

https://dspace.org/

Unravelling nature: integrating architecture and nature

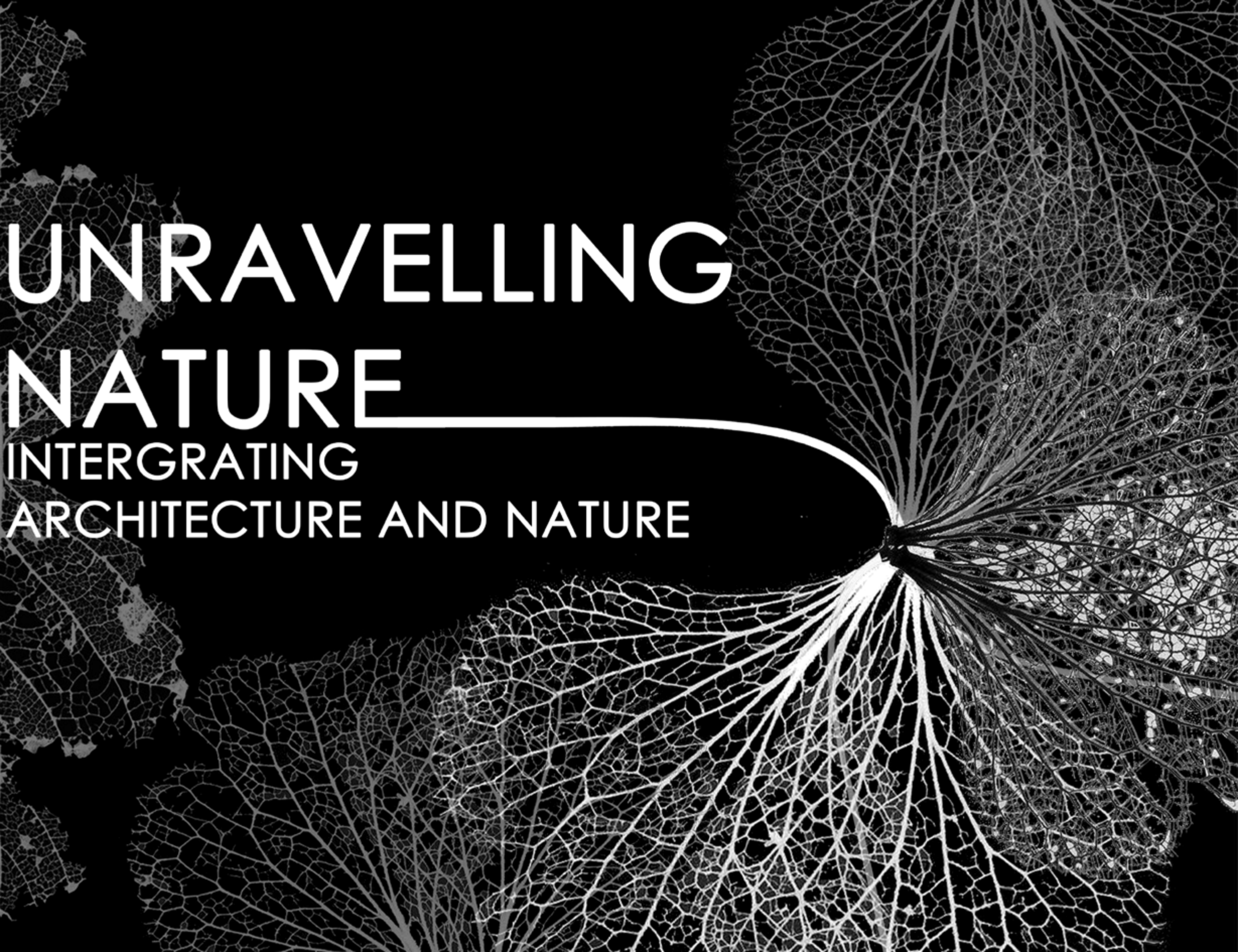
Katete, Lungo

2024
https://hdl.handle.net/10539/37352

Downloaded from a DSpace repository. https://dspace.org/

UNRAVELLING NATURE

INTERGRATING ARCHITECTURE AND NATURE



UNRAVELLING NATURE

Integrating Architecture and Nature

Lungo Katete
1415842

This document is submitted in partial fulfilment for the degree: Master of Architecture (Professional) at the University of the Witwatersrand, Johannesburg, South Africa, 2022.

I, [Lungo Katete 1415842] am a student registered for the course Master of Architecture (Professional) in the year 2022. I hereby declare the following: I am aware that plagiarism [the use of someone else's work without permission and/or without acknowledging the original sources] is wrong. I confirm that the work submitted for assessment for the above course is my own unaided work except where I have stated explicitly otherwise. I have followed the required conventions in referencing thoughts, ideas, and visual materials of others. For this purpose, I have referred to the Graduate School of Engineering and the Built Environment style guide. I understand that the University of the Witwatersrand may take disciplinary action against me if there is a belief that this is not my unaided work or that I have failed to acknowledge the source of the ideas or words in my own work.

ABSTRACT

The ability to bring to life what is created in one's mind, is perhaps the most remarkable feat of human kind. Without the ability to imagine, innovation ceases to exist, resulting in the overall demise of evolution itself. We exist in a time during which the destruction of nature and its essential continues to expand as quickly as nature diminishes right before our eyes. Our environment is populated with built structures and design artefacts, but very few of these rattle the domain of intellect in a way that provokes cultural reorientation. Persuaded by nature's grand design, this research document proposes a new approach to architecture, through model development and alternative/natural material exploration. It aims to scrutinise the potential of a new way to create architecture through nature's lens, encompassing formation that consolidates maximal performance and minimal resources through local material variations.

In this approach, architecture will be viewed through the lens that is nature, promoting the consolidation of form, materiality and structure. This will be done by exploring aspects such as form development, material analysis and fabrication, allowing for the utilisation of materials found naturally occurring in nature. Materiality precedes form making, allowing for an approach that is structured based on the material properties as a function of structural and environmental performance. This approach shall integrate material properties as a prospective driver of the form generating process, it shall establish how such processes contribute to a novel way of generating, dispensing and depositing material form. In an environment populated primarily by built structures, it is essential that we take into consideration how we can integrate nature's grand design in the evolution of the design fabric and the built environment process, for without the ability to imagine, innovation ceases to exist.

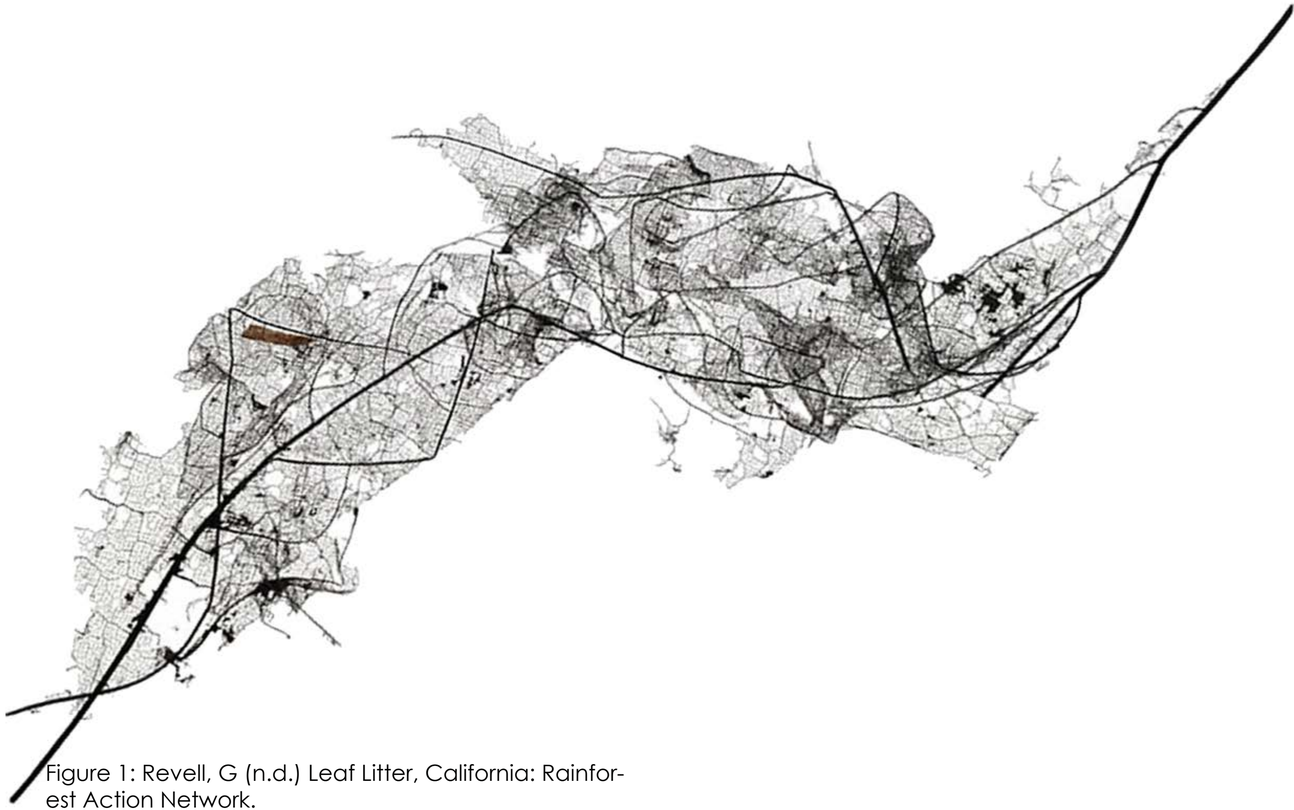
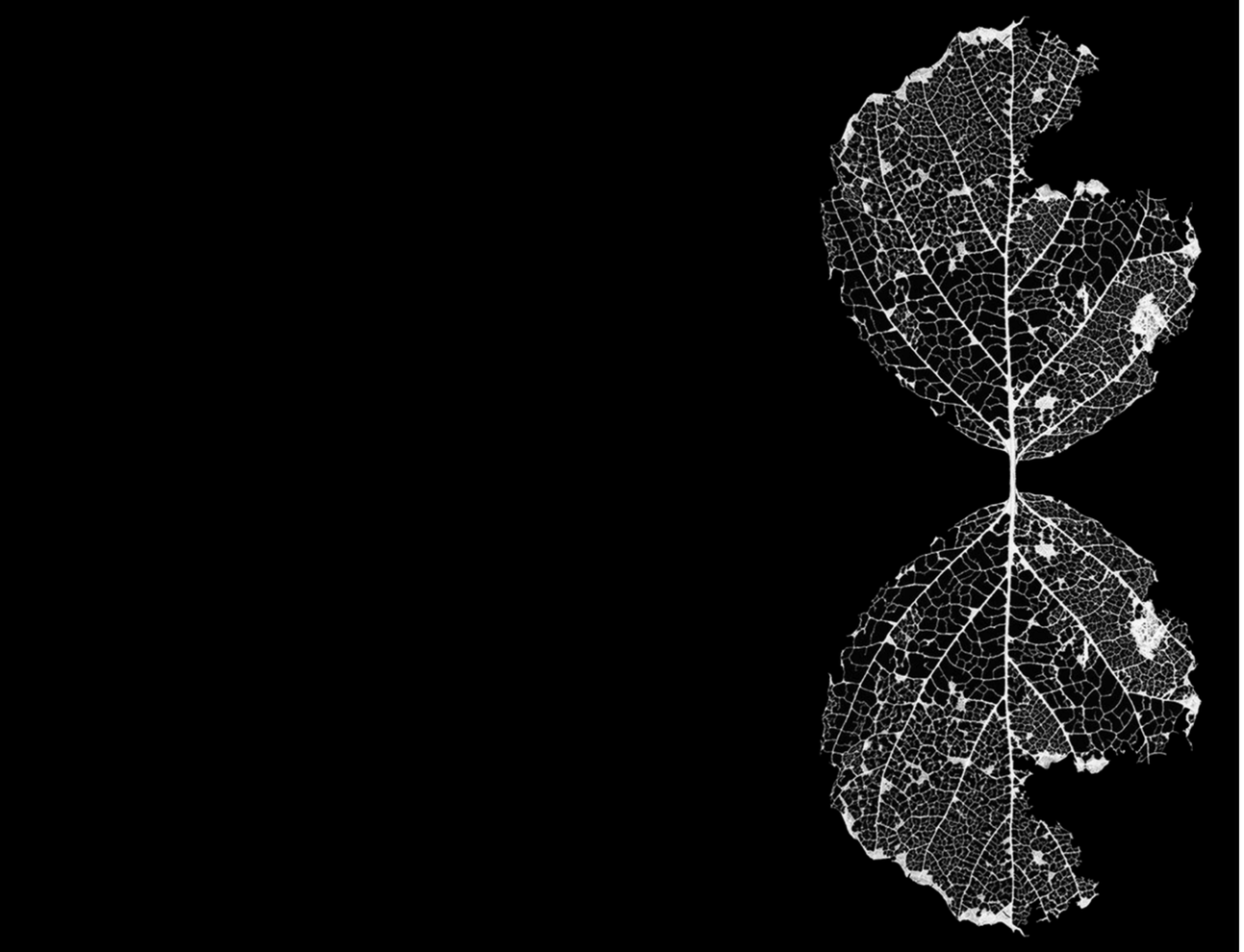


Figure 1: Revell, G (n.d.) Leaf Litter, California: Rainforest Action Network.



CONTENTS

PART 1

1. INTRODUCTION....08
2. MIMICKING NATURE....12
3. THE GENERATION OF FORM....20
4. UNRAVELLING NATURE....28
5. INTERGRATING ARCHITECTURE AND NATURE....42
6. CONCRETE JUNGLE....52
7. DESIGN INTENTION....64
8. HISTORY....68
9. INTRODUCTION TO SITE....74
10. DESIGN CONCEPT....98

PART 2

11. DESIGN DEVELOPMENT....116
12. FINAL DESIGN....132
13.REFERENCES....166

INTRODUCTION

There was a time when architecture was characterised as more than just form making. It was seen as the amalgamation of material, form and nature which was naturally intertwined into a tradition of making (Sennett, 2008). In a world developing so rapidly, this notion ceases to exist with the idea that form is to be conceived and cultivated by the power of a machine based manufacturing and mass production industry that was a result of the Industrial Revolution. The notion that form follows function took over and began to play a leading role in the way in which architecture was created, with the focus being on architecture that was built fast, cheap, repetitive and modular. The values of ancient craft and vernacular forms of design, which focused on this notion of integration of material, form and nature were completely abandoned, with the emergence of mass production and the automation of construction quickly taking its place as computer aided design emerged (Oxman, 2010). As technology continued to advanced, the notion of form following function became completely abandoned from the physical realities from which it was manifested. This created separation between form, matter and nature, resulting in an even greater abandonment of the modelling, analysis and fabrication process that has always existed in design. Intricate forms became the objective of creativity in computer aided design supporting the emergence of complex geometric forms that are in a sense void of their reality (Oxman, 2010).





MIMICKING NATURE

MIMICKING NATURE

Throughout history, architecture and design have always been inspired by nature. It has found ways to not only mimic organisms in terms of shape and form, but to also find strategies, logic and methods that exist in nature that can be applied to design (EL-MAHDY, 2017). Although they are seen as different from one another, architecture and nature are held together by common threads as they follow the same logic in relation to growth and adaptation. That being said, designers merely translate forms that exist in nature into buildings that follow a similar geometric form as opposed to fully understanding the logic behind it. This has resulted in a gap between methods of the physical and computer aided form finding that is dependent on nature (EL-MAHDY, 2017).

As remarkable as nature is, it too is formulated by rules and systems that exist in both living and non-living organism. Nature is formulated according to a concept that focuses on minimal energy as a response to forces and loads as she demonstrates a wide range of form from basic principles and minimal materials (Oxman, 2010). This principle which is often referred to as closest packing is found in the animate and inanimate realm and is equivalent to the notion of triangulation which exhibits intrinsic geometric stability. It is a remarkable principle that operates independent of scale or material, allowing for an energetic conservative effect either on a molecular, cellular or a man-made level as its intrinsic stability demonstrates a condition that allows for minimal potential energy. Such principles allow for framework structures to be developed without moment joints, ensuring axial loaded members which allows for high strength per weight minimum energy structures (Oxman, 2010). The inspiration offered to us from nature is not only about mimicking form, but also about understanding the manner in which these organism behave to fully understand what principles can be beneficial in architecture. In nature, living and non-living organism have their own characteristics which are notable in their form, structure, behaviour, materiality and pattern. These behavioural characteristics can be investigated to extract adaptable and sustainable solutions that can be utilised to formulate a different approach to design.

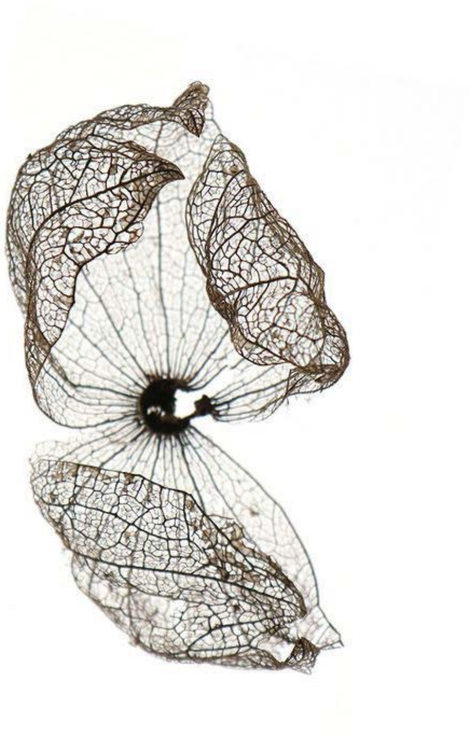


Figure 2: Jo Hoffman, M (2018) Extinct Flowers, Italy: Mattia Tarantino.



Figure 3: Unknown (n.d.) Nature, California: Pinterest.

LIVING ORGANISM
CHARLOTTE'S WEB

Just as Charlotte the spider, spins her silk to create a home and to prepare a safe haven for her spiderlings, we begin to understand that spiders use their silk for various purposes including protection and hunting. The silk produced by spiders is said to be an engineering miracle and is considered to be one of the strongest materials in comparison to its scale. The strength of its silk is embedded in its fibrous atoms which can be closely identified as composite silks being the joint and spindle knot droplet, which enables the web to effortlessly flex and stretch without inflicting any damage (EL-MAHDY, 2017).

This molecular structure influences the elasticity of the silk, making it resistant to rupture as a result of mechanical forces. The silk fibres are said to be ten times stronger than Kevlar (a very strong fabric), five times more substantial than steel and double the elasticity of nylon. The fibres are made up of spinnerets with each spinnerets having what is referred to as a spigot. These spigots then produce a material in the form of a liquid which twists and connects together to formulate the spiders' silk and give it the strength it is popularly known for (EL-MAHDY, 2017).



Figure 4: Strauhmanis, E (2014) Spider Web, Canada: Flickr.



Figure 5: Holmes, R (n.d.) Spiders Silk, Canada: Flickr.



Figure 6: Holmes, R (2014) Dew Drops, Canada: Flickr.

THE BEE

Similarly the structure of a honeycomb is said to be one of the most magnificent forms in nature. The excellence lies in the hexagonal shape and the manner in which the composition is formulated. The hive is made up of hexagonal units which are linked along each side, formulating an even larger composition, popularly known as the honeycomb. The hive is both a safe haven and storage facility for the nectar collected by the bees as it is transformed into honey. The hexagonal wax units are designed for space efficiency to ensure the buzzing bees are able to accommodate the honey they individually produce (EL-MAHDY, 2017).

The form of the hexagonal units is the perfect ratio between materiality and space needed in order to ensure material efficiency. If the honeycomb was made up of circular forms as opposed to the hexagonal shapes, the circles would only be connected at four points along the circular circumference, leaving gaps between the larger compositions. If the composition was triangular or a quadrangle, this would result in an even smaller area, making the space less efficient (EL-MAHDY, 2017). Therefore the hexagonal shape has proven to be the most efficient form allowing for the largest storage possible for the honey produced by the bees, as well as the most luxurious living space using the least amount of wax as possible. This is an illustration of balance between material efficiency and space.



Figure 7: Carstens, A (Circa 2020) Body Heat Melts Wax to Form Hexagons, Missoula: Biomimicry Institute.

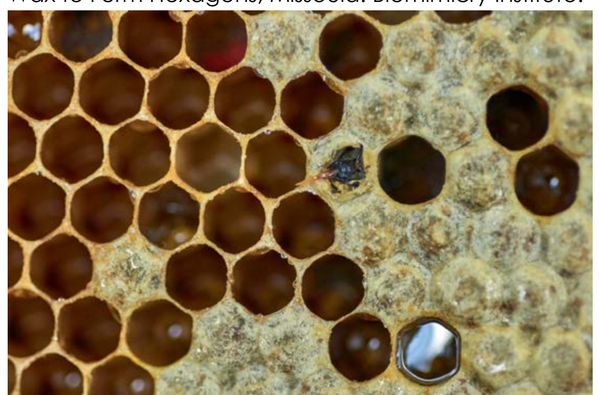


Figure 8: Carstens, A (Circa 2020) Wax Hexagon Forms, Missoula: Biomimicry Institute.

The various characteristics found in the different organisms can be investigated to extract adaptable and sustainable solutions to formulate a new approach to architecture. It is evident that forms and structures in nature are created in accordance with their requirements, be it material efficiency or the need to hunt and protect. This has resulted in the diversity of forms that are rooted in basic principles whose focus is centred towards efficiency. When the usage of natural materials is taken into account, one is unable to clearly differentiate between the structure and the skin which it is embedded in. This is because as the forms that exist in nature assimilate between the varied functions as well as their materials and properties. This is also evident in human beings as our skin is one continues element of tissue that is in a constant back and forth between acting as a barrier and a filter, which are functions that are contradictory to one another (Oxman, 2010). With that being said, there is one common thread that ties all of these elements together. This is the fact that they are all made up of complex fibre structures that are formulated with seamlessness and precision allowing them to serve their functions with ease.

Nature's grand design is dependent on its ability to exist concurrently between various functions and determine its relative importance within a process that focuses on the integration of growth, response and adaptability (Oxman, 2010). She is able to manage and promote the viability of the forms she creates and still meet the desired mechanical properties related to toughness, strength, resistance and stiffness. This makes nature one of the most intrinsic biological systems as it is able to not only diagnose localised damage to its structure but also repair the damage. So how does one mimic elements in nature and integrate them into architecture in a way that is not only beneficial for the planet, but also for the way in which we design going forward? For without the ability to imagine, innovation ceases to exist.

In a world that is constantly at odds between consumerism and nature, it is evident that presentation is key. As beautiful as nature is and with the knowledge that has been acquired over the years regarding the damage that has been inflicted upon her, the notion to protect her is seen by many as regressive, whilst consumerism is perceived as innovative regardless of the damage that it has inflicted (Hagan, 2001). The integration of architecture and nature would require a reappraisal of the way in which architecture is created to allow for a new approach that is of equal importance to what exists in today's day and age (Hagan, 2001). A new approach is critical in what can be considered a power struggle between our everyday approach to architecture and an approach that may be beneficial in the long run.

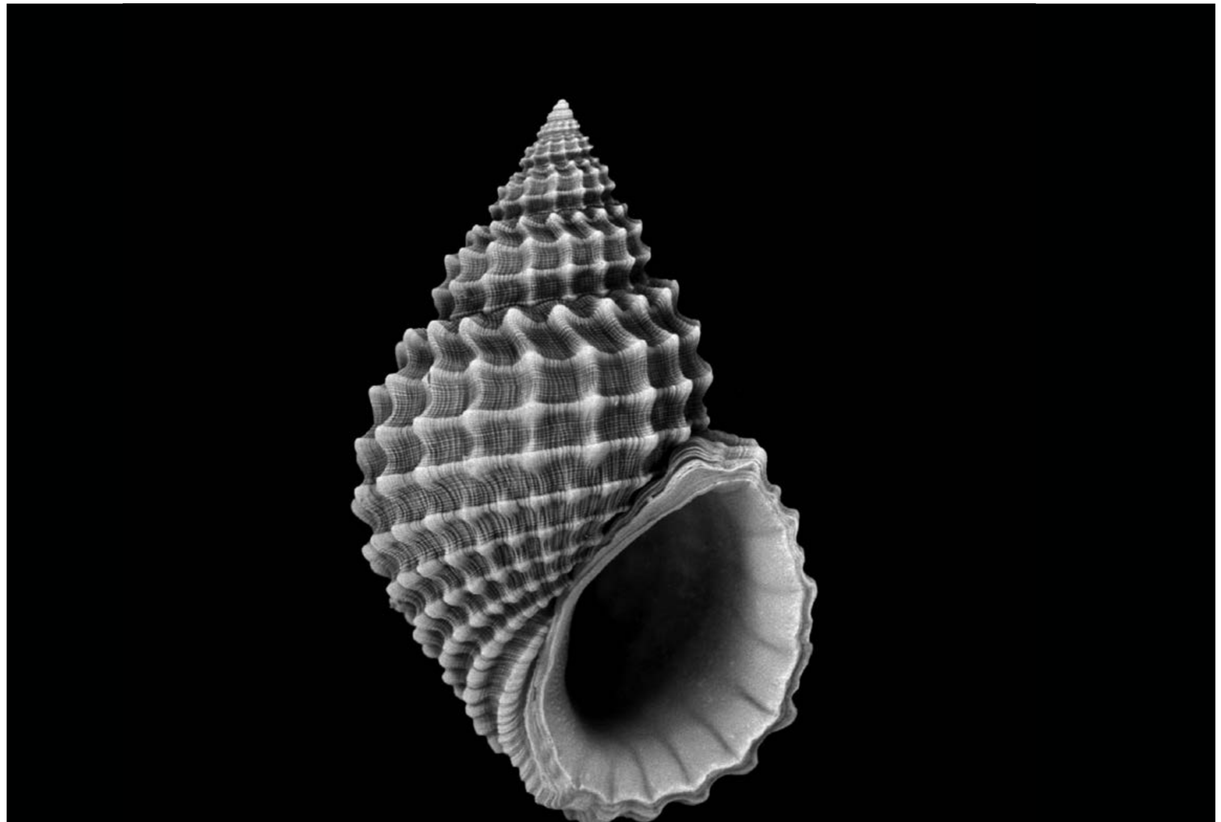
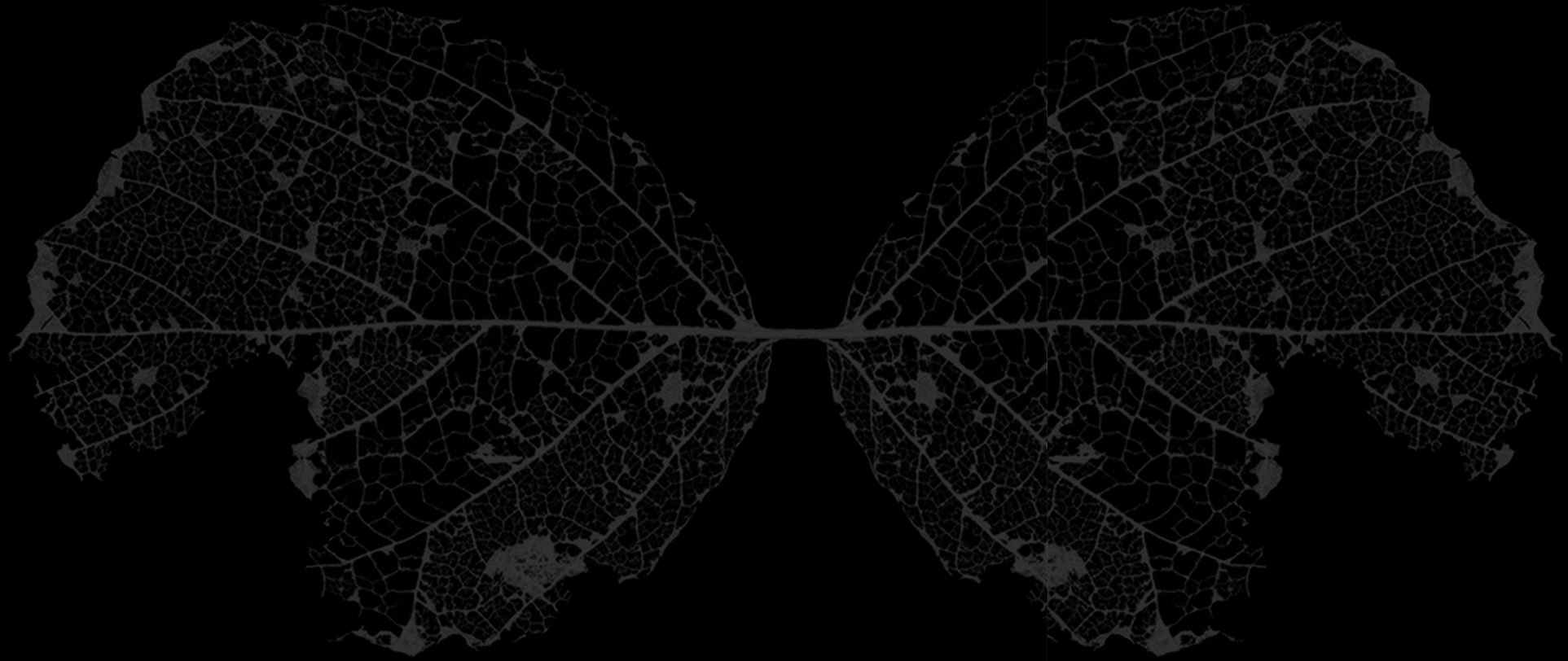


Figure 9: Liu, T (2014) Shell Lace Structure, London: Tonkin Liu.



THE GENERATION OF FORM

THE GENERATION OF FORM

Throughout history, architecture started the very moment a physical natural material was placed on the surface of the earth to cultivate space, quantity it, adjust it and recognise it. It all began with a man's primitive and natural instinct to create a space in which he is able to exist, one that is embedded within its landscape, allowing him to co-exist with the nature that surrounds him. In essence, architecture is able form architectural context by exposing and unravelling nature, by adjusting, measuring as well as utilising the landscape to create forms beyond one's imagination. In the past architecture focused on the creation of form as an amalgamation of various elements such as materiality, space and nature. These elements were embedded into the creation of architecture, but as technology has evolved so has this approach to form generation. Instead form is generated based on mass production in order to generate profit in the quickest way possible even if it is at the expense of nature's grand design and quality spaces (Sennett, 2008). Ancient values that focused on the notion of integration have been abandoned with a shift in focus towards an architectural style that is repetitive, modular and easily built. Form has become completely separated from the physical realities that make up its surrounding, resulting in an even greater abandonment of the modelling, analysis and fabrication process that has always existed in design. Intricate forms have become the objective of creativity, resulting in the emergence of complex geometric forms that are isolated from their surroundings (Oxman, 2010).

It is said that "the work of art is far from being merely an image of balance… Just as the emphasis of living is on directed activity and not on empty repose, so the emphasis of the work of art is not on balance, harmony, unity, but on a pattern of forces that are being balanced, ordered and unified" (Arnheim, 1954). Throughout history, architecture and design have always been influenced by nature. Nature's grand design is governed not by particular characteristics of their own, but based on the forces that they are dependent on within the system that they exist. The way in which organisms create their forms in accordance with the forces surrounding them, is similar to the way in which form in architecture is created (Baker, 1996). Form does not exist independently of its own accord, but is highly influenced by the forces surrounding it, with one of the main forces being the context in which it is situated. When a building's form is able to take influence from its immediate context and surroundings, it is guided by elements such as the view, the position of the sun, the topography of the land as well as major routes and desire lines found within the context.



Figure 10: Purbita, S (2014) Royals of American Oil Divest from Fossil Fuels, New York: National Audubon Society.

Such aspects can only influence the form in a positive manner and can be seen as forces that influence the way in which the desired form is generated. Although the context is a major force that influences form generation, other forces can also be taken into consideration as the stages of form generation can be divided into various elements beginning with a point and a line and ending with principles focused on symmetry, hierarchy, axis, transformation and rhythm (Baker, 1996). The generation of form is an illustrative and analytical study of space that is influenced by the forces surrounding it. These forces then carve, manipulate, transform and organise form in a detailed way to create architecture that is a response to its context and to its needs. This allows for a relationship between built fabric and environment, symmetry and balance, form and function, as well as geometry (Abdalwahid, 2013). It is important to understand that architecture is a cultivated response to conditions such as purpose, function, economy, politics, society, as well as climate. These elements although very different, have an effect on the way in which humans experience space, their mood, the quality of their lives as well as the way they perceive the world and architecture. One needs to understand when creating form that it is not only an isolated structure where function takes place, but a space that is able to create a sense of calmness and creativity, amongst other things (Abdalwahid, 2013).

Form is an element that should be at one with its surroundings, it should be able to respond to its surroundings, and be able to create and have influence in one's life through its attraction to experience the space.

Through the evolution of time and the technological era, architecture has remained the same with the only thing evolving being the approach to form generation. Although the principles stay the same, it is now explored in a new way that allows for endless possibilities and forms that one could never imagine (Abdalwahid, 2013). Architecture that exists in this era features aspects of spatial complexity and a sense of ambiguity that one cannot formulate in a simple way. Such complexity may not be achieved without the assistance of a new approach to form generation and a new approach to architectural programs that are able to interpret ones imagination in a way that can be applied to the built environment (Abdalwahid, 2013). These new technologies allow for one to design, embed their forms within the context, as well as create simulations that allow one to test the design forms and interpret the valuable information for construction purposes.
The process of form generation can be seen as a form of science, it requires one to do thorough investigation in order to acquire a comprehensive knowledge and understanding of the nature of the project as one needs to erase the barriers that are created with the notion or idea of not knowing, for without creativity and being able to unravel the unknown, innovation cannot exist. This approach allows one to view form making from a different angle, as the context and understanding becomes the basis for form to be created (Abdalwahid, 2013). Once a thorough understanding of the context and the project has been acquired, one is able to begin formulating the notion of form, which is often closely related to the influences of site and for some involves an ongoing process of model explorations. This allows one to test theories and ideas in a way that assists in discovering what may be applicable and what is of no use. Through this exploration of form generation, the most successful form (being the one that meets all the site and project requirements) is then carved, manipulated and transformed in a more detailed way to create architecture that is a response to its context and to the project (Abdalwahid, 2013). Forces such as light, gravity, circulation, movement and programme are explored in a detailed way through a layering process, as we begin to visualise how one would experience the building created, as a whole. Once these elements have all been considered in an intentional manner, our form is ready to be embedded within an entire culmination of articulate forces, as it attempts for the very first time to illustrate features from its context so in the end, a sense of embedded-ness is created within its context (Abdalwahid, 2013).



Figure 11: Poliza, M (2018) Fairy Chimney Rock Formations, Washington DC: National Geographic Society.



Figure 12: Gerges, T (n.d.) When Nature Meets Architecture, California: CGarchitect.

In essence, the ability to bring to life what is created in one's mind, is perhaps the most remarkable feat of the architectural creative agenda, for without the ability to imagine, innovation ceases to exist. However, one cannot forget the principles and forces that exist both in nature and in architecture that allow for the notion of form to be one that guided by its surrounds and transformed by the world that is architecture. One needs to understand when creating form that it is not only an isolated structure that exists of its own accord, but a space that is able to create a sense of calmness and creativity, amongst other things, as form is able to create influence in the lives of human beings (Abdalwahid, 2013). With the above being said, the architecture that we create should not be void of reality, but rather it should be one that embodies light, gravity, circulation and elements existing in nature. In that way, it will create a sense of harmony, unity and balance between what exists on the planet we call Earth and what exists in our minds, that which is yet to be. The end result will then be that we will create architecture that is ordered and unified with nature in a world that is always evolving.

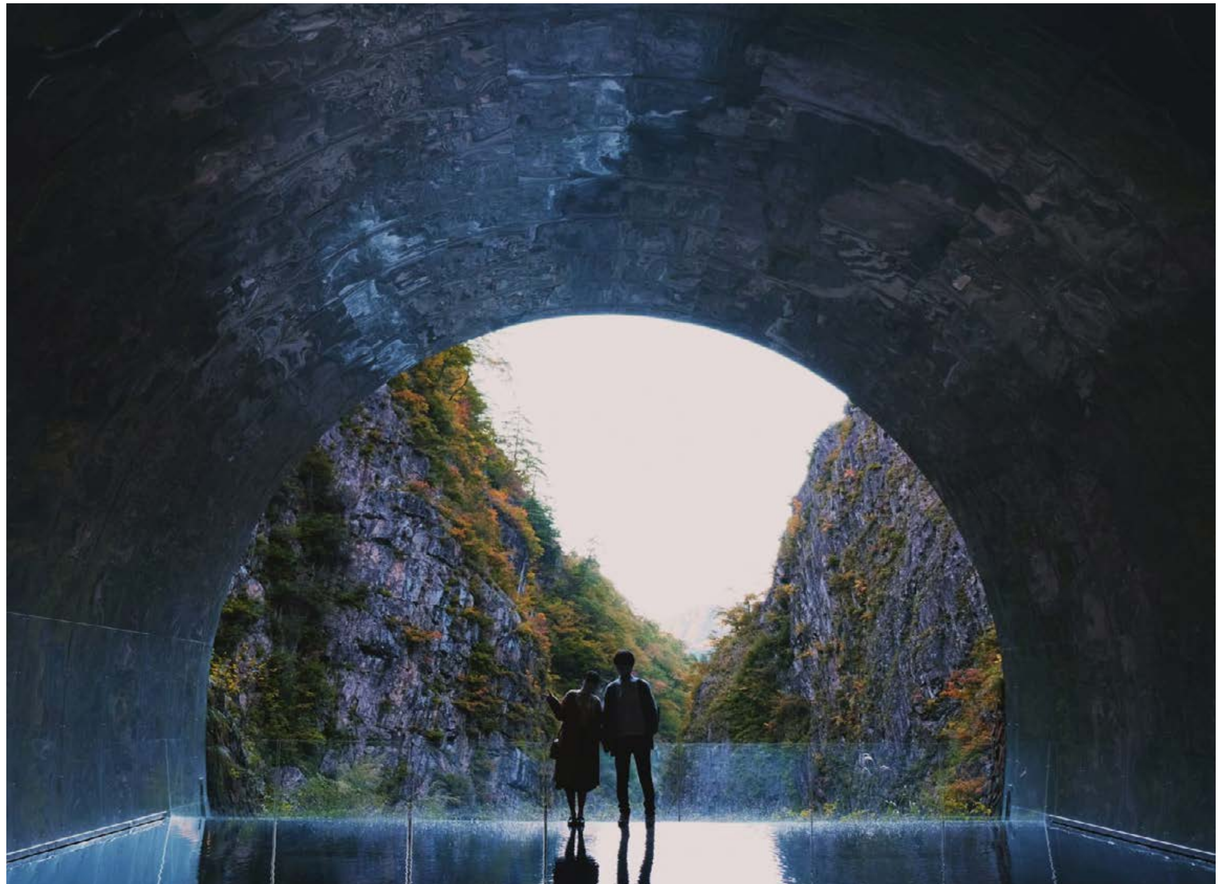
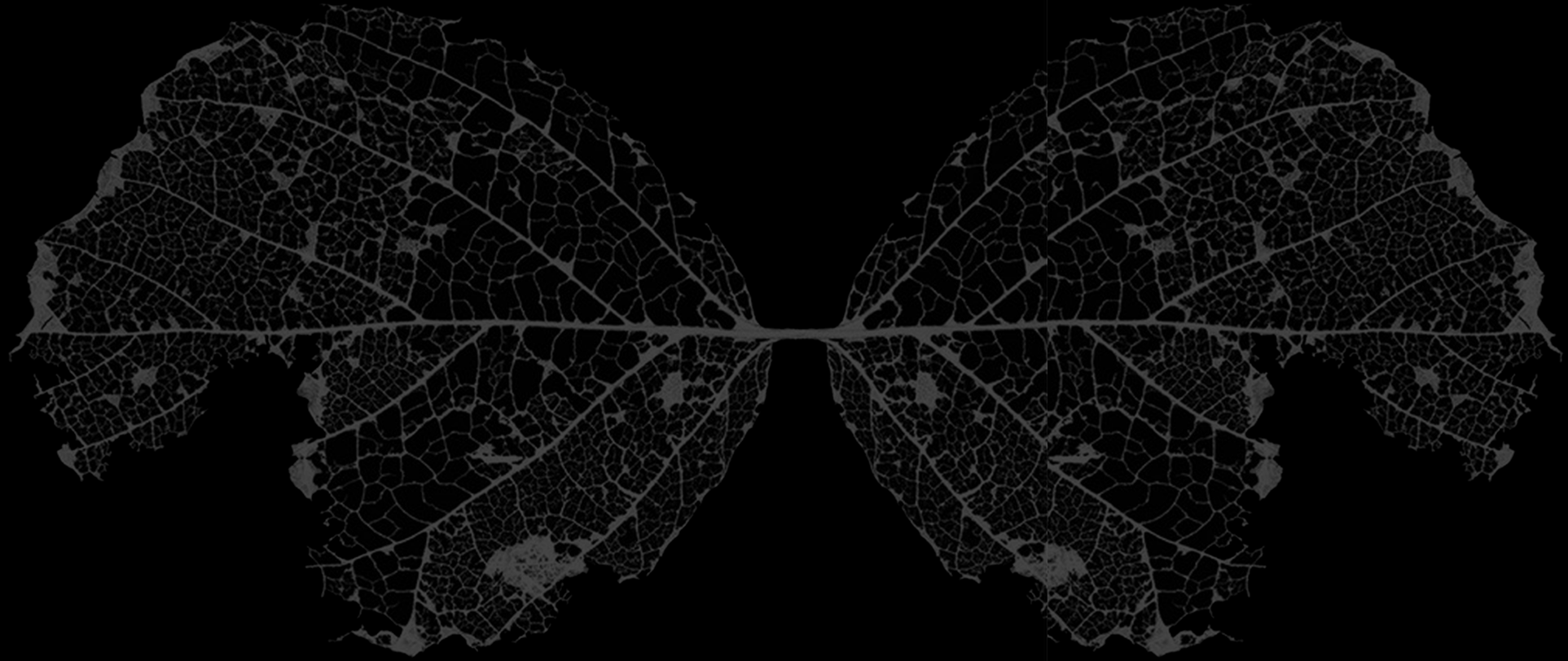


Figure 13: MAD Architects (2018) Tunnel of Light, Japan: MAD Architects.



UNRAVELLING NATURE

UNRAVELLING NATURE

TO UNRAVEL By Ana Lisa de Long

When we unravel
we can find in the strangest way
we are taking shape.
A shape we couldn't see
when wound up tight in a ball
all contained.
But if we unravel
pull a thread and watch it unfurl
dangerously loose

we might find
it falls as it's meant.
A picture to speak a thousand words.

A picture that reveals
in our unravelled form
we're more beautiful than we thought.

Are more valuable than we had guessed
or had forgotten we were
before life caused us to hoard our treasure.
Yes, when we unravel
it's as though a muscle memory comes back
to remind us of our strength.

We're to never fear the unfurling
or the pain that begs
a question
to find an answer in
the twirling
dancing thread.

The shape it makes when it lands
we recognise
as an old friend returned.

'Could it be', we hear ourselves ask
'that we have always been
what we imagined?' (Jong, 2018)

And so, similarly, as we unravel nature, we are bound to find it falls as it's meant to, painting a picture worth a thousand words, revealing its unravelled form, more beautiful than we imagined.

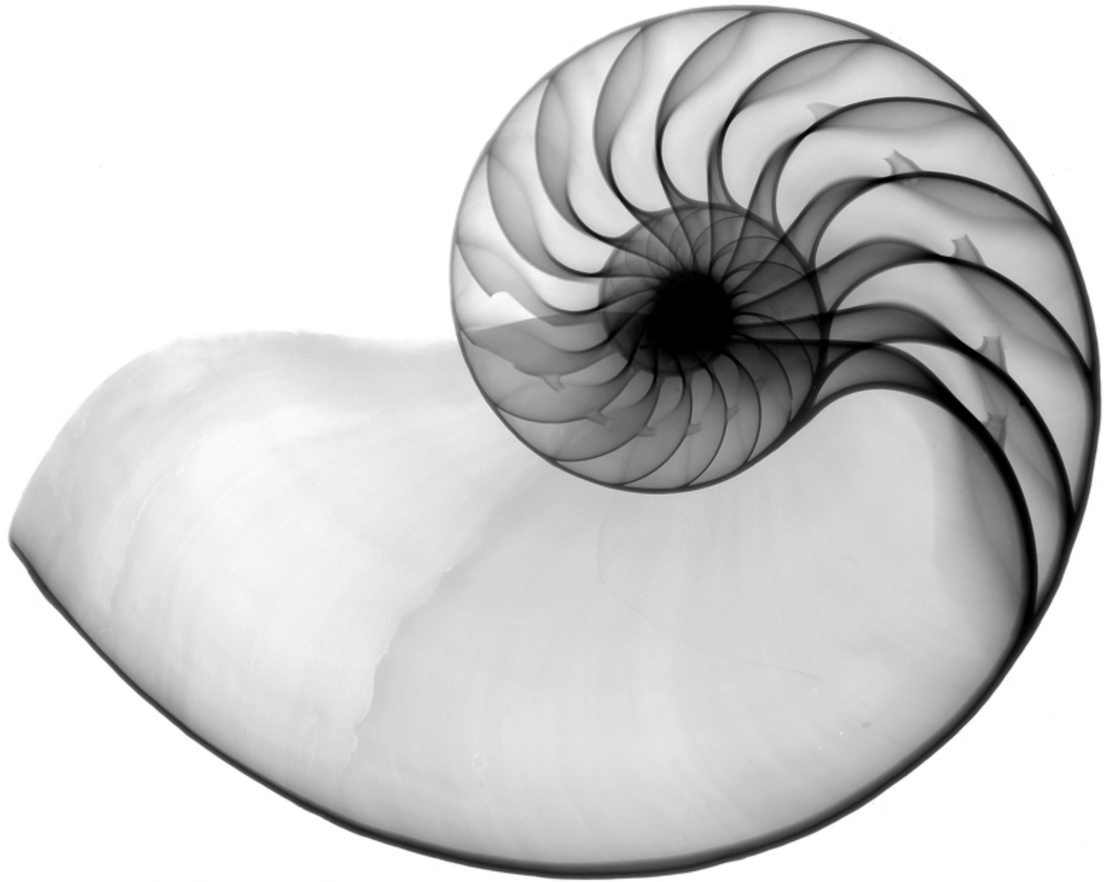


Figure 14: Myers, B (2012) X-ray Nautilus shell, New York: Tumblr.

In the last two centuries, humans have become a dominant force, changing reality as we know it. The year 2020 marked a transition towards a mass embodied built fabric, known as the anthropomass. Evidently, this transition means materials such as concrete, metal, glass and brick have surpassed elements occurring naturally in nature such as trees, animals, plants, fungi, bacteria and viruses. Although the notion of less fungi, bacteria and viruses may seem ideal, it may result in the overall demise of ecology as all elements in nature have a role to play, making our approach to building technologies as well as materiality the propelling factor that is leading us to an unavoidable future where we as humans, will have to create structures to shield us from ourselves (Nature x Humanity, 2020).

Throughout history, architecture has always been inspired by nature, but has since abandoned its relationship with nature resulting in challenges of language as we replace elements of growth with elements of construction. Architecture has always been centred on one's ability to sketch along three dimensions being X, Y and Z, forgetting that the buildings we are cultivating, are to exist in an environment that is much more dimensionally complex and dynamic. These dimensions include elements such as heat, humidity, light and viral loads that influence urban immunity (Nature x Humanity, 2020).

The moment we are able to communicate nature's grand design and transcend the notion that nature is an entity that knows no bounds and transcend the notion that the building is the core of an architectural project, when we are able to allow for a scientific inquiry and advanced technological innovation, only then will the art of building, allow for new ways through which humans and nature interact. Only then will we be able to create, construct, evolve and design as equals (Nature x Humanity, 2020).



Figure 15: Stein, B (n.d.) Chinese Lantern Seed Pods, France: Repro Tableaux.

TENANTS FOR A NEW ECOLOGY

CASE STUDY: GLASS
GLASS II
LOCATION: COOPER HEWITT, SMITHSONIAN DESIGN MUSEUM, 2017, NEW YORK
YEAR: 2016

Optically transparent, structurally sound and chemically inert, glass in a material that has been in existence for over 4000 years and is utilised in construction daily. For centuries glass has been produced and utilised in billions of glass facades across the globe which begs the question, what if the surface area of this vast material could be used to harvest solar energy more efficiently and effectively (Nature x Humanity, 2020). The notion of 3D glass printing, in contrast to blowing or forming glass, produces smooth, continuous surfaces, allowing for high levels of control over the shape and optical properties. The simple ratio of height to speed can produce a wide range of shapes, as a result, these shapes become the building blocks for intricate three dimensional optical structures.

Another unique feature associated with the lensing effect is the ability to reverse engineer shadow detection and behaviour. Essentially one can generate shapes based on the shadow footprints as well as optimize them as they wish.

Using this technology, individuals are able to print full scale columns of integrated lighting, generating a large caustic footprint. The printed columns rounded surface allows light rays to be reflected and refracted over the surrounding floor and walls. Due to their geometric, complex and dynamic optical properties, the columns are able to act as architectural lenses that focus or diffuse light from within or outside the glass (Nature x Humanity, 2020).

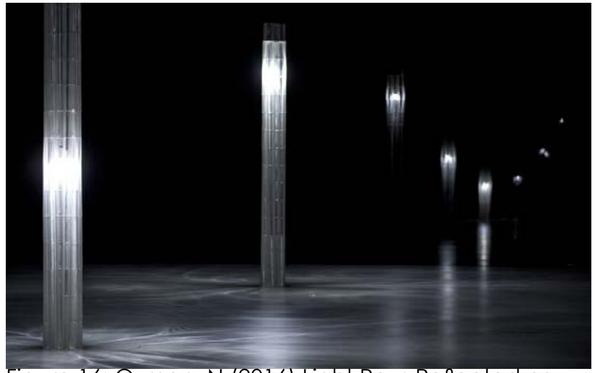


Figure 16: Oxman, N (2016) Light Rays Reflected or Refracted by the Columns, Massachusetts: Massachusetts Institute of Technology.



Figure 17: Oxman, N (2015) Caustic Pattern of a 3D Printed Glass Structure, Massachusetts: Massachusetts Institute of Technology.



Figure 18: Oxman, N (2016) Disassembled Column, Massachusetts: Massachusetts Institute of Technology.

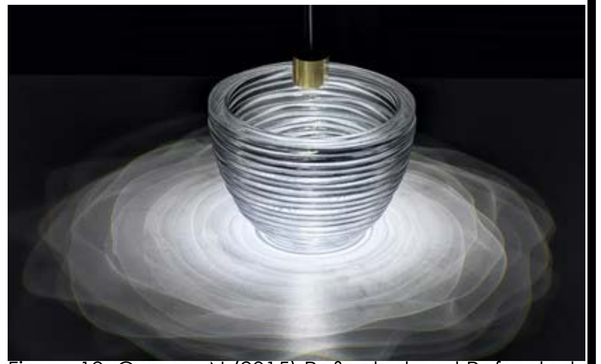


Figure 19: Oxman, N (2015) Reflected and Refracted Light, Massachusetts: Massachusetts Institute of Technology.

CASE STUDY: BIOPOLYMERS
AGUAHOJA
LOCATION: SFMOMA, 2020, SF, CALIFORNIA
YEAR: 2014-2020

In order to fully understand nature's grand design, it is important to speak in a language that she is able to understand. One way this can be done is through the exploration of bio based structural materials and biopolymers, which are natural polymers that are produced by the cells of living organisms. Molecular components such as celluloses, chitin and pectin are naturally found in trees, apple skin and crustaceans, these components embody an array of materials that are able to outperform man made functional materials through resilience, adaptability as well as sustainability (Nature x Humanity, 2020).

The Aguahoja pavilion is a five meter structure formulated of 80% water and 20% trees, apple skins and shrimp shells. The pavilion aims to subvert the notion of toxic waste through the cultivation of biopolymer composites with adjustable mechanical and optical properties. The renewable polymers are able to leverage natural resources, making them able to decay and return to nature to fulfil their purpose and generate growth. Trees grow into towers, and towers grow into trees (Nature x Humanity, 2020). The shell and skin like elements provide stiffness, as well as strength that allows the pavilion to endure changes in environmental circumstances related to temperature and moisture, while still retaining a sense of flexibility.

As water begins to evaporate from the shell, the flexible and rather fragile system transforms to a more firm structure that is able to respond to temperature and moisture. When the skin like structure is exposed to rainwater, the structure will begin to dissipate programmatically, restoring its constituents to its existing ecology. Through life and programmed decomposition, shelter becomes organism and organism becomes shelter, as it holds the potential to promote the health of natural resource cycles by such means as promoting soil microorganisms and providing nutrients for growing buildings (Nature x Humanity, 2020).



Figure 20: Oxman, N (2014-2020) Chitosan-Based Cellular Network. Colour Indicates Property Variations, Massachusetts: Massachusetts Institute of Technology.



Figure 21: Oxman, N (2014-2020) East Elevation, Massachusetts: Massachusetts Institute of Technology.

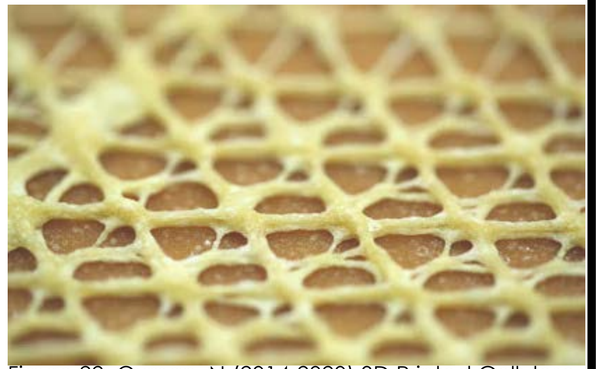


Figure 22: Oxman, N (2014-2020) 3D Printed Cellulose a Plant Derivative, Massachusetts: Massachusetts Institute of Technology.



Figure 23: Oxman, N (2014-2020) Internal View of Architectural Pavilion, Massachusetts: Massachusetts Institute of Technology.

CASE STUDY: FIBRES
SILKWORM PAVILION II
LOCATION: MOMA, 2020, NEW YORK
YEAR: 2020

In a world where we often neglect the quantity of materials consumed in our industry, how can architecture take into consideration materials found in nature, in a way that allows for collaboration as opposed to destruction? How can we reorient architecture to see materials not as consumables, but as outputs of increasingly scarce ecological niches? The Silk Pavilion explores the co-creation of six meter high fibre structure that is made almost entirely out of silk. It became evident that without a vertical post, the silkworms spun flat sheets, with the distribution and density of the silk being highly influenced by environmental conditions such as gravity, heat and light (Nature x Humanity, 2020).

The primary structure of the pavilion is made up of a soluble knit scaffold that has been tensioned using a cable system to provide support for the silkworms, as well as create paths of travel as they spin. The silkworm's metabolic fluxes and flows affect these structural forces in a biochemical manner, resulting in a metabolic footprint. This is a prime example of how insects as small as silkworms, with rather unique features are able to act as architects, as well as a reminder that although planet earth is rather abundant, it can no longer provide an infinite yield of materials (Nature x Humanity, 2020).



Figure 24: Oxman, N (2020) Interior View of Kinetic Jig, Soluble Knit and Live Silkworms in the Spinning Phase, Massachusetts: Massachusetts Institute of Technology.



Figure 25: Oxman, N (2020) Concentrated Silk Deposition at Point Connections Between Knit and Suspension Cables, Massachusetts: Massachusetts Institute of Technology.



Figure 26: Oxman, N (2020) Fifth Instar Silkworms Upon Dissolvable Knit, Massachusetts: Massachusetts Institute of Technology.



Figure 27: Oxman, N (2020) Unique Spinning Patterns of Flattened Cocoons' Spread over Soluble Knit, Massachusetts: Massachusetts Institute of Technology.

Scientists predict in the year 2050, the planet we call home will be 4 degrees hotter, populated with approximately 11 billion people living on it, with large pieces of land being entirely uninhabitable, resulting in millions of climate refugees attempting to escape the storm and fires that may engulf the places we have lived in for centuries, creating irreversible damage to planet earth. As creators of built fabric, the manner in which we approach our surrounding will either make or break our connection to nature (Nature x Humanity, 2020). The way we approach architecture in the future should not differentiate between atoms and genetic matter, nor should it discriminate against other species. Instead it should infuse itself with nature through various forms to cultivate a new approach to architecture that in turn is able to adapt, evolve and respond to its surroundings in a manner that is beneficial for architecture and nature. Such a future is rather complex and ethically charged, but it is imaginative as it promises a synergy between humans and nature (Nature x Humanity, 2020).

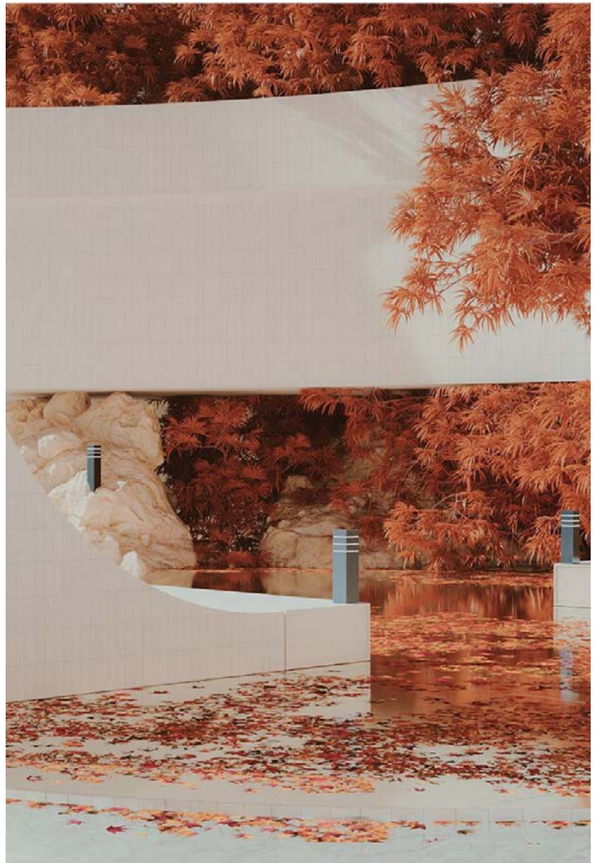


Figure 28: Christodoulou, A (2019) Escape to a Dreamland, Cape Town: Alexis Christodoulou Studio.

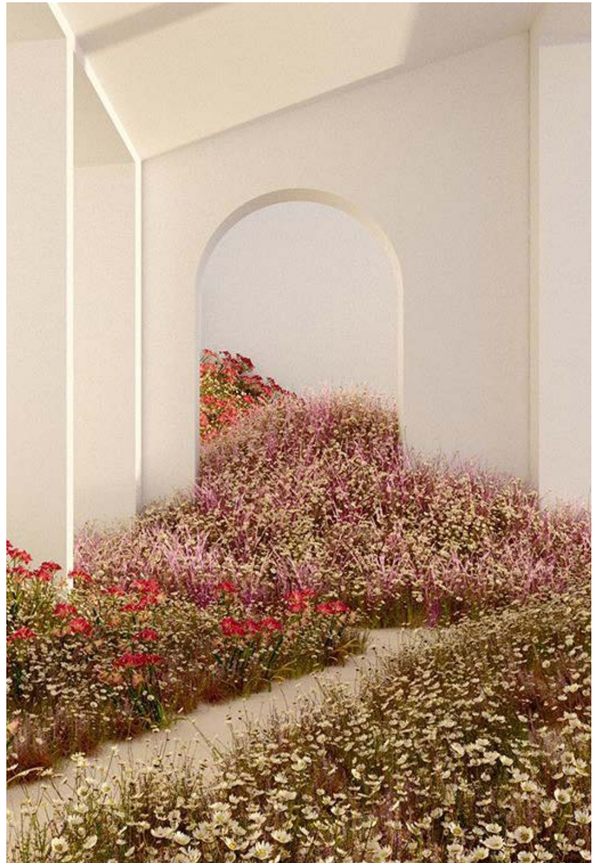
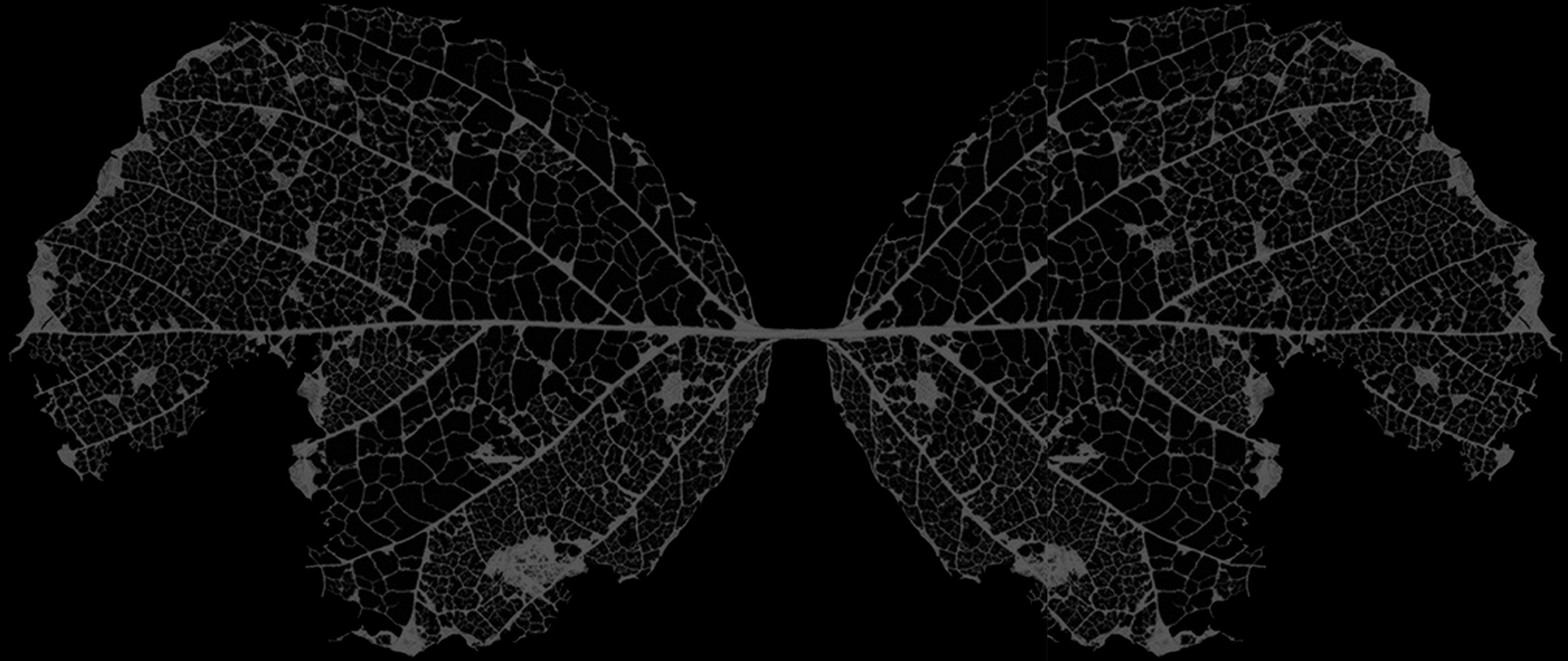


Figure 29: Christodoulou, A (2020) Let Nature In, Cape Town: Alexis Christodoulou Studio.



Figure 30: Christodoulou, A (2019) Hues of Rust and Bronze, Cape Town: Alexis Christodoulou Studio.



INTERGRATING ARCHITECTURE AND NATURE

INTERGRATING ARCHITECTURE AND NATURE

Throughout history architecture and nature have continued to exist independently of each other, however it is evident that the built environment is one of the largest polluters resulting in even more damage being endured by nature. As environmental conditions continue to worsen, so will the way we create and design going forward. Architecture will become a form of protection, as we attempt to escape the horrific environmental conditions that are a result of our ignorance and need to dominate. The forms we create will no longer create a sense of calmness and serve our needs, but rather encapsulate us from our surroundings, as they have become too toxic to inhabit. Although unimaginable, such a future will become a reality if we continue to ignore the realities of the existence of the human race.

The human race have long surpassed the physical limitations of their abilities through the development and evolution of new technologies, allowing for endless possibilities in any environment we inhabit. From the very beginning, nature has been reconceptualised as a machine whose mere function is to produce based on the needs of the human race. With nature's ability to endlessly produce what is needed for our survival, it is expected that one would think this endless supply will never be at jeopardy. However nature's ability to provide is based on the notion that once it provides what is needed, it is given the time it needs to replenish its resources, allowing it the time to reproduce and provide once more. However, at the rate that the human race is developing and the constant need to selfishly satisfy our needs and desires, nature is unable to provide at the rate with which we consume her gifts, which may result in the demise of evolution and life itself.

With that being said, the thought that the existence of the human race has resulted in nothing but negativity in terms of its impact on nature is rather despairing, because just as there is bad in the good, there is also good in the bad. However, one has to be able to learn from the bad that may consume them in order to find a new approach that may be critical in what can be considered a power struggle between our everyday approach to life and an approach to nature that may be beneficial in the long run. So how does one mimic elements in nature and integrate them into architecture in a way that is not only beneficial for Mother Earth, but also for the way in which we design going forward? It is said that good architecture is one that is able to let nature in, therefore the integration of architecture and nature would require a reappraisal of the way in which we approach architecture and the manner in which we treat nature. When architecture is able to extract principles from the notions that exist in nature and is able to integrate these principles with architectures need to serve and create a sense of calmness and creativity, only then can a sense of synergy exist between the built fabric and nature's grand design.



Figure 31: Voge, C and MASU (2017) Site Plan, Odense, Denmark: Kengo Kuma and Associates.



Figure 32: Voge, C and MASU (2017) Section, Odense, Denmark: Kengo Kuma and Associates.

PRECEDENT: CULTIVATING THE FUTURE
AM3 ARCHITETTI ASSOCIATI
LOCATION: GIBELLINA, ITALY
YEAR: 2018

Rebuilt amongst the vineyards of an ancient valley after being destroyed by an earthquake in 1968, a Piazza that is a symbol for new growth now stands in Gibellina. Cultivating a future that aims to make life better through the stimulation of a Rural Lad that focuses on a high quality food chain supply. The existing structure has been re-inhabited by a new building that occupies the space beneath it, with the interior of the existing structure being transformed into public space that is accessible through various vertical systems that are independent of the existing structure. What once existed as a basements, has now been transformed into an agricultural market that cuts through the existing surface, making it permeable and easily accessible to the surrounding communities (AM3 Studio, 2018).

This approach allows for balance between built fabric and free space, allowing for a variety of functions and uses that can be adjusted in the course of time. The new urban configuration relies on the availability of public space, but allows the immaterial spaces to also generate opportunities. The park provides plant density to an arid urban centre, connecting two inhabited areas of a town as it represents the productive nature that is now being embedded into Gibellina (AM3 Studio, 2018).

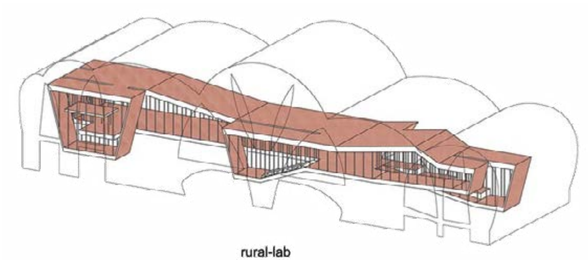


Figure 33: AM3 Architetti Associati (2018) Rural Lab, Gibellina Italy: AM3 Architetti Associati.

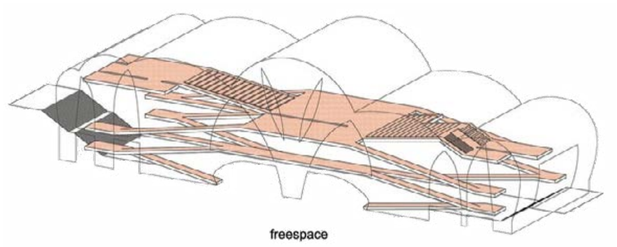
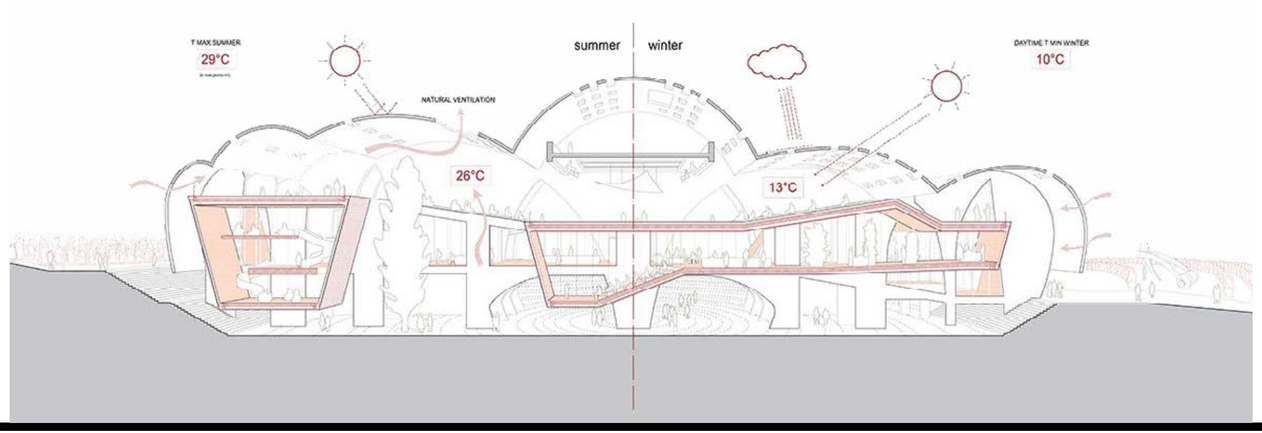


Figure 34: AM3 Architetti Associati (2018) Freespace, Gibellina Italy: AM3 Architetti Associati.

Figure 35: AM3 Architetti Associati (2018) Sectional Illustrations, Gibellina Italy: AM3 Architetti Associati.



PRECEDENT: EU JOINT RESEARCH CENTRE
COBE
LOCATION: SEVILLE, SPAIN
YEAR: 2022

The EU Joint Research Centre connects La Cartuja's dense and small scale historic city centre with its large scale typologies. The research centre exists beneath a large timber roof that shelters a dense village, created out of rammed earth. Due to the harsh Andalusian climate, the urban fabric within the research centre has been tailored to prevent overheating. The bright façade, narrow streets and courtyard spaces that have been populated with water features and vegetation allows the air to cool down naturally (Cobe, 2022). These small building that are united under one roof, allow for a comfortable micro climate to exist, whilst the roof generates and distributes energy. The series of landscape irrigation grooves allow cross-ventilated air to pass through the Joint Research Centre, cooling the facades and increasing evaporative cooling. The 6500 square meter performative roof averts heat again and solar glare, creating a shaded interface between the built fabric and outdoor spaces (Cobe, 2022).

The EU Joint Research Centre challenges the notion space, as it blurs the line between what exist outside and what exists inside, establishing a new found connection with nature. In addition to connecting the indoor and outdoor spaces, the building offers a flexible, future proof working environment that caters to the demands of the modern workplace.

The research centre is made up of low carbon footprint materials such as rammed earth and pre-fabricated elements that assist is reducing the emissions released through transportation as well as construction. Over the lifecycle of the building, the rammed earth blocks can be safely disassembled and disposed of (Cobe, 2022).



Figure 36: Cobe (2022) EU Joint Research Center, Seville Spain: Cobe.

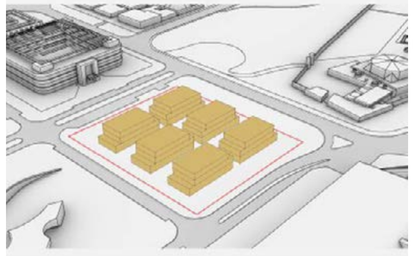


Figure 37: Cobe (2022) Building Placement, Seville Spain: Cobe.



Figure 38: Cobe (2022) Connecting Terraces, Seville Spain: Cobe.

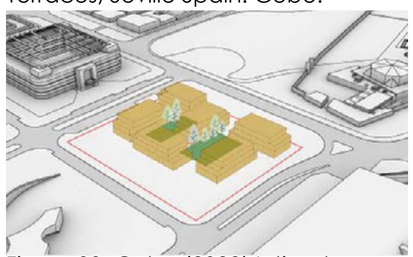


Figure 39: Cobe (2022) Intimate Green Spaces, Seville Spain: Cobe.



Figure 40: Cobe (2022) Roof Capabilities, Seville Spain: Cobe.



Figure 41: Cobe (2022) Greenspaces, Seville Spain: Cobe.

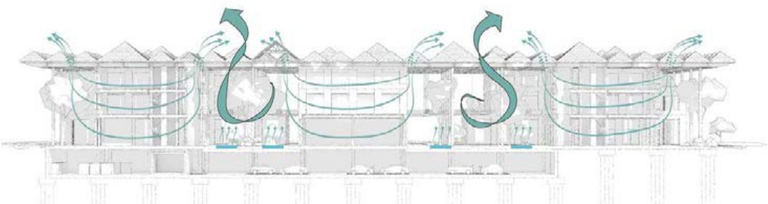


Figure 42: Cobe (2022) Cross Ventilation, Seville Spain: Cobe.

PRECEDENT: FOREST OF TALES
AN-DRE
LOCATION: ODENSE, DENMARK
YEAR: 2014

The Forest of Tales serves as a gate to the writer's imaginary universe materialized through architectural expressions, with momentums that gently link the outside to the inside. This Fairy tale forest merges public and private domains, blurring the line between nature and the built fabric (Divisare, 2014). The Forest of Tales is made up on columns and beams that are placed systematically, allowing for void spaces where nature can exist freely, as well as spaces for programme to occur seamlessly within nature. These beams act as passages above the landscape, allowing you to experience the site and the surroundings from a different perspective. The visitor is elevated off the ground and placed within the trees, allowing them to be fully submerged within nature, creating an experience beyond ones imagination (Divisare, 2014).



Figure 43: And_Re (2014) Forrest of Tales Perspective A, Odense Denmark: And_Re.



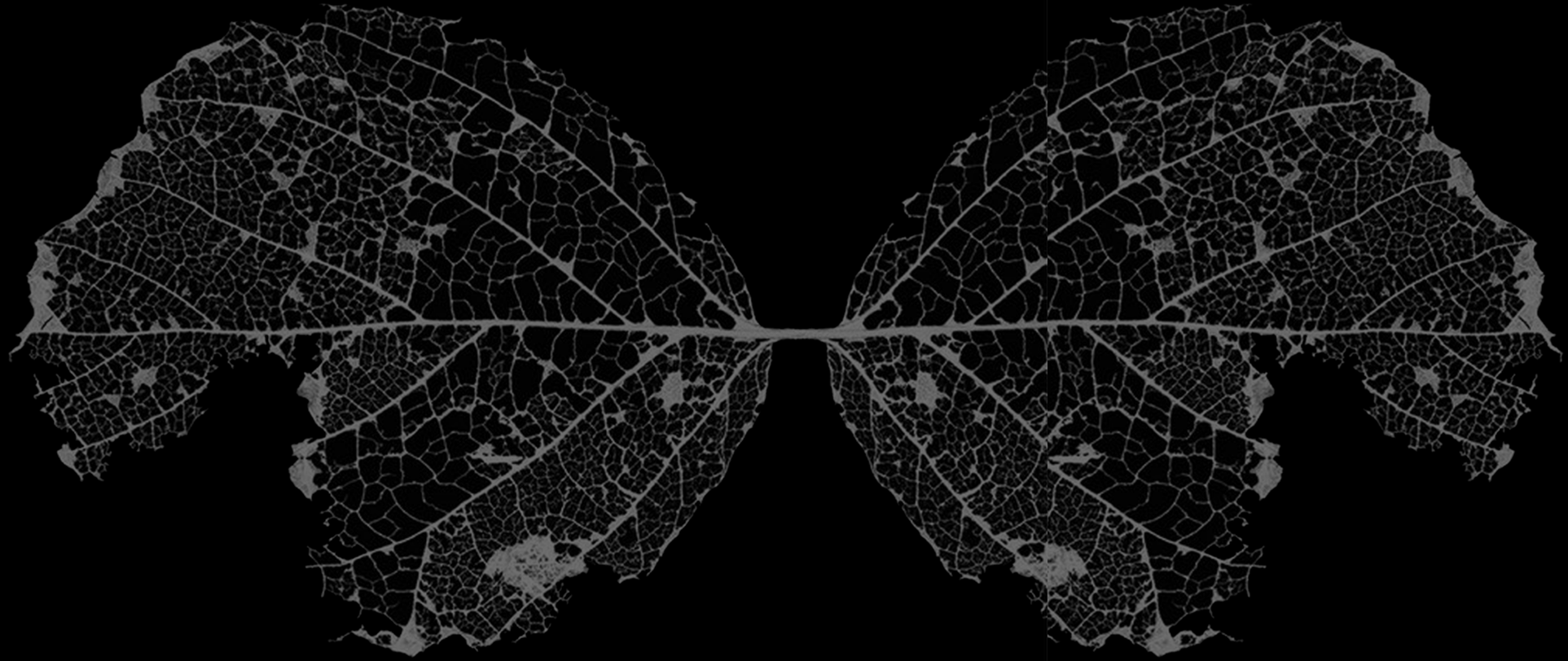
Figure 44: And_Re (2014) Forrest of Tales Perspective B, Odense Denmark: And_Re.



Figure 45: And_Re (2014) Forrest of Tales Perspective C, Odense Denmark: And_Re.



Figure 46: And_Re (2014) Forrest of Tales Perspective D, Odense Denmark: And_Re.



CONCRETE JUNGLE

CONCRETE JUNGLE

It is evident that as we design "we borrow from nature the space upon which we build" (Ando, 2021) and so instead of destroying it completely in our efforts to create form, it should be intertwined in the spaces which we create. Blurring the line between what once inhabited the land and what became of it. Architecture needs to be able to act in response to nature as much as it needs to serve the needs of the human race. It should be able to behave just as gently as nature does, treating water, light, air and all elements existing in nature as though they are living. For those very elements allow us to feel that we are alive. The spaces we create as architects should act as a vessel that allows us to experience the beauty and soul that exists in the nature that surround us, as our existence is very much rooted in nature, as it is in our technological advancements. In order to facilitate a new approach to architecture and nature, it is important as architects that we are able to create spaces that allow us to feel at ease in its embrace, allowing us to live together with nature. Therefore these concrete jungles we are creating should be toned down so as to make them behave and blend in, in harmony with nature.



Figure 47: Voge, C and MASU (2017) Ground Floor Plan, Odense, Denmark: Kengo Kuma and Associates.



Figure 48: Voge, C and MASU (2017) Longitudinal Section, Odense, Denmark: Kengo Kuma and Associates.



Figure 49: Voge, C and MASU (2017) Rendering A, Odense, Denmark: Kengo Kuma and Associates.



Figure 50: Voge, C and MASU (2017) Rendering B, Odense, Denmark: Kengo Kuma and Associates.

However, as the world deals with the perils of climate change, there is one thing that seems to stay the same; the notion that the built environment is an integral part of life as we know it (Imrie, 2021). Although that may be true, it is evident that our approach to life on earth is doing more harm than good, which will eventually result in the demise of the human race. As it stands, the planet we call home has very few spaces that have been left untouched by excavations for natural resources, as well as resources needed for the construction of concrete cities, homes, roads, pipelines and dams that dominate the planet. Spaces that were once occupied by trees and vegetation have now been replaced by the smell, sound and sight of construction, allowing for an environment that is increasing shaped by what can be seen as a never ending phase of construction. This never ending phase of construction and infrastructure is increasing at an even greater, more ambitious rate in terms of its scale and form as the global population and economy continues to increase along with it (Imrie, 2021).

This continued growth has led to a significant impact on land cover globally, with continents such as Europe exceeding 921 km2 of greenfield sites being occupied by built form, which is equivalent, if not larger than the area of Berlin. While counties such as China have had a drastic increase from 2.3 million hectares of built form in 2000, to 8.8 million hectares of built form in 2013 (Imrie, 2021).

Spaces that were once occupied by forestry and vegetation, are now becoming concrete jungles occupied by resources that were once a part of the surrounding land. This pattern continues to ravage through large cities such as Johannesburg, South Africa, where 46 hectares of tree cover has been lost in the span of 21 years, which is equivalent to a 12% decrease.



Figure 51: WWF (2019) Deforestation, Europe: WWF.

BUILT FABRIC
CITY OF JOHANNESBURG

The proliferation of built form in cities continues to evolve based on need and the growing economy and population, without taking into consideration the amount of space already occupied by buildings. In essence cities are concrete jungles occupied solely by concrete structures towering over us, with very little nature in site. Although this may be beneficial to the growing economy, we are slowly destroying the very natural elements that are vital for our very existence, as though they can simply be replaced by the next best thing.

We exist in a time where ecological destruction is attributed by building and construction, which will evidently result in the despoliation of ecology, as well as life as we know it (Imrie, 2021). When in actuality, we should be creating spaces that allow both humans and nature to coexist in a way that is beneficial for us all. Only then can a sense of synergy exist between the built fabric and nature.



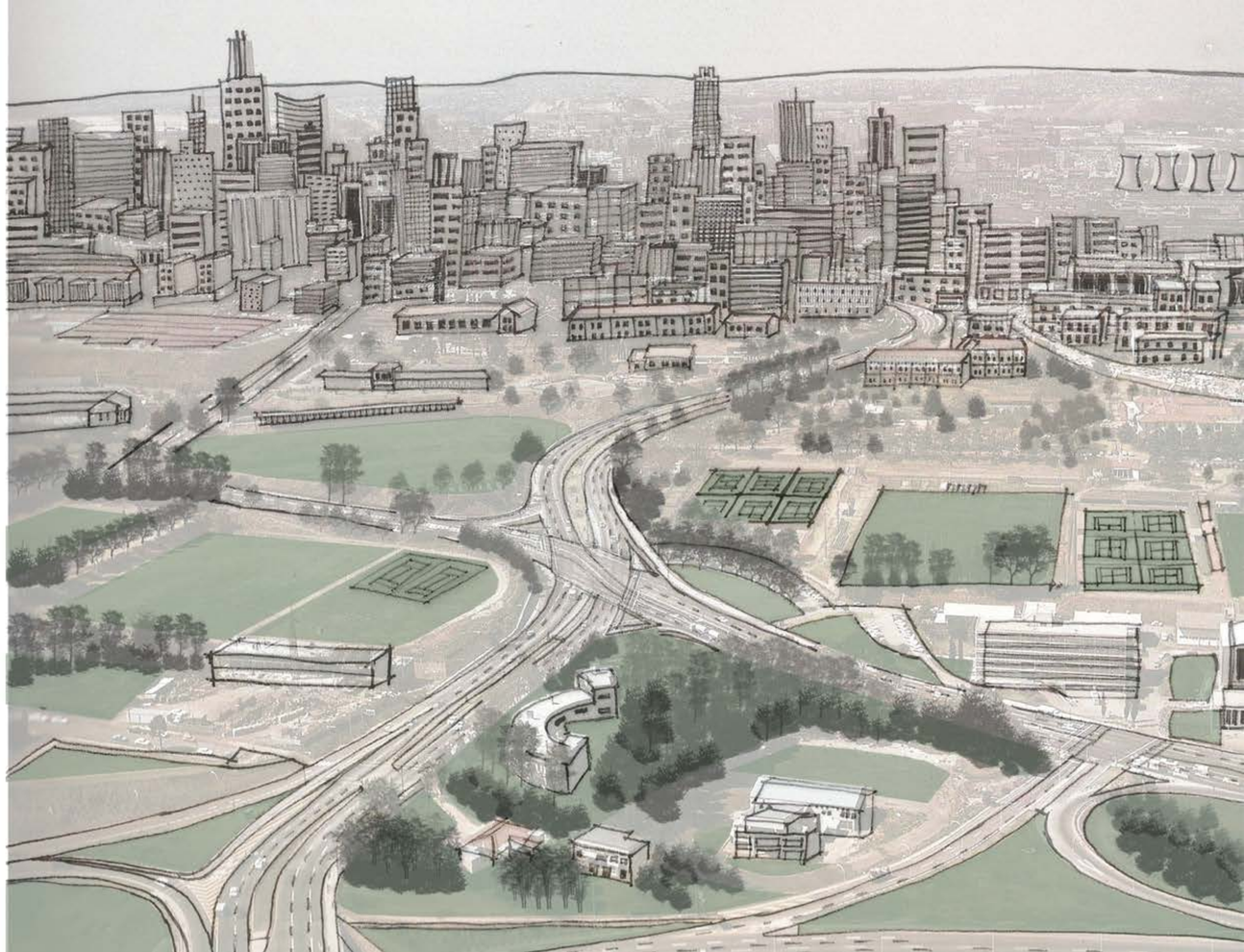
Figure 52: Author (2022) Nolli Map, Johannesburg: University of the Witwatersrand.

GREEN SPACES

CORNER OF JAN SMUTS AVENUE AND EMPIRE ROAD, JOHANNESBURG

The golden city of Johannesburg has continued to grow and evolve, with the establishment of businesses, universities, schools and recreational spaces becoming a vital part of the growing atmosphere. As the city grows, unoccupied green spaces continue to diminish in order to feed the growing economy and population. This has resulted in a rather interesting green belt to develop along the intersection of Empire road and Jan Smuts Avenue, due to the university and schools that have been established within the area. Allowing for a contrast between the highly developed compacted city and the green open spaces along the major intersection. An intersection that in essence is a breath of fresh air in what can be seen as the centre of a growing city.

Figure 53: Author (2022) Green Space, Johannesburg: University of the Witwatersrand.



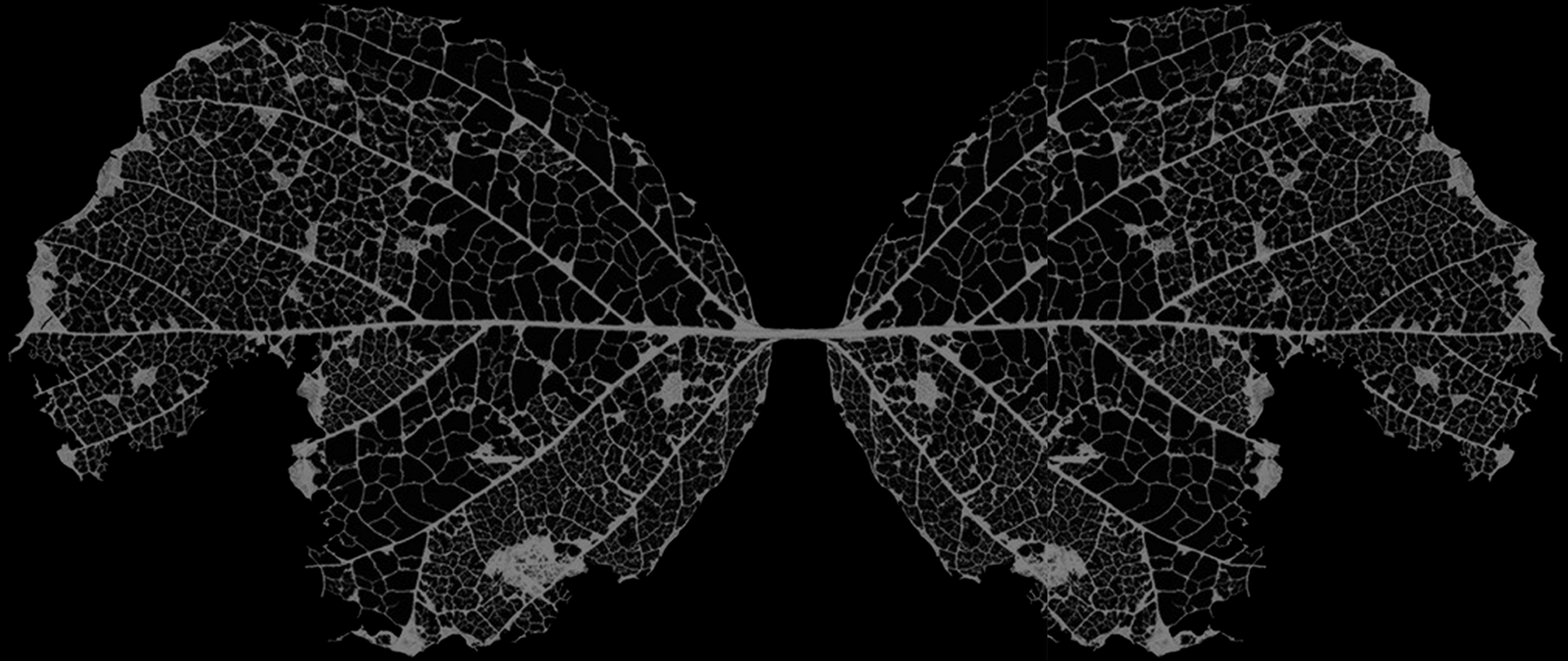
GREEN SPACES
CITY OF JOHANNESBURG

However as time continues to pass, the green belt that was once a breath of fresh air on the intersection of Jan Smuts Avenue and Empire Road, is slowly being occupied by built form, with companies such as KPMG Crescent and New Motion logistics now inhabiting the land. While the additional recreational space along the property line of the University of the Witwatersrand, was redeveloped into parking.

Spaces that once inhabited an entirely different function, have now become places of work, while the previous green space on the University of the Witwatersrand is now used for parking. As time continues to pass, more and more of these pieces of land will be redeveloped into built form, while nature is slowly eradicated from the cities that we occupy.

Figure 54: Author (2022) Green Space Map, Johannesburg: University of the Witwatersrand.





DESIGN INTENTION

DESIGN INTENTION

As the world deals with the perils of climate change, it is time that we stop viewing the building as an object, but rather view it as a collaborative element that is firmly connected to its natural environment, cultivating an ecological niche that woks in collaboration with nature (Nature x Humanity, 2020). It is time that the building becomes submerged in nature, blurring the line between the built fabric and what exists in nature. It is evident that as cities continues to evolve, the remaining ecology and nature itself will continue to diminish until we have nothing left. Leaving us with concrete jungles, rather than elements that are vital for our very existence.

My proposed design aims to act a catalyst that allows architecture and nature to coexist, allowing nature to take back what is rightfully hers. While creating a space for the human race to explore advanced technologies to facilitate the rebirth of nature within cities as we begin to explore a new way of life. Allowing for an approach that works in synergy with nature that is able to adapt, evolve and respond to its surroundings in a manner that is beneficial for our evolution and beneficial for nature. Therefore I propose an environmental research institute that will facilitate an approach that allows us to fully understand nature and its value, while focusing on integrating and unravelling principles that exist in nature, to ensure past mistakes are rectified.

This intervention will be housed along the property line of the University of the Witwatersrand, where recreation space was redeveloped into parking. Allowing for facilities such as labs, lecture halls, exhibition spaces, as well as simulation labs that recreate atmospheric conditions in order for certain ecologies that are at risk to thrive once more, as mother earth takes back what once belonged to her.

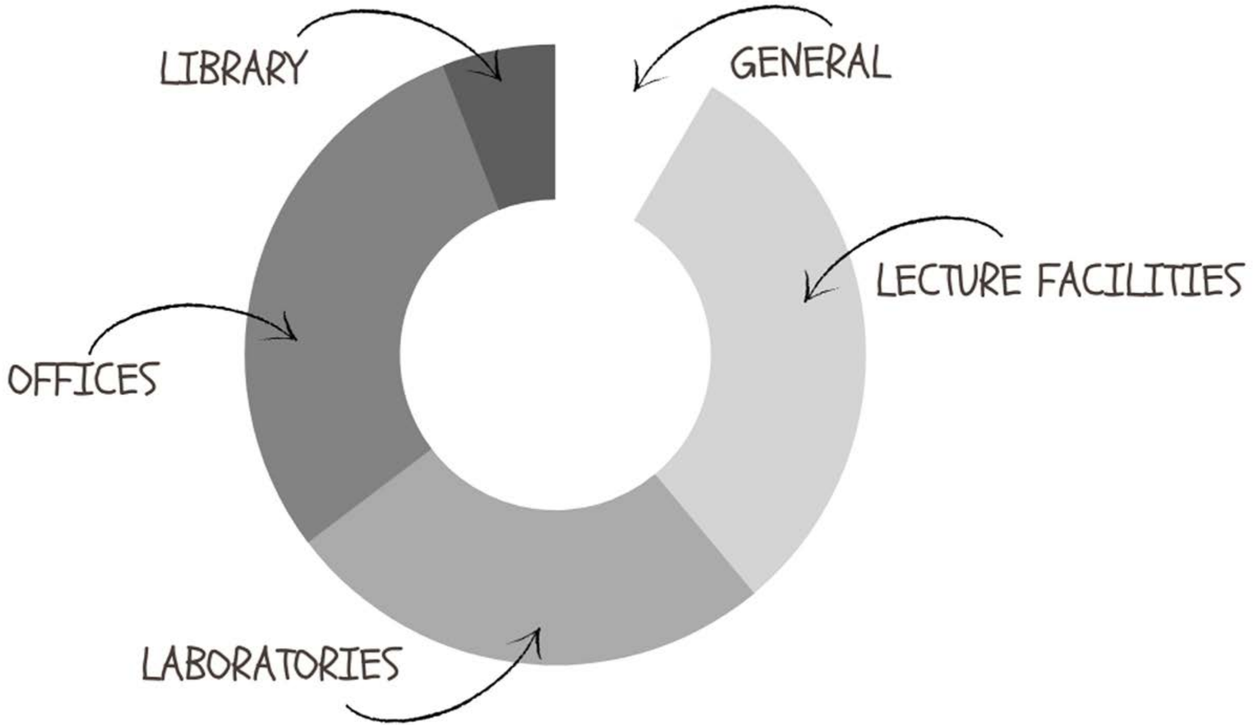
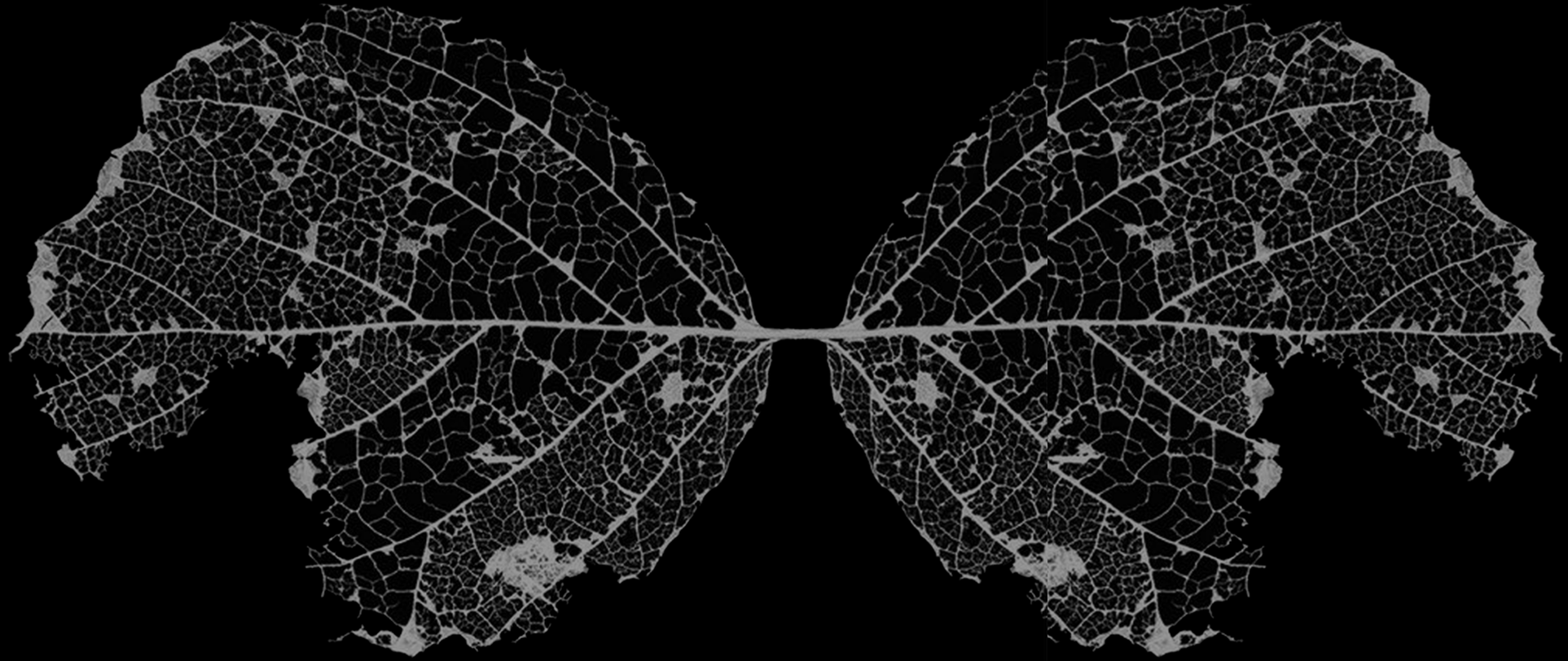


Figure 55: Author (2022) Building Programme, Johannesburg: University of the Witwatersrand.



HISTORY

HISTORY

The University of the Witwatersrand dates back to the late 1890's, with the South African School of Mines that was originally established in Kimberly, before being relocated to the City of Johannesburg in 1904. The South African School of Mines was then renamed the Transvaal University College in the year 1906. Sixteen years later, the university was then granted full university status, which has brought us to what is now known as the University of the Witwatersrand. The University then began development on Milner Park shortly after and took occupancy of the first completed teaching blocks in 1923. At this stage the university comprised of six faculties being, art, medicine, science, law, commerce and engineering, with a little over one thousand students and seventy three members of staff (The University of the Witwatersrand, 2000 - 2022).

The University continued to grow rapidly with over 10 000 students in 1975, making land acquisition of adjacent properties imperative as expansion continued into Braamfontein. In 1984 The University of the Witwatersrand acquired the Milner Park showground from the Witwatersrand Agricultural Society, which was then renamed and established as West Campus. As a result the Amic deck was built to establish a connection between the East and West campus (The University of the Witwatersrand, 2000 - 2022). Today, The University of the Witwatersrand comprises of various faculties with the first being Commerce, Law and Management, followed by Humanities, then Health Science as well as Science and lastly, the Engineering and the Built Environment, offering approximately 3 400 courses (The University of the Witwatersrand, 2000 - 2022). Wits University is a multi-disciplinary research university, making it a prime location for my proposed Environmental Research Institute.



Figure 56: University of the Witwatersrand (1896) Wits University Early Beginnings, Johannesburg: University of the Witwatersrand.

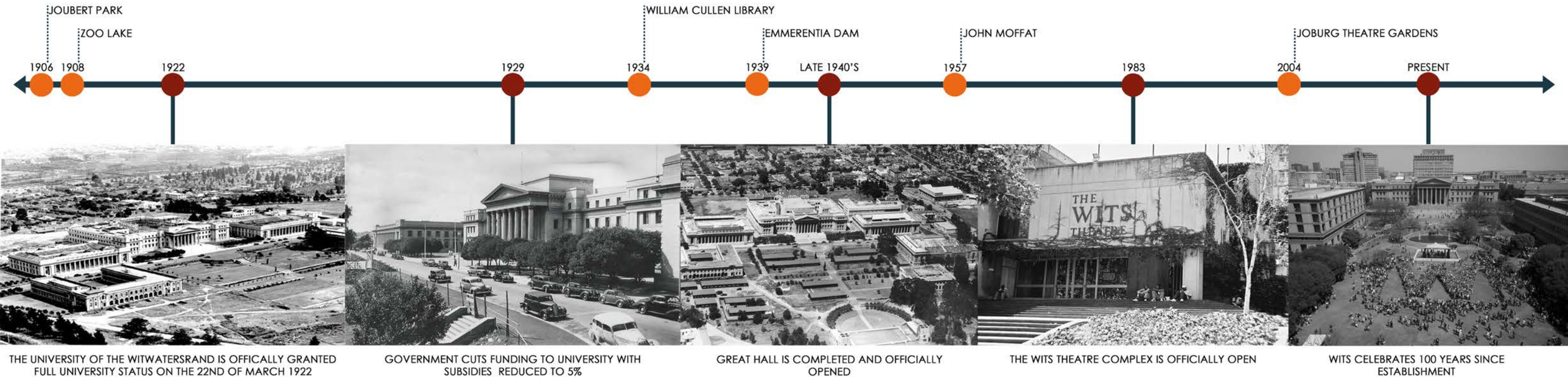
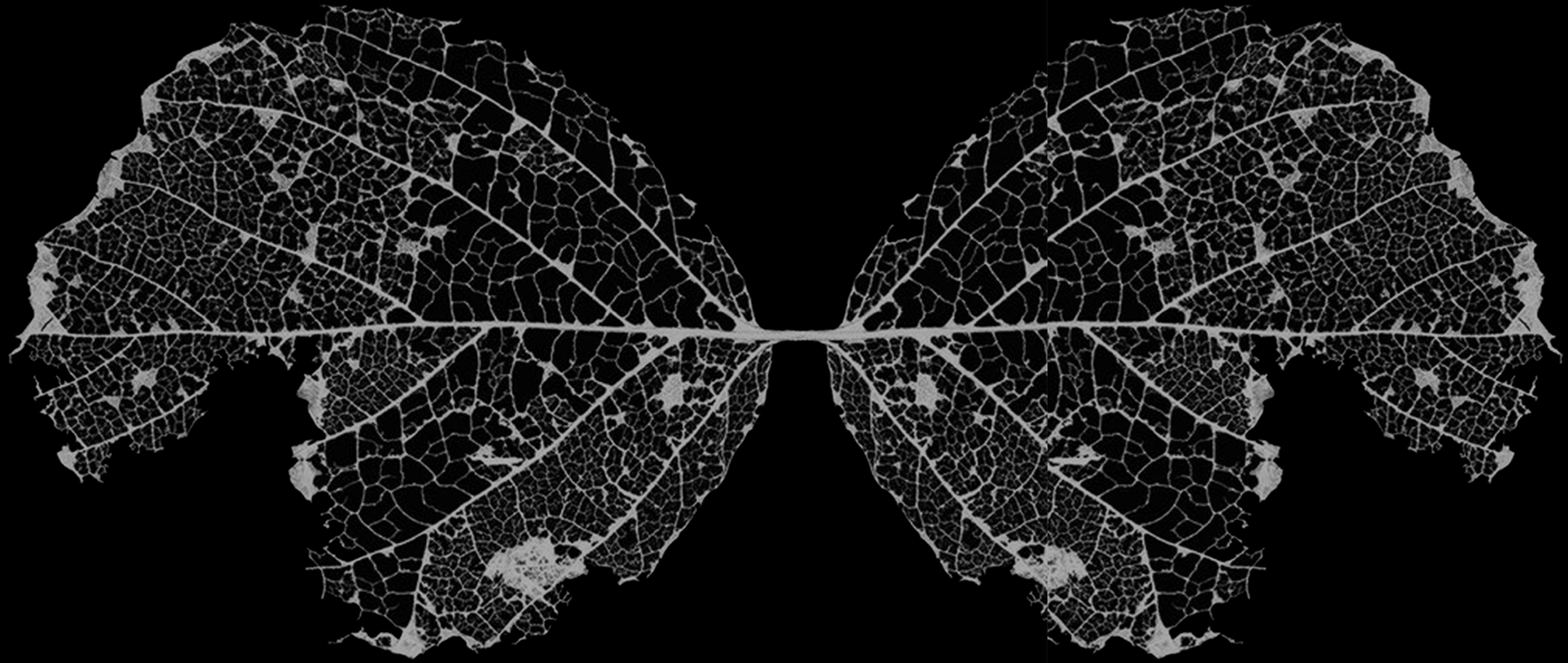


Figure 57: Author (2022) History of Wits, Johannesburg: University of the Witwatersrand.



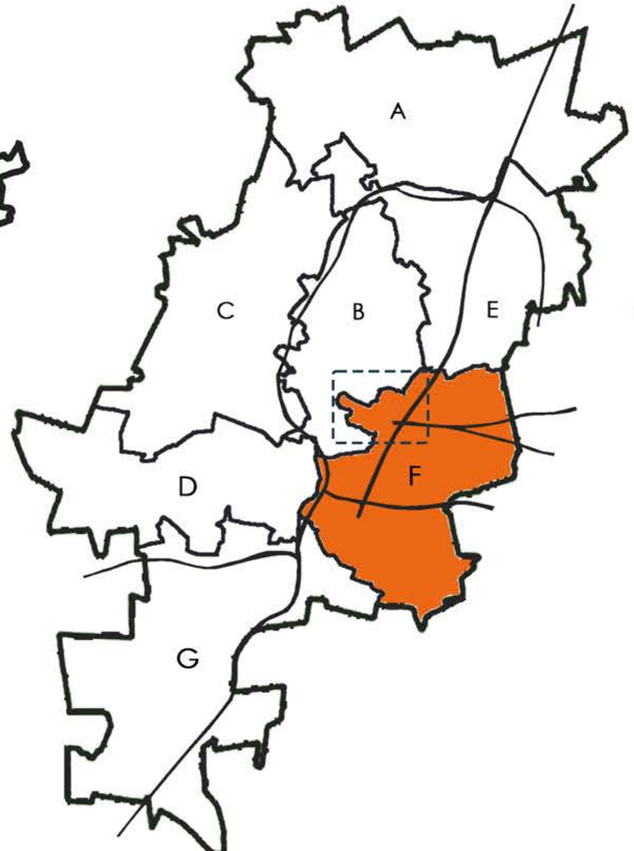
INTRODUCTION TO SITE

LOCATION AND CONTEXT
UNIVERSITY OF THE WITWATERSRAND

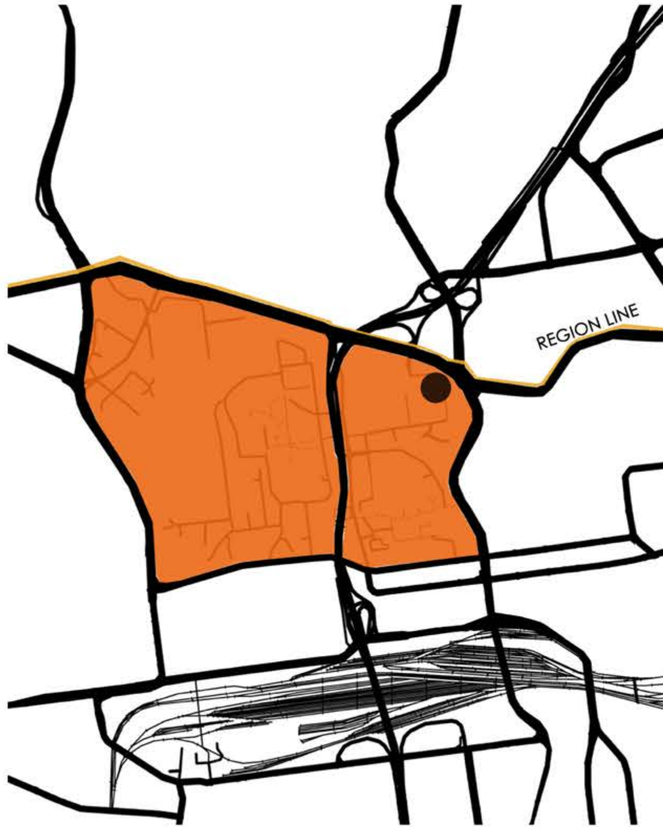
My site is located in Gauteng in the golden city of the Johannesburg metropolitan, with the University of the Witwatersrand located in Region F. It is located along the north eastern quadrant of the east campus, at the corner of Empire Road and Jan Smuts Avenue.



GAUTENG PROVINCE



JOHANNESBURG METROPOLITAN



INNER CITY

Figure 58: Author (2022) Location and Site, Johannesburg: University of the Witwatersrand.

MACRO CITY
CITY OF JOHANNESBURG

The University of the Witwatersrand is surrounded by two major greenbelts, comprising of the Johannesburg Botanical Gardens, Melville Koppies Nature Reserve, Emmarentia Park, as well as the Johannesburg Zoo. In addition to the universities' dominant presence within Johannesburg, it is surround by various university campuses such as the University of Johannesburg and schools in conjunction with various parks, reserves, cemeteries and other green spaces.

Figure 59: Author (2022) Macro City, Johannesburg: University of the Witwatersrand.

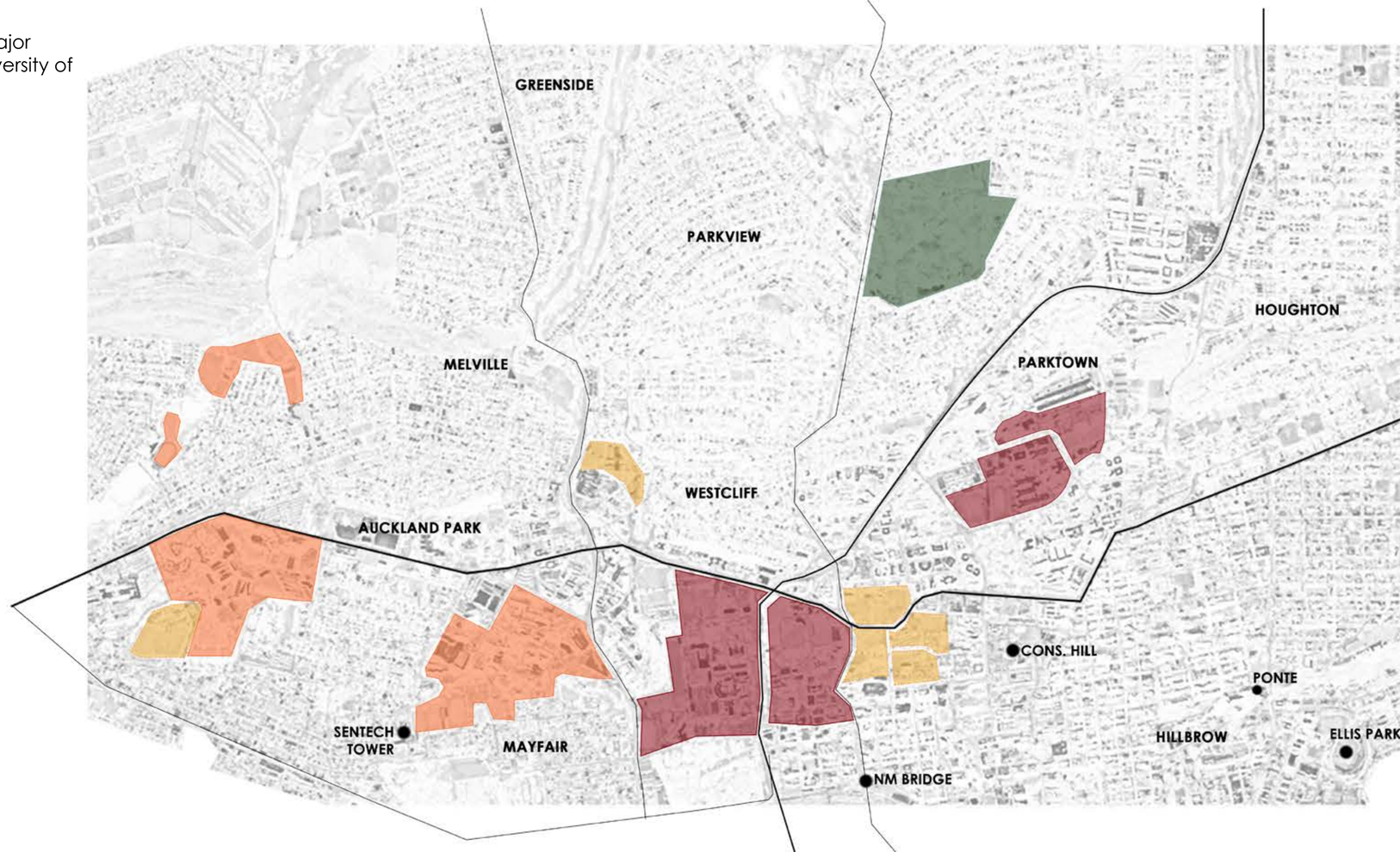


NODES
CITY OF JOHANNESBURG

The growing city comprises of various teaching facilities that are located along Empire road and the M1 highway. With Institutes such as the University of the Witwatersrand and the University of Johannesburg primarily along the lower half of Empire, with smaller campuses spread out along the top portion, creating a school district that caters to student life.

Schools such as Parktown Boys' and Helpmekaar College are located to the right of the University of the Witwatersrand, while Vorentoe High School is along the left side of the University of Johannesburg. Allowing for a connection between higher education and the universities that shape the minds of the future generations.

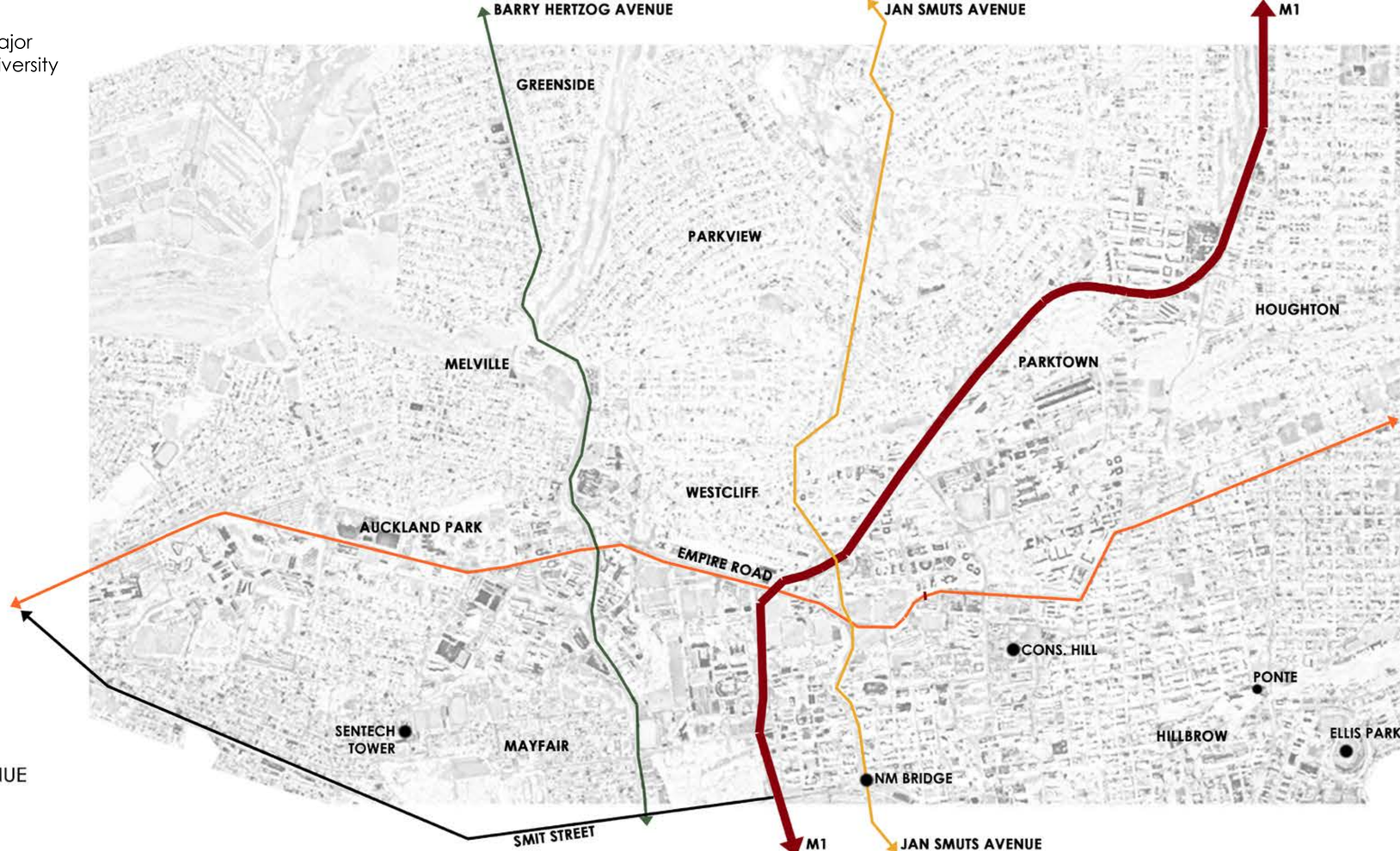
Figure 60: Author (2022) Major Nodes Johannesburg: University of the Witwatersrand.



MAJOR ROUTES
CITY OF JOHANNESBURG

The M1 highway is the one major road that leads to the University of the Witwatersrand, this may seem ideal, as it would allow for easy access to the University. However the three lane highway makes it rather difficult due the congestion as a result of heavy traffic during peak time. Making routes such as the M5, M9, M11 and M16 of equal importance as alternative routes to the University. Additional feeder routes such as Barry Hertzog Avenue, Jan Smuts Avenue, Smit Street and Empire Road also allow for various connections that will lead you to your desired destination.

Figure 61: Author (2022) Major Routes, Johannesburg: University of the Witwatersrand.



CIRCULATION
CITY OF JOHANNESBURG

As we take a closer look at the Empire and Jan Smuts intersection, it is evident that more than one form of transportation is utilised within the region. The main form of transport is vehicular, with cars traveling along Empire Road, the M1 Highway, Jan Smuts Avenue and Yale Road which is the main entrance to the University.

The next form of transportation is the Reya Vaya bus service that runs along Empire road, with a station located along the centre, between the M1 and Jan Smuts Avenue. This transport system is supported by pedestrians that move in various way within the city.

Figure 62: Author (2022) Circulation, Johannesburg: University of the Witwatersrand.



MOVEMENT AND CIRCULATION

UNIVERSITY OF THE WITWATERSRAND

The University of the Witwatersrand boundaries are defined by four major traffic routes, with the main entrance to the university being located along Empire Road as Yale Road begins to cut through the centre of the east and west campus. In addition to Empire Road, the east boundary of the university is defined by Jan Smuts Avenue, with the south boundary being defined by Enoch Sontonga Avenue and a portion of the east boundary being defined by Annet Road. As a result, these traffic routes have resulted in movement nodes at the various corners and intersections.

Figure 63: Author (2022) Movement and Circulation, Johannesburg: University of the Witwatersrand.



PEDESTRIAN ACCESS
UNIVERSITY OF THE WITWATERSRAND

The University is made up of four access points with the main entrance being located along Empire Road, the three additional access points are all located along Enoch Sontonga Avenue. It is evident that upon arrival at the university, the most effective way to access various building and spaces is by foot. Most of the pedestrian circulation includes movement around the buildings themselves, as well as along the edge of the main roads. The common spaces are densely populated as they can be seen as desirable gathering spaces, making circulation towards them popular paths of travel.

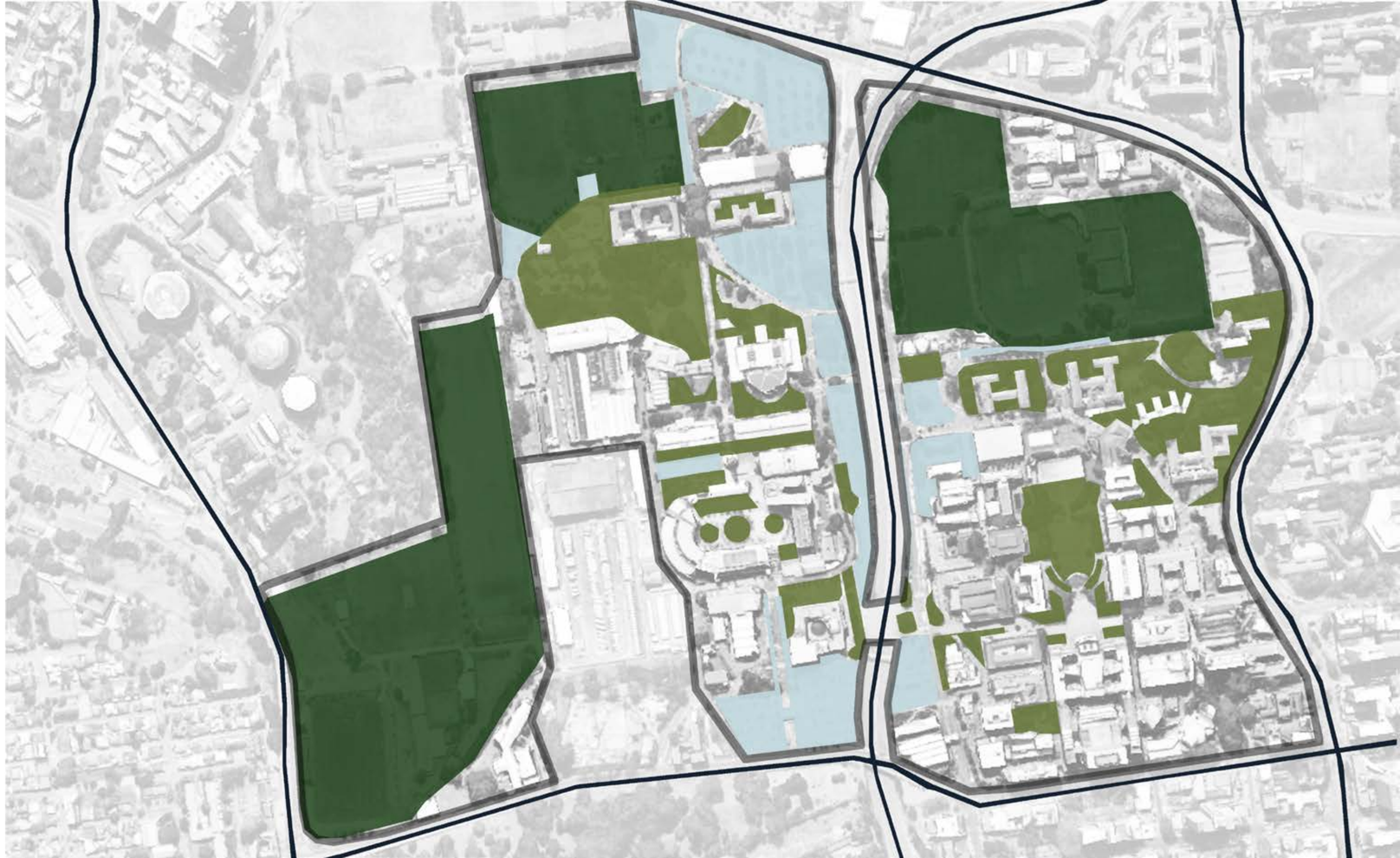
Figure 64: Author (2022) Pedestrian Access, Johannesburg: University of the Witwatersrand.



GREEN INFRASTRUCTURE
UNIVERSITY OF THE WITWATERSRAND

With 42 sports clubs and various cultural opportunities, the university sports grounds are very prominent on both east and west campus, with smaller pockets of green spaces located throughout the university. Prominent green spaces include the Library Laws located on east campus, as well as the Law Lawns located on west campus. These lawns allow for spaces of relaxation and gathering, adding to the atmosphere of the university.

Figure 65: Author (2022) Green Infrastructure, Johannesburg: University of the Witwatersrand.



IMMEDIATE CONTEXT
UNIVERSITY OF THE WITWATERSRAND

Located at the North Eastern quadrant of east campus, my site is currently used as a parking lot and is located not too far from what used to be the main entrance to the university. This Cape Dutch Entrance is located along Jan Smuts Avenue, which at the time was ideal. However, as the university has developed and expanded over the years, the entrance to the university needed to be relocated as Jan Smuts Avenue became a rather busy intersection, making vehicular access rather difficult. In addition to this historic element, the ground keepers house still stands today as an emblem of where things once began. The historical trees still stand tall along the periphery of the site, as the weeping willows leaves dangle with its roots stretched beneath the surface of the earth beyond where the eyes can see. This site encompasses the past, as my proposed design looks towards the future as it facilitates a reawakening of nature.



Figure 66: Fairbridge, D (1922) Gateway at Boshof, London: Humphrey Milford.



Figure 67: Google (2022) Wits Ground Keepers House, Johannesburg: Google.



Figure 68: Author (2022) Willow Tree, Johannesburg: University of the Witwatersrand.



Figure 69: Author (2022) Historical Trees, Johannesburg: University of the Witwatersrand.

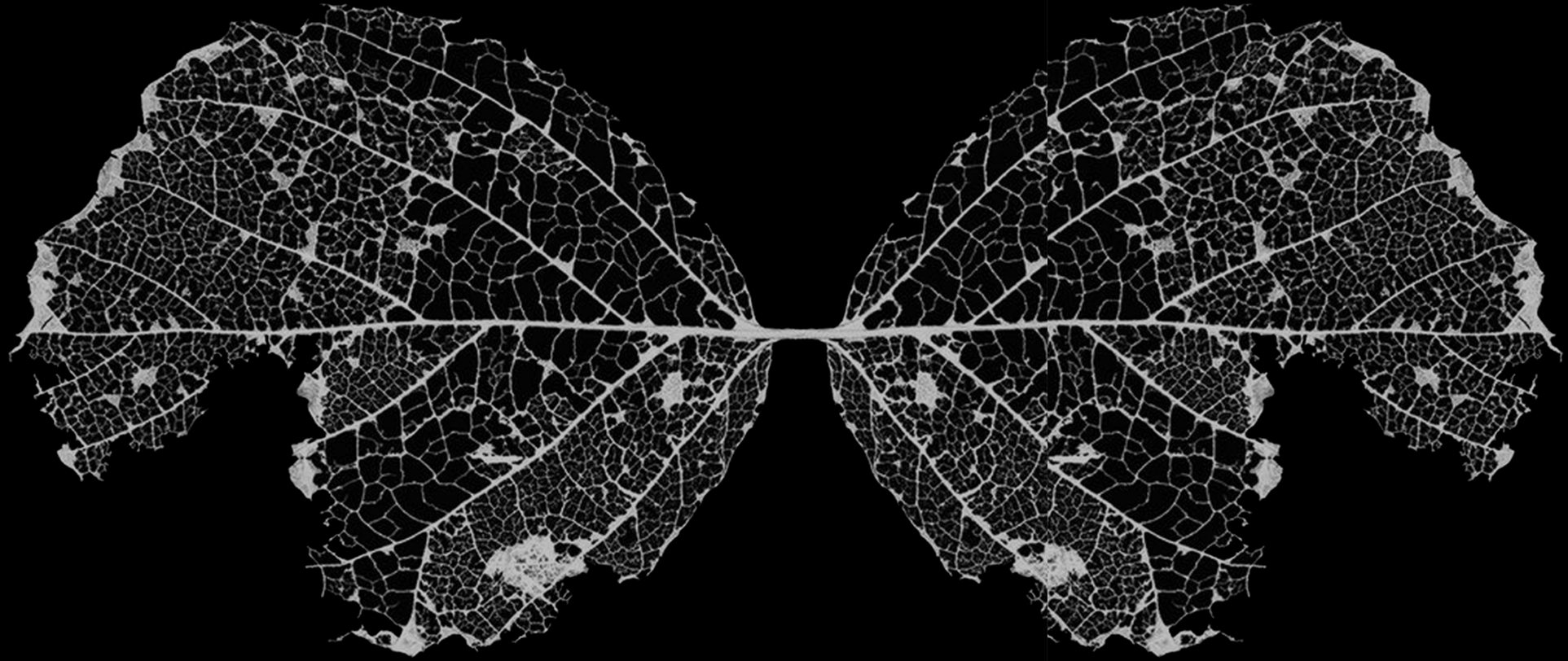


Figure 70: Author (2022) Site Context, Johannesburg: University of the Witwatersrand.

SECTIONAL EXPLORATION
UNIVERSITY OF THE WITWATERSRAND



Figure 71: Author (2022) Sectional Exploration, Johannesburg: University of the Witwatersrand.



DESIGN CONCEPT

DESIGN CONCEPT
DESIGN ITERATION 1

The initial design iteration is based on the notion of connection and integration, with the main focus being on how this approach can facilitate and encourage spaces. The initial attempt focused on the natural circulation on the site, forgetting the influence of the city to its right and the campus to its left. This disconnection between the city, the selected site and campus, allowed me to shift my focus from an isolated building, to one that is able to create a link between what exists on campus and the ever growing city. The terraced slopes acts as a defining factor, dividing the building along each terrace in response to the natural elements on site, while still taking into consideration the historical trees.

In an attempt to create a connection between the campus and the city, the building is divided along the terraces, consisting of four blocks that are linked at the various nodes. The first block is dedicated to teaching facilities, while the second block is primarily for laboratories. The third block is dedicated to administration, whilst the last block is dedicated to simulation laboratories.

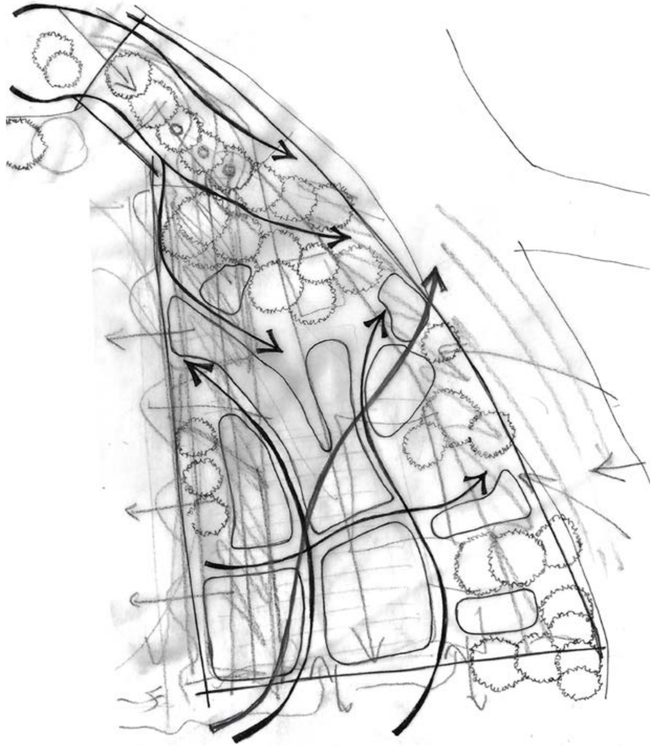


Figure 72: Author (2022) Notion of Connection Between the City and Campus, Johannesburg: University of the Witwatersrand.

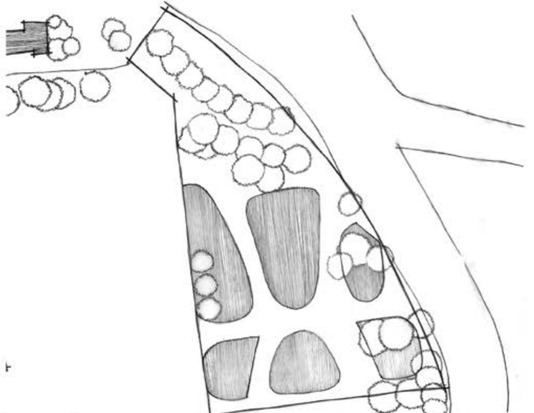


Figure 73: Author (2022) Design Scheme A, Johannesburg: University of the Witwatersrand.

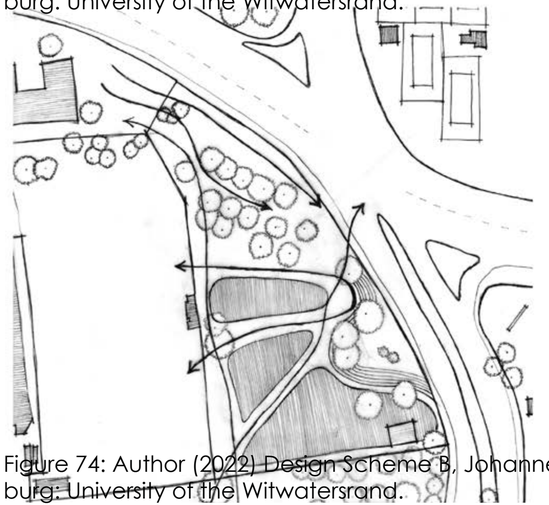


Figure 74: Author (2022) Design Scheme B, Johannesburg: University of the Witwatersrand.

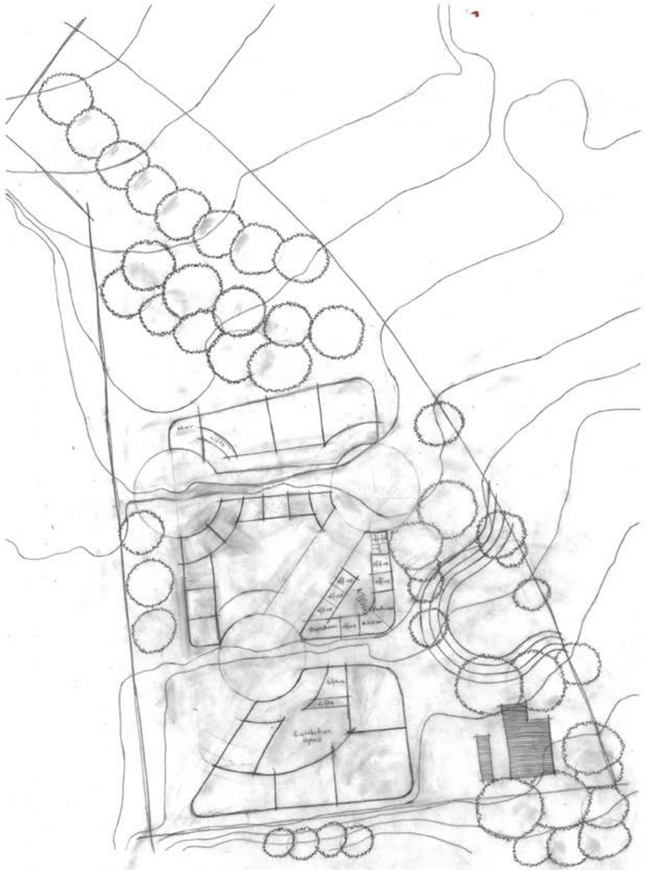


Figure 75: Author (2022) Initial Floor Plan Layout, Johannesburg: University of the Witwatersrand.

Nature becomes embedded into the site, creating a balance between the built fabric and the trees found on site, creating green social spaces through the major corridors and nodes. The various buildings are linked by a singular roof element, allowing for an openness between spaces. This allows for cross ventilation through the various spaces, resulting in a natural cooling effect.

The aim was to create a building that is blurs the line between architecture and nature, however in this approach the building mass became rather dominant. Creating a mass structure than was rather imposing, instead of a structure that works in conjunction with its surroundings.

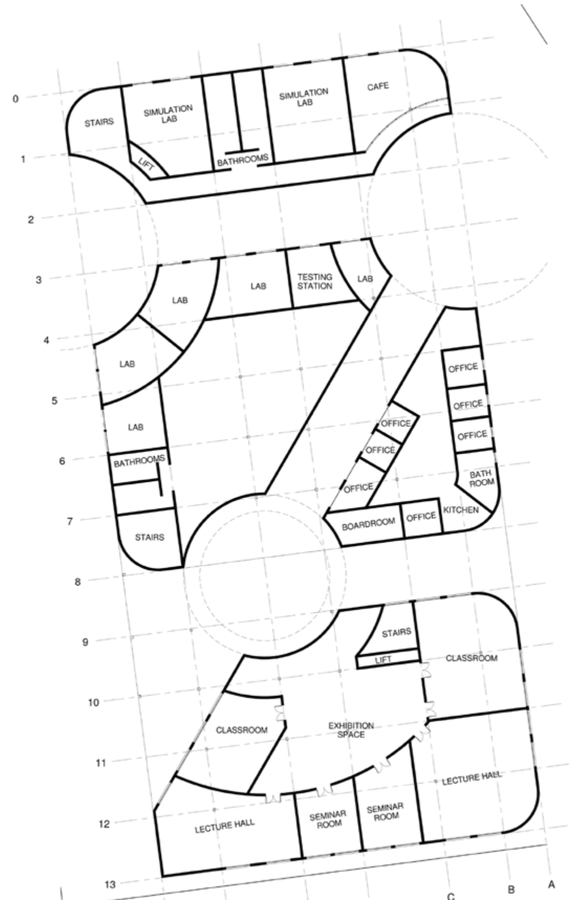


Figure 76: Author (2022) Ground Floor, Johannesburg: University of the Witwatersrand.

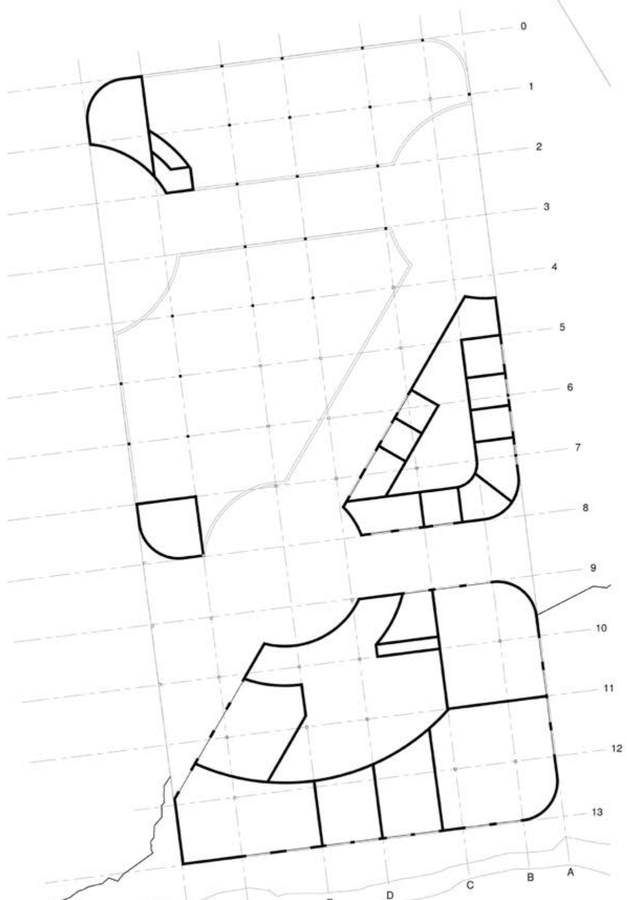


Figure 77: Author (2022) First Floor, Johannesburg: University of the Witwatersrand.

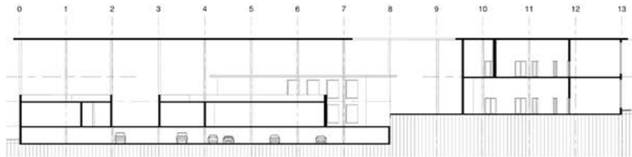


Figure 78: Author (2022) Section A, Johannesburg: University of the Witwatersrand.

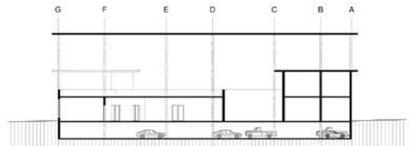


Figure 79: Author (2022) Section B, Johannesburg: University of the Witwatersrand.



Figure 80: Author (2022) Perspective A, Johannesburg: University of the Witwatersrand.



Figure 81: Author (2022) Perspective B, Johannesburg: University of the Witwatersrand.

DESIGN ITERATION 2

With the notion of integrating nature at the forefront, this iteration allows nature to be the defining factor with regards to defining space. Large historical trees occupy the north, east and west boundaries of the site, with main access to the site located at the south west and north potion of the site boundary.

As a result of the main access points and the location of the trees, the building responds almost in unison with its surrounds. However this approach resulted in rather abstract shapes, a layout that made the internal spaces difficult to work with and a structural system that is more complicated than it needs to be.

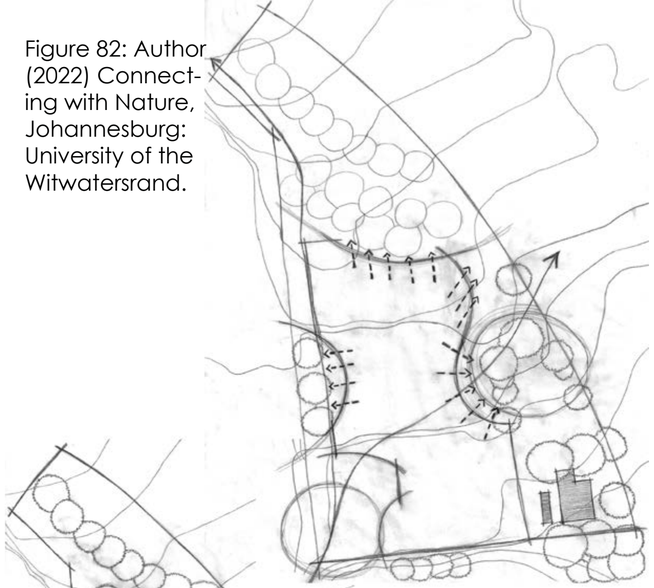


Figure 82: Author (2022) Connecting with Nature, Johannesburg: University of the Witwatersrand.

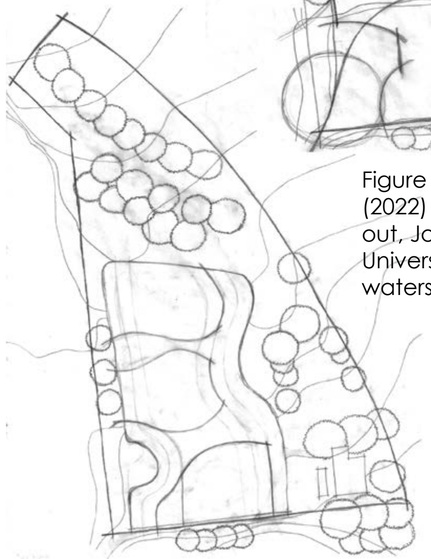


Figure 83: Author (2022) Initial Floor Layout, Johannesburg: University of the Witwatersrand.

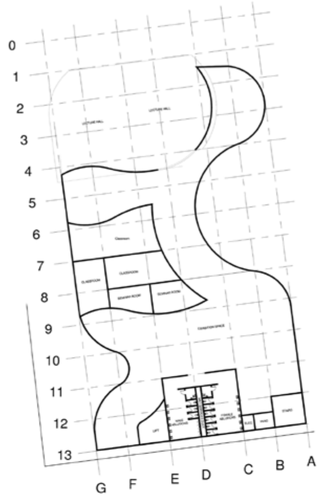


Figure 84: Author (2022) Ground Floor, Johannesburg: University of the Witwatersrand.

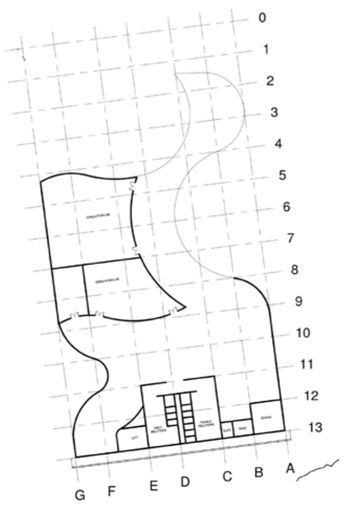


Figure 85: Author (2022) First Floor, Johannesburg: University of the Witwatersrand.

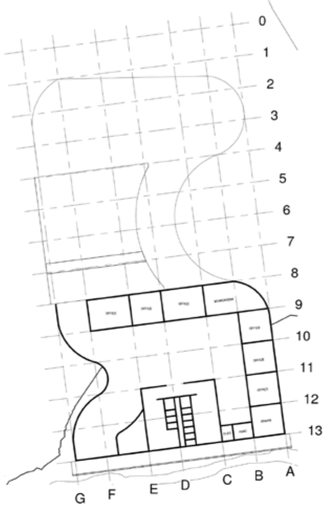


Figure 86: Author (2022) Second Floor, Johannesburg: University of the Witwatersrand.

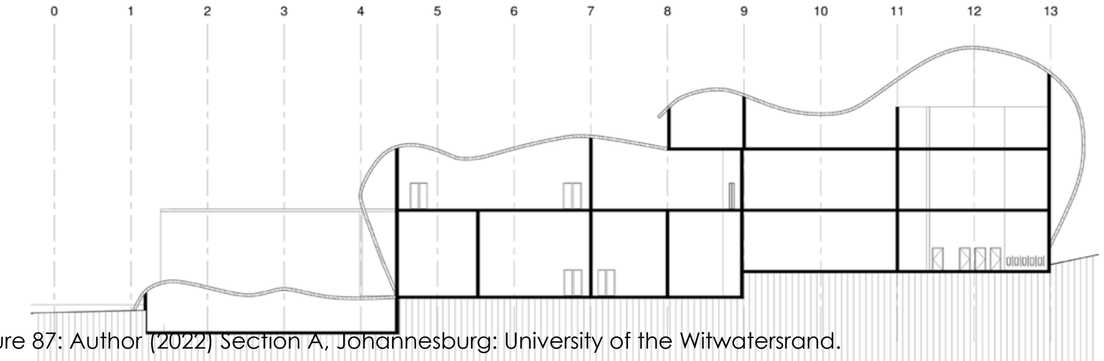


Figure 87: Author (2022) Section A, Johannesburg: University of the Witwatersrand.

DESIGN ITERATION 3

It is evident that in life everything we see and experience exists together in a rather delicate balance. One needs to be able to understand that balance and respect all the elements that allow for it to exist. Only then can we create spaces that are connected to the greater circle of life.

This iteration focuses on the notion of balance and integration with the natural elements that influence the site, in an attempt to create a building that works in collaboration with nature. The site is divided along three main terraces that fall as you move across it, calling for an approach that as a result falls just as it does. This approach allows for northern sunlight to gently linger along each terrace without negatively impacting or taking away from the other, In comparison to one uniform mass that spans across the site.



Figure 88: Author (2022) Terraced Landscape Site Plan, Johannesburg: University of the Witwatersrand.

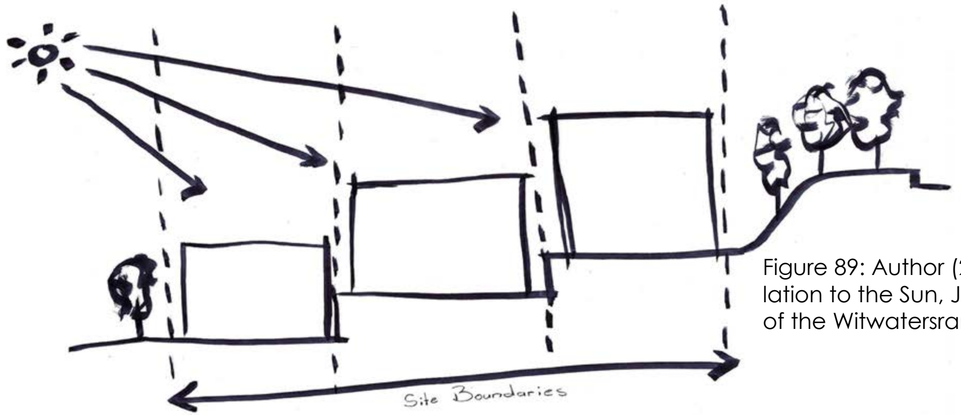


Figure 89: Author (2022) Building Mass in Relation to the Sun, Johannesburg: University of the Witwatersrand.

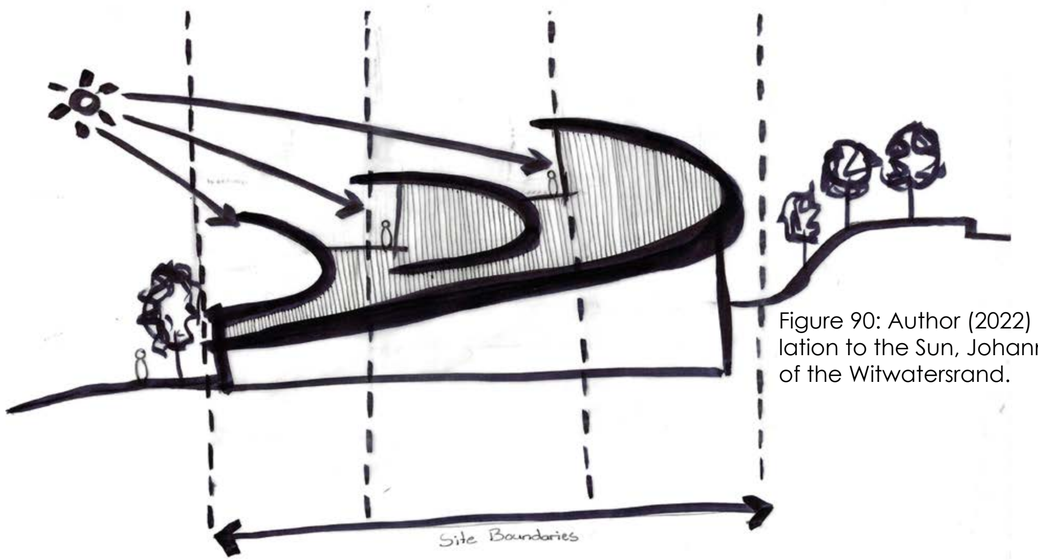


Figure 90: Author (2022) Building Form in Relation to the Sun, Johannesburg: University of the Witwatersrand.

The various terraces allow for a natural division with regards to building function, allowing for a more public interface on the ground floor, a semi-public interface on the first floor and a private interface on the second floor. Each floor is then subdivided and arranged in accordance with the building programme. The Building services and utilities are located along the southern portion of the site and carried through on each floor. The ground floor programmes focus on teaching facilities and classrooms, whilst the first floor is primarily used for research purposes, with the second floor being dedicated to offices and administration.

These spaces will not only comprise of built fabric, but will be intertwined with natural elements already existing on site, as well as natural elements that are indigenous to the site that may have been stripped away in the past. The site encompasses the past while the proposed design looks towards the future, as it facilitates a reawakening of nature.

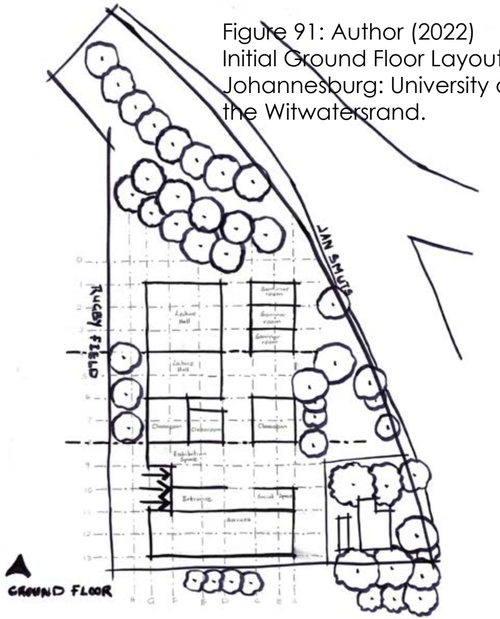


Figure 91: Author (2022) Initial Ground Floor Layout, Johannesburg: University of the Witwatersrand.



Figure 92: Author (2022) Initial First Floor Layout, Johannesburg: University of the Witwatersrand.



Figure 93: Author (2022) Initial Second Floor Layout, Johannesburg: University of the Witwatersrand.

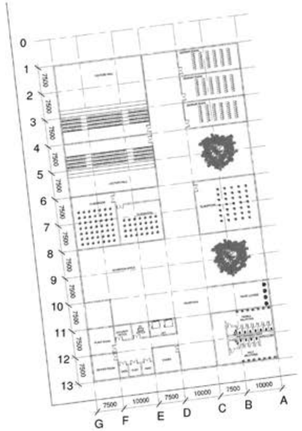


Figure 94: Author (2022) Ground Floor, Johannesburg: University of the Witwatersrand.

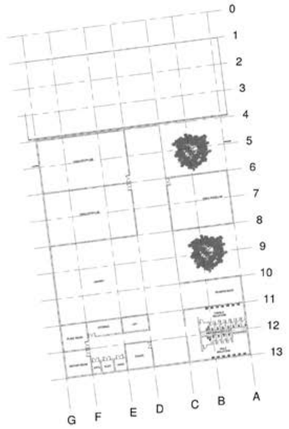


Figure 95: Author (2022) First Floor, Johannesburg: University of the Witwatersrand.

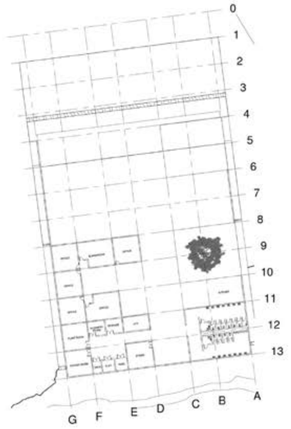


Figure 96: Author (2022) Second Floor, Johannesburg: University of the Witwatersrand.

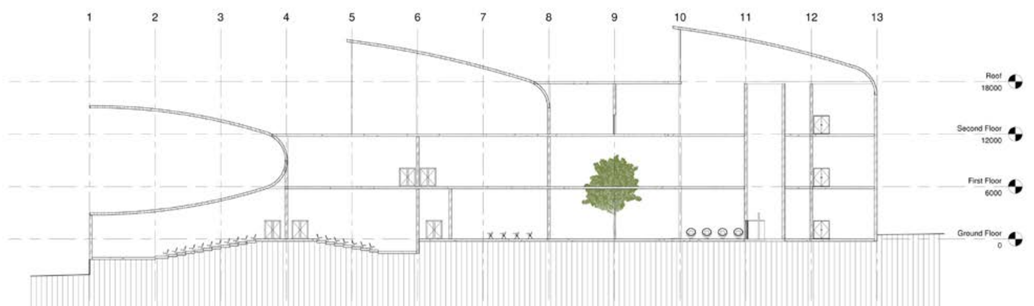


Figure 97: Author (2022) Section A, Johannesburg: University of the Witwatersrand.

FINAL DESIGN ITERATION

It is evident that the selected site once inhabited an entirely different function, however over the years it has been stripped and redeveloped into parking space with only the historical trees left untouched. Land that once inhabited various forms of nature, is now populated by vehicles that only cause more harm. The final iteration focuses on the notion of integration, as nature takes back what once belonged to her, in an attempt to restore balance.

The parking lot is divided into terraces creating a natural division along the site. This allows for the building programme to be spread out along the site, while integrating nature within the space in an attempt to create a building that works in collaboration with nature. This allows for northern sunlight to gently linger along each terrace without negatively impacting or taking away from the other.

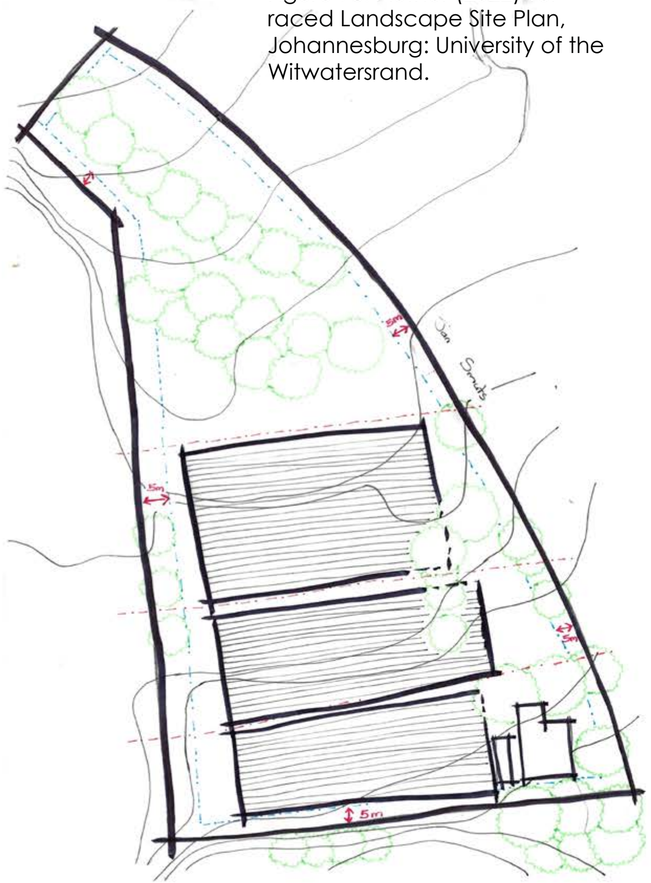
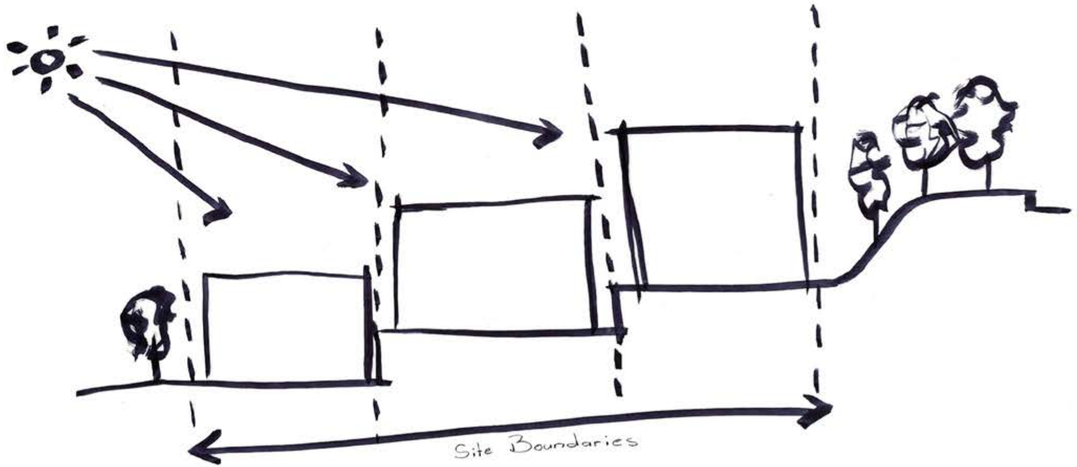


Figure 98: Author (2022) Terraced Landscape Site Plan, Johannesburg: University of the Witwatersrand.

Figure 99: Author (2022) Building Mass in Relation to the Sun, Johannesburg: University of the Witwatersrand.



The various buildings will each house a specific programme with natural elements integrated in between, connecting them with one another as nature filters through the space, blurring the line between the built fabric and what exists in nature.

The initial scheme focuses on defining the building in a more structural manner while creating pockets of spaces in between. Although this approach allows for a sense of structure, it is counter to the natural forms that exist in nature.

The next scheme focuses on creating unique spaces in a more organic manner, while still aligning them to each other. This allows for unique experiences as you move through the site based on your location.

These spaces will be linked by natural elements throughout the site, as well as a continuous roof element containing all the building within one space. This allows individuals to experience the built fabric that serves specific function, while experiencing the natural environment as well.

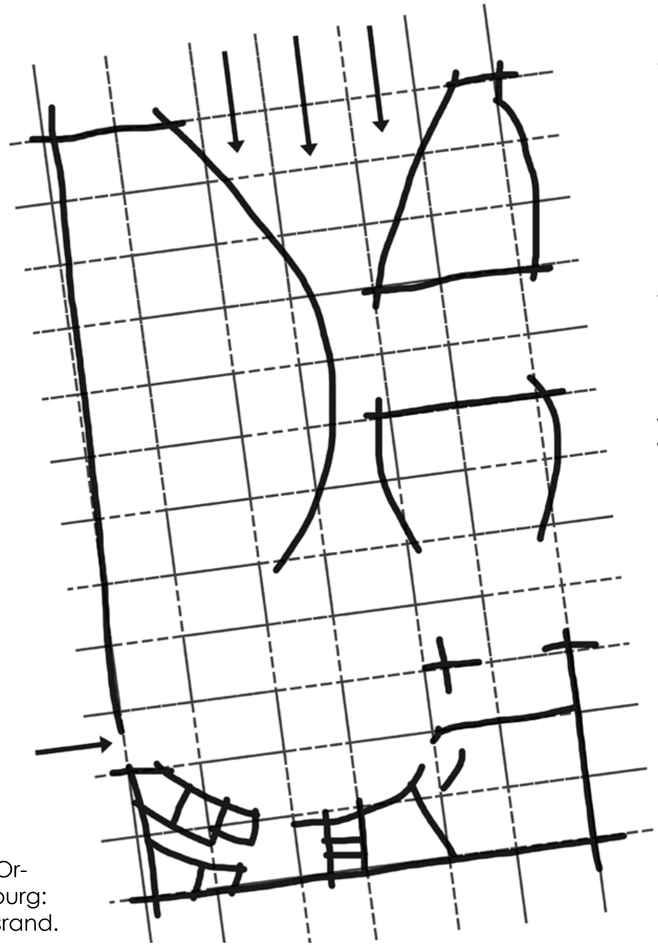


Figure 100: Author (2022) Orthogonal Grid, Johannesburg: University of the Witwatersrand.

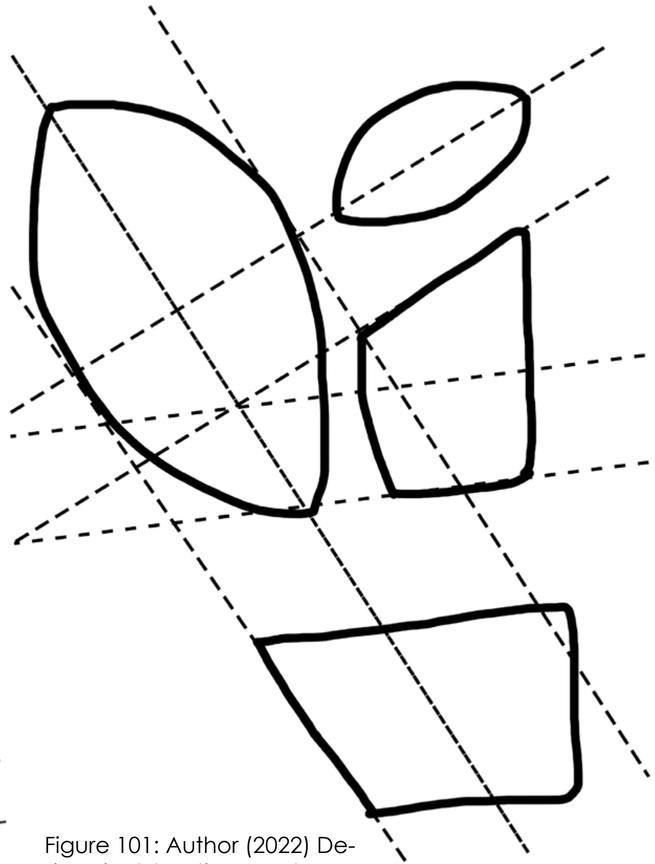


Figure 101: Author (2022) Design Final Iteration 1, Johannesburg: University of the Witwatersrand.

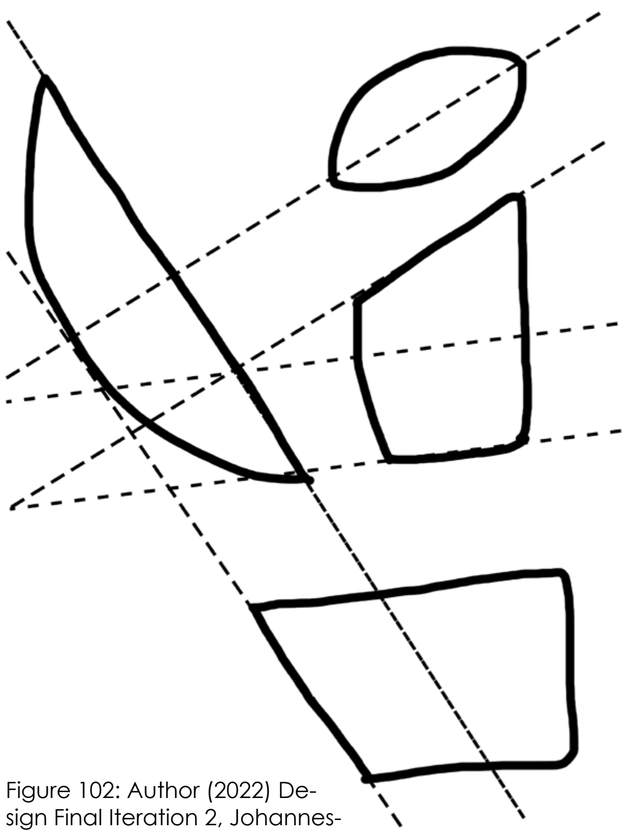
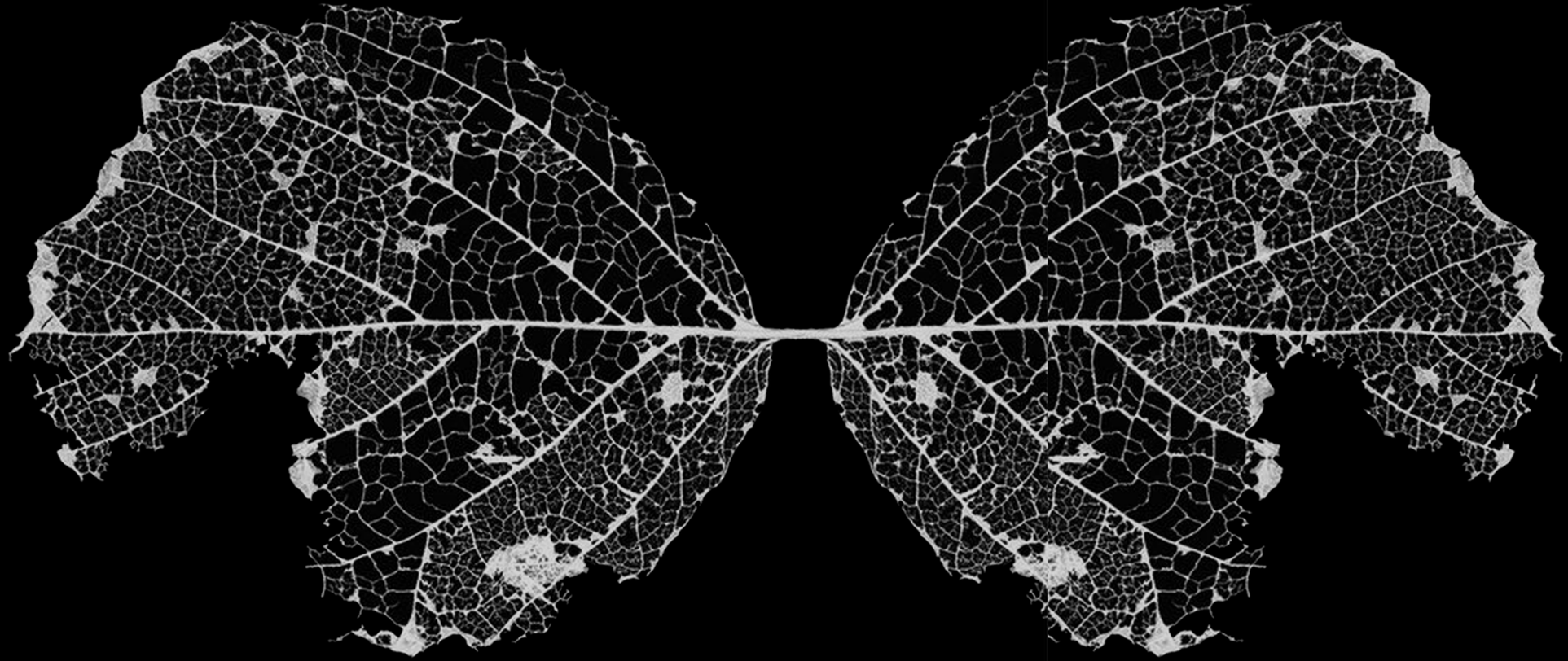


Figure 102: Author (2022) Design Final Iteration 2, Johannesburg: University of the Witwatersrand.

Upon exploring the site, the one element that instantly caught my attention was the historical willow tree and the manner in which it emerges from the ground creating an almost umbrella like effect, as it cradles you within its surrounding. This notion allows you to experience the towering willow tree in a different form as you move within its space.

It is fixed at the centre as its supple nature branches out, allowing its extremities to bend and fold in order to accommodate gushes of wind and adverse weather conditions. This notion was the start of my approach regarding my outer roof element as it would enclose the various building structures, while creating a space that allows you to experience nature differently at each point along the site.





DESIGN DEVELOPMENT

DESIGN DEVELOPMENT
ROOF ITERATION 1

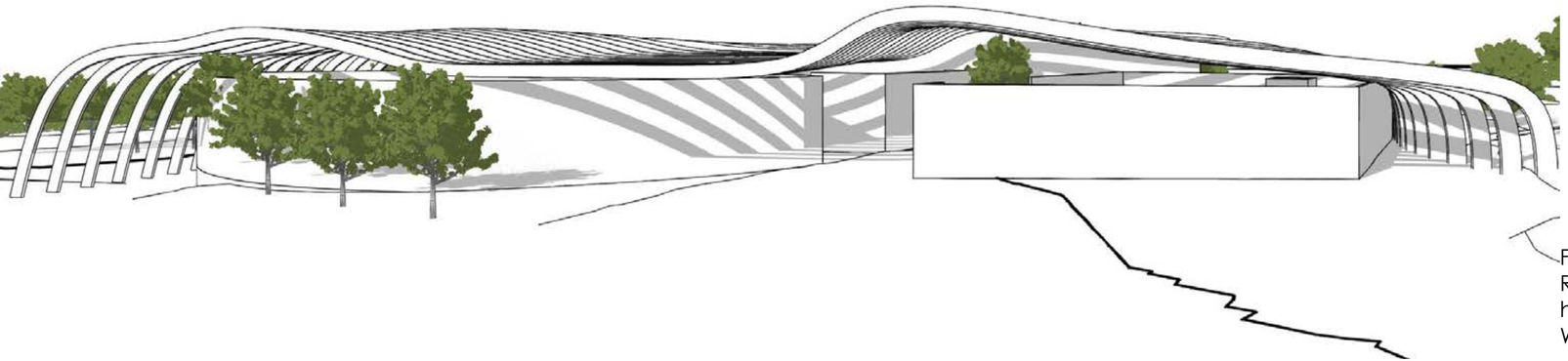


Figure 103: Author (2022)
Roof Iteration1 View 1, Johannesburg: University of the Witwatersrand.

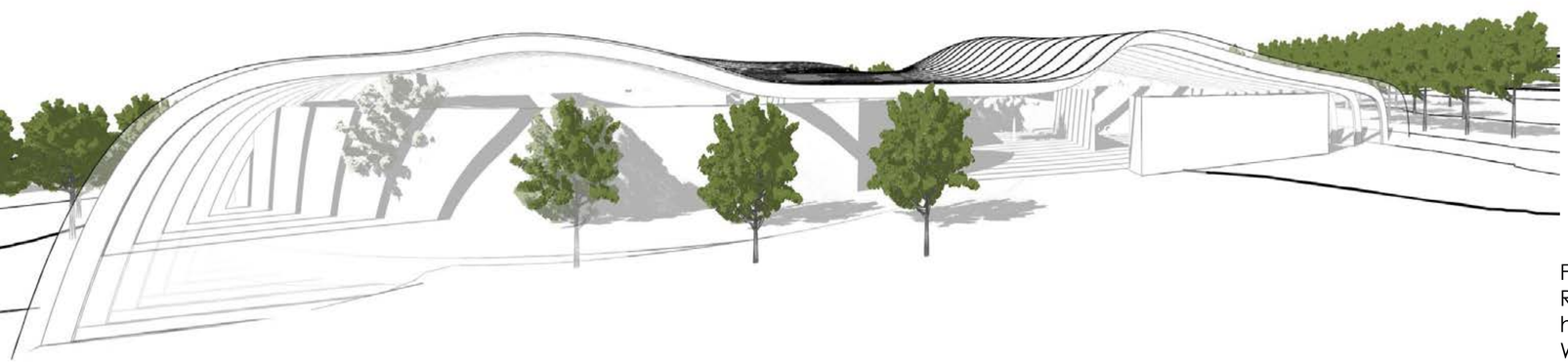


Figure 104: Author (2022)
Roof Iteration1 View 2, Johannesburg: University of the Witwatersrand.

The initial roof iteration borrows from the cradling effect seen in the willow tree, as it branches out allowing its extremities to fold and bend, creating an outer roof structure that house the main building programmes. This structure emerges from the ground, wrapping itself over the site before embedding itself into the ground one more.

Even though this iteration creates a rather dynamic form, the spaces beneath the structure are still rather restricted and tight due to the height and formation, which take away from the experience as opposed to enhancing it.

ROOF ITERATION 2

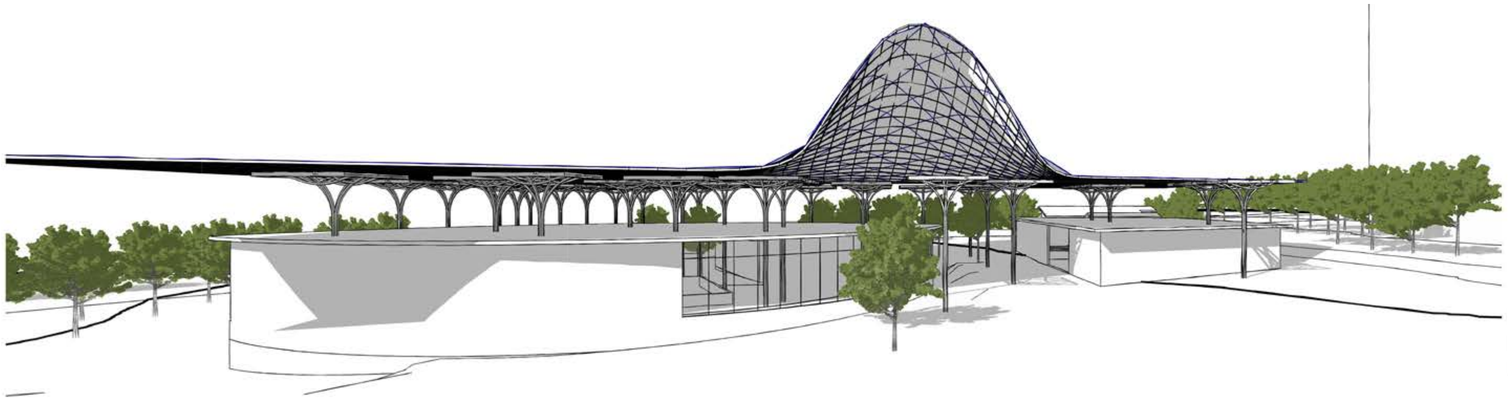


Figure 105: Author (2022) Roof Iteration 2 View 1, Johannesburg: University of the Witwatersrand.

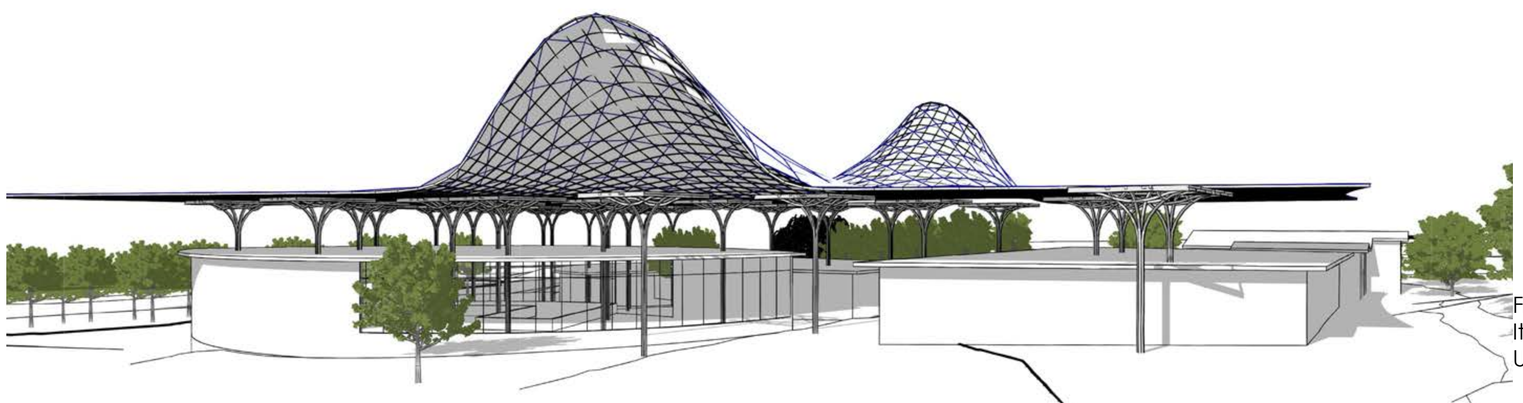


Figure 106: Author (2022) Roof Iteration 2 View 2, Johannesburg: University of the Witwatersrand.

The second iteration focuses more on the notion of shelter for the various building programmes, while enhancing the users experience as they move through the site. This structure is supported by columns that mimic the formation of a tree as it emerges from the ground, providing support for the roof structure above.

The form explores various pockets of space, creating dome like structure to highlight spaces of importance throughout the site. These dome like structures are used to signify the main points of entry, drawing attention to the site, while creating an experience unique to its users. However, the experience throughout the various spaces becomes rather stagnant once the user has passed the main points of entry, as the structure then becomes linear and flat thereafter.

FINAL ROOF ITERATION

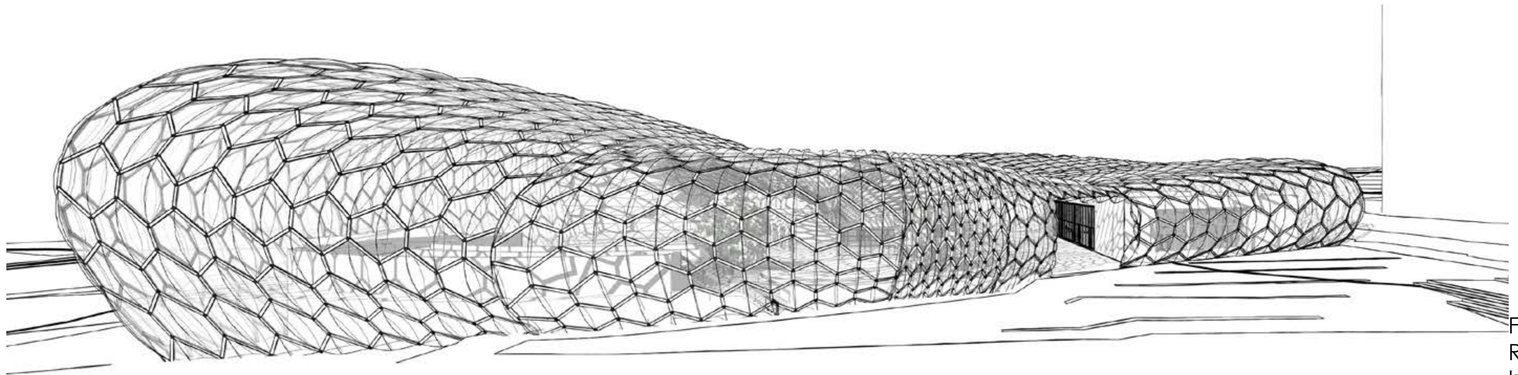


Figure 107: Author (2022) Final Roof Iteration View 2, Johannesburg: University of the Witwatersrand.

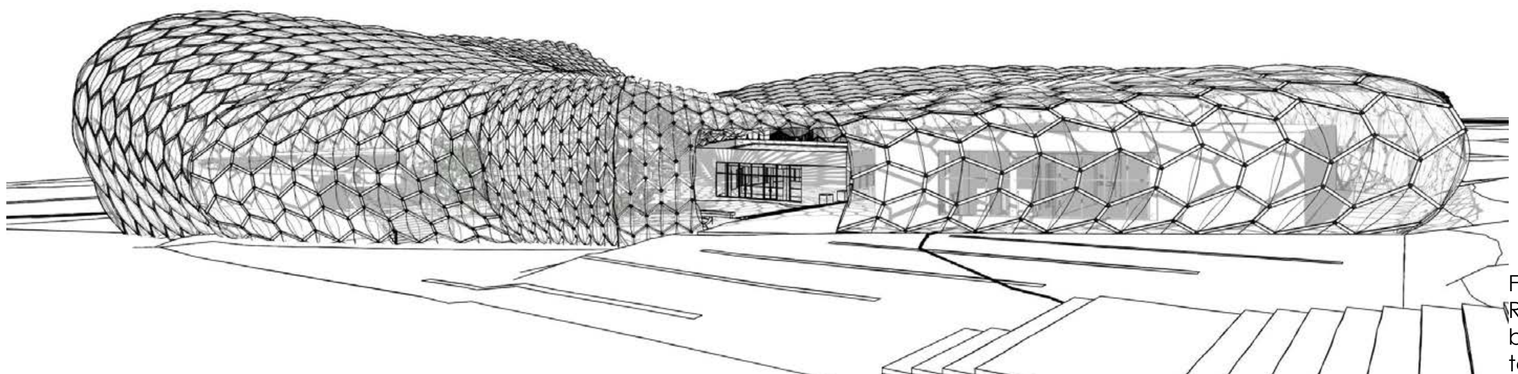


Figure 108: Author (2022) Final Roof Iteration View 2, Johannesburg: University of the Witwatersrand.

The final roof iteration is a combination of the first and second notion, with the main focus being providing shelter for the various programmes and nature elements beneath the roof, as well as mimicking the way the extremities of the willow tree bend and fold to create a rather unique experience. This allows the user to experience the site differently at each point as they move through the various spaces.

The structure appears to emerge from the ground creating rounded shapes that vary along each point. The site is divided into quadrants in a circular manner along one main axis, allowing these quadrants to be used to formulate the dome like structures that makes up the bigger form. These elements are pieced together, curving at various magnitudes based on site placement and the required outcome.

PARAMETRIC ROOF STRUCTURE



Due to the nature of the roof structure and geometric characteristics, a parametric roof will allow for the exploration of a geometric shell like structure that provides shelter while mimicking nature. This shell like structure is made up of smaller units that when put together, creates a larger structure. Similarly the structure of a honeycomb is said to be one of the most magnificent forms in nature. As the excellence lies in the hexagonal shape and the manner in which the composition is formulated, making the hexagonal the most efficient form in nature. This geometric composition will allow for a parametric roof structure that is efficient and structural, while mimicking nature.

In order to achieve the desired outcome regarding transparency, there are two materials capable of achieving such an outcome; one being glass and the other being Ethylene tetrafluoroethylene (ETFE) a fluorine based plastic. Although glass is often the solution where transparency is require, a glass parametric roof would be high maintenance, counter to natures ability to care for itself. Therefore, the exploration of an ETFE roof allows for a similar outcome, with a material that is thin and lightweight, durable, recyclable, sustainable and transparent. This high transparency due to the infrared range allows for the most ideal conditions for photosynthesis and thus optimal for plant growth.

PARAMETRIC ROOF

↓

HEXAGONAL UNITS

↓

ETHYLENE TETRAFLUOROETHYLENE

↓

TENSILE STRUCTURE
THIN AND LIGHTWEIGHT
TRANSLUCENT
SUSTAINABILITY
DURABLE
100% RECYCLABLE

This final iteration broke away from the constraints of the orthogonal grid. This iteration focuses on creating unique spaces in a more organic manner, while still aligning them to each other. This allows for unique experiences as you move through the site based on your location.

Although this creates very interesting spaces, certain points along the form will result in very difficult spaces and tight corners that may be of no use. These rather large forms restrict the immediate pubic space within the site, only allow for narrow corridors between building, opposed to vast spaces that allow for public interaction and nature to coexist.

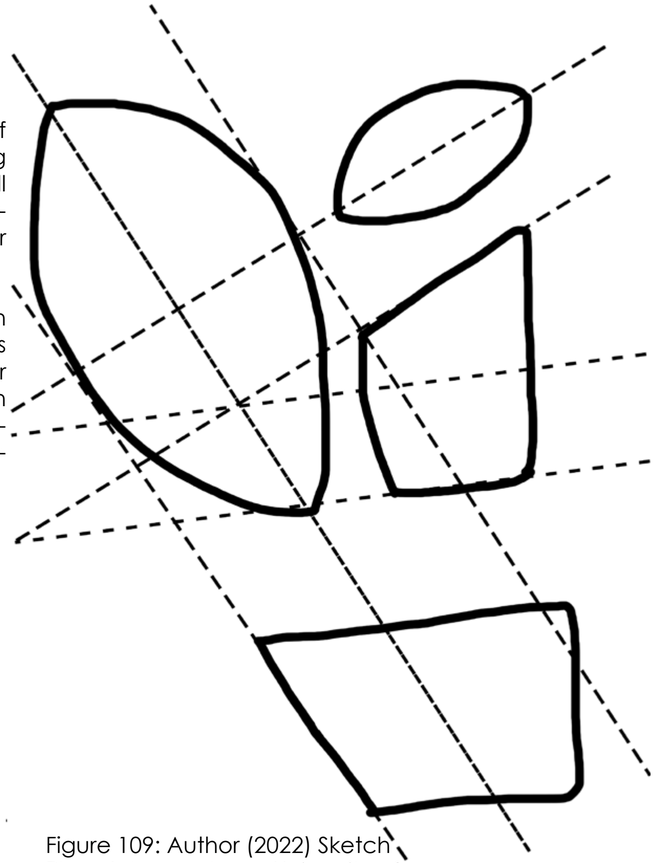


Figure 109: Author (2022) Sketch Plan, Johannesburg: University of the Witwatersrand.



Figure 110: Author (2022) Initial Floor Plan, Johannesburg: University of the Witwatersrand.

As a result, my focus shifted from the idea of form, to the notion of creating spaces of value, while integrating a more public interface and natural elements. This allowed for the exploration of built fabric and nature, in an attempt to create a sense of balance that allowed all elements to exist, with all elements adding to a unique experience of space.
This exploration took on many forms as it attempted to blur the line between built form and nature. However, the structure was still rather rigid and needed to be explored in a more organic manner that mimicked forms in nature. These sharp and rigid corners were of no use and called for a more delicate approach that was more welcoming in shape and sensitive in its approach to define space, which is evident in the final design.

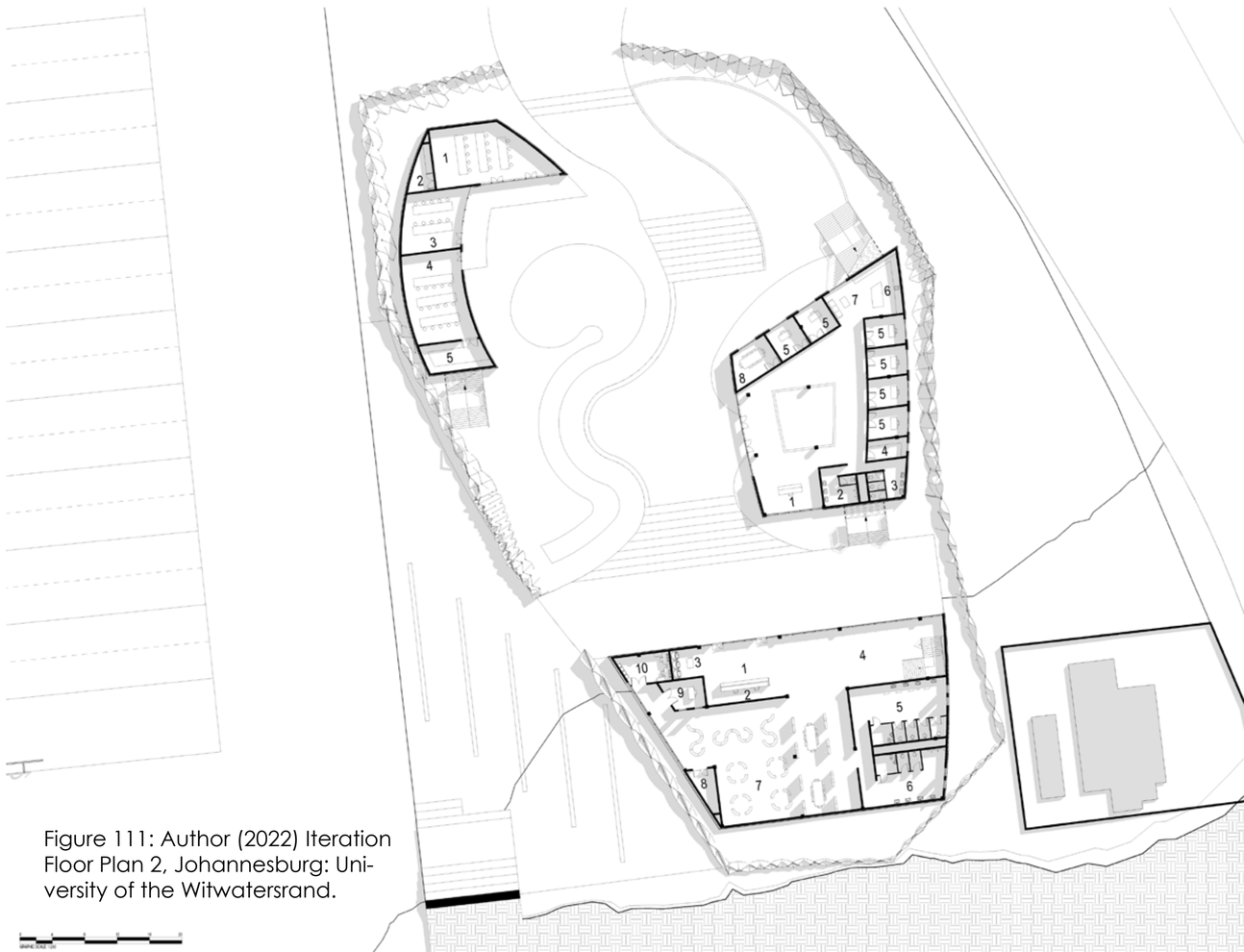


Figure 111: Author (2022) Iteration Floor Plan 2, Johannesburg: University of the Witwatersrand.

SOLAR STUDY

SUMMER SOLSTICE : 22 DECEMBER

Daylight Duration: 13hours 47minutes
Altitude: 2.32 degrees
Azimuth: 115.22 degrees
Shadow Length: 24.67 meters

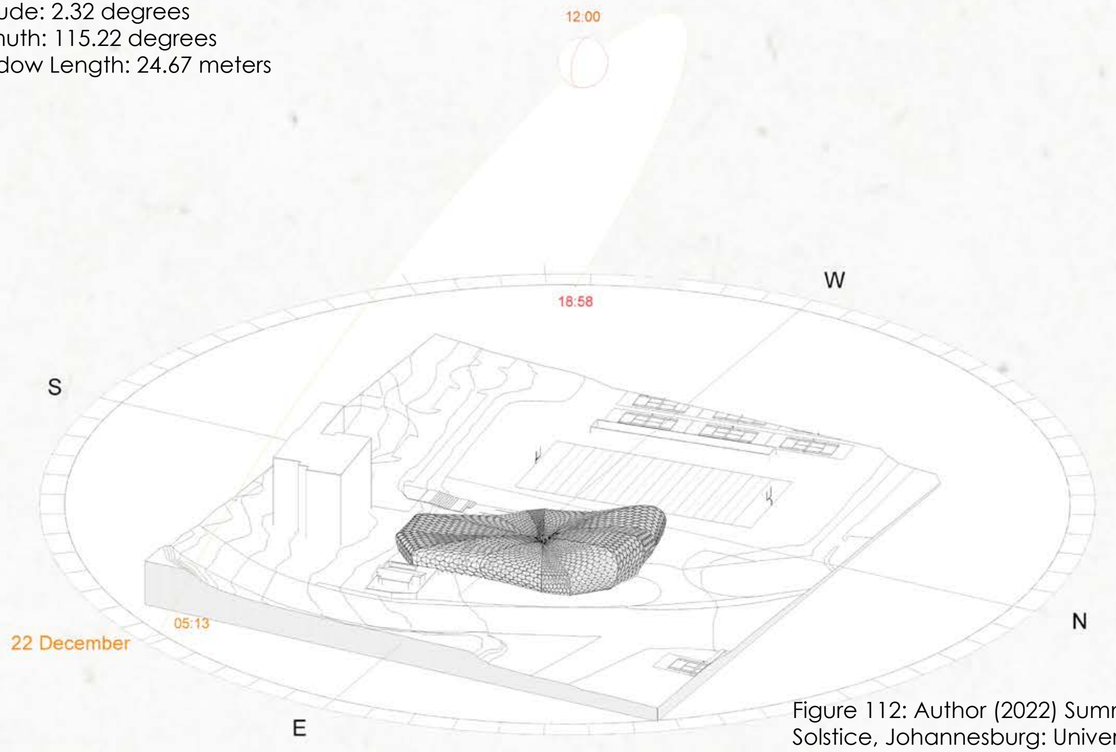


Figure 112: Author (2022) Summer Solstice, Johannesburg: University of the Witwatersrand.

WINTER SOLSTICE : 21 JUNE

Daylight Duration: 10hours 30minutes
Altitude: -25.62 degrees
Azimuth: 75.17 degrees
Shadow Length: n/a

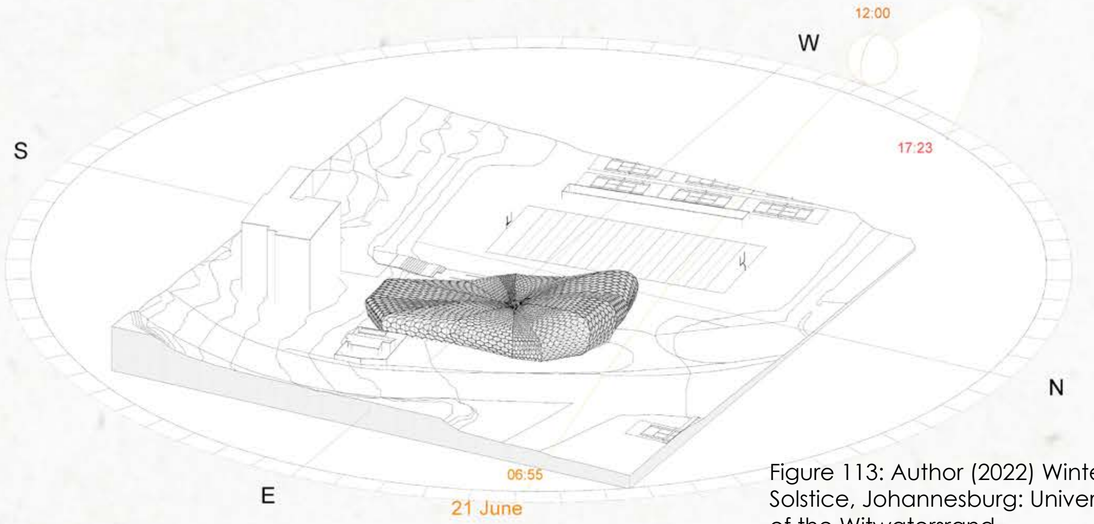
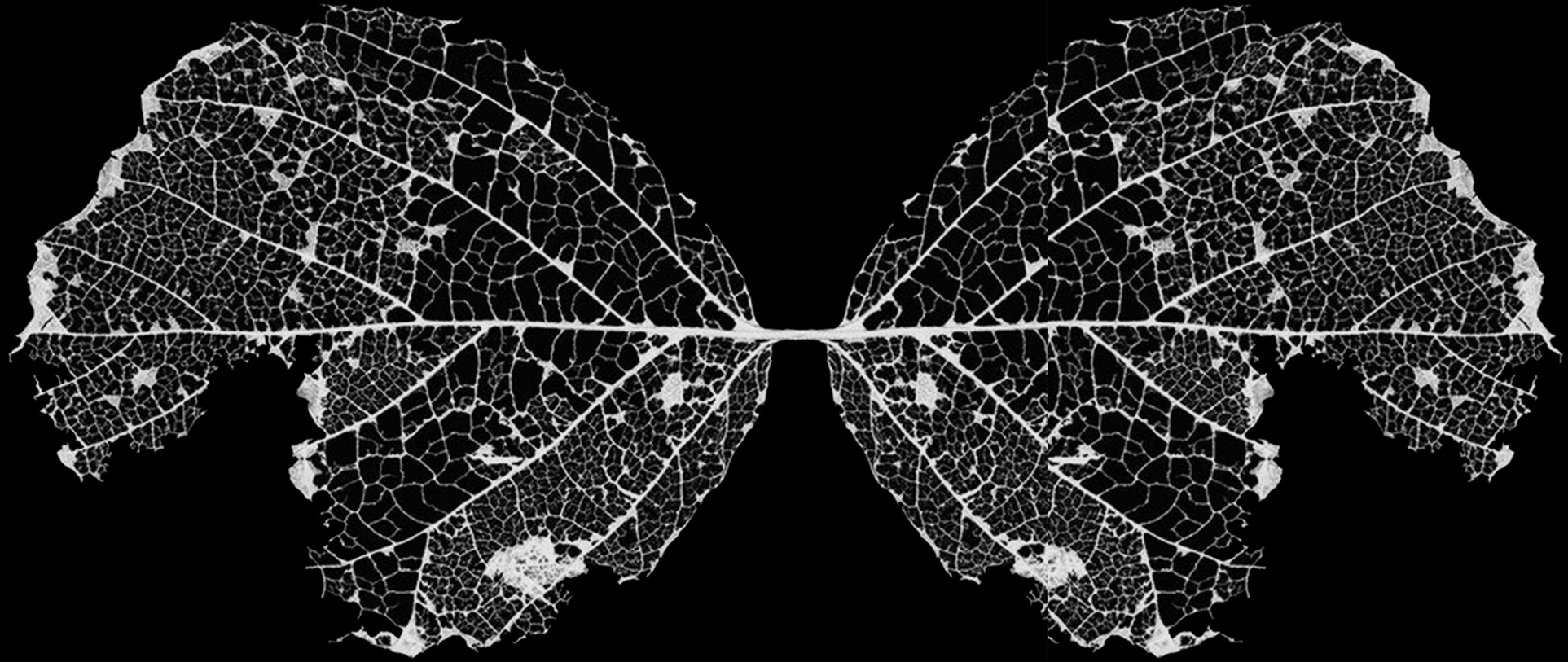


Figure 113: Author (2022) Winter Solstice, Johannesburg: University of the Witwatersrand.



FINAL DESIGN

FINAL DESIGN

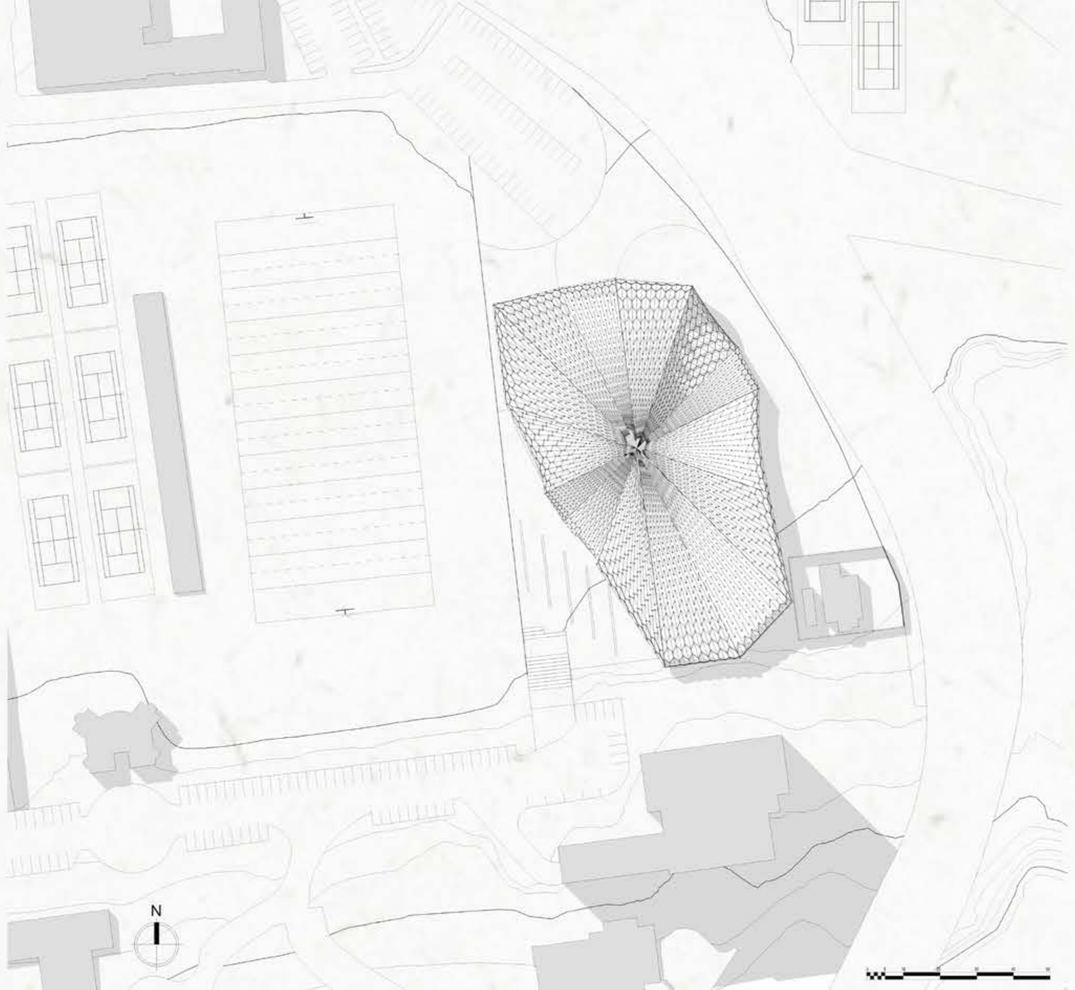
From the rising of the sun to its settling, life on Earth has always been centred around natures grand design.

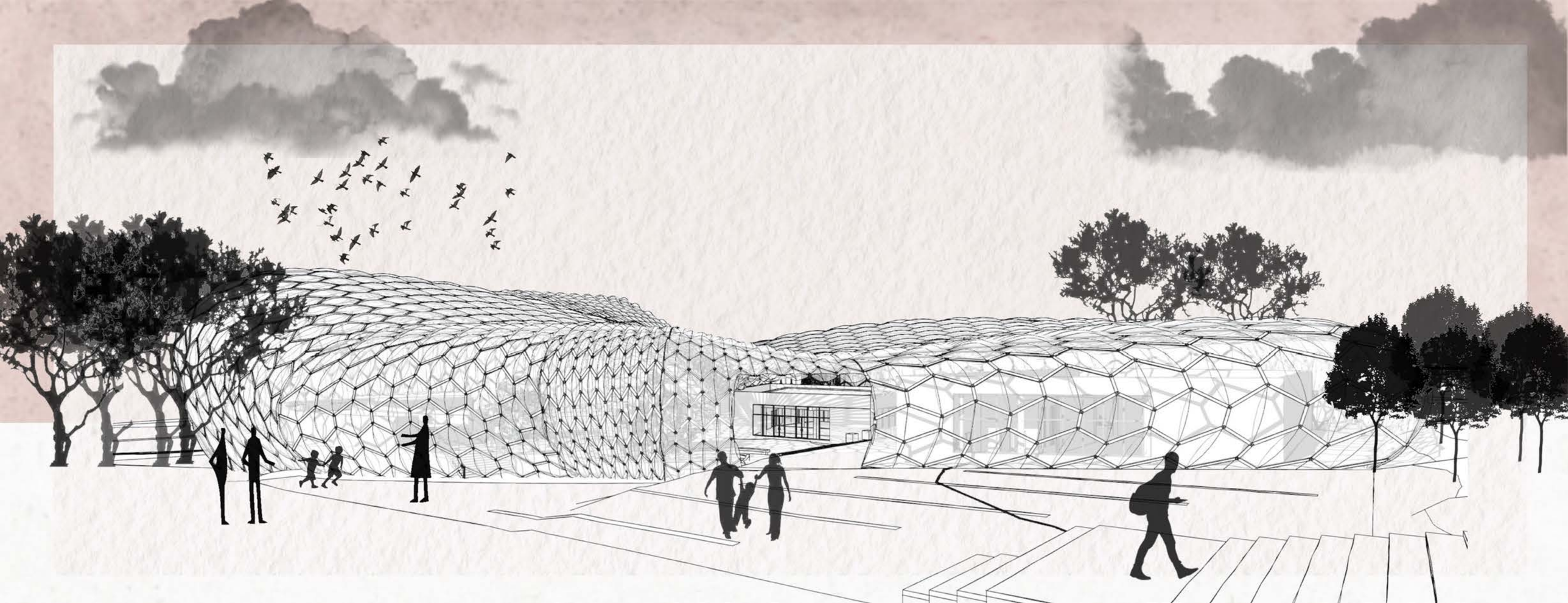
My final design invites one to imagine a form of architecture that focuses on inclusivity and the cultivation of nature. This design proposes a connection between the built fabric and what exists in nature today, allowing for an amalgamation of form and the urban fabric that has continued to evolve with the developing city to its right and the University campus to its left.

The Environmental Research Instsitute is centred around nature, with the notion of sustainability remaining at the very core of the design. It allows for the intergration of its diverse surrounding, as it filters between various programmes. Blurring the line between architecture and nature, while still enhancing the local bio diversity. The Environmental Institute facilitates a prominent connection between the outside and inside, establishing itself as nature's neighbour.

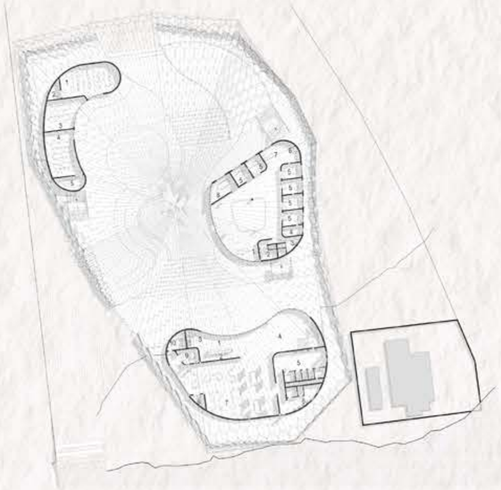


SITE PLAN



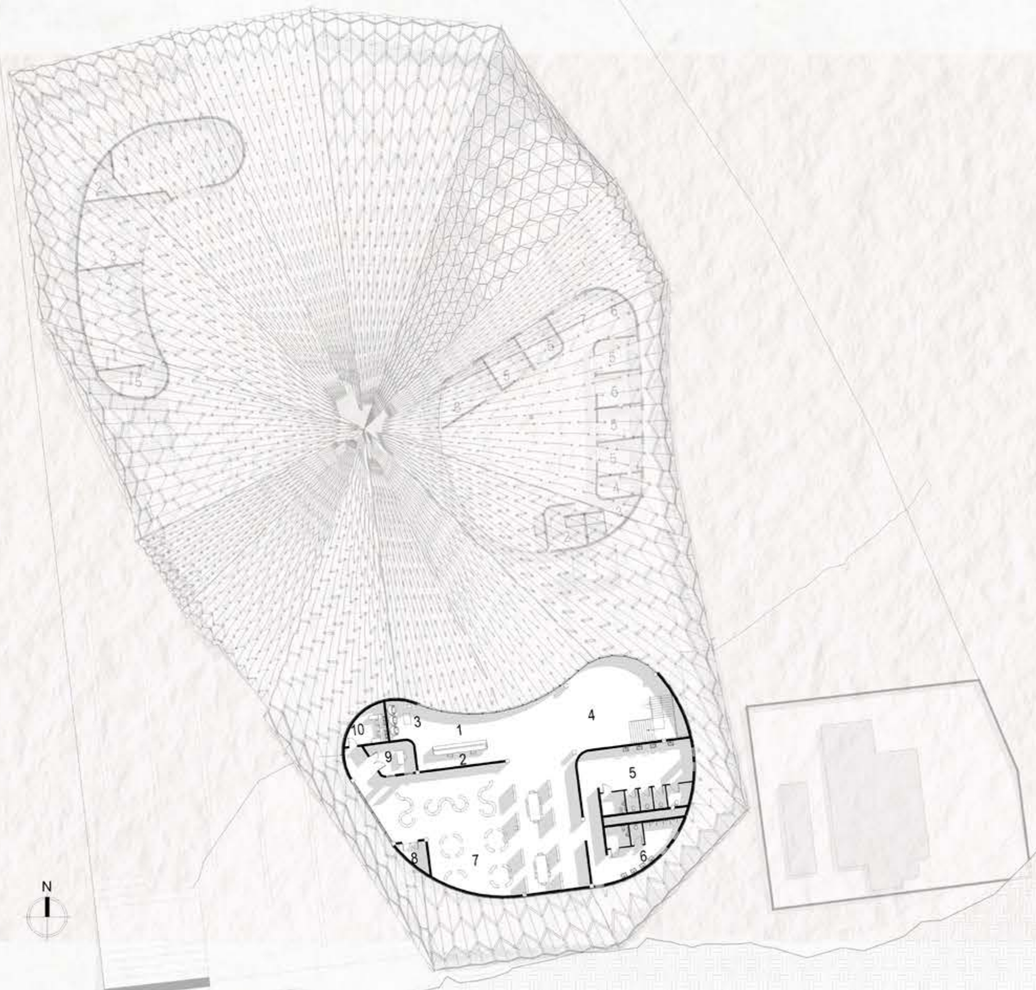


GROUND FLOOR BLOCK A

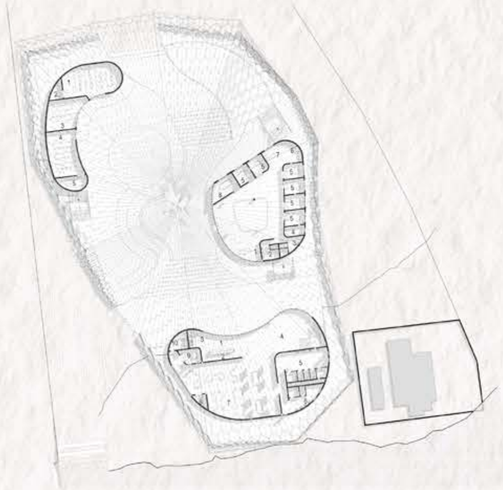


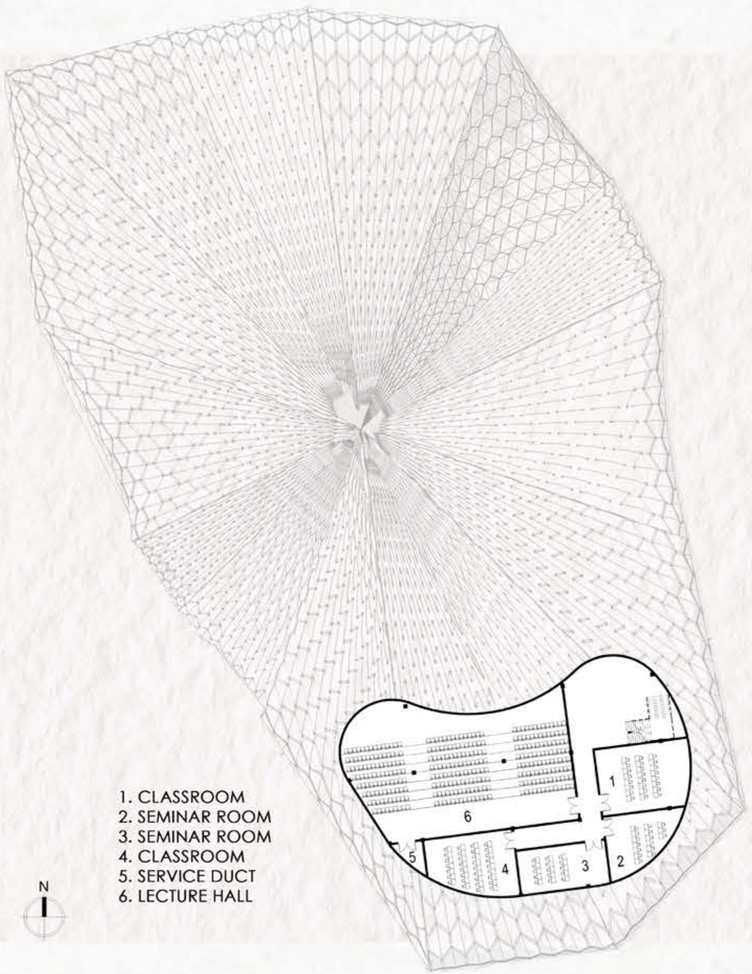
1. ENTRANCE FOYER
2. RECEPTION
3. WAITING AREA
4. EXHIBITION SPACE
5. FEMALE ABLUTIONS
6. MALE ABLUTIONS
7. LIBRARY
8. SERVICE DUCT
9. OFFICE
10. SECURITY OFFICE

N

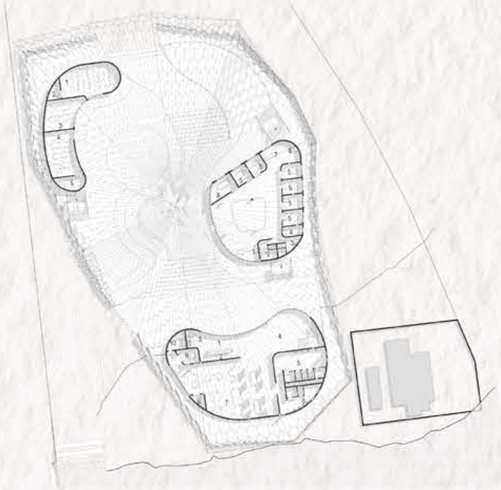


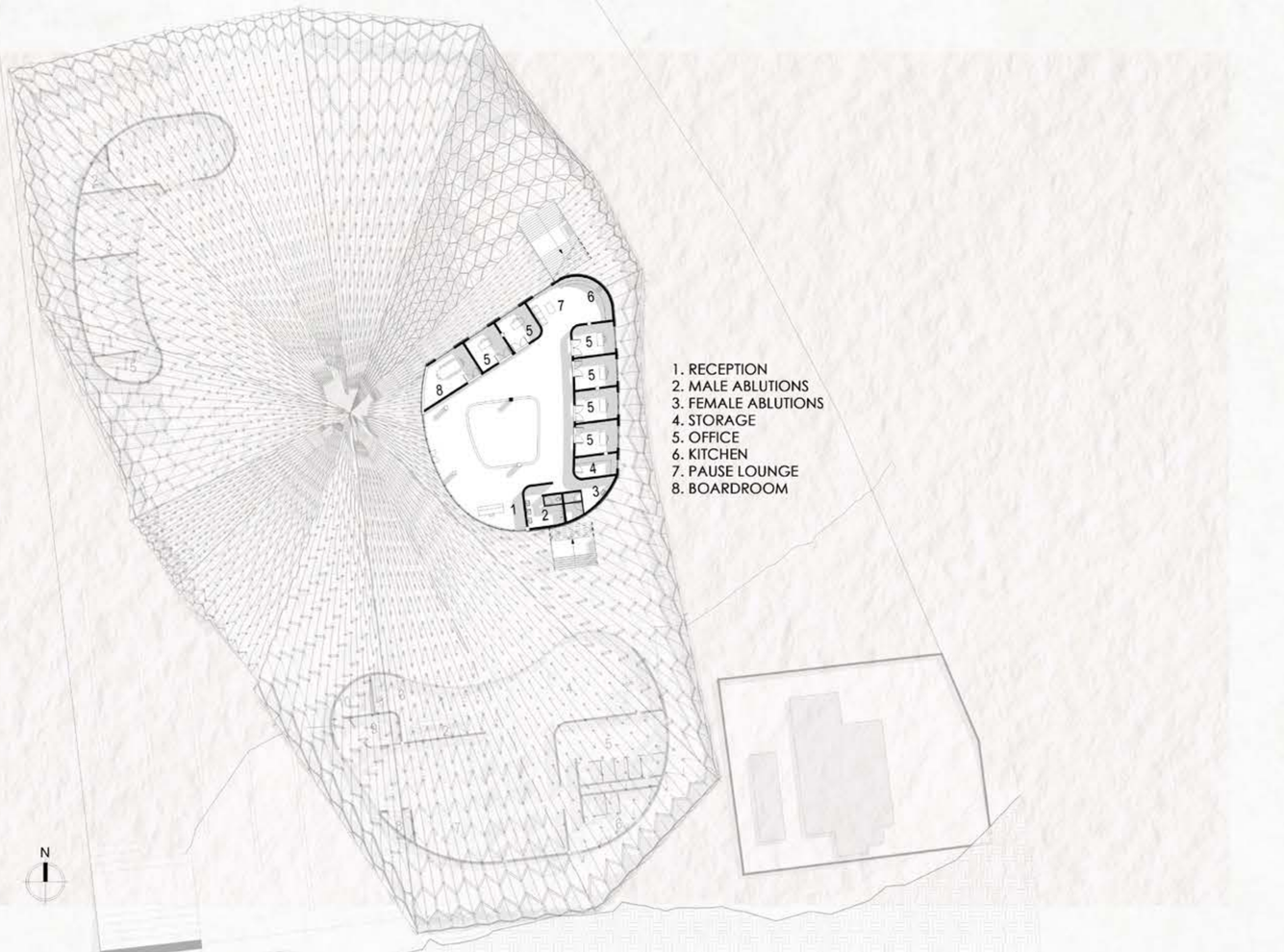
LOWER GROUND BLOCK A



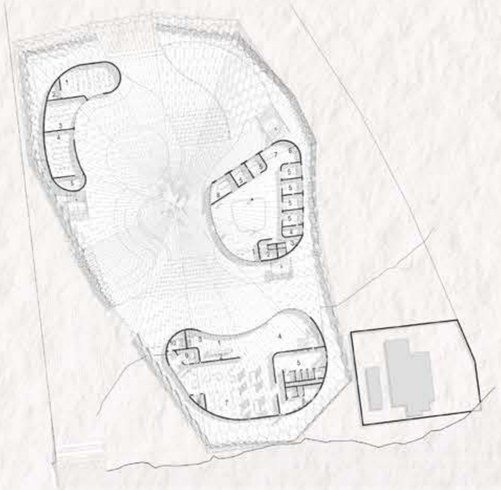


GROUND FLOOR BLOCK B

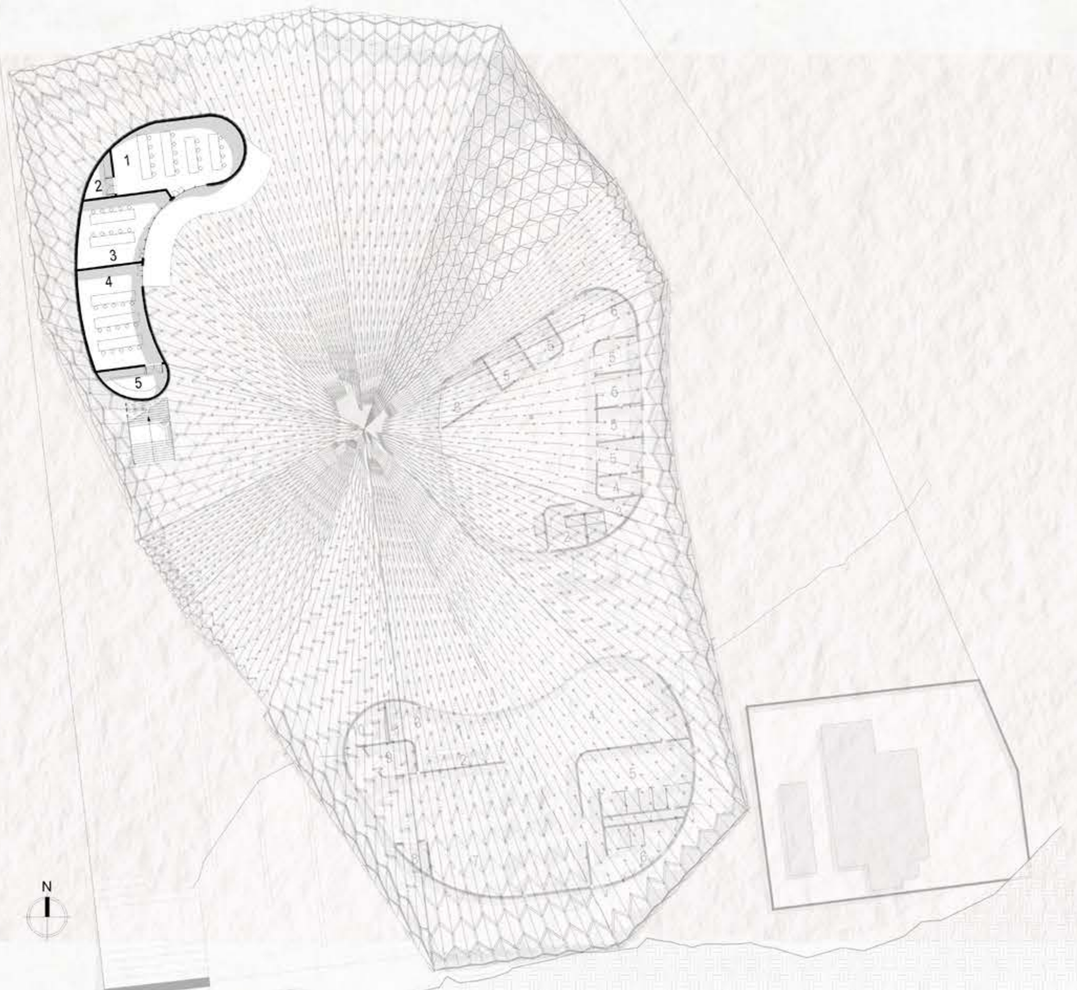


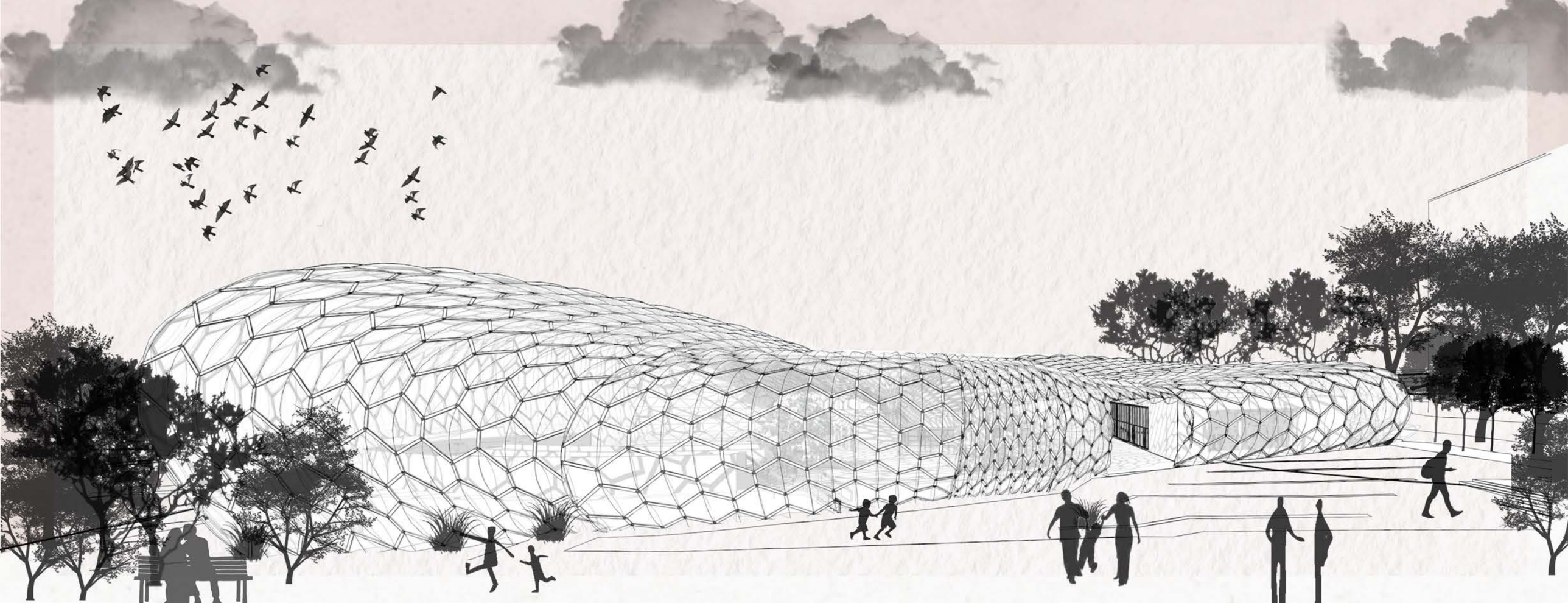


GROUND FLOOR BLOCK C

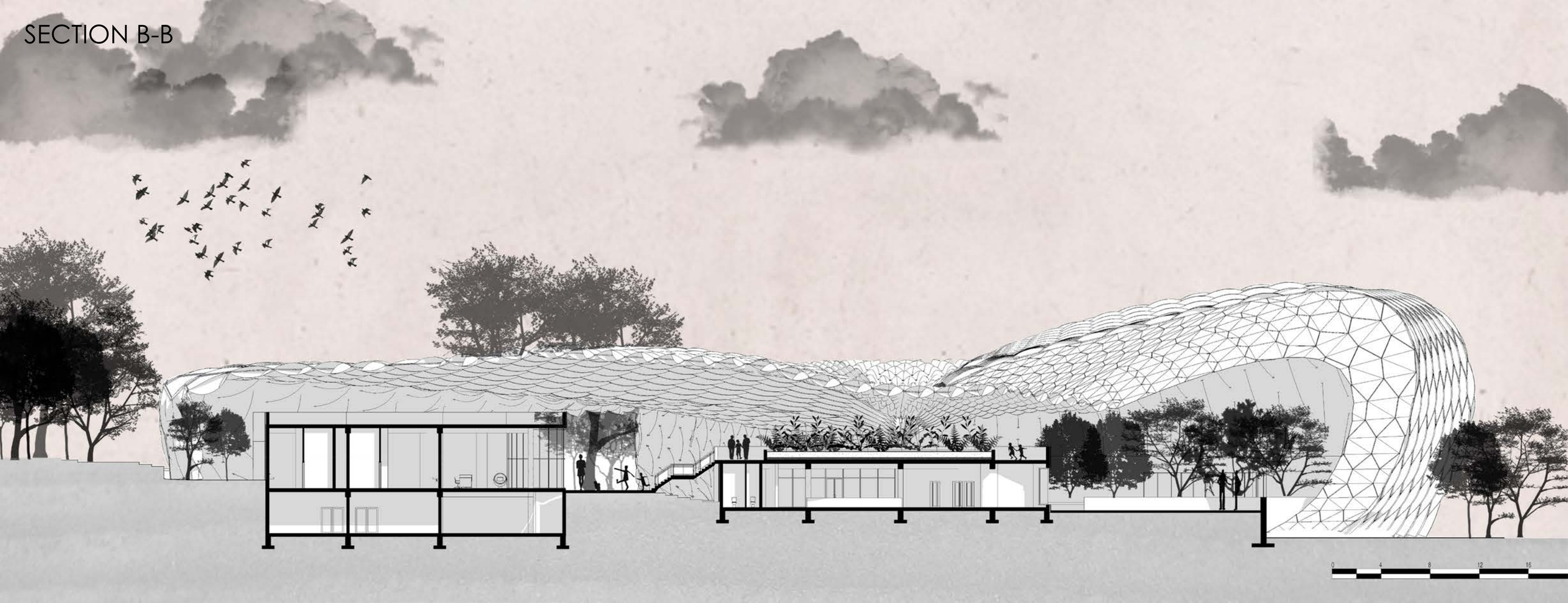


1. SIMULATION LAB
2. STORAGE
3. SIMULATION LAB
4. SIMULATION LAB
5. STORAGE



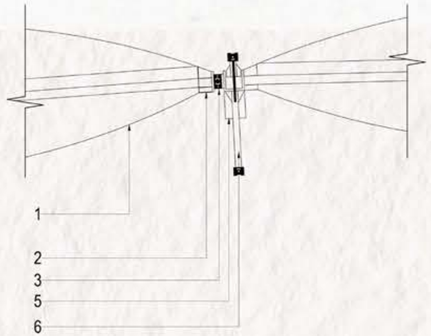


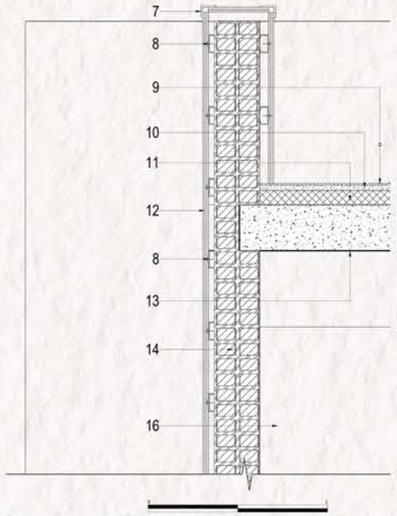
SECTION B-B

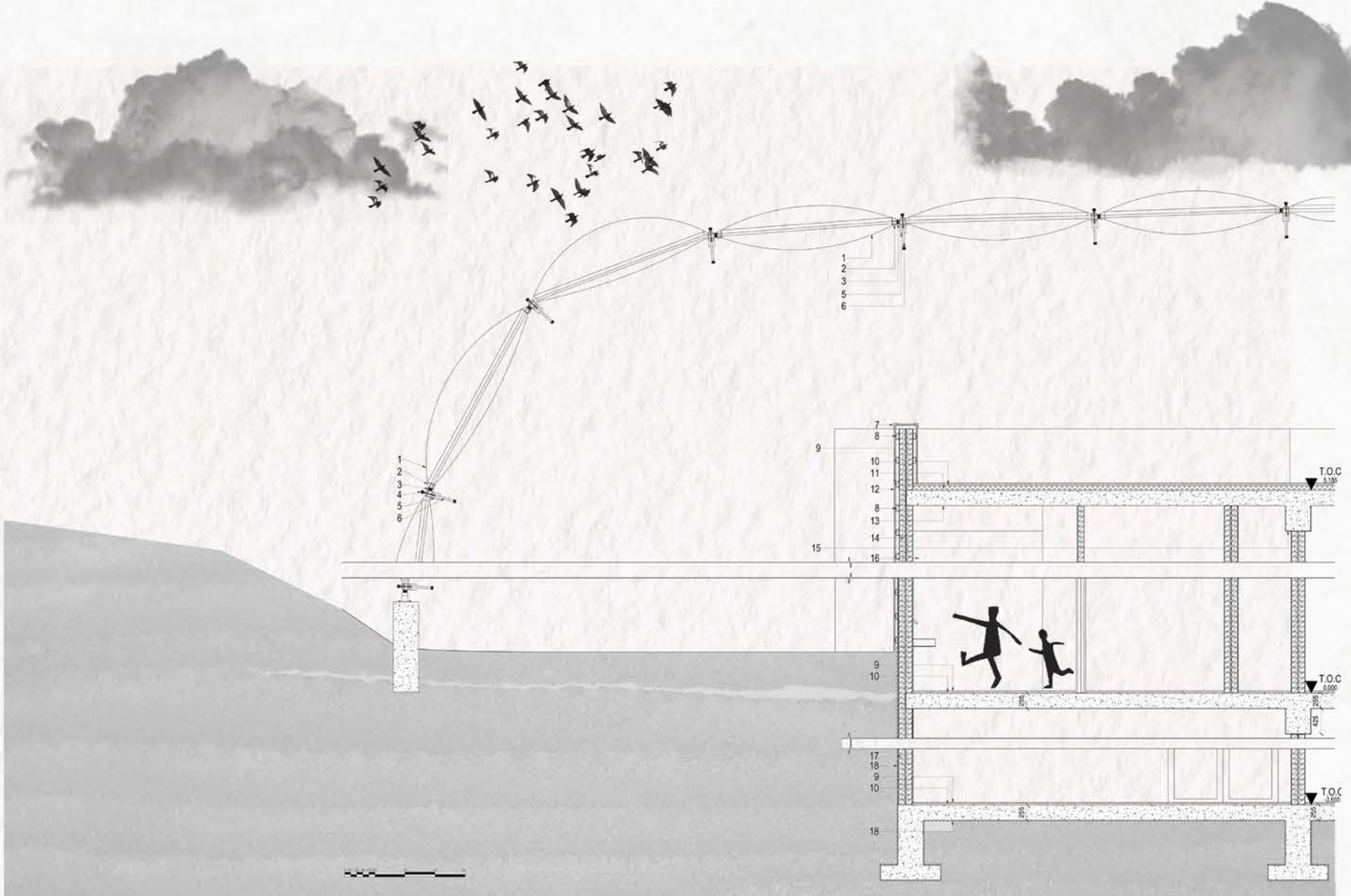


PERIMETER SECTION

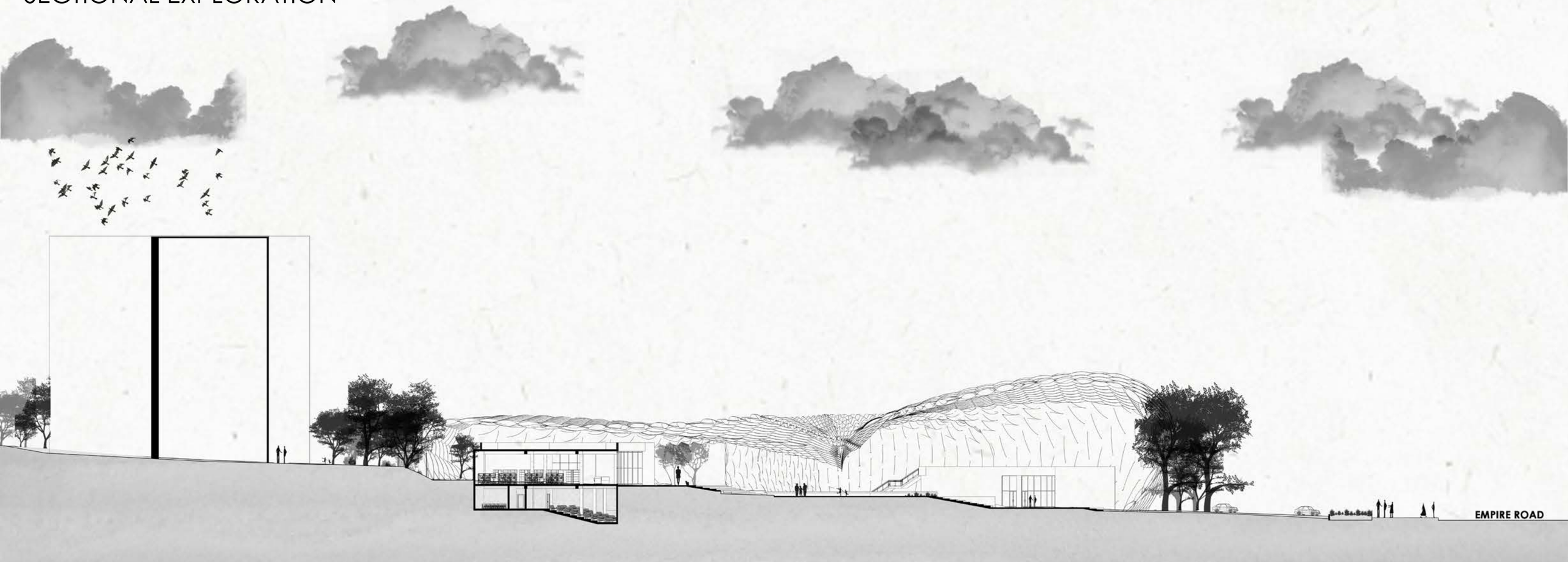
1. MICRON TRANSPARENT ETFE FOIL
2. EXTRUDED ALUMINIUM SECTION WITH EPDM GASKET
3. SYSTEM JOINT
4. STAINLESS STEEL ROD
5. MOVABLE WHEEL 180MM DAIMETER
6. STAINLESS STEEL SUPPORT 50X50MM
7. COMPOSITE CORNER COVER STRIO SCREWED ONTO
COMPOSITE WALL CLADDING
8. GMS LIPPED CHANNELS FIXED TO WALL MAXIMUM
SPACING 400C/C
9. MONOCIBEC CHIARPSCURO SOLAR NATURAL RECTIFIED 600X600MM TERRAZO TILE
10. 30MM CLASS II STRENGTH CATEGORY 2 SCREED
11. 80MM HYDROBOARD MOULDED THERMAL INSULATION BOARD
12. COFFE BROWN COMPOSITE WALL CLADDING SCREWED ONTO GMS CHANNELS
13. 255MM REINFORCED CONCRETE SLAB TO STRUCTURAL ENGINEERS DETAIL
14. 230MM FACEBRICK FBX FROM COROBRICK WITH BRICKFORCE EVERY FOURTH COURSE
15. 425X425MM REINFORCED CONCRETE BEAM
16. 425MM REINFORCED CONCRETE COLUMN TO STRCUTURAL ENGINEERS DETAIL
17. 230MM PLASTERBRICK RETAINING WALL WITH BRICKFORCED EVERY COURSE
18. 250 MICRON USB DAMP PROOF MEMBRANE ON WELL COMPACTED HARDCORE



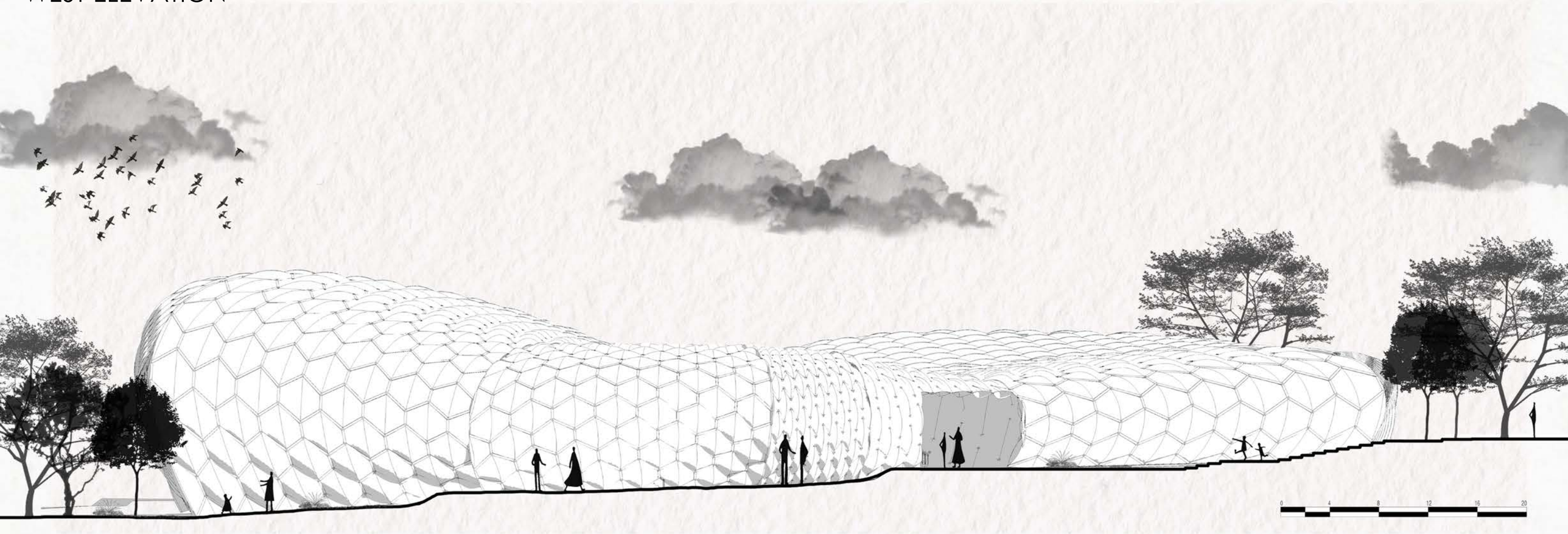




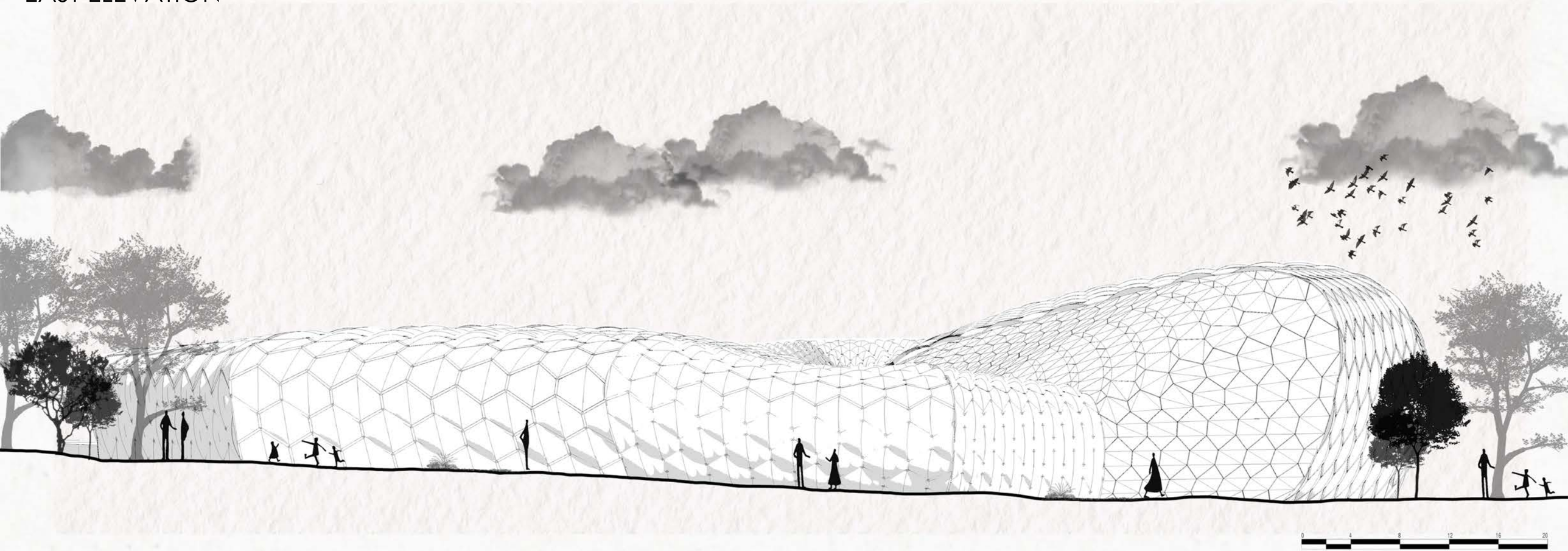
SECTIONAL EXPLORATION



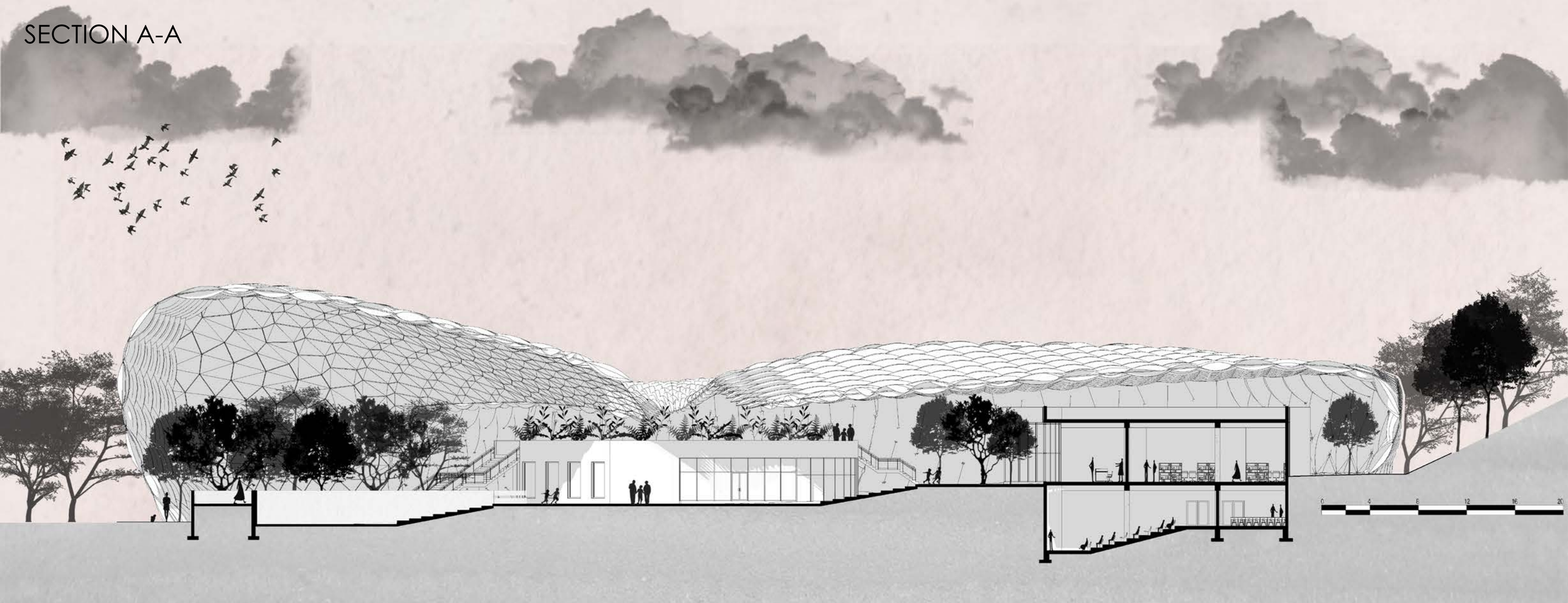
WEST ELEVATION

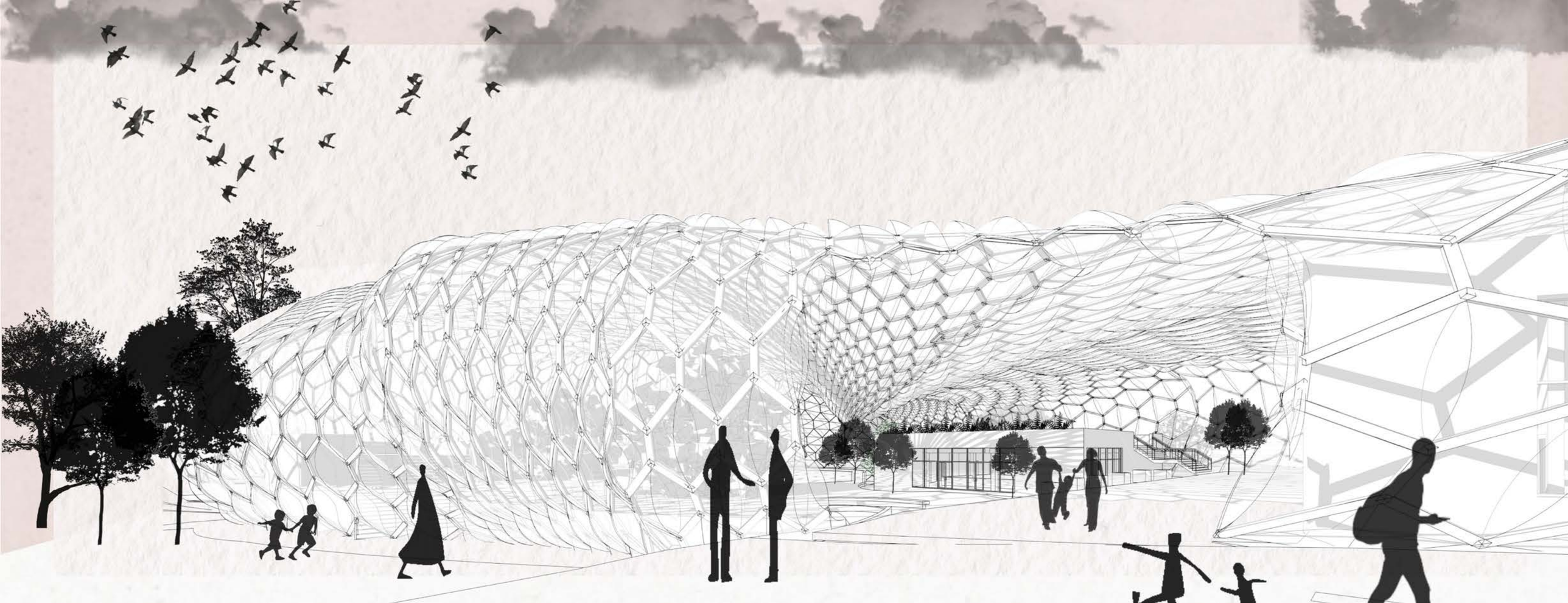


EAST ELEVATION



SECTION A-A

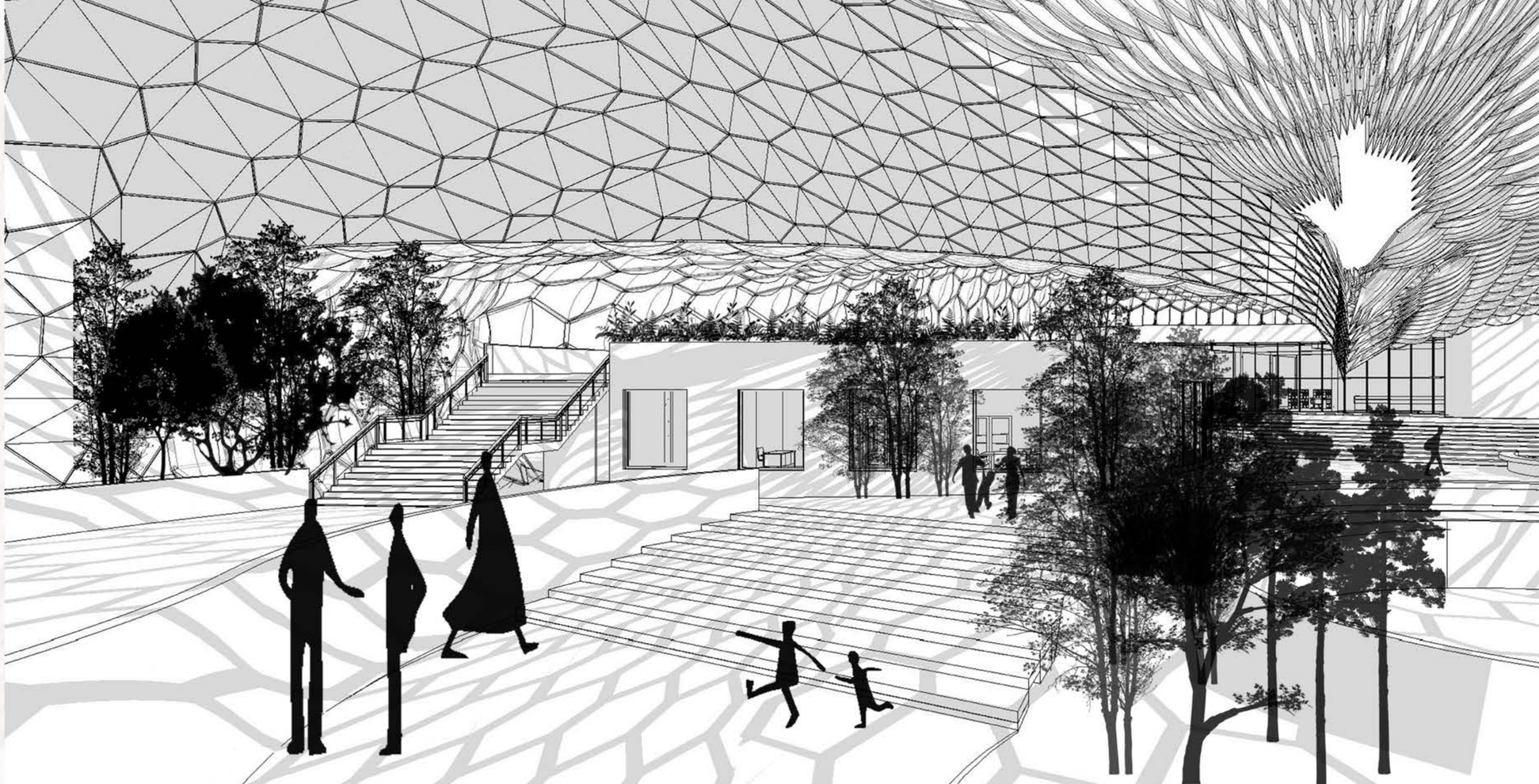


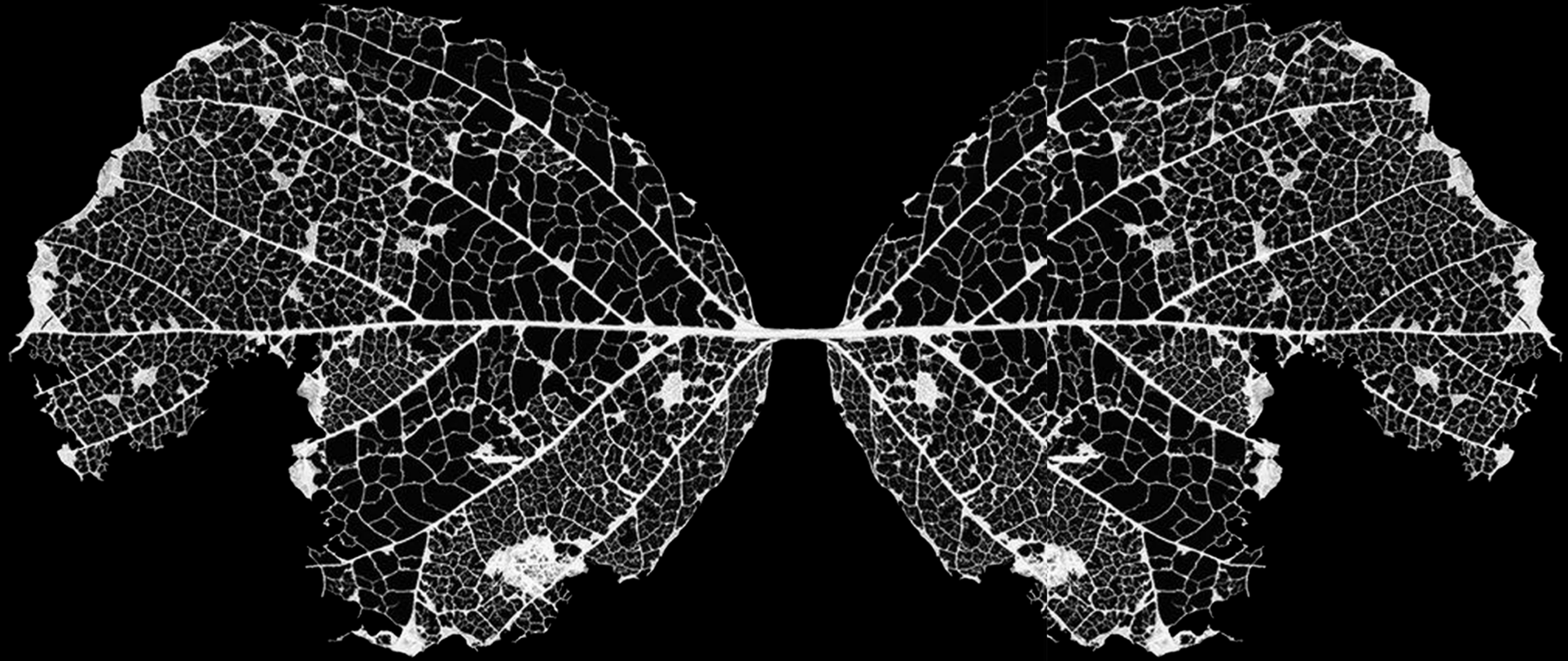


CONCLUSION

As the world deals with the perils of climate change, it is time that we stop viewing the building as an object, but rather view it as a collaborative element that is firmly connected to its natural environment, cultivating an ecological niche that woks in collaboration with nature (Nature x Humanity, 2020). It is time that the building becomes submerged in nature, blurring the line between the built fabric and what exists naturally. My proposed design aims to act a catalyst that allows architecture and nature to coexist, while creating a space for advanced technologies to be developed in order to generate a new approach to design. An approach that works in synergy in nature and is able to adapt, evolve and respond to its surroundings in a manner that is beneficial for architecture and beneficial for nature.

A prominent connection between what exists outside and inside is established, as opposed to the destruction of nature itself. Nature becomes a driving factor of the design and becomes just as important as the building itself. As life continues to evolve, so should the way in which we approach architecture and design. As we design “we borrow from nature the space upon which we build” (Ando, 2021) and so instead of destroying it completely in our efforts to create form, it should be intertwined in the spaces which we create. Blurring the line between what once inhabited the land and what became of it.





REFERENCES

REFERENCES

Abdalwahid, A. A., 2013. Zaha Hadid Form Making Strategies For Design. s.l.:s.n.

Ahmar, S. A. S. E., 2011. Biomimicry As A Tool For Sustainable Architectural Design. Egypt: Alexandria University.

AM3 Studio, 2018. AM3 Studio. [Online]
Available at: http://www.am3studio.it/index.asp?pag=project_sng&id=35
[Accessed 26 July 2022].

Ando, T., 2021. Dreamideamachine Art View. [Online]
Available at: http://www.dreamideamachine.com/?p=2670
[Accessed 08 September 2022].

Arnheim, R., 1954. Art and Visual Perception. London: University of California Press.

Baker, G. H., 1996. Le corbusier an analysis of form. London, Mew York: Spon Press.

Cobe, 2022. Cobe. [Online]
Available at: https://cobe.dk/idea/eu-joint-research-center
[Accessed 27 July 2022].

Divisare, 2014. [Online]
Available at: https://divisare.com/projects/256553-and-re-forest-of-tales
[Accessed 25 July 2022].

EL-MAHDY, D., 2017. Behaviour of Natual Organisms as a Mimicking Tool in Architecture. In: Design & Nature and Ecodynamics. Cairo: WIT Press, pp. 214-224.

Fabio Gramazio, M. K. S. L. (. g. V., 2014. Fabricate: Negotiating Design and Making. s.l.:UCL Press.

Hagan, S., 2001. Taking Shape: A New Contract Between Architecture and Nature. London: Architectural Press.

Headrick, D. R., 2019. Humans Versus Nature: A Global Environmental History. New York: Oxford University Press.

Imrie, R., 2021. Concrete Cities: Why We Need to Build Differently. Great Britin: Bristol University Press.

Jong, A. L. d., 2018. God Space. [Online]
Available at: https://godspacelight.com/2018/09/27/to-unravel-a-poem/
[Accessed 20 July 2022].

Michael Ulrich Hensel, A. M., 2008. Versatility and Vicissitude. s.l.:John Wiley & Sons Ltd.

Michelle Addington, D. S., 2005. Smart Materials and New Technologies: For Architecture and Design Professions. s.l.:Architectural Press.

Nature x Humanity. 2020. [Film] Directed by Neri Oxman & Carson Davis-Brown. United States of America: Neri Oxman and The Mediated Matter Group.

NERI OXMAN, J. L. M. K. J. D. a. C. G. U., 2017. SILK PAVILION: A CASE STUDY IN FIBRE-BASED DIGITAL FABRICATION. In: Fabricate 2014. s.l.:UCL Press, pp. 248-255.

Oxman, N., 2010. Material-based Design Computation. Massachusetts: Massachusetts Institute of Technology.

Sennett, R., 2008. The Craftsman. New Haven & London: Yae University Press.

The University of the Witwatersrand, 2000 - 2022. University of the Witwatersrand Johannesburg. [Online]
Available at: https://www.wits.ac.za/about-wits/history-and-heritage/
[Accessed 28 July 2022].

Tibbits, S., 2021. Thing Fall Together. Princeton: Princeton University Press.

Zolotovsky, K., 2012. BioConstructs methods for bio-inspired and bio-fabricated design. Massachusetts: Massachusetts Institute of Technology.



LIST OF FIGURE SOURCES

Figure 1: Revell, G (n.d.) Leaf Litter, California: Rainforest Action Network.

Figure 2: Jo Hoffman, M (2018) Extinct Flowers, Italy: Mattia Tarantino.

Figure 3: Unknown (n.d.) Nature, California: Pinterest.

Figure 4: Strauhmanis, E (2014) Spider Web, Canada: Flickr.

Figure 5: Holmes, R (n.d.) Spiders Silk, Canada: Flickr.

Figure 6: Holmes, R (2014) Dew Drops, Canada: Flickr.

Figure 7: Carstens, A (Circa 2020) Body Heat Melts Wax to Form Hexagons, Missoula: Biomimicry Institute.

Figure 8: Carstens, A (Circa 2020) Wax Hexagon Forms, Missoula: Biomimicry Institute.

Figure 9: Liu, T (2014) Shell Lace Structure, London: Tonkin Liu.

Figure 10: Purbita, S (2014) Royals of American Oil Divest from Fossil Fuels, New York: National Audubon Society.

Figure 11: Poliza, M (2018) Fairy Chimney Rock Formations, Washington DC: National Geographic Society.

Figure 12: Gerges, T (n.d.) When Nature Meets Architecture, California: CGarchitect.

Figure 13: MAD Architects (2018) Tunnel of Light, Japan: MAD Architects.

Figure 14: Myers, B (2012) X-ray Nautilus shell, New York: Tumblr.

Figure 15: Stein, B (n.d.) Chinese Lantern Seed Pods, France: Repro Tableaux.

Figure 16: Oxman, N (2016) Light Rays Reflected or Refracted by the Columns, Massachusetts: Massachusetts Institute of Technology.

Figure 17: Oxman, N (2015) Caustic Pattern of a 3D Printed Glass Structure, Massachusetts: Massachusetts Institute of Technology.

Figure 18: Oxman, N (2016) Disassembled Column, Massachusetts: Massachusetts Institute of Technology.

Figure 19: Oxman, N (2015) Reflected and Refracted Light, Massachusetts: Massachusetts Institute of Technology.

Figure 20: Oxman, N (2014-2020) Chitosan-Based Cellular Network. Colour Indicates Property Variations, Massachusetts: Massachusetts Institute of Technology.

Figure 21: Oxman, N (2014-2020) East Elevation, Massachusetts: Massachusetts Institute of Technology.

Figure 22: Oxman, N (2014-2020) 3D Printed Cellulose a Plant Derivative, Massachusetts: Massachusetts Institute of Technology.

Figure 23: Oxman, N (2014-2020) Internal View of Architectural Pavilion, Massachusetts: Massachusetts Institute of Technology.

Figure 24: Oxman, N (2020) Interior View of Kinetic Jig, Soluble Knit and Live Silkworms in the Spinning Phase, Massachusetts: Massachusetts Institute of Technology.

Figure 25: Oxman, N (2020) Concentrated Silk Deposition at Point Connections Between Knit and Suspension Cables, Massachusetts: Massachusetts Institute of Technology.

Figure 26: Oxman, N (2020) Fifth Instar Silkworms Upon Dissolvable Knit, Massachusetts: Massachusetts Institute of Technology.

Figure 27: Oxman, N (2020) Unique Spinning Patterns of Flattened Cocoons' Spread over Soluble Knit, Massachusetts: Massachusetts Institute of Technology.

Figure 28: Christodoulou, A (2019) Escape to a Dreamland, Cape Town: Alexis Christodoulou Studio.

Figure 29: Christodoulou, A (2020) Let Nature In, Cape Town: Alexis Christodoulou Studio.

Figure 30: Christodoulou, A (2019) Hues of Rust and Bronze, Cape Town: Alexis Christodoulou Studio.

Figure 31: Voge, C and MASU (2017) Site Plan, Odense, Denmark: Kengo Kuma and Associates.

Figure 32: Voge, C and MASU (2017) Section, Odense, Denmark: Kengo Kuma and Associates.

Figure 33: AM3 Architetti Associati (2018) Rural Lab, Gibellina Italy: AM3 Architetti Associati.

Figure 34: AM3 Architetti Associati (2018) Freespace, Gibellina Italy: AM3 Architetti Associati.

Figure 35: AM3 Architetti Associati (2018) Sectional Illustrations, Gibellina Italy: AM3 Architetti Associati.

Figure 36: Cobe (2022) EU Joint Research Center, Seville Spain: Cobe.

Figure 37: Cobe (2022) Building Placement, Seville Spain: Cobe.

Figure 38: Cobe (2022) Connecting Terraces, Seville Spain: Cobe.

Figure 39: Cobe (2022) Intimate Green Spaces, Seville Spain: Cobe.

Figure 40: Cobe (2022) Roof Capabilities, Seville Spain: Cobe.

Figure 41: Cobe (2022) Greenspaces, Seville Spain: Cobe.

Figure 42: Cobe (2022) Cross Ventilation, Seville Spain: Cobe.

Figure 43: And_Re (2014) Forrest of Tales Perspective A, Odense Denmark: And_Re.

Figure 44: And_Re (2014) Forrest of Tales Perspective B, Odense Denmark: And_Re.

Figure 45: And_Re (2014) Forrest of Tales Perspective C, Odense Denmark: And_Re.

Figure 46: And_Re (2014) Forrest of Tales Perspective D, Odense Denmark: And_Re.

Figure 47: Voge, C and MASU (2017) Ground Floor Plan, Odense, Denmark: Kengo Kuma and Associates.

Figure 48: Voge, C and MASU (2017) Longitudinal Section, Odense, Denmark: Kengo Kuma and Associates.

Figure 48: Voge, C and MASU (2017) Longitudinal Section, Odense, Denmark: Kengo Kuma and Associates.

Figure 49: Voge, C and MASU (2017) Rendering A, Odense, Denmark: Kengo Kuma and Associates.

Figure 50: Voge, C and MASU (2017) Rendering B, Odense, Denmark: Kengo Kuma and Associates.

Figure 51: WWF (2019) Deforestation, Europe: WWF.

Figure 52: Author (2022) Nolli Map, Johannesburg: University of the Witwatersrand.

Figure 53: Author (2022) Green Space, Johannesburg: University of the Witwatersrand.

Figure 54: Author (2022) Green Space Map, Johannesburg: University of the Witwatersrand.

Figure 55: Author (2022) Building Programme, Johannesburg: University of the Witwatersrand.

Figure 56: University of the Witwatersrand (1896) Wits University Early Beginnings, Johannesburg: University of the Witwatersrand.

Figure 57: Author (2022) History of Wits, Johannesburg: University of the Witwatersrand.

Figure 58: Author (2022) Location and Site, Johannesburg: University of the Witwatersrand.

Figure 59: Author (2022) Macro City, Johannesburg: University of the Witwatersrand.

Figure 60: Author (2022) Major Nodes Johannesburg: University of the Witwatersrand.

Figure 61: Author (2022) Major Routes, Johannesburg: University of the Witwatersrand.

Figure 62: Author (2022) Circulation, Johannesburg: University of the Witwatersrand.

Figure 63: Author (2022) Movement and Circulation, Johannesburg: University of the Witwatersrand.

Figure 64: Author (2022) Pedestrian Access, Johannesburg: University of the Witwatersrand.

Figure 65: Author (2022) Green Infrastructure, Johannesburg: University of the Witwatersrand.

Figure 66: Fairbridge, D (1922) Gateway at Boshof, London: Humphrey Milford.

Figure 67: Google (2022) Wits Ground Keepers House, Johannesburg: Google.

Figure 68: Author (2022) Willow Tree, Johannesburg: University of the Witwatersrand.

Figure 69: Author (2022) Historical Trees, Johannesburg: University of the Witwatersrand.

Figure 70: Author (2022) Site Context, Johannesburg: University of the Witwatersrand.

Figure 71: Author (2022) Sectional Exploration, Johannesburg: University of the Witwatersrand.

Figure 71: Author (2022) Notion of Connection Between the City and Campus, Johannesburg: University of the Witwatersrand.

Figure 73: Author (2022) Design Scheme A, Johannesburg: University of the Witwatersrand.

Figure 74: Author (2022) Design Scheme B, Johannesburg: University of the Witwatersrand.

Figure 75: Author (2022) Initial Floor Plan Layout, Johannesburg: University of the Witwatersrand.

Figure 76: Author (2022) Ground Floor, Johannesburg: University of the Witwatersrand.

Figure 77: Author (2022) First Floor, Johannesburg: University of the Witwatersrand.

Figure 78: Author (2022) Section A, Johannesburg: University of the Witwatersrand.

Figure 79: Author (2022) Section B, Johannesburg: University of the Witwatersrand.

Figure 80: Author (2022) Perspective A, Johannesburg: University of the Witwatersrand.

Figure 81: Author (2022) Perspective B, Johannesburg: University of the Witwatersrand.

Figure 82: Author (2022) Connecting with Nature, Johannesburg: University of the Witwatersrand.

Figure 83: Author (2022) Initial Floor Layout, Johannesburg: University of the Witwatersrand.

Figure 84: Author (2022) Ground Floor, Johannesburg: University of the Witwatersrand.

Figure 85: Author (2022) First Floor, Johannesburg: University of the Witwatersrand.

Figure 86: Author (2022) Second Floor, Johannesburg: University of the Witwatersrand.

Figure 87: Author (2022) Section A, Johannesburg: University of the Witwatersrand.

Figure 88: Author (2022) Terraced Landscape Site Plan, Johannesburg: University of the Witwatersrand.

Figure 89: Author (2022) Building Mass in Relation to the Sun, Johannesburg: University of the Witwatersrand.

Figure 90: Author (2022) Building Form in Relation to the Sun, Johannesburg: University of the Witwatersrand.

Figure 91: Author (2022) Initial Ground Floor Layout, Johannesburg: University of the Witwatersrand.

Figure 92: Author (2022) Initial First Floor Layout, Johannesburg: University of the Witwatersrand.

Figure 93: Author (2022) Initial Second Floor Layout, Johannesburg: University of the Witwatersrand.

Figure 94: Author (2022) Ground Floor, Johannesburg: University of the Witwatersrand.

Figure 95: Author (2022) First Floor, Johannesburg: University of the Witwatersrand.

Figure 96: Author (2022) Second Floor, Johannesburg: University of the Witwatersrand.

Figure 97: Author (2022) Section A, Johannesburg: University of the Witwatersrand.

Figure 98: Author (2022) Terraced Landscape Site Plan, Johannesburg: University of the Witwatersrand.

Figure 99: Author (2022) Building Mass in Relation to the Sun, Johannesburg: University of the Witwatersrand.

Figure 100: Author (2022) Orthogonal Grid, Johannesburg: University of the Witwatersrand.

Figure 101: Author (2022) Design Final Iteration 1, Johannesburg: University of the Witwatersrand.

Figure 102: Author (2022) Design Final Iteration 2, Johannesburg: University of the Witwatersrand.

Figure 103: Author (2022) Roof Iteration1 View 1, Johannesburg: University of the Witwatersrand.

Figure 104: Author (2022) Roof Iteration1 View 2, Johannesburg: University of the Witwatersrand.

Figure 105: Author (2022) Roof Iteration 2 View 1, Johannesburg: University of the Witwatersrand.

Figure 106: Author (2022) Roof Iteration 2 View 2, Johannesburg: University of the Witwatersrand.

Figure 107: Author (2022) Final Roof Iteration View 1, Johannesburg: University of the Witwatersrand.

Figure 108: Author (2022) Final Roof Iteration View 2, Johannesburg: University of the Witwatersrand.

Figure 109: Author (2022) Sketch Plan, Johannesburg: University of the Witwatersrand.

Figure 110: Author (2022) Initial Floor Plan, Johannesburg: University of the Witwatersrand.

Figure 111: Author (2022) Iteration Floor Plan 2, Johannesburg: University of the Witwatersrand.

Figure 112: Author (2022) Summer Solstice, Johannesburg: University of the Witwatersrand.

Figure 113: Author (2022) Winter Solstice, Johannesburg: University of the Witwatersrand.

APPENDIX

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG | SCHOOL OF ARCHITECTURE PLANNING

13 June 2022

Faculty of Engineering and the Built Environment:

Ethics clearance letter:

Dear Lungo Katete

Student number (1415842), this letter confirms that your ethics application has been cleared. Your clearance/protocol number: SOAP010/03/2022

Yours sincerely

Lerato Nkosi

School of Architecture and Planning, Faculty of Engineering and the Built Environment, John Moffat Building, Wits, 2050, South Africa
Tel: +27 11 717- 7692| Email: lerato.nkosi@wits.ac.za | www.wits.ac.za

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

Private Bag 3 Wits, 2050
Fax:
Tel:

Reference: Mr Yaseen Stoffberg
E-mail: facultyregistrar.ebe@wits.ac.za

09 September 2022
Person No: 1415842
PAA

Miss L Katete
Po Box 12626
Vorna Valley
Midrand
1686
South Africa

Dear Miss Lungo Katete

Master of Architecture (Professional): Acknowledgement of receipt of research proposal

I am pleased to acknowledge receipt of your research proposal entitled *Unravelling Nature: Integrating architecture and nature* under the supervision of Gustavo Triana Martinez (Principal Supervisor).

You will hear from us in due course.

Yours sincerely

Mr Yaseen Stoffberg
Faculty Registrar
Faculty of Engineering and the Built Environment

100 1922 2022

ARCHITECTURE AND NATURE
INTERCRATING
NATURE
UNRAVELLING