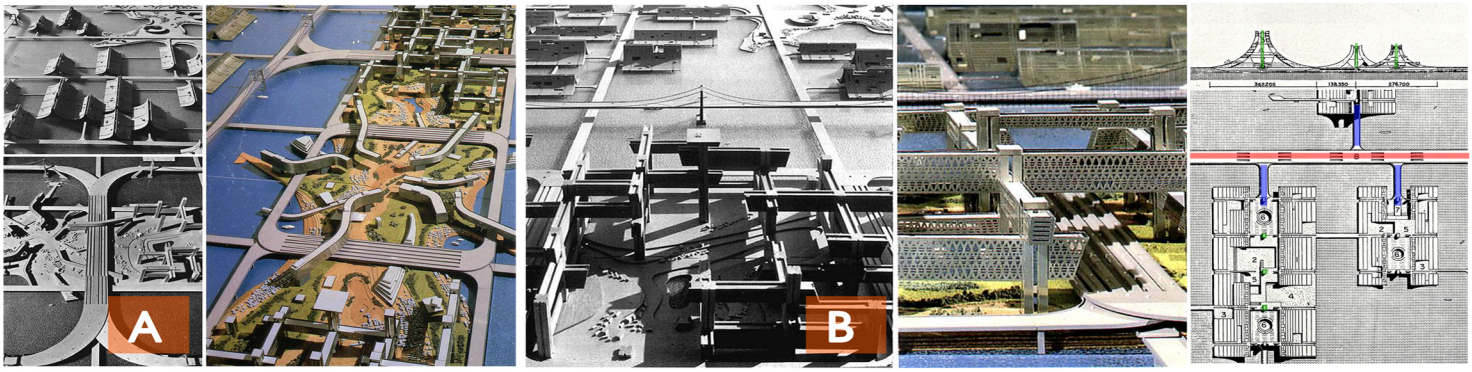
20 year plan



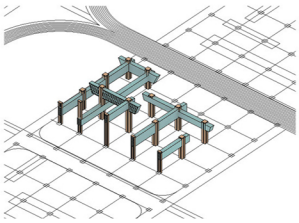


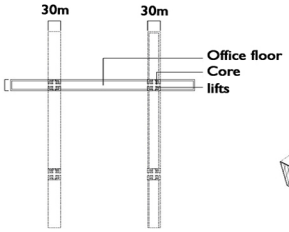
Functional Zoning

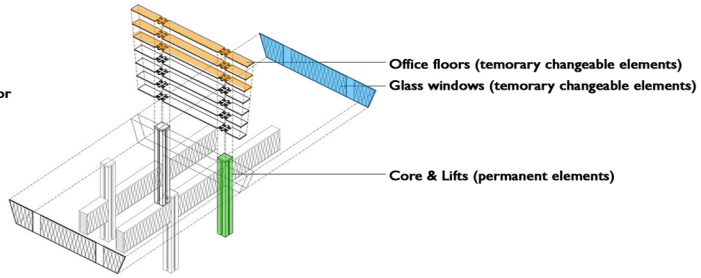




Structural System







2- Case Study - #2

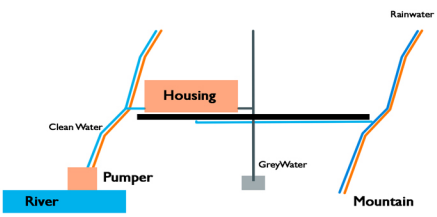
Mountain Band Aid - 2012 Evolo Magazine

Industrialization and mining are destroying China's natural settings, especially mountains, which are excavated to the point of destruction in man's search for minerals. These processes don't just devistate regions' ecologies; they also displace whole populations of people, separating them from their homes and also their means of living, as many in these rural areas work as farmers. The "Mountain Band-Aid" project seeks to simultaneously restore the displaced Hmong mountain people to their homes and work as it restores the mountain ecology of the Yunnan mountain range.

This is achieved with a two-layer construction project. The outer layer is a skyscraper that is built into and stretched across the mountain. By building the structure into, and as part of, the mountain, the skyscraper helps the Hmong people recover their original lifestyle. It is organized internally by the villagers to replicate the traditional village design they utilized before they were displaced. The building's placement on the mountain means that its height is mainly determined by the height of the mountain. The design as a whole is one of "dual recovery:" the Hmong people living on the damaged mountain can keep the unique organization of space in their village, recreating it within the skyscraper, but they won't be contributing to the mountain's degradation. Instead, they help the mountain's environmental restoration by recycling domestic water for mountain irrigation. It is this irrigation system that comprises the project's inner layer: an irrigation system is constructed to stabilize the mountain's soil and grow plants.

The skyscraper is constructed in the traditional Chinese Southern building style known as Chuan Dou. Small residential blocks are used as the framework: The blocks are freely organized as they were in the original village, but the framework controls this organization of blocks into different floors, acting as the contour line in traditional Hmong village.

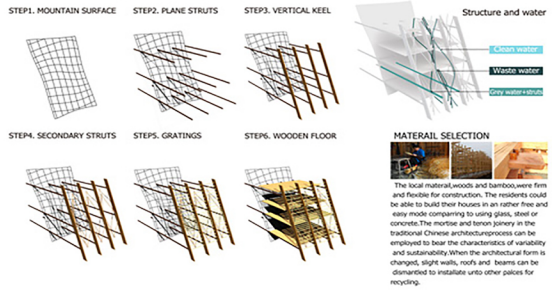
- **WATER TRANSITION SYSTERM**



The water transition system was generated on the idea that water in this consumption structure was a circulation between the mountain and the com munity. Clean water were pumped up in the outer parts of the secondary S-shaped strucure, and used by the residents. The result as grey water could be purified and reused for purposes like mountain surface recovery, toilet usage and farm irrigation. The black water was seperated and drained down the building in the middle strut weaving the secondary structure unit together.

- **CONSTRUCTION STRATAGIES**

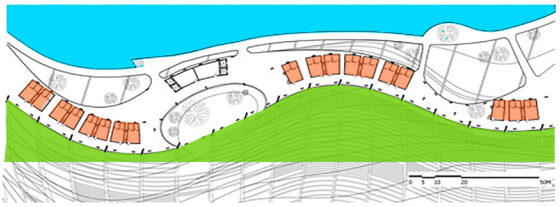
This project followed the historical lineage and renewed the system to fit into a new constructural system following the arranged functions. The traditional Chinese architecture was consisted of components of modulus and connected by tenon and mortise works. Struts acting as pillars for plane buildings was nailed into the rocks and perpendicular (vertical) components worked as beams could be attached to them by handwork. Secondary structure, shaped in S, connected the system as additional crossing beams of the traditional architecture. This layer of structure carried the drainage system to the top of the vertical village and enabled the wholesystem to be flexible to reduce the effect of possible earthquakes. The floor plane were finally fit into the system supported by the three levels of structure.

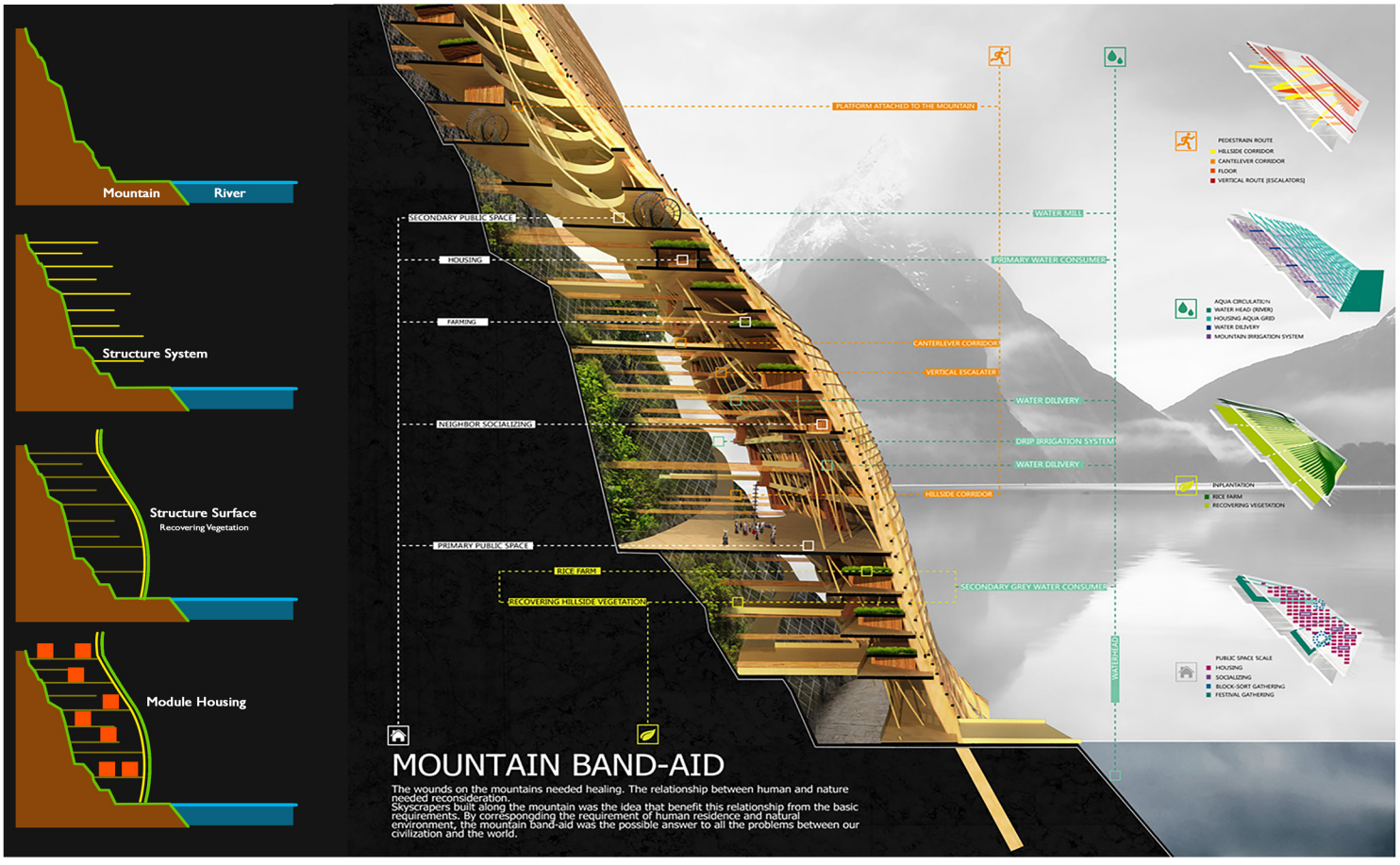


MATERAIL SELECTION

The local material,woods and bamboo,were firm and flexible for construction. The residents could be able to build their houses in an rather free and easy mode comparing to using glass, steel or concrete. The mortise and tenon joinery in the traditional Chinese architectureprocess can be employed to bear the characteristics of variability and sustainability. When the architectural form is changed, slight walls, roofs and beams can be dismantled to installate unto other palces for recycling.

- **Plan**



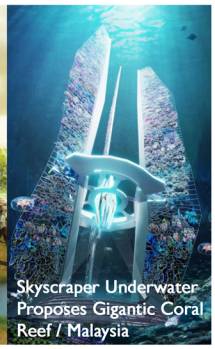


2- Case Study - #3

Schematic Design
(Food Production)

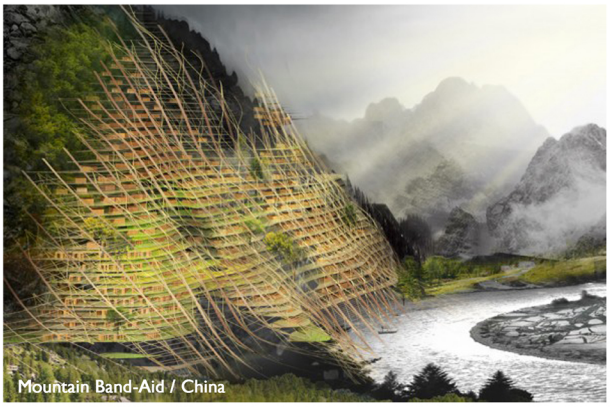
Urban Agriculture/Storages


Aeroponic Vertical Farming / United Kingdom

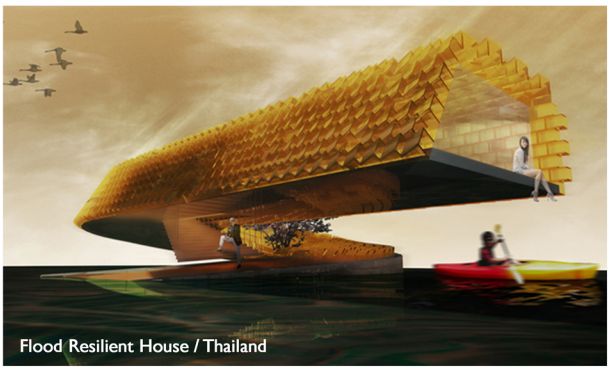

Skyscraper Underwater Proposes Gigantic Coral Reef / Malaysia

Housing

Natives


Mountain Band-Aid / China

Tourism


Flood Resilient House / Thailand

Transportation


Teleferik

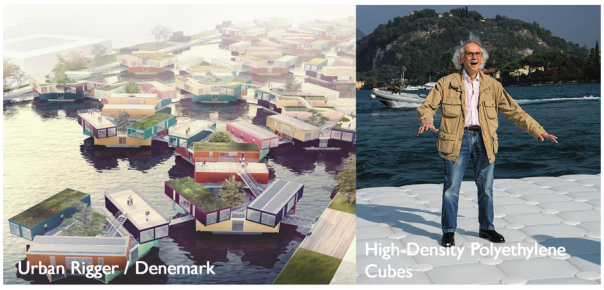
Pods

Other Functions

Education, Health, Entertainment, and Administration

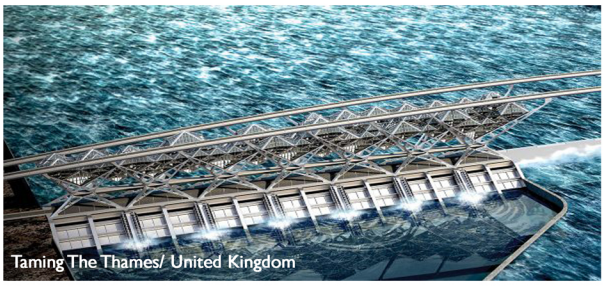
Climate Change
(Consequences)

Sea Level Rise (Floating)

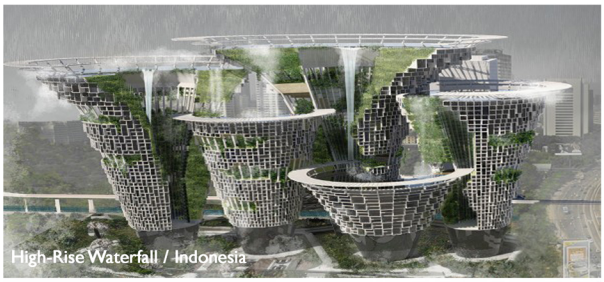

Urban Rigger / Denemark

High-Density Polyethylene Cubes

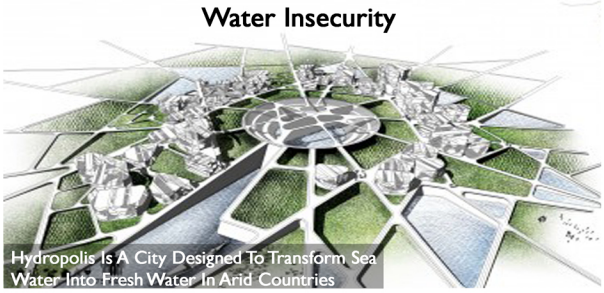
High Waves (Flooding)


Taming The Thames/ United Kingdom

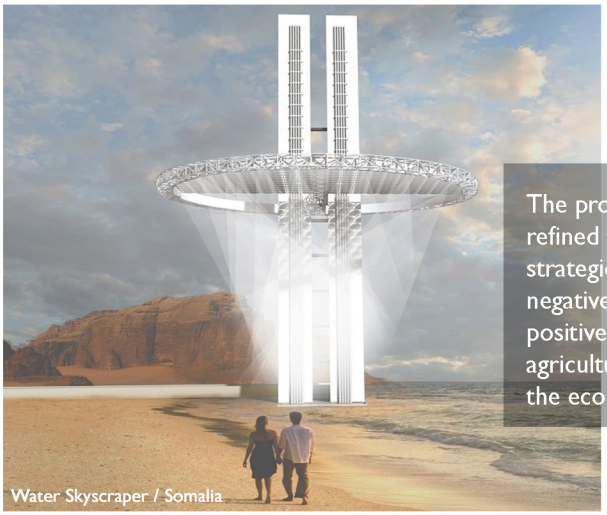
Rainfall


High-Rise Waterfall / Indonesia

Water Insecurity

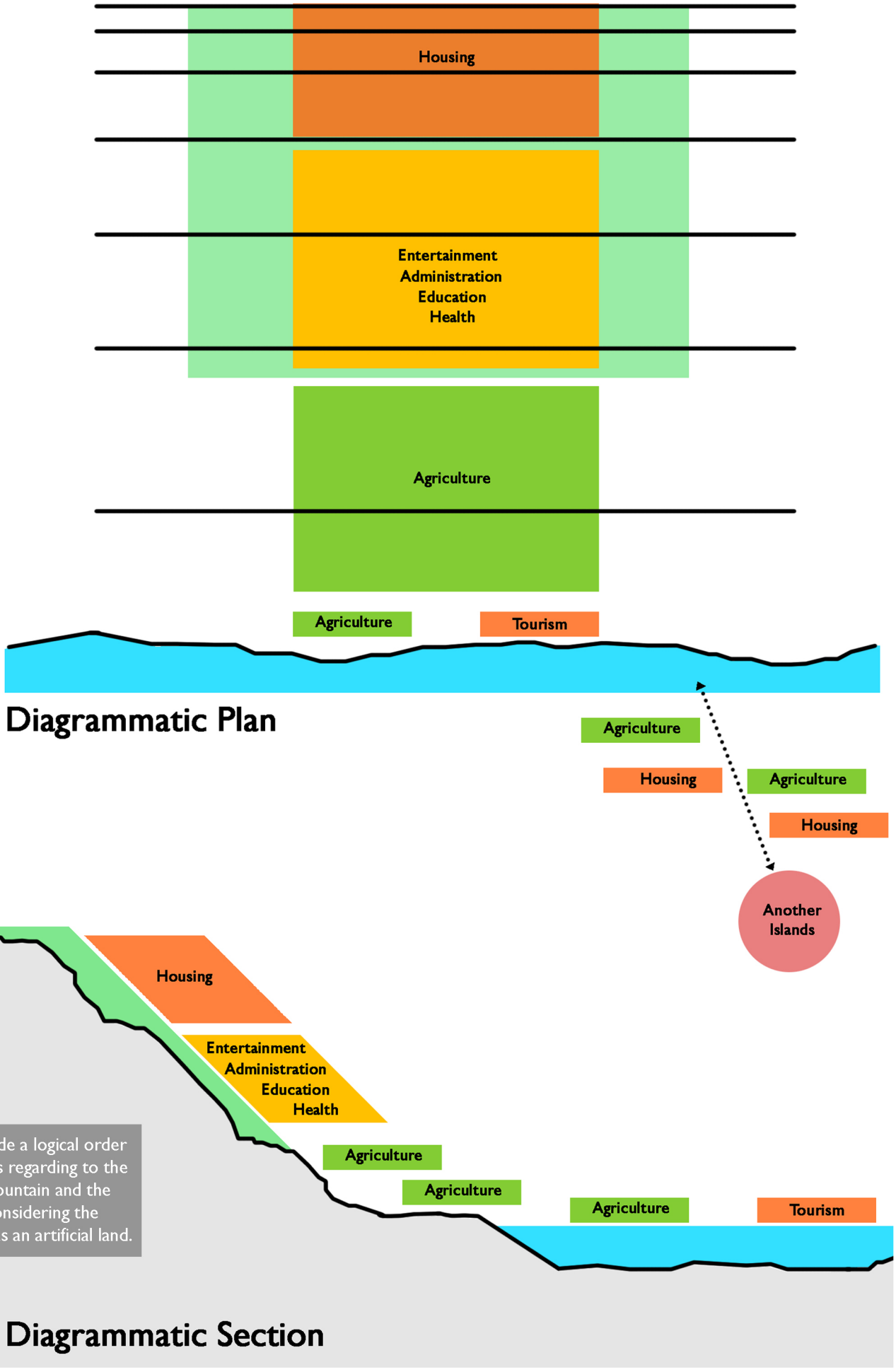

Hydropolis Is A City Designed To Transform Sea Water Into Fresh Water In Arid Countries

Hot Climate

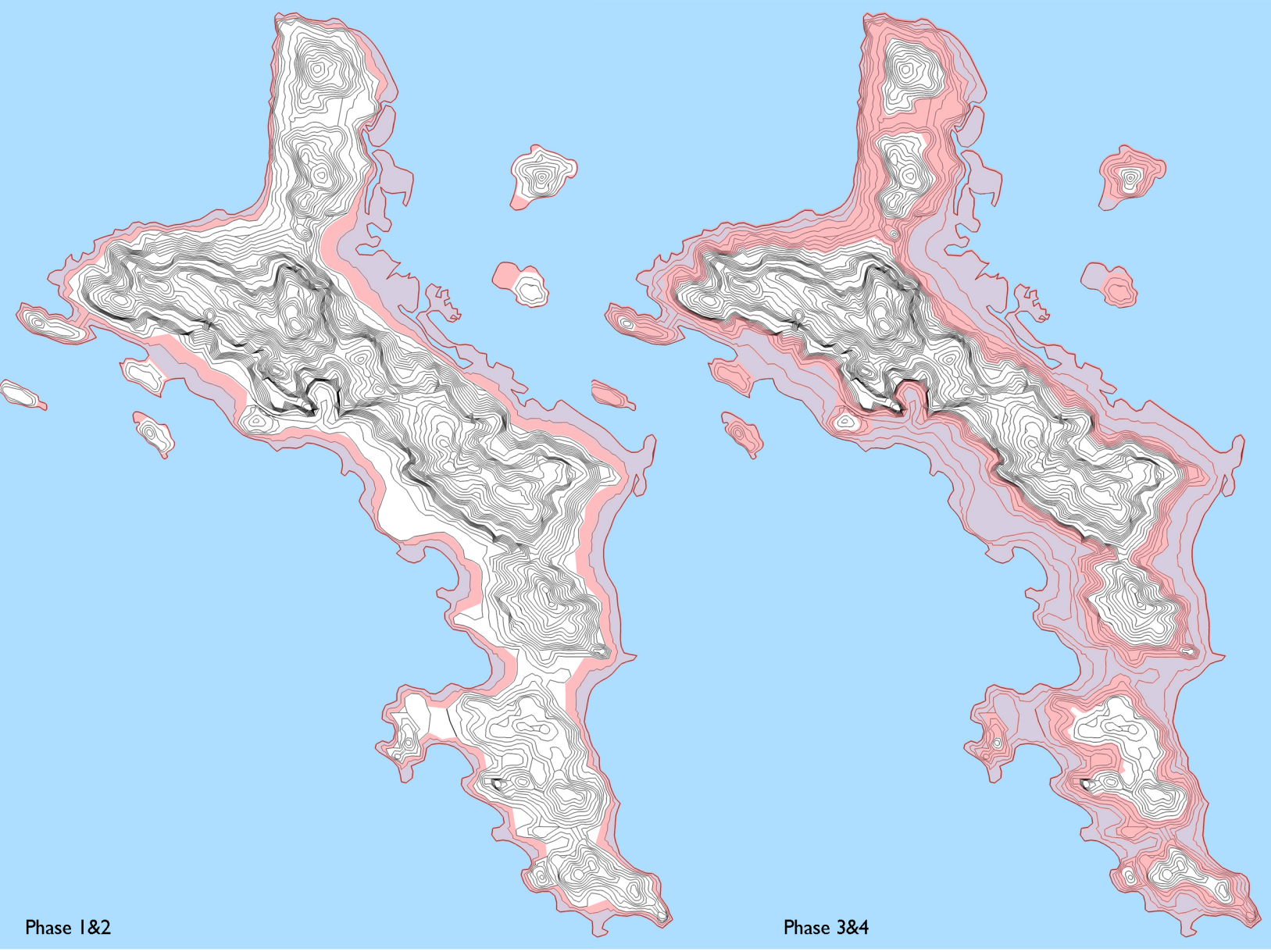

Water Skyscraper / Somalia

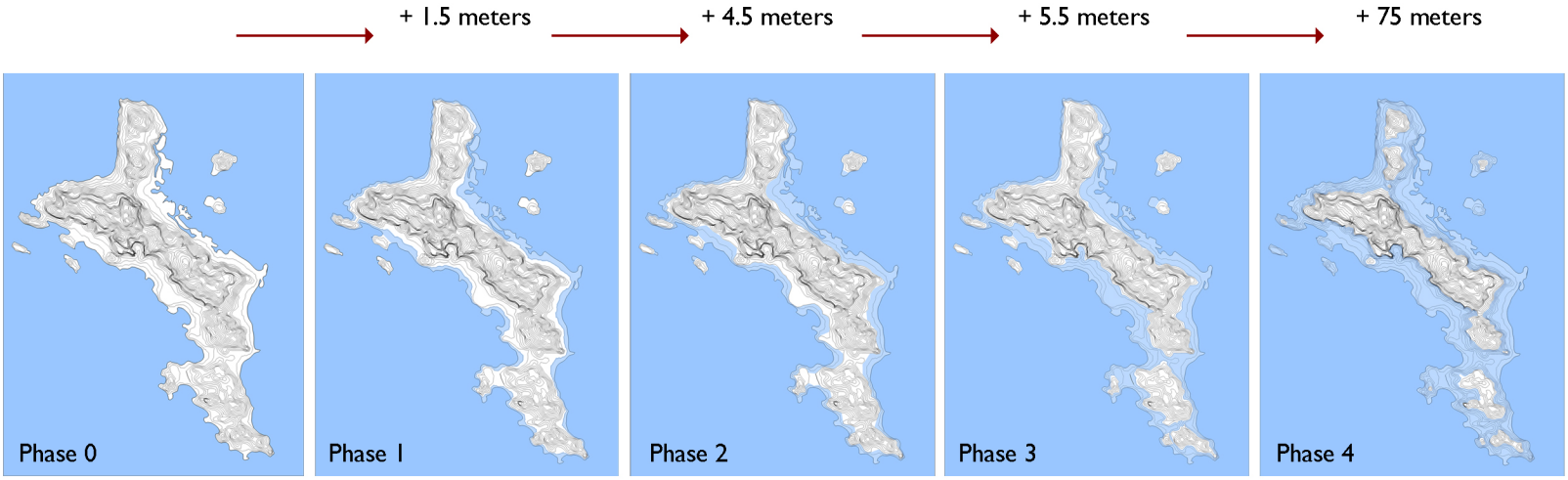
The program of the society refined through methods and strategies that can turn the negatives of climate change into positives in order to support agriculture as a main source of the economy besides tourism.

3- Schematic Design - Strategies/Program



3- Schematic Design - Strategies/Program





Current Condition in 2018

The effects will be mostly on the economy

The effects will be on residential

The first three divisions

Another two divisions

4- Design Development - Timeline/Sea Level

The direction that the sea level is rising. (Blue line)

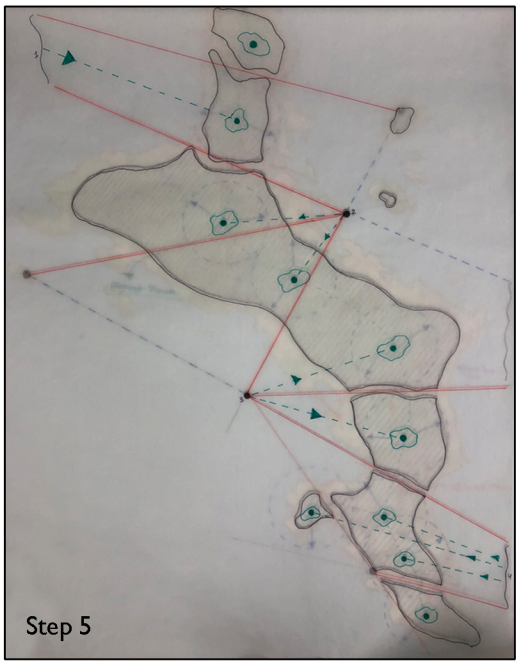
The direction that the sea level will rise after covering the lowest areas of the island. (Red line)

Within the time the sea level will create divisions in the physical shape of the island. (Red line)

Selecting the highest points of all the parts of the island that the sea level will not effect (Green dots)

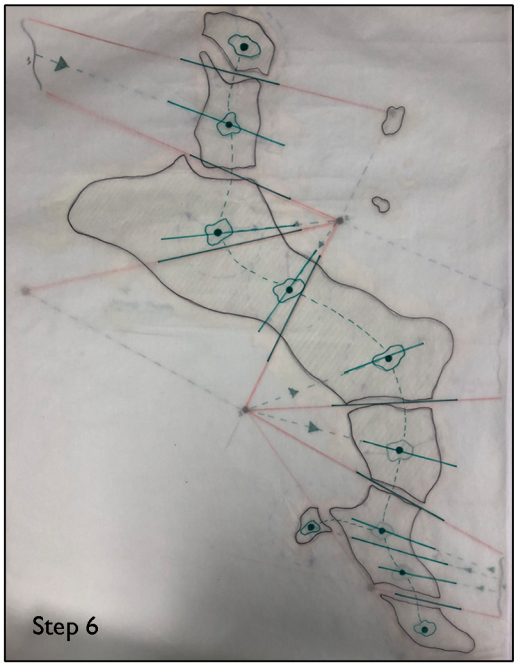
Connecting the highest points to create a natural spine (Green line)

Geometrical map out of traingles, created by visionary lines passing through the division spots (Red line)



Selecting 4 importnat spots that contorl the triangular map (Black dots)

Connecting lines between the green and the black dots to create axes that help the natural spine to spread. (Green Line)

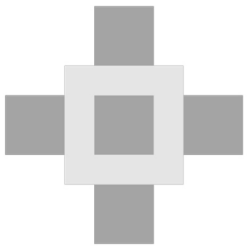


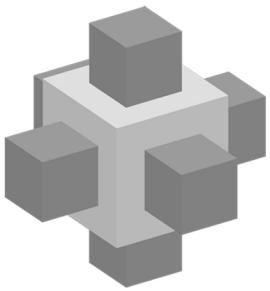
Natural spine with its axes that match the geometrical shape of the island (Green line)

4- Design Development - Geometrical Mapping

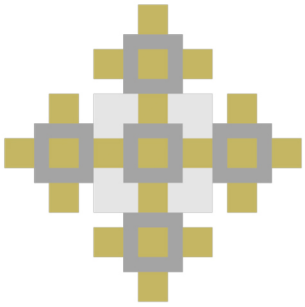
Initiator

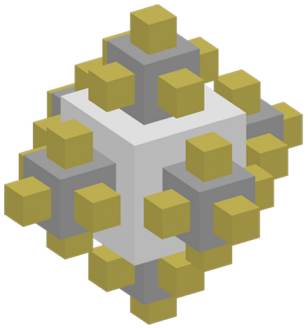
Generator/
Iteration 1



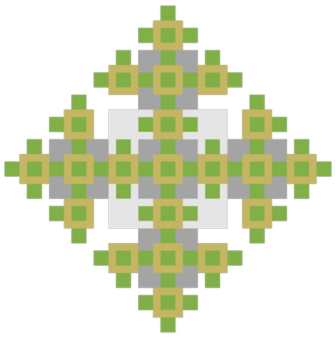


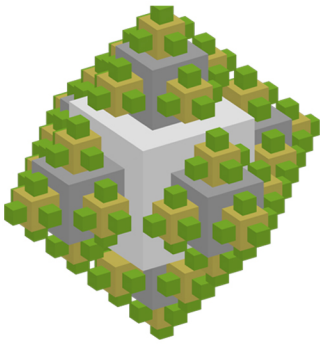
Iteration 2



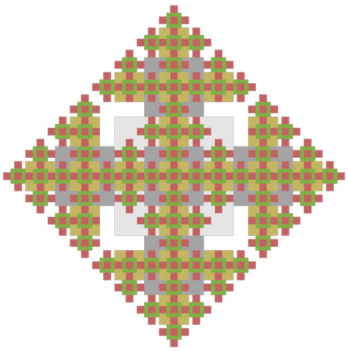


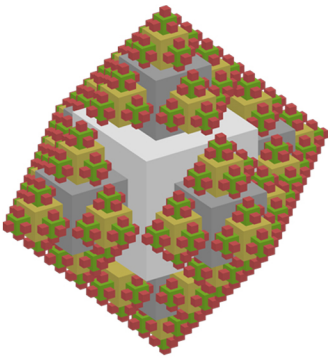
Iteration 3



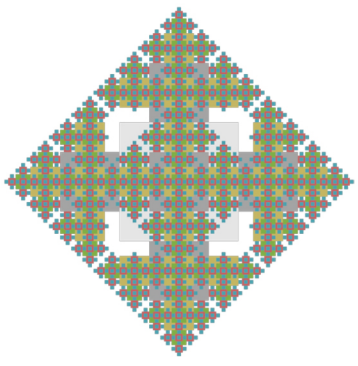


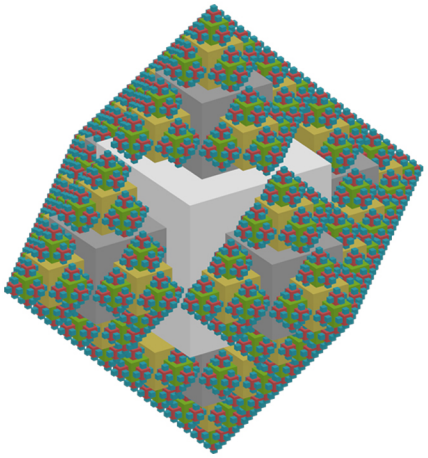
Iteration 4





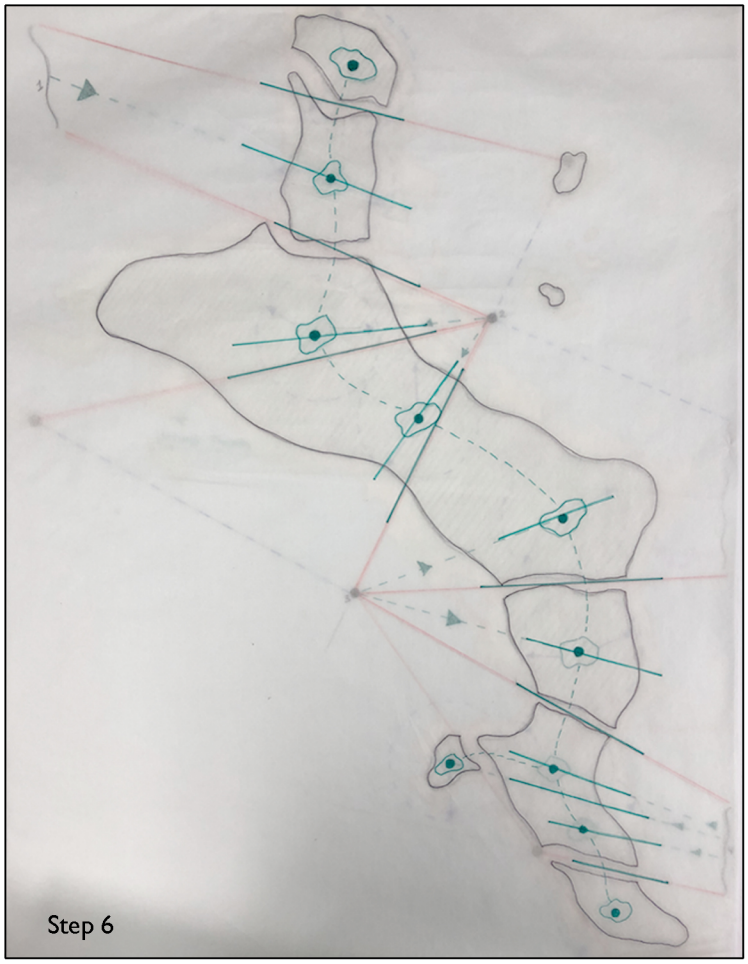
Iteration 5



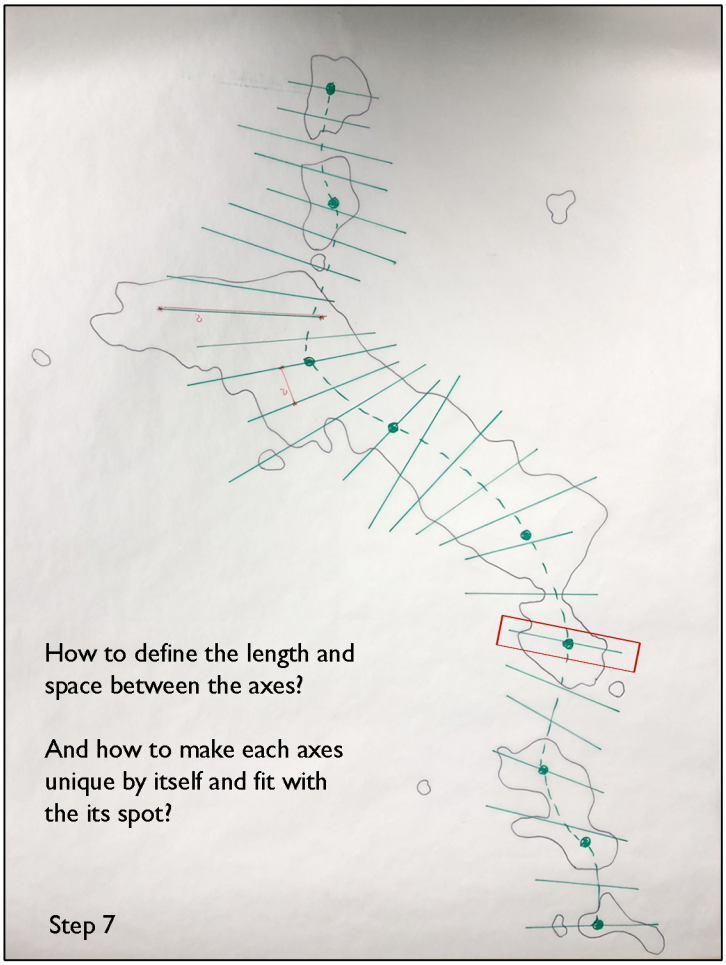


Primary object is a cube, reduced by 50% and placed on all the 6 faces of the original cube.
The same process has been repeated 6 times

4- Design Development - Fractal System



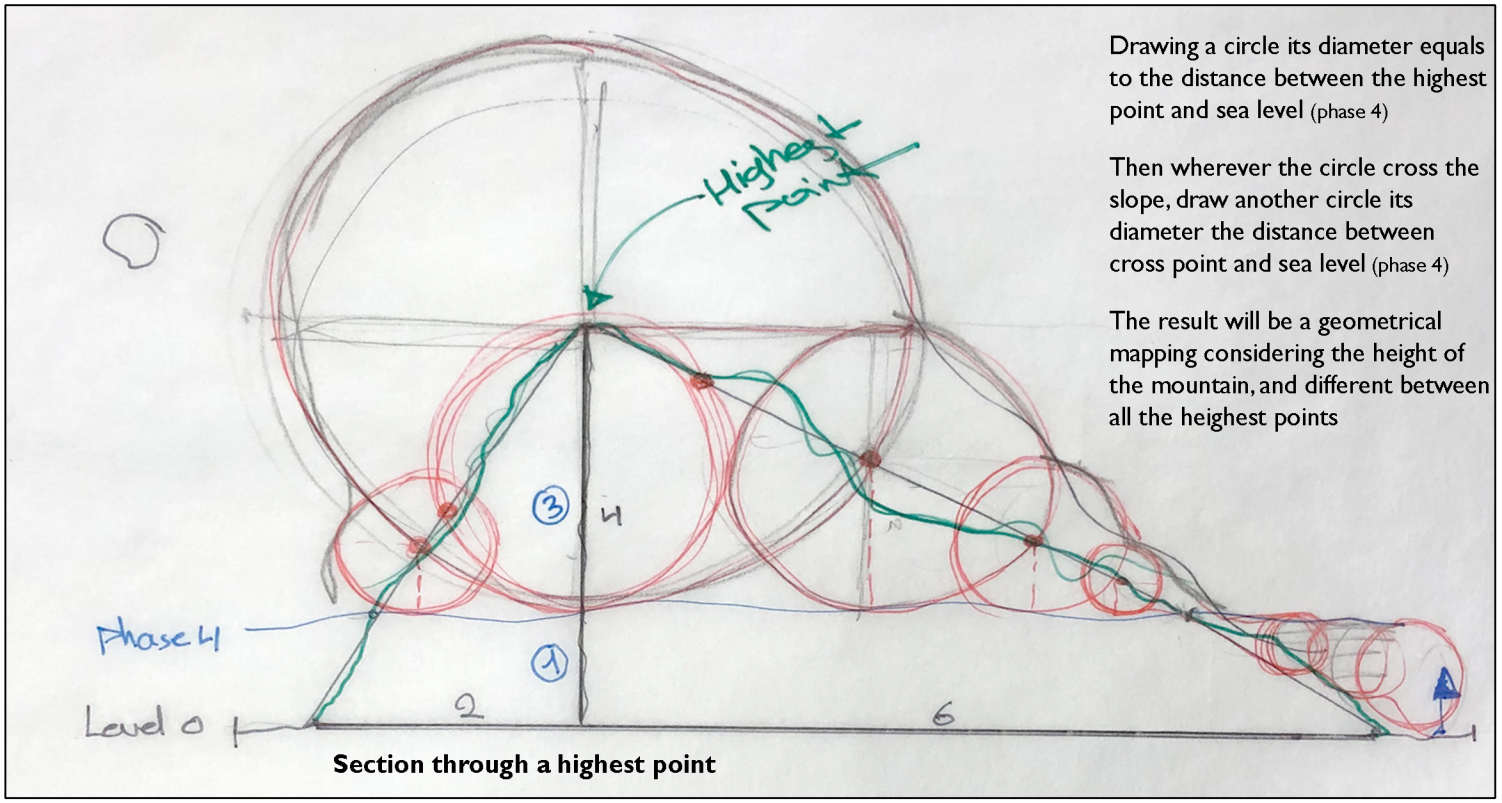
Step 6



How to define the length and space between the axes?

And how to make each axes unique by itself and fit with the its spot?

Step 7



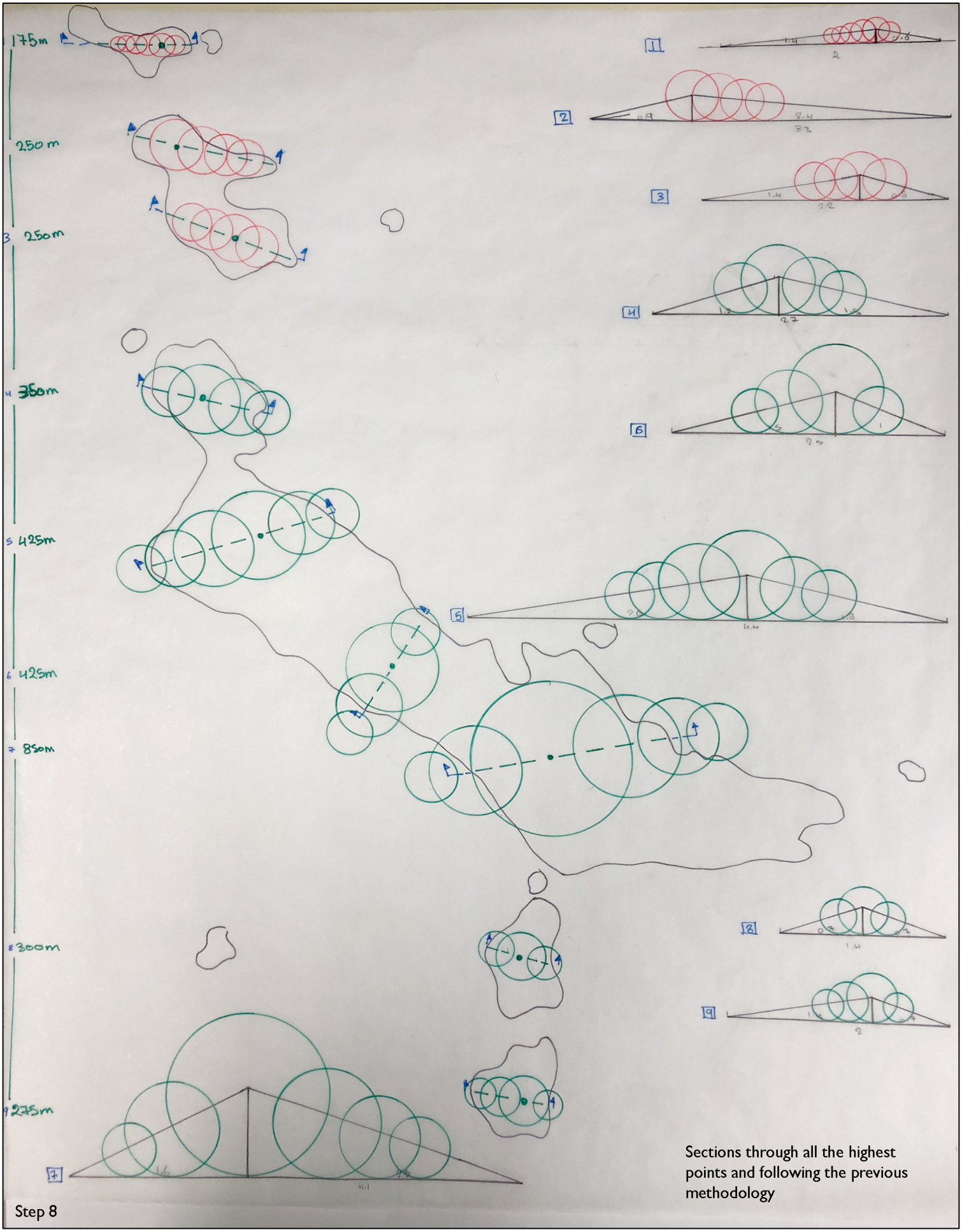
Drawing a circle its diameter equals to the distance between the highest point and sea level (phase 4)

Then wherever the circle cross the slope, draw another circle its diameter the distance between cross point and sea level (phase 4)

The result will be a geometrical mapping considering the height of the mountain, and different between all the heighest points

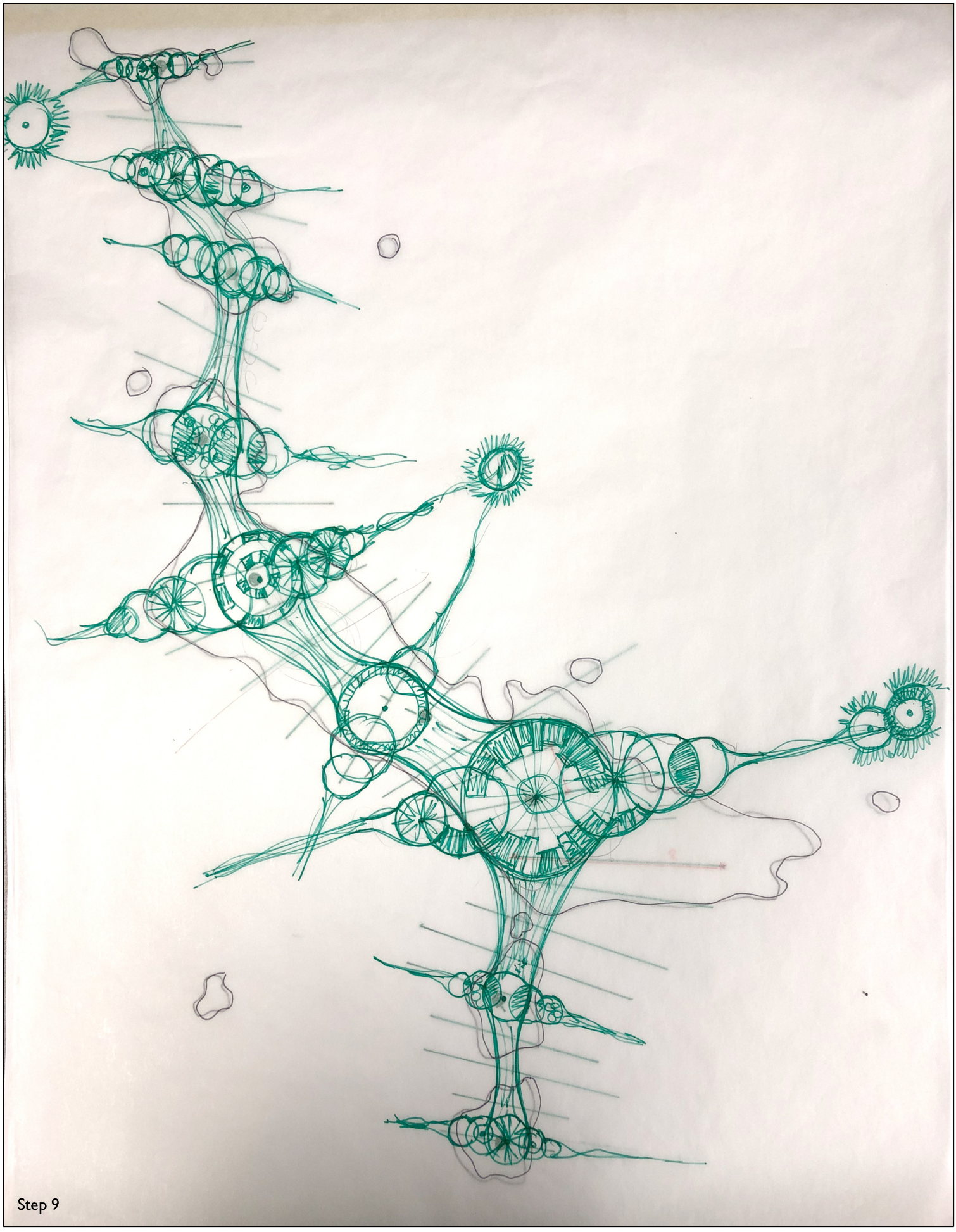
Section through a highest point

4- Design Development - Geometrical Mapping



Step 8

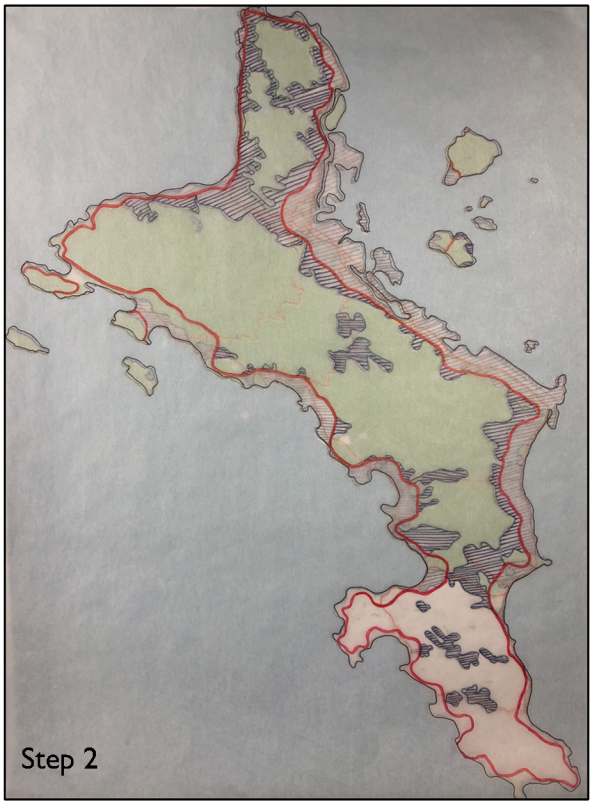
4- Design Development - Geometrical Mapping



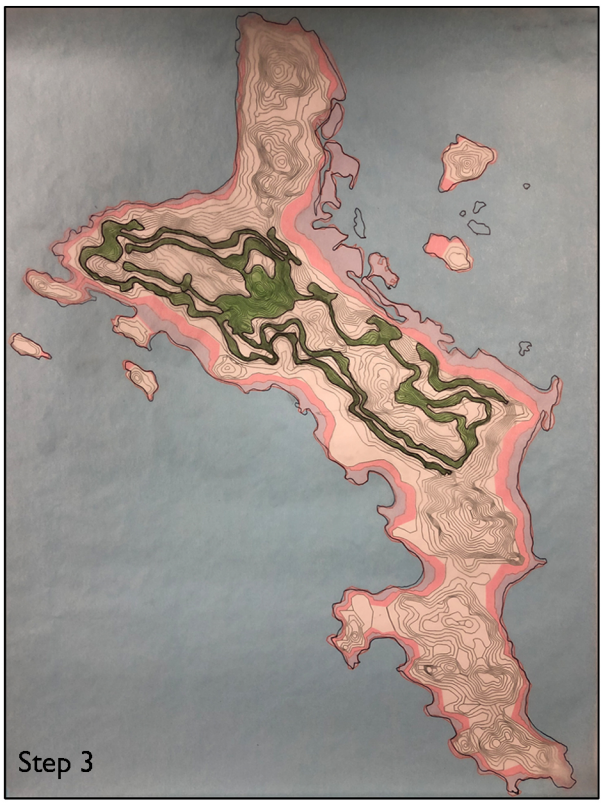
4- Design Development - Geometrical Mapping

Habited area (Black area)

Roads and highways (Red line)



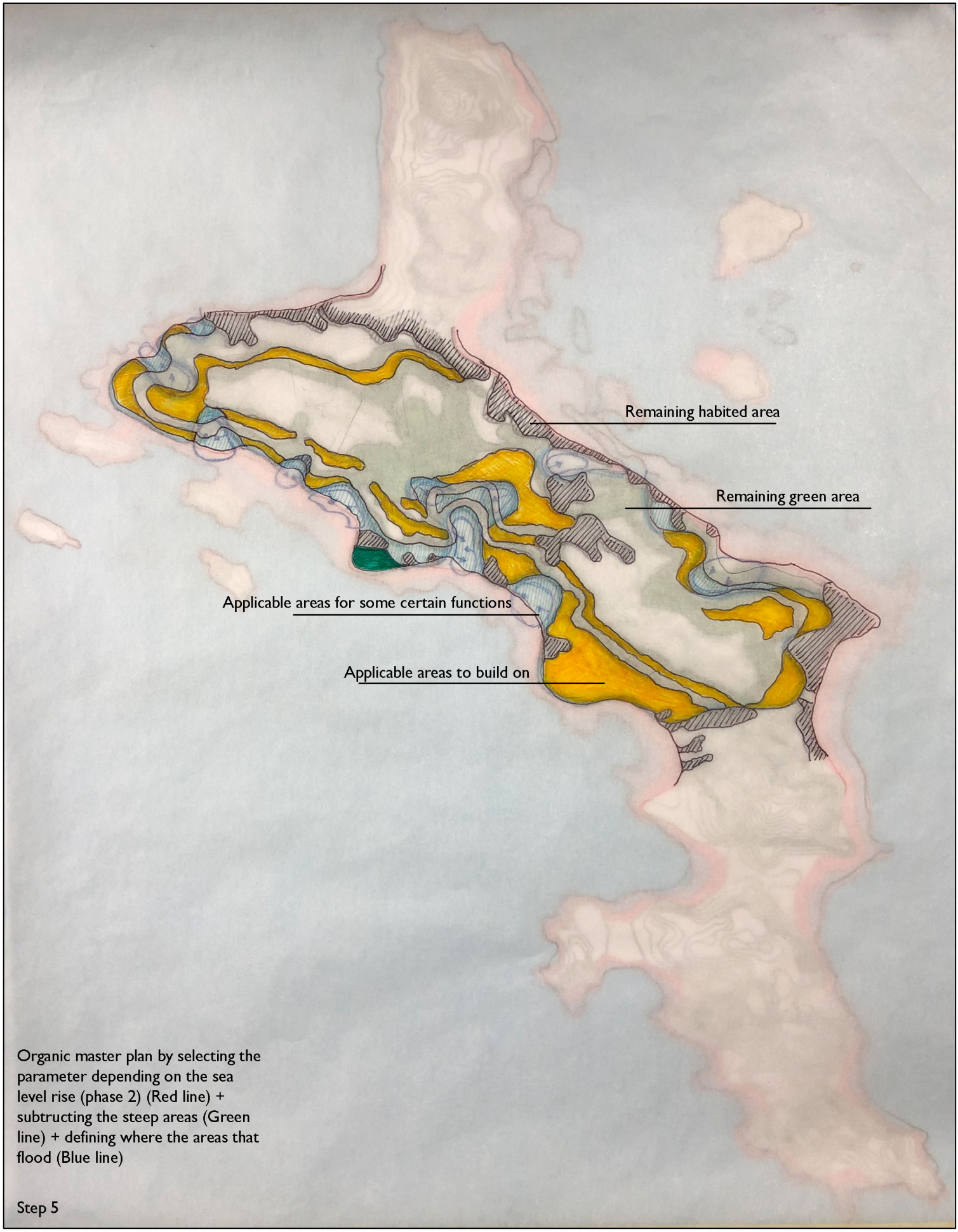
Sea level rise (phase 2)(Red line)



Following the topography of the area and selecting the spots that have a very steep slope to avoid building there (Green area)

Avoiding the valleys that would flood because of the heavy rainfall (Blue line)

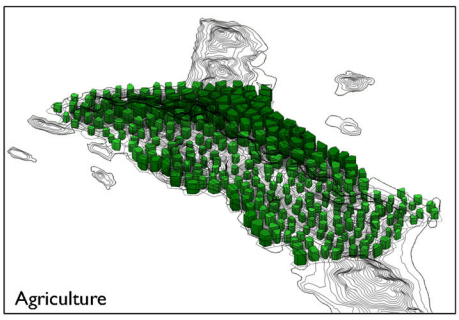
4- Design Development - According to Nature

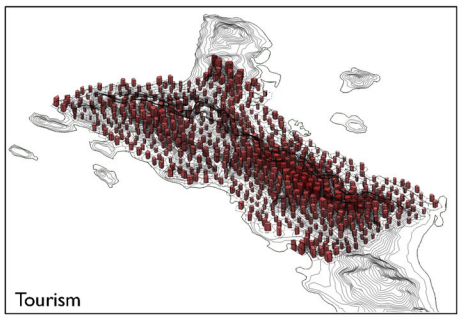


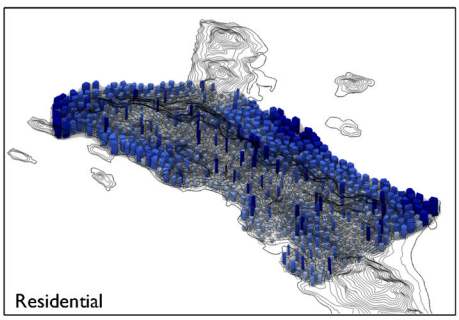
Organic master plan by selecting the parameter depending on the sea level rise (phase 2) (Red line) + subtructing the steep areas (Green line) + defining where the areas that flood (Blue line)

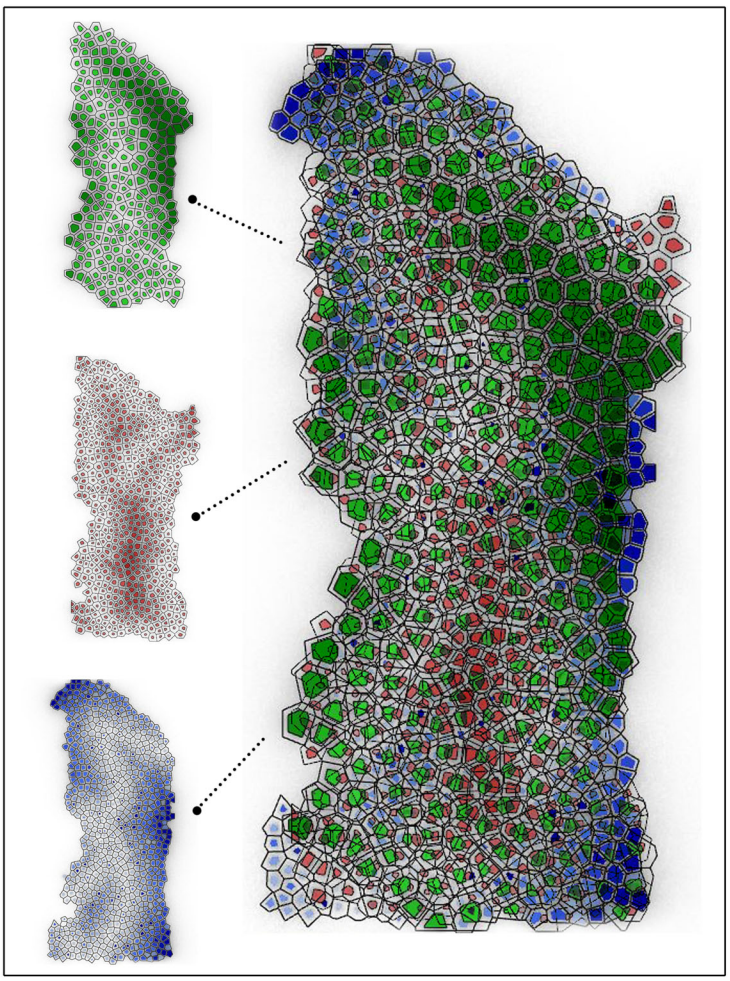
Step 5

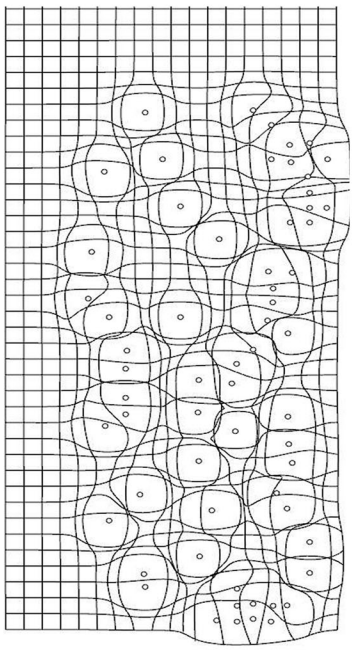
4- Design Development - According to Nature

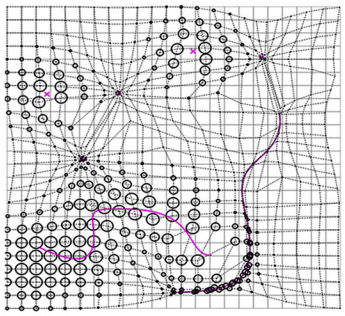


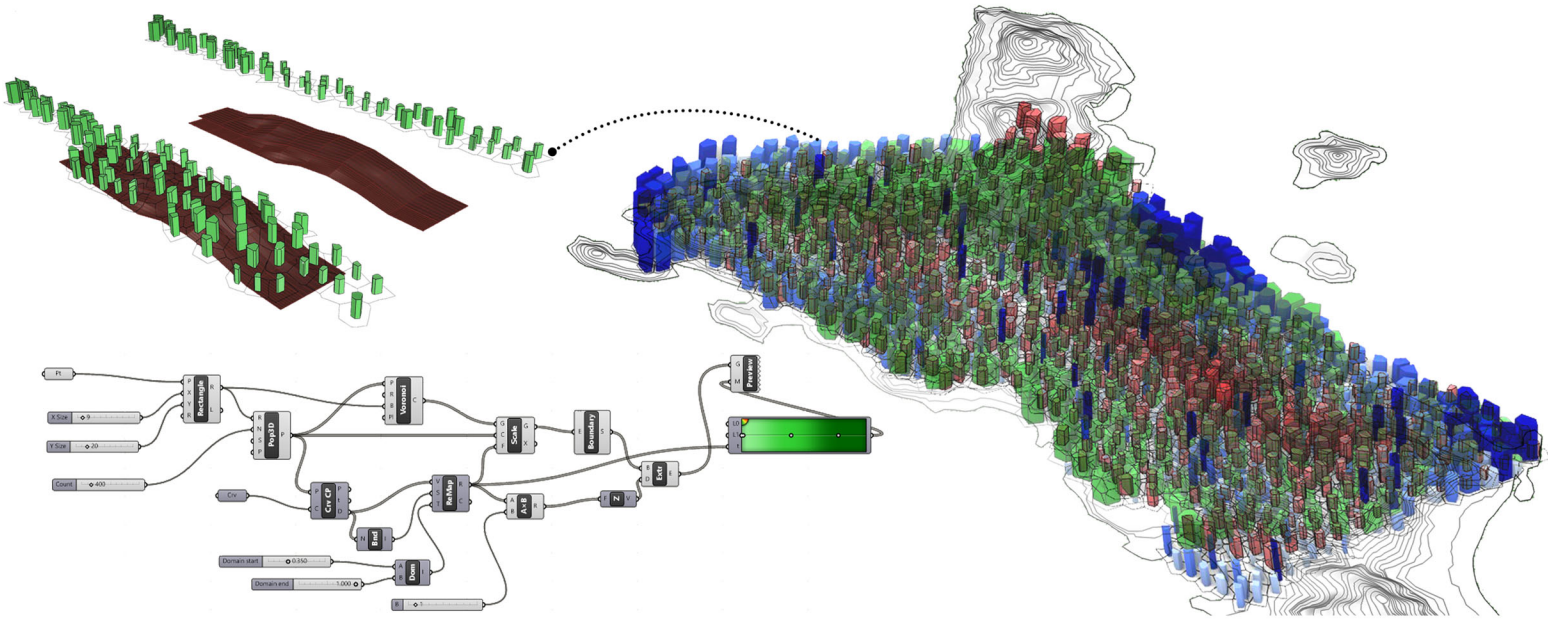










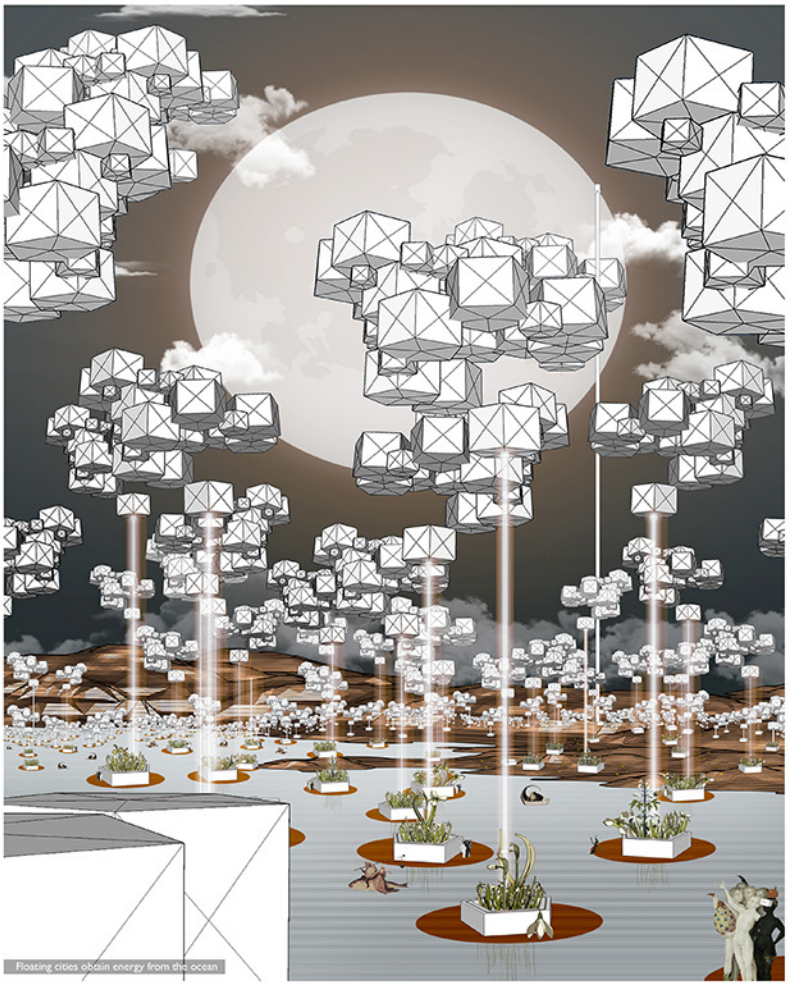


4- Design Development - Voronoi Analysis

4- Design Development - Initial Sketch of Final Proposal

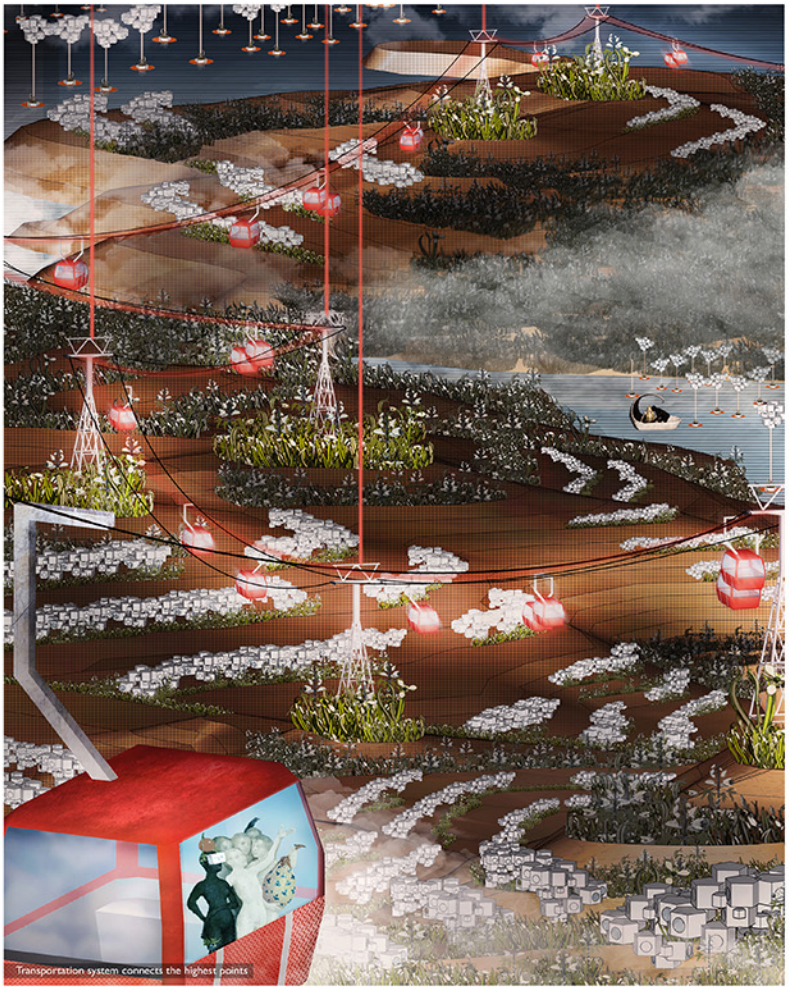
Final Proposal

REVISION OF SEYCHELLES'S FUTURE: AN ECO-TOURISM PROTOTYPE

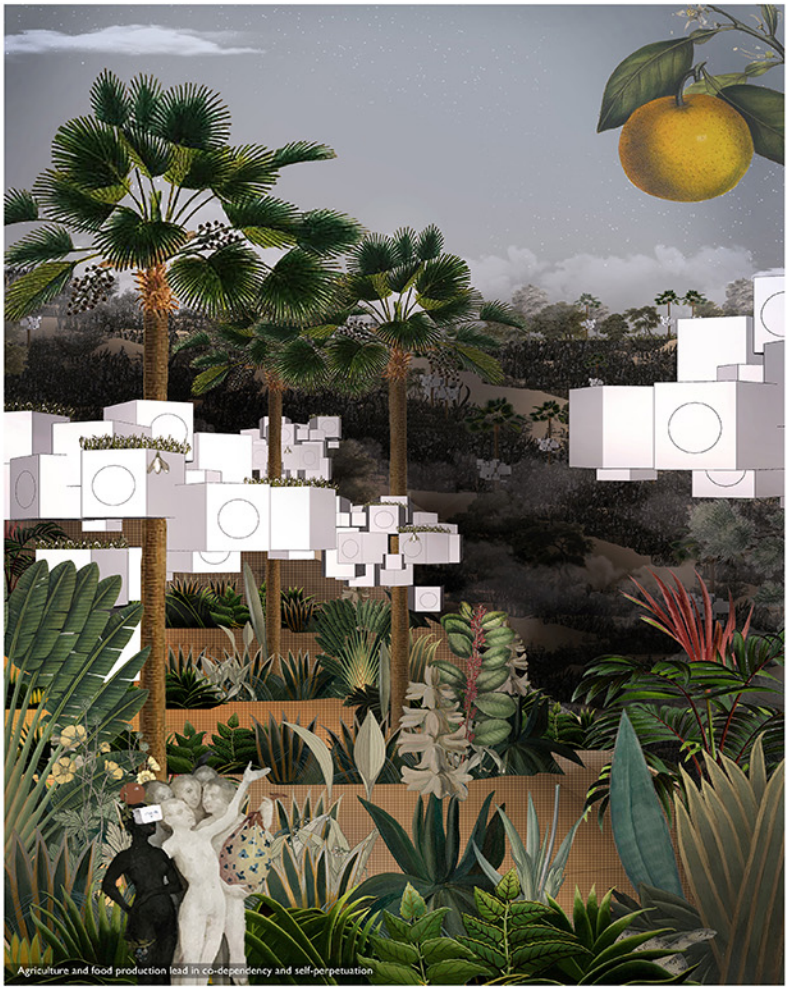


Floating cities obtain energy from the ocean

Ecological symbiosis between nature and built form



Transportation system connects the highest points



Agriculture and food production lead in co-dependency and self-perpetuation

REVISION OF SEYCHELLES'S FUTURE: AN ECO-TOURISM PROTOTYPE

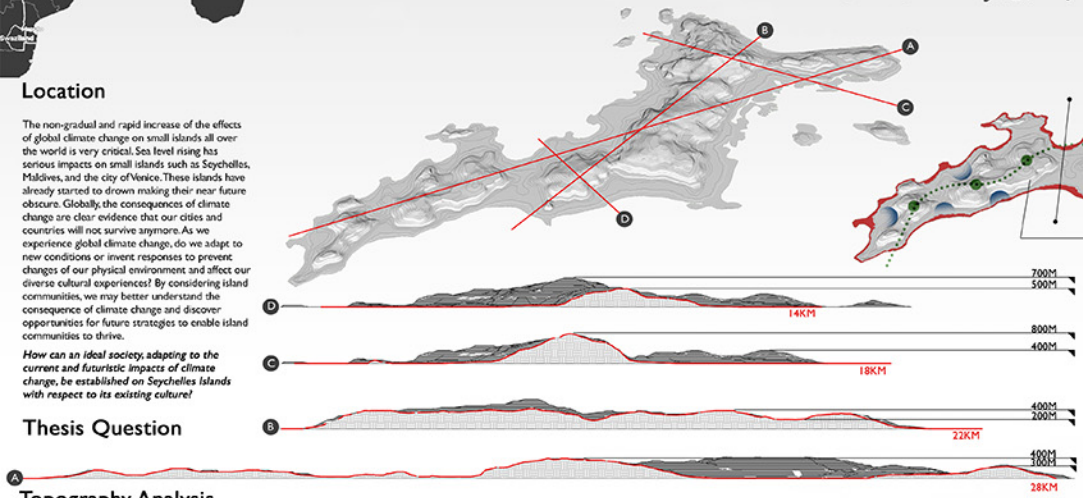
Site Elements

Location

The non-gradual and rapid increase of the effects of global climate change on small islands all over the world is very critical. Sea level rising has serious impacts on small islands such as Seychelles, Maldives, and the city of Venice. These islands have already started to drown making their near future obscure. Globally, the consequences of climate change are clear evidence that our cities and countries will not survive anymore. As we experience global climate change, do we adapt to new conditions or invent responses to prevent changes of our physical environment and affect our diverse cultural experiences? By considering island communities, we may better understand the consequence of climate change and discover opportunities for future strategies to enable island communities to thrive.

How can an ideal society, adapting to the current and futuristic impacts of climate change, be established on Seychelles Islands with respect to its existing culture?

Thesis Question



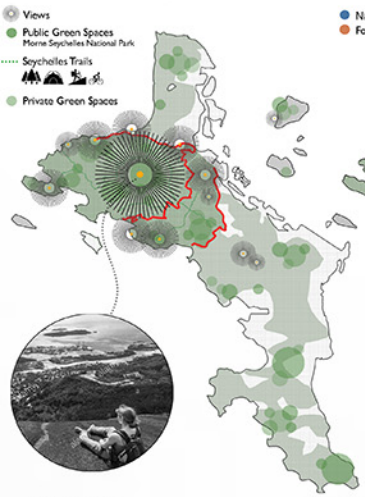
Topography Analysis

0 1 2 4km

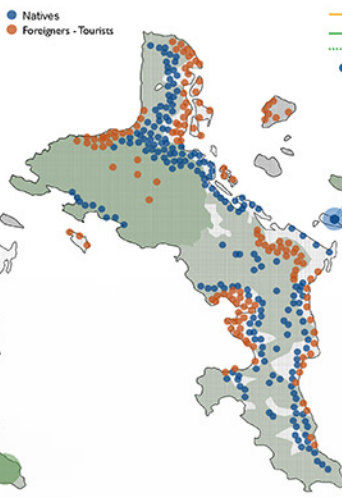
Electricity Generation Mix

Projection of Energy Demand to 2035

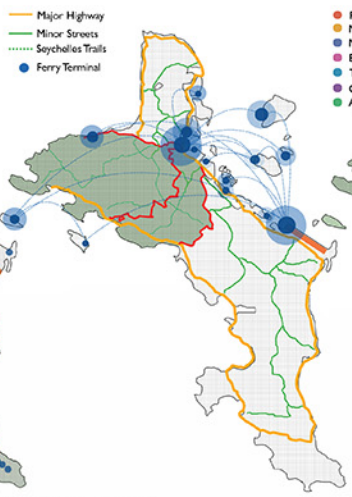
Energy Analysis



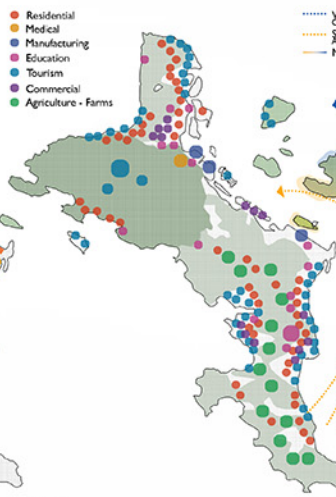
Natural Tourism



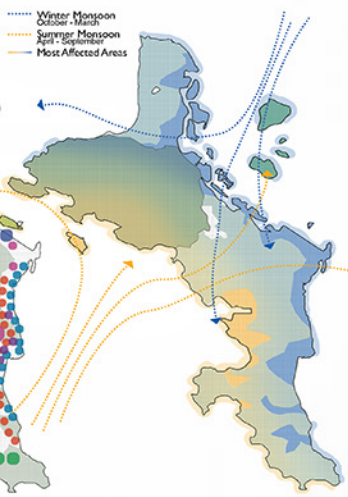
Population



Transportation System



Land Use

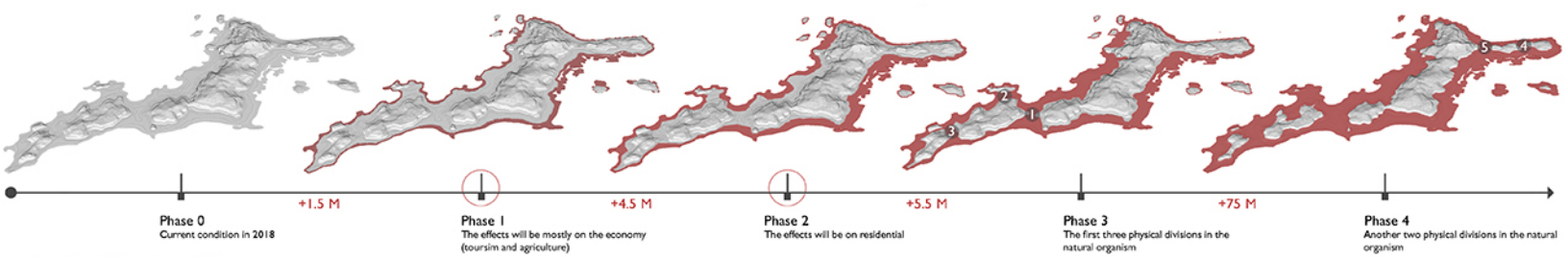


Monsoon Direction

Site Analysis

0 2 4 8km

REVISION OF SEYCHELLES'S FUTURE: AN ECO-TOURISM PROTOTYPE



Phase 0
Current condition in 2018

Phase 1
The effects will be mostly on the economy (toursim and agriculture)

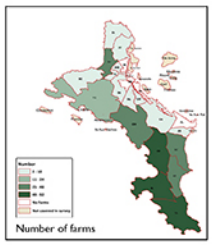
Phase 2
The effects will be on residential

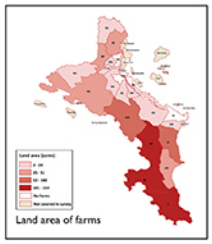
Phase 3
The first three physical divisions in the natural organism

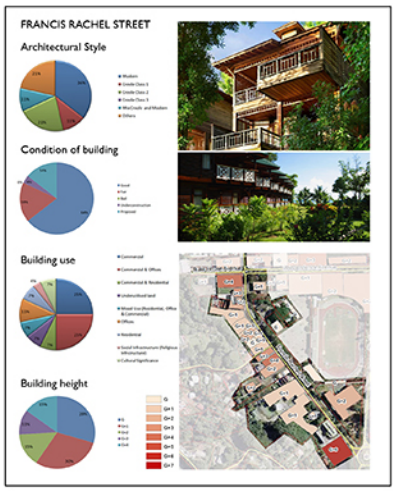
Phase 4
Another two physical divisions in the natural organism

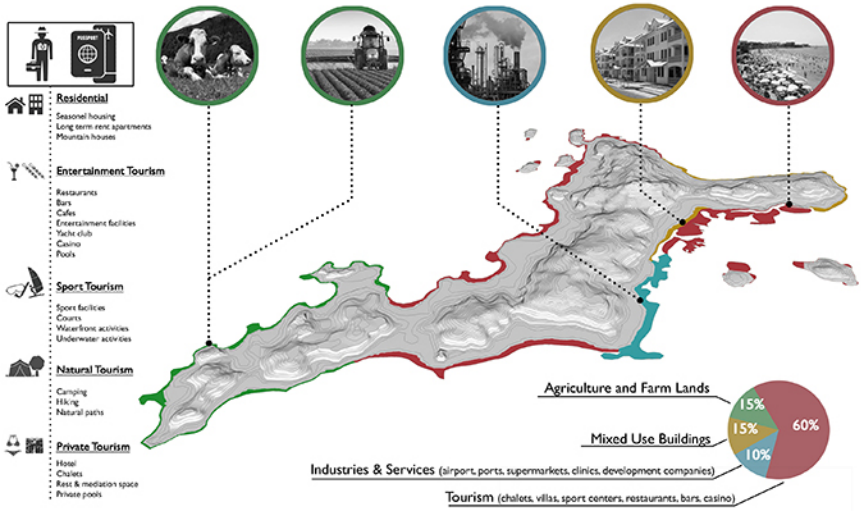
Timeline/ Sea Level Rise

IS REQUIRED

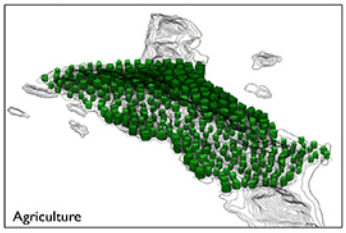


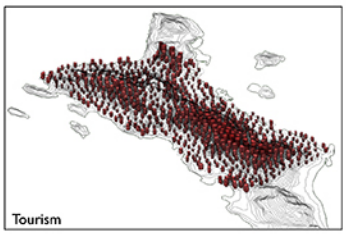


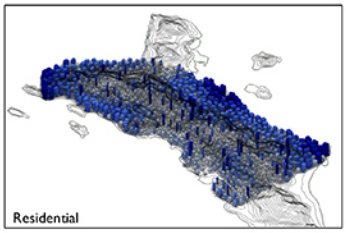


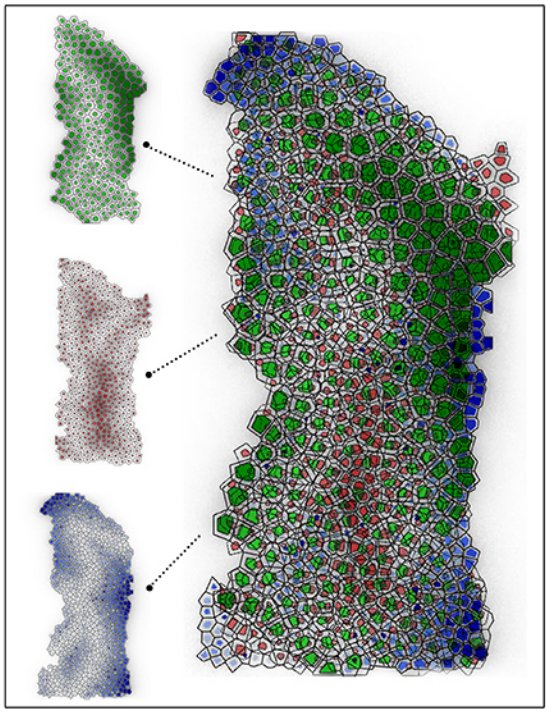


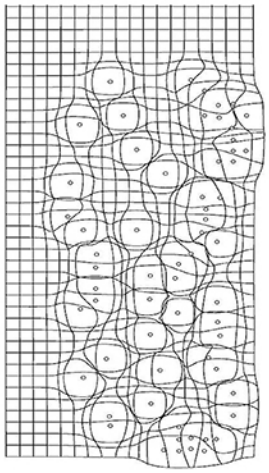
Program Analysis (Proposed & Effected)

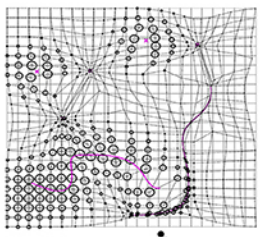


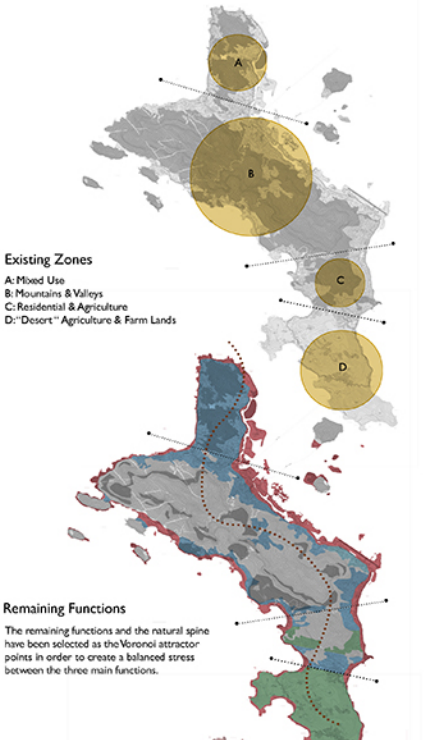






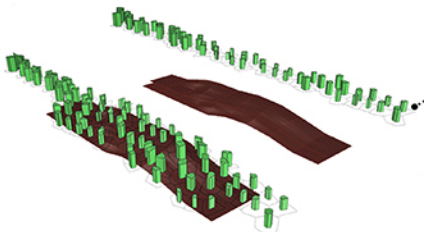


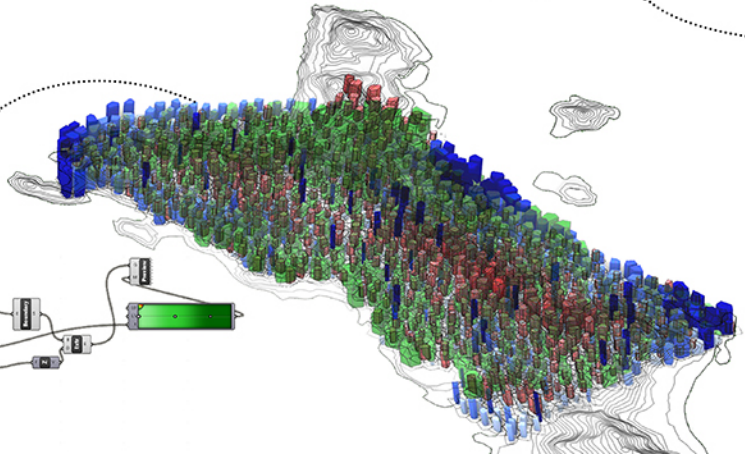


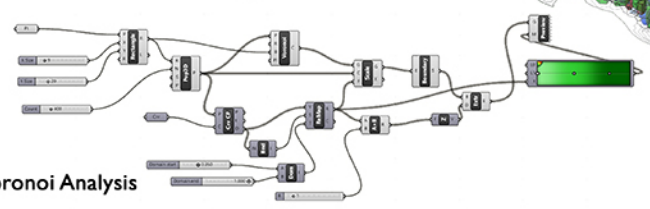


Existing Zones
A: Mixed Use
B: Mountains & Valleys
C: Residential & Agriculture
D: "Desert" Agriculture & Farm Lands

Remaining Functions
The remaining functions and the natural spine have been selected as the Voronoi attractor points in order to create a balanced stress between the three main functions.







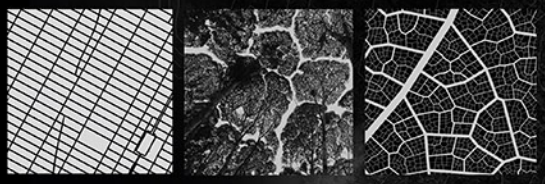
Voronoi Analysis

Final Result
Every geometry has the possibility to combine all the three main functions at the same, and in different ratio, without effecting on the rest of the geometries.

Methodology

REVISION OF SEYCHELLES'S FUTURE: AN ECO-TOURISM PROTOTYPE

Urban Systems VS. Natural Systems

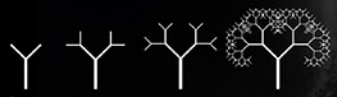


How can we change our way of life to come to terms with these transformed natural systems and processes?

Climate change requires strategies beyond any adaption or mitigation plan that lacks of the ecological symbiosis between nature and built form.

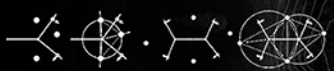
So, how can we be a part of the natural system?

Natural Geometry (Organic Growth)



Conncecting Nodes

Sierpinski's Set



Voronoi Geometry

The previous examples are a part of the natural geometry, whic is a branch pf mathematics concerned with irregular patterns made of parts that are is some way similar ro the whole (exc clouds, trees and branches).

Patterns exist in every natural element and self similar and similatr to the whole

Design Process

Highest Points

Connecting the highest points of the island

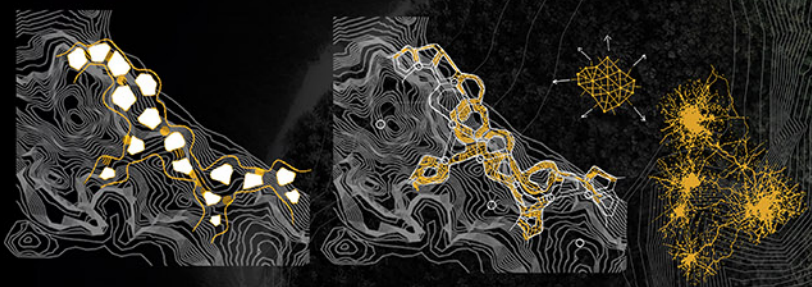
Stressing

Allowing Voronoi to spread in the proposed zone

Intersecting

Trim Voronoi diagram that fall in the highest points zone in order to avoid building on a steep land.

Result



Natural Bridges

Allowing the green elements to spread in the center of the Voronoi geometries and while keeping the groon elements connected through natural bridges to maintain the unity of the natural system

Stressing

Applying functions in a way that respects the topography, views and the final result of the Voronoi analysis of the island

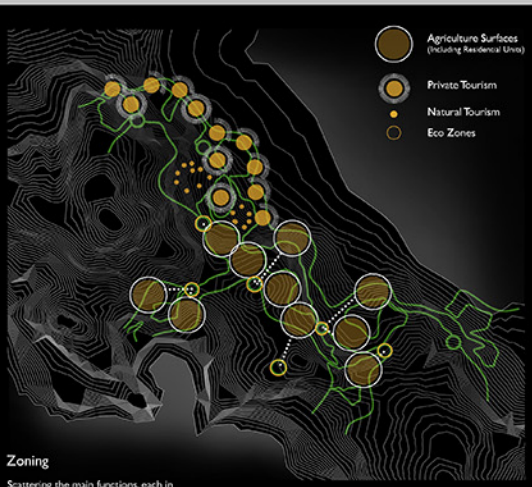
Future Expansion

The proposed system can grow from any point for future needs using the same method

Master Plan

0 0.5 1 2 4km

REVISION OF SEYCHELLES'S FUTURE: AN ECO-TOURISM PROTOTYPE

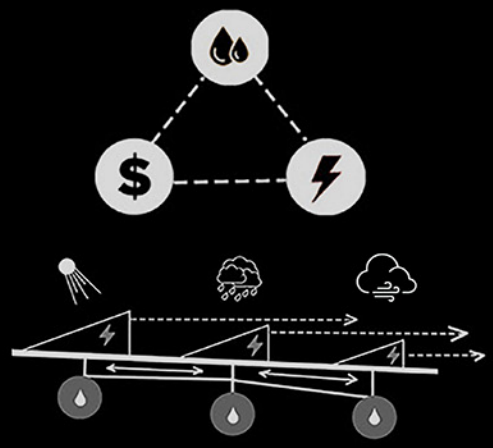


Zoning

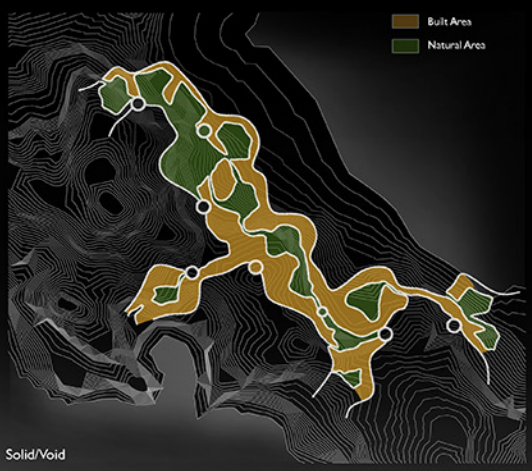
Scattering the main functions, each in its suitable picked area

Eco Zones

An Eco zone is an area that is placed between every 2-3 Voronoi geometries to collect grey water, rain water, solar power and wind power and out it back to the bigger network

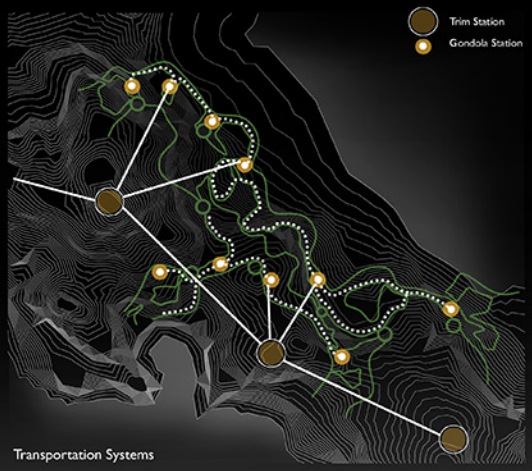


All grey water from services and collected rain water could be used for agriculture and farming purposes



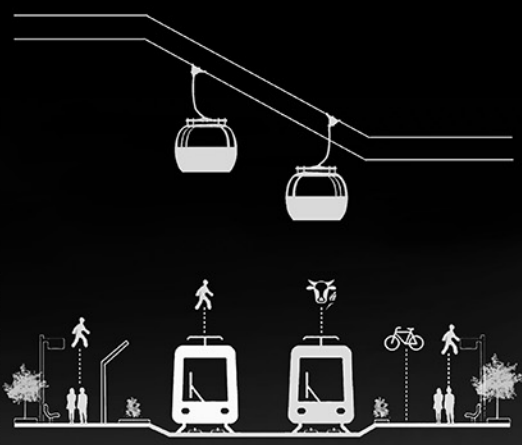
Solid/Void

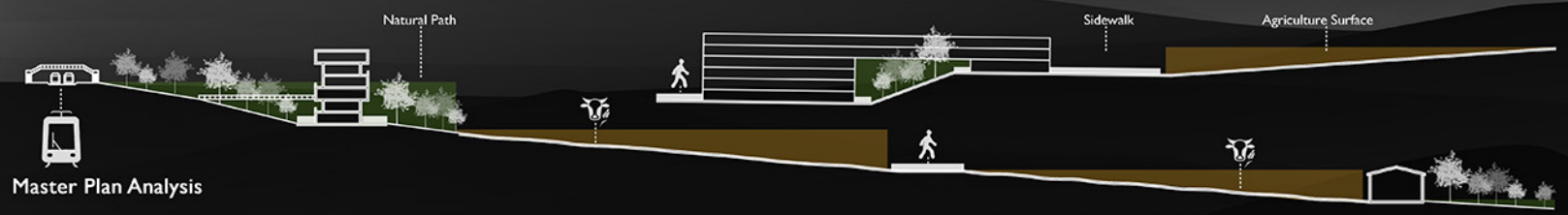
Almost the half of the land was left natural while the rest of the land is used to accommodate different functions



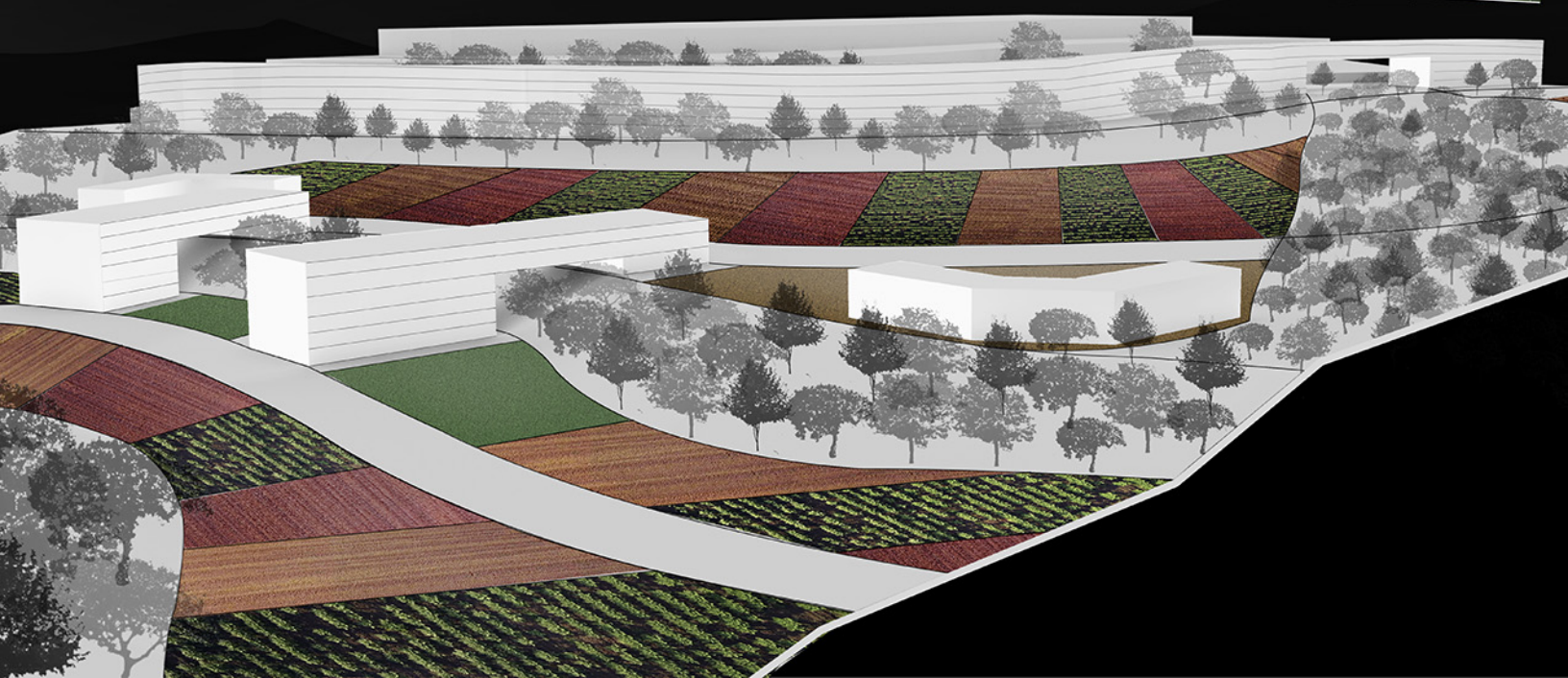
Transportation Systems

Two main systems, trim system is used to the horizontal movement while the gondola is for the vertical movement especially between the highest points

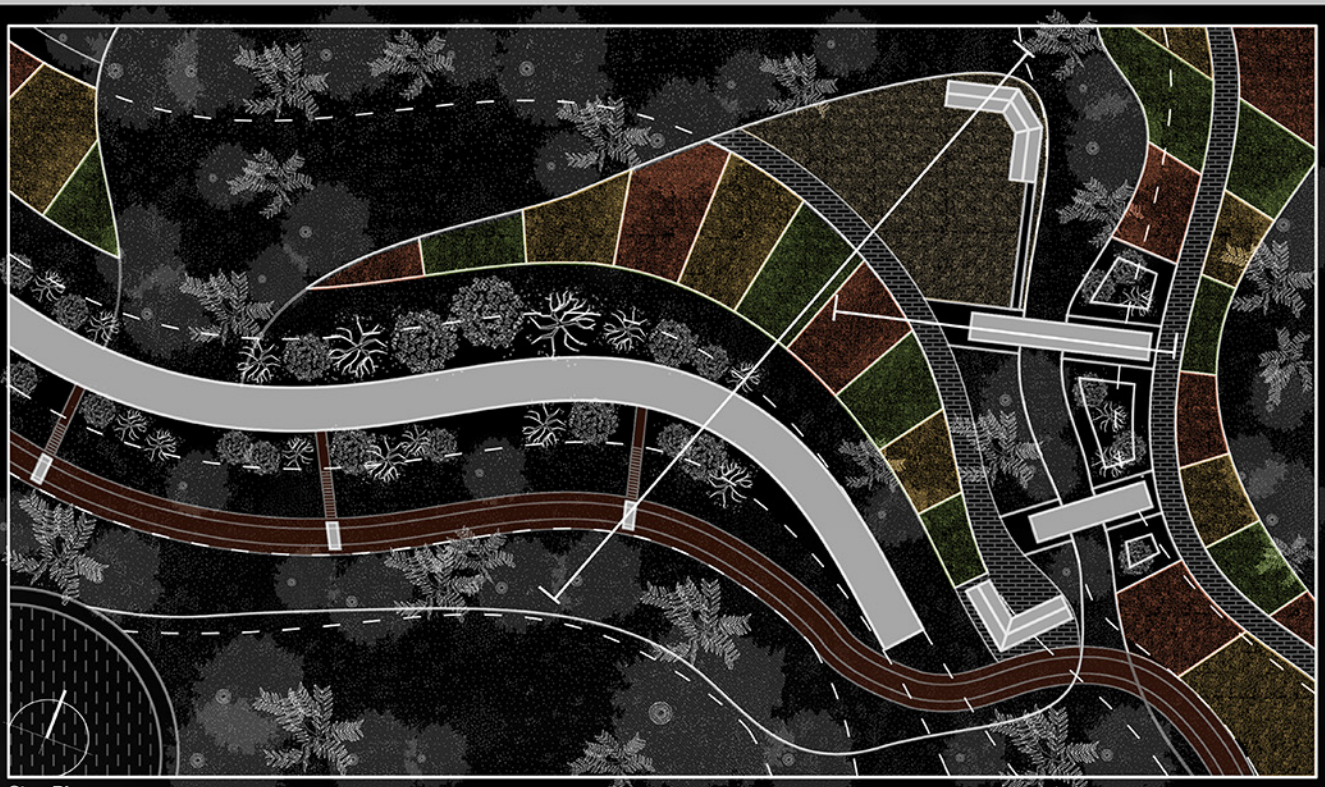




Master Plan Analysis

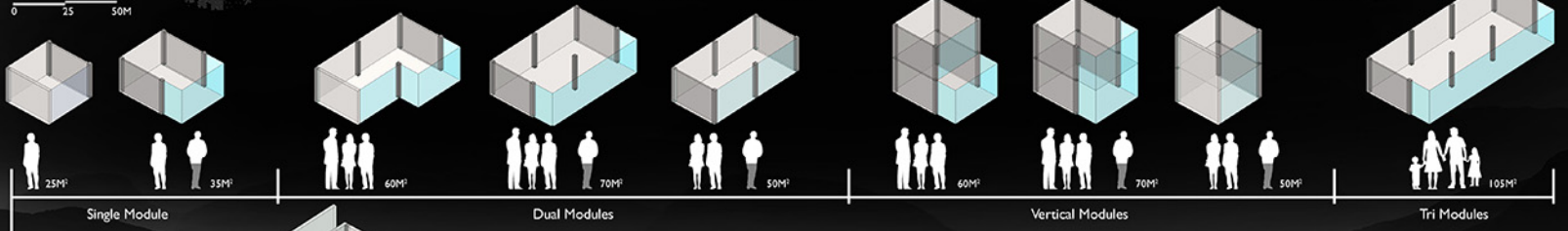


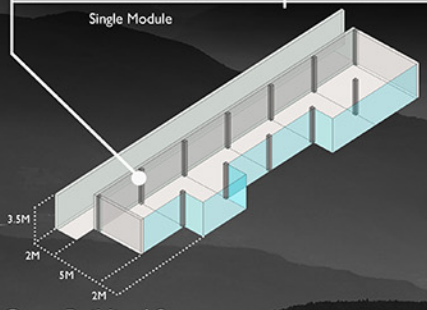
REVISION OF SEYCHELLES'S FUTURE: AN ECO-TOURISM PROTOTYPE



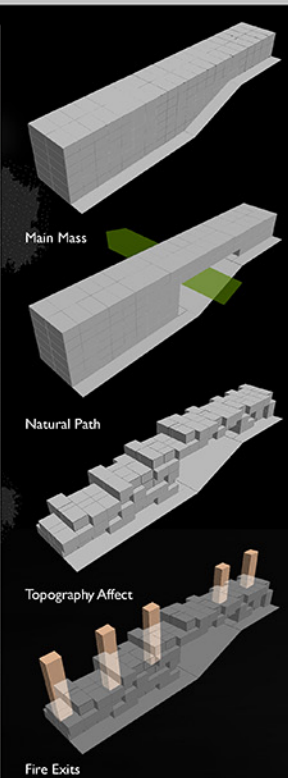
Site Plan

0 25 50M





Open Building/ Support



Concept