



# CHALMERS

## THE BIO BUILDING

*Bio inspired design at Ålgårds Mill and Saw*

**LORENA GISMONDI PETT**

Master Thesis at Chalmers Architecture  
Program of Design for Sustainable Development  
CHALMERS UNIVERSITY OF TECHNOLOGY  
Gothenburg, Sweden 2016





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## ABSTRACT

Bio inspiration has been long present in human history, by creating structures with bio morphological characteristics, systems inspired by natural processes, and interpretations of nature used for aesthetic purposes, thus enhancing our senses and fulfilling our needs.

Our innate biological connexion is manifested by perceiving and processing, information and meaning of natural elements and types of environments, the way we live, think, feel and act is a reflection of these perceptions.

The rapid urbanization, evolution of technology and prioritisation of economic aspects, create an artificial culture which is detached from nature conceiving buildings and humans as protagonists of the environment instead of a part of it.

This thesis aims at creating experiences, which could change the view "being in contact with nature" into "being connected to nature" physically and mentally. A regenerative built environment is created, by using bio Architecture as a teaching and inspiring tool of reconnect-

tion with natural systems.

In order to achieve healthier designs and a healthier sustainable culture, it is necessary to interconnect nature, architecture, and technology.

In the presented work, a bio inspired design is proposed for an eco tourist destination in the south west of Sweden, biomimetics and biophilia are the tools for synthesizing an architecture which is in tune with nature, the proposal incorporates sensorial and biomorphological elements for the site design, and zooms in to "the bio building" an eco cottage which explores biomimetics with biophilic qualities, the building is intended to produce a new breed of eco tourists that could take this experience home, and see as a possible future " The bio era".

The work ends with a open discussion of how a bio inspired future could look like.

*"In order to successfully integrate ecology and design, we must mirror nature's deep interconnections in our own epistemology of design" (ECOLOGICAL DESIGN - Sim Van Der Ryn, Steward Cowan p.3)*

**Keywords:** Bio inspiration, Biomimetics, Biophilic design, natural living, Ecotourism.

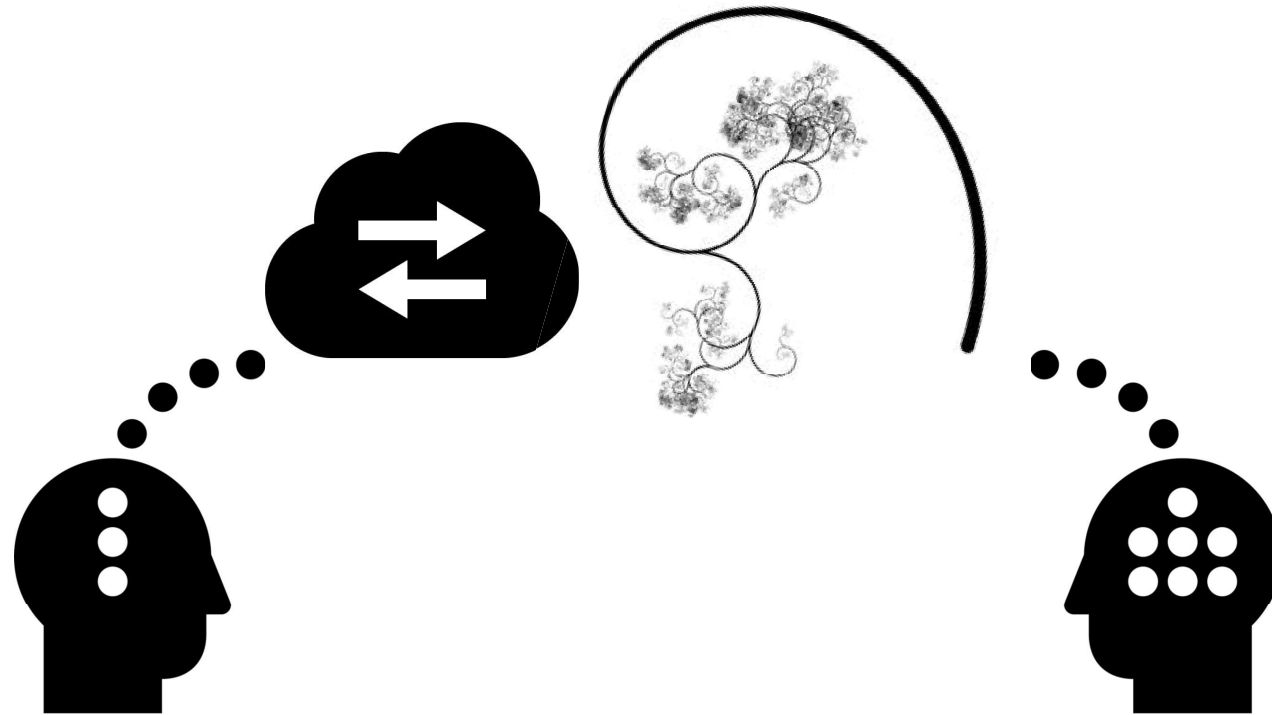
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# CHAPTER 1

## INTRODUCTION



## 1.1 INTRODUCTION

### Why is important to reconnect ourselves with nature?

Each day there are built, refurbished and demolish thousands of buildings around the world, generating waste, using large amounts of energy, consuming, polluting and wasting valuable resources of the planet.

Humans transform their surroundings to fit their own needs, taking into consideration almost only economic aspects. This has created a culture which is detached from "nature" considering it as something to take advantage, instead of being a part of.

Reconnect and get inspired by nature is highly important to reach a sustainable development, as nature has solved the problems that humanity is trying to solve, without creating reverse aspects and even more integrating the answers and generating a chain of events where every system benefits from the other.

Architecture is always a response to tradition and culture of its time. It reflect the pulse of society, environment action, life style of inhabitants and their aesthetic value as well as their building technology. ( Almjad Almusaed, 2011)

Architecture plays an important role in how humans interact with their surroundings and it is a decisive component at influencing people's life styles. In order to achieve healthier designs and a healthier sustainable development, nature and architecture should have a deeper connection and better understanding of the benefits of a comprehensive interaction.

Historically Architects through time have taken Nature as a way of inspiration...not only of the functional and structural efficiencies, but also of the patterns and cycles of life... to create an architecture that sprout, grow, and harmonize with surrounding environments. (Shafik Ramzy, 2015)

It is clear to think that architecture that imitates nature will be a more sustainable one, for this reason nature is still an inspiration source for contemporary architects, that keep trying to connect to it and learn from it; taking different pathways, bio-mimicry, bio-gnosis, bio-philial, and bio-morphology all have the same concern, but with different priorities, weightings, and principles. (Shafik Ramzy, 2015)

Nowadays when we think about a deep connection with nature, we normally imagine a walk in the woods or if we really mean it, a trip into a lost eco cottage somewhere in the forest, where we will be a tourist, detach from our daily life and ready to "get dirty", possibly thinking in staying a couple of days in a small place deprive from the comfort and technology of our home. But what if we could see eco tourism as a tool to teach and inspire sustainable living and as a laboratory to test new biotechnology?

In the work presented in this thesis, I want to explore the view of sustainable living and human connection with nature, by implementing design criteria of awareness and integration to the surrounding ecosystem.

It is clear that the way we live, affects the way we think and see the world, for this reason psychological aspects that induce a deep connection with nature are highly important design criteria.

In addition to answer a design with morphological and psychological qualities inspired by nature, the design attempts to challenge the view of eco tourism into a more inclusive design that can reach and inspire all kinds of tourists.

## 1.2 AIM OF THE THESIS

The aim of this thesis is focused on an ideal future of architecture, where bio inspiration plays the main role in all processes of design, where I intend to answer one main question and a sub question:

***How can Architectural design get inspired by nature to encourage a bio based future?***

*How can design criteria derived from such approach be implemented in a design project?*

I intend to answer these questions through a design for a real client in a specific location.

The design is divided in 2 focus points:

- Propose a unique eco tourist experience, where all elements of nature are enhanced and can be fully enjoyed by visitors and people passing by. Use the site as a teaching system of sustainable living and connection with natural flows, supporting the local economy and respecting the local culture.
- Design a bio inspired building with biomimetic and biophilic principles as design criteria, where materials, shapes, systems, construction and sensations inspire its visitors into a new possible bio future.

## 1.3 DELIMITATIONS

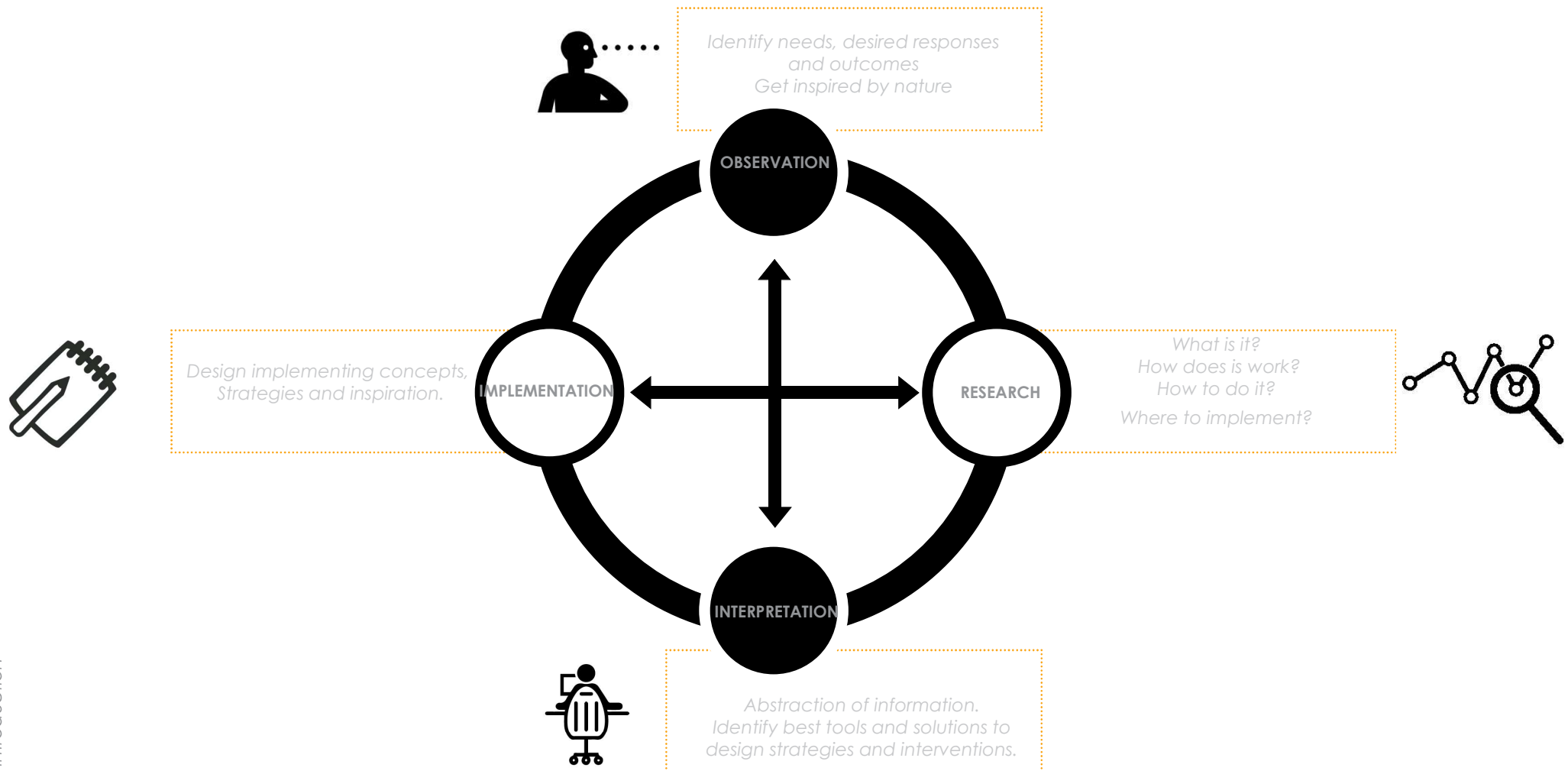
**1** The concept, idea and end view of the site is extensive and requires much time and detail for a fully developed design, because of this, only concepts and strategies that would serve as a guide for the possible implementation will be presented.

**2** Technological elements that will be introduced in this thesis, are indicative only and are taken from existing prototypes, it is not to give a final solution to the implementation of such, but to show the possibility that in the future similar technologies can be used in designs of this type.

**3** The boundaries of the site are given by the client, the design intervention in this thesis is limited by these boundaries, although driving forces and external factors should be taken into consideration as reality shows that any intervention has no land limits, it is affected and affects at a local and global level.

## 1.4 DESIGN PROCESS

The design process was conformed by a wheel which cross intersect itself, this process was a continuous back and forward and think again, this wheel has 4 main stages: Observation, research, interpretation and implementation.



# OUTLINE OF THESIS

## CHAPTER 1

*The first chapter is introductory to the project, the reader will be able to understand what is the context surrounding the subject, the aim of the thesis, delimitations and how the design process was carried out.*

## CHAPTER 2

*This chapter introduces concepts of bioinspiration, Biophilia, biomimetics and Eco tourism. Examples of eco tourism in Swedish context are shortly described.*

## CHAPTER 4

*This chapter covers the first and second design step, it begins with design strategies linked to biophilic qualities and eco tourism, it continues to explain how they were implemented on each element of the design.*

## CHAPTER 3

*The third chapter presents the Client of this thesis, shows an analysis of the site of intervention and explains the conceptual idea that links the research questions, bioinspiration and Client/site analysis, resulting in design steps for its implementation.*

## CHAPTER 5

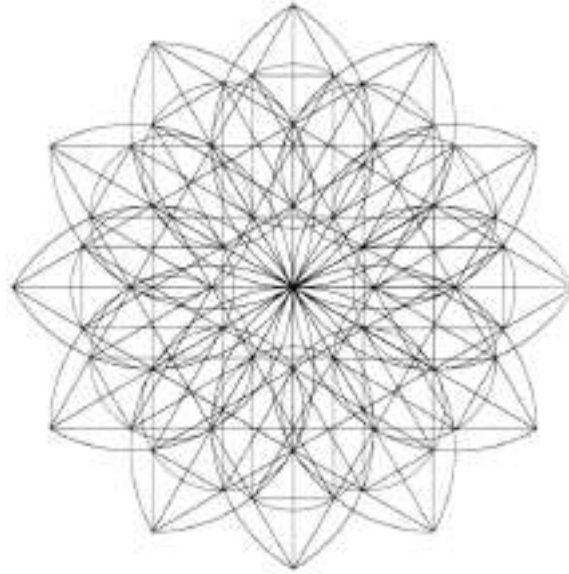
*In this part the third step of design is presented, this chapter begins with a mapping of design elements that conform the bio building, following by developing each bio inspired part, form, construction, materials and systems.*

## CHAPTER 6

*In the final chapter a conclusion to the work is discussed, where a reflection the main questions of my thesis are related to the result of the project.*

# CHAPTER 2

## BIO INSPIRATION



## 2.1 BIOPHILIA

**Biophilia** is a contemporary philosophy of architecture, which is based in the theory that human health and well-being has a biologically-based need to affiliate with nature (Wilson, 1993). This approach seeks to find the answers in nature, not by replicating its forms, but by finding qualities within which affect our sensorial system in order to improve the conditions in which humans live and develop activities.

The term 'biophilia' was first coined by social psychologist Eric Fromm (*The Heart of Man*, 1964) and later popularized by biologist Edward Wilson (*Biophilia*, 1984). The sundry denotations – which have evolved from within the fields of biology and psychology, and been adapted to the fields of neuroscience, endocrinology, architecture and beyond – all relate back to the desire for a (re)connection with nature and natural systems. (Browning, Ryan, Clancy, 2014)

The biologist Stephen Boyden argues that environments need to fully satisfy both "survival needs" and well-being needs (Boyden, 1971). The built environment should seek to address these qualities to influence a healthy development of the human mind and body.

The descriptive term "patterns" is used in Biophilia to propose a clear and standardized language of the special qualities of this design. They are meant to guide and assist the design process.

Based on "14 patterns of Biophilic design by terrapin" these patterns are divided into 3 categories:

### **Nature in the Space**

*P1. Visual Connection with Nature.* A view to elements of nature, living systems and natural processes.

*P2. Non-Visual Connection with Nature.* Auditory, haptic, olfactory, or gustatory stimuli that engender a deliberate and positive reference to nature, living systems or natural processes.

*P3. Non-Rhythmic Sensory Stimuli.* Stochastic and ephemeral connections with nature that may be analysed statistically but may not be predicted precisely.

*P4. Thermal & Airflow Variability.* Subtle changes in air temperature,

relative humidity, airflow across the skin, and surface temperatures that mimic natural environments.

*P5. Presence of Water.* A condition that enhances the experience of a place through seeing, hearing or touching water.

*P6. Dynamic & Diffuse Light.* Leverages varying intensities of light and shadow that change over time to create conditions that occur in nature.

*P7. Connection with Natural Systems.* Awareness of natural processes, especially seasonal and temporal changes characteristic of a healthy ecosystem.

### **Natural Analogues**

*P8. Biomorphic Forms & Patterns.* Symbolic references to contoured, patterned, textured or numerical arrangements that persist in nature.

*P9. Material Connection with Nature.* Materials and elements from nature that, through minimal processing, reflect the local ecology or geology and create a distinct sense of place.

*P10. Complexity & Order.* Rich sensory information that adheres to a spatial hierarchy similar to those encountered in nature.

### **Nature of the Space**

*P11. Prospect.* An unimpeded view over a distance, for surveillance and planning.

*P12. Refuge.* A place for withdrawal from environmental conditions or the main flow of activity, in which the individual is protected from behind and overhead.

*P13. Mystery.* The promise of more information, achieved through partially obscured views or other sensory devices that entice the individual to travel deeper into the environment.

*P14. Risk/Peril.* An identifiable threat coupled with a reliable safeguard. (Browning, Ryan, Clancy, 2014)

### *How can it be implemented in this project?*

Each of the patterns stimulates human senses and creates specific responses to human/nature relationships, the patterns will be applied at all levels and scales of architectural design.

From this approach I will use elements of nature to provoke or stimulate physical and psychological human responses. Biophilia cares most about the human experience.

Biophilia in this design is sometimes applied unconsciously, traces of these patterns will be visible in many parts, where aesthetics and provoked sensations shape the design criteria, this is done to enhance the innate search of the human being, to connect to natural elements.

To this particular design, Biophilia will help to form a site and a building thinking in human/nature relationships, and will reinforce the emotional desired response "connect with nature for the sake of well being".

Biophilia will guide the design into the specific outcome, "Inspire a bio based future" by experiencing well being and sensorial stimulation.

## 2.2 BIO MIMETICS

**Bio Mimimetics** implies the understanding of biological structures and processes and their comparable technological applications, methods, or procedures. (Phol,Nachtigall, 2015)

In Germany, the pioneers of this field were Heinrich Hertel and Ingo Rechenberg. Werner Nachtigall performed substantial research in the areas of technical biology and biomimetics and promoted the use of "precedents in nature" for technology and economics for decades. Engineers and architects such as Richard Buckminster Fuller and Frei Otto had concerned themselves since the 1950s with "natural structures" and developed structures that have not lost any of their fascinating appeal. Otto linked "natural structures" with the aesthetic and functional expressions of buildings so that they appear logical or "natural," and with the aid of technology they accomplish similar tasks as they do in nature. (Phol,Nachtigall, 2015)

This design approach refers to the fact that natural models have evolved in a process of millions of years and have developed extremely complex solutions depending on various conditions, this can be translated in the optimization of structures, forms, functions and systems. Biomimeticis is not only about mimicking shapes of nature, furthermore it refers to understanding the laws of nature, "in nature the principle of integration of function+form+structure is effective, and it's adapted to the existent and interrelation with the environment." (Lebedew,1983)

As nature and natural elements respond to a complex evolution according to its function and environment, the implementation of its qualities must not have a too direct interpretation, it should go through a three-step-process, for a more adapted and efficient result.

### **Research → Abstraction → Implementation**

The term covers materials, applications, modes of operation, entities, design, or management (Phol,Nachtigall, 2015)

The subjects of biomimetics can be summarized by 3 fundamental disciplines:

- *Structure biomimetics* pertains to issues of substances, materials, prosthetics, and robotics.
- *To process biomimetics* belong the corresponding viewpoints of climate and energy, construction and possibly architectural design, sensor technology, and ultimately kinetics and dynamics of machine construction.
- *Development or evolution biomimetics* ultimately encompasses areas of neurophysiology, the already implied aspects of biological evolution, and also corresponding viewpoints of procedural and organizational methods.

(Phol,Nachtigall, 2015)

But if we refer directly to Biomimetics in architecture the term "building biomimetic" is used where architects and engineers apply the research of these disciplines, and biologically inspired components, or parts of a building. Architecture uses biomimetics as a tool for creativity.

A building it's considered Biomimetic if it fulfil the following criteria:

1. Biological precedent
2. *Abstraction from biological precedent*
3. Transfer and application

Biomimetic buildings are classified as:

Similar to nature: buildings as sculptures similar in appearance to nature  
Nature analogue: building methods analogous to nature  
Integrative: biomimetic principles as components of architecture

A building it's a complex machine and biomimetics is a source of knowledge in technology and nature and a tool to help us integrate bio inspired solutions into designs that are more efficient in form, material, construction, process and function.

### *How can it be implemented into this project?*

Biomimetics helps us understating nature's design solutions, which are most effective and efficient.

The implementation of this field of architecture in designs also affect humans in a psychological way, but its implementation is more directed to functional and material, aspects, It refers to Nature's engineering.

The implementation of Biomimetics in this project, will be by observing the structure and functioning of nature elements at the site of intervention, as well as researching the functioning of such, to later on, apply them on the design.

The design will follow biomimetic principles by mimicking and responding in a positive way, as a native plant would do, to the terrain, weather conditions, functioning systems, structures and relationship with the ecosystem.

## 2.3 ECO TOURISM

**Eco tourism** is defined as “responsible travel to natural areas that conserves the environment, sustains the well-being of the local people, and involves interpretation and education” (TIES, 2015)

Eco tourism is about conservation of natural and cultural heritage, through providing economical incentives, it empowers local communities by creating employment opportunities fighting against poverty and achieving a sustainable development. By creating enriching personal experiences and environmental awareness, it promotes a greater understanding for nature, local society and culture.

According to “The International Eco tourism society” the creation of eco tourism destinations must take into account the following principles:

- Minimize physical, social, behavioural and psychological impacts.
- Build environmental and cultural awareness and respect.
- Provide positive experiences for both visitors and hosts.
- Provide direct financial benefits for conservation.
- Generate financial benefits for both local people and private industry.
- Deliver memorable interpretative experiences to visitors that help raise sensitivity to host countries' political, environmental, and social climates.
- Design, construct and operate low-impact facilities.
- Recognize the rights and spiritual beliefs of the people in the country and work in partnership with them to create empowerment.

**Eco-lodges** are part of an eco tourism destination, and are defined as “a tourist accommodation facility designed to have minimal impact on the environment, often constructed as part of an environmental project” (dictionary reference, 2015)

These facilities' main concern is to allow a safe and non-toxic environment that is integrated with the natural surroundings, which protects native flora and fauna, and supports biodiversity. Non-chemical products should be used in the cleaning or maintaining the facilities, and encourages its visitors to bring only natural products.

The main characteristics of Eco lodges are:

- Uses local, sustainable building materials where possible.
- Is small, usually less than 20 rooms.
- Employs energy saving tactics and renewable energy where possible.
- Buildings are built in harmony with the natural surroundings.
- Buildings consume less than 1/3 of the overall land area.
- Buildings reflect traditional designs.
- Uses only local trades persons where possible.
- Recycles organic, and non organic wastes where possible.
- Has a system in place to offset carbon.

(baliecolodge, 2015)

### How can it be implemented into a design?

By taking into consideration eco tourism principles combined with the clients ambitions (pp. 20) The design as well as the material selection are thought to minimize the impact to the surroundings, as well as conserving the natural habitat by being in harmony with it.

The place and design, aims to attract locals as well as visitors, to create a meeting point, where they can appreciate the rich natural and cultural heritage of the place. By designing a beautiful sustainable place to stay, relax and enjoy it will contribute to the self-financing of the Algars Mill and Saw, as well as preserving the Mill and Saw cultural heritage for generations to come.

## 2.4 EXAMPLES IN SWEDEN

Following three of the most interesting examples of tourism in nature, with characteristics of eco tourism, biophilia and biomimetics.

### Kollarbyn *Primitive experience*

The hostel is a collection of charcoal huts in the middle of the spruce forest close to a lake.

- No electricity/running water
- Bio materials in buildings
- Minimum size, 2 people/cottage
- Economical support to conservation of nature and cultural values
- Outdoor activities

### Urmatur *Traditional experience*

The hotel is located in a forest close to a lake and has a main building that can host up to 30 people.

- No electricity
- Bio materials in buildings
- Different sizes of cottages, for 1 to 4 people
- Ecological products for sale
- Offers seminars, workshops, exhibitions and outdoor activities

### Tree hotel (the bird nest). *Modern experience*

The main attraction of this hotel is that all the “cottages” are placed up from the ground resembling the tree houses, each with its own theme, and with a exclusive design.

- Partially bio materials in buildings
- Different sizes of cottages, for 1 to 4 people
- Luxury experience in nature.
- Outdoor activities.
- This cottage can be labelled as a biomimetic building as it mimics the nest of a bird.



Pictures\*source Kollarby



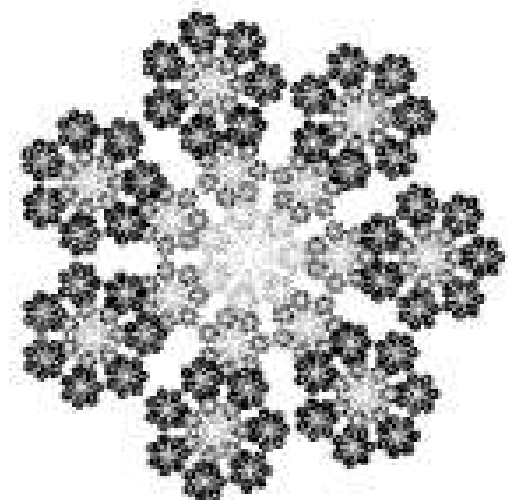
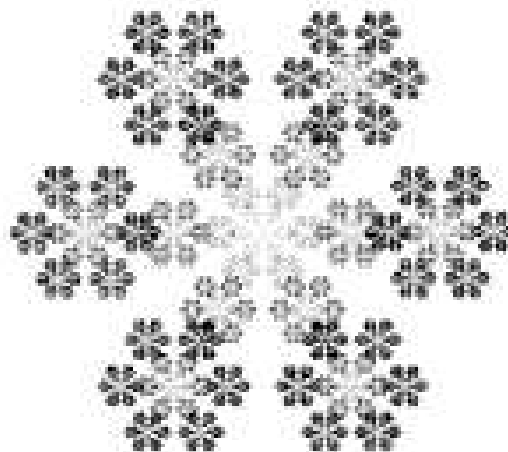
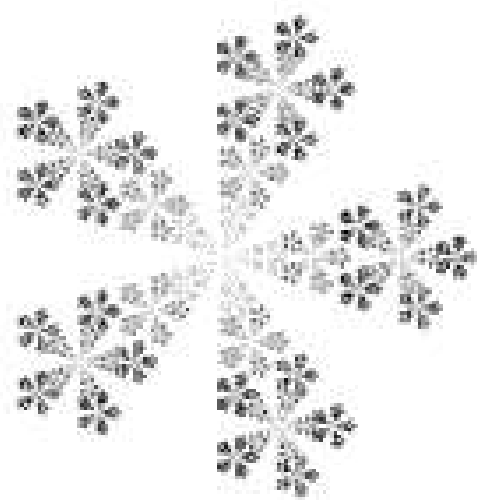
Pictures\*source Urmatur.se



Bird nest Pictures\*source Treehotel.se

# CHAPTER 3

## CLIENT, SITE AND IDEA



## 3.1 FÖRENINGEN ÅLGÅRD

### Who are they?

**Föreningen Ålgård** is the client of this Thesis. They are a voluntary group conformed by people that mostly live in the area of Ålgård located in the island of Orust. This group works together with the Orust council to conserve, revitalize and activate the property of Ålgårds mill and saw owned by the local council. Most of them have created memories and followed the history of the place since they were children, they see the place as a meeting point and as part of their lives and they wish this history to continue to evolve and be even better.

Most of the people conforming the group share interests of sustainable living, respect for nature and community values as well as an interest to conserve their cultural heritage. These people Love Ålgårds mill and saw and nature!

### What is their aim?

Their main interest is to develop the site and create better conditions and opportunities for the community. The main idea is to conserve the historical value, and the rich natural diversity found in the area as well as creating an attraction center not only for the community but for people from everywhere.

Throughout the years they have pursued this aim by creating activities with sustainable values and working towards the renovation and activation of the historical buildings at Ålgårds mill and saw.

### Which is their design request and their role in this thesis?

Föreningen Ålgård plays a big part in this thesis as it's their need of activating the site and their request of eco cottages that are the scenario where my research questions will be answered with a design for this specific context and for their specific needs.

Meetings with members of the group and visits to Ålgårds mill and saw were carried out as a fundamental part of the design process. A continuous communication with the group and their collaboration with information have been key to the development of this design.



Pictures \* source Föreningen Ålgård

## 3.2 ÅLGÅRDS KVARN OCH SÅG

Where is the site located?



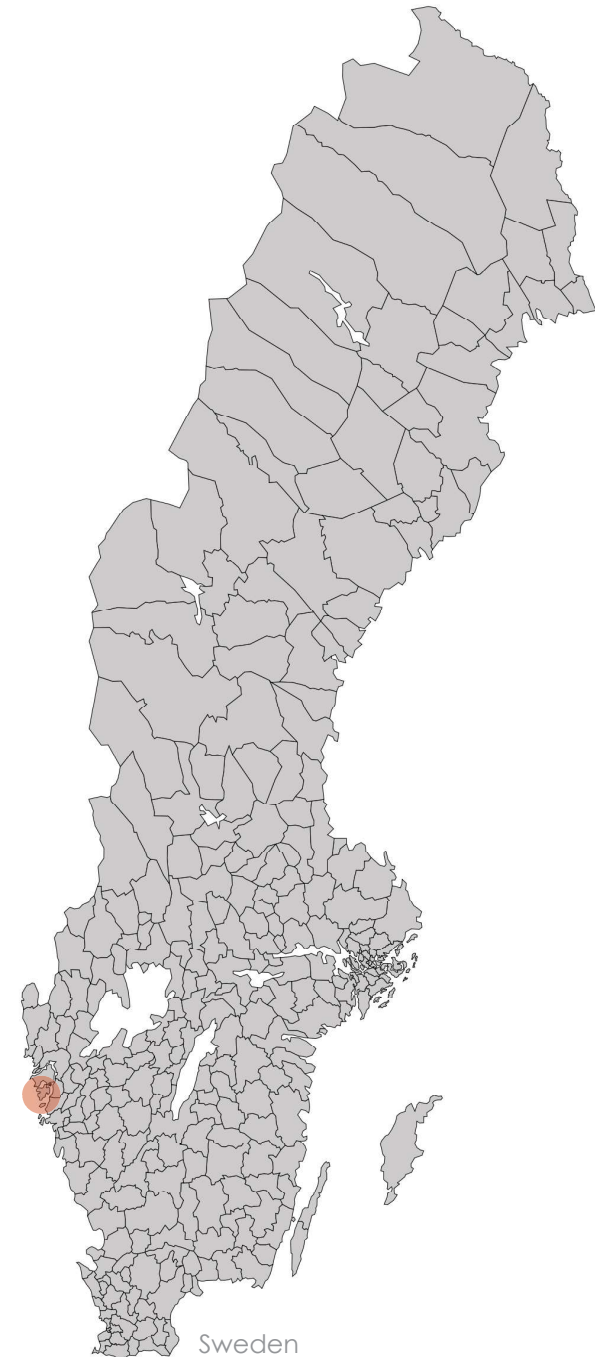
Satelite Picture\*source Google maps

**HERE!**



Picture\*source Orust Master Plan

Ålgårds mill and saw is located 6 km east of Henan in the Island of Orust. The place has a very beautiful and attractive location in the meeting between the road, the rapids and the two lakes Grindsbyvattnet and Assmunderödvatten.



Sweden

Picture\*source mapsoft.net

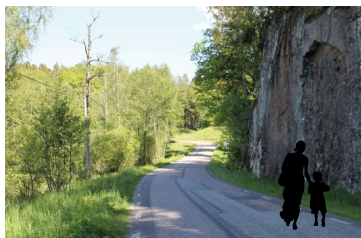
### 3.3 SITE ANALYSIS



## Site description

Ålgårds mill and saw is a beautiful site, it has diverse elements that makes it very interesting. It has cultural heritage with beautiful old buildings and a mill full of history, wetlands along the road producing a very characteristic feeling, a canoe club in the northeast side and beautiful views on the high points of each part. Ålgårds mill and saw, is reachable by car or a bus that stops on the road right in front of one of the buildings.

Walking trough the site the first and main problem is the disconnection between its parts by the main road, which is not a high traffic road but it's in constant use, that means that pedestrians need to be alert when walking to another part due to there are no sidewalks, the site is also disconnected by 2 properties, this make difficult to connect or to have a feeling that all parts belong to the same place. When walking trough the high points of each part one experience beautiful views, in some parts its possible to see the 2 lakes and the old buildings.



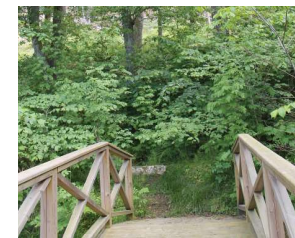
walking throuth the roads



Bus stop



Existing buildings



Pedestrian bridge



Canoe Club

Pictures \* own source

## What does the Orust Master Plan says?

After visiting Ålgårds kvarn och såg and talking to Föreningen Ålgård it was clear that the site was an important and valuable asset for Orust.

According to The Orust Master plan Ålgårds kvarn och såg is located in a valuable landscapes protected area, Culturally and historically significant area, and it's a conservation interest, this means that for any development or change intended in the Site the master plan has set rules and recommendations that must be followed and respected.

*"At any development should be exercised extreme caution with regard to the particular values of the landscape, nature and heritage sectors and outdoor activities..... Particular consideration shall be given to older cultural traces and remnants traditionally characterized the grasslands and fetörtrika clip moors.*

*In areas of heritage program identified as of particular value with respect to heritage sectors should new buildings be designed and placed with great respect to the local building tradition."* page 185 Orust Master plan

The design of the Site should take into account the value of the landscape cultural heritage and conservation of nature.

### LOCALLY VALUABLE LANDSCAPES

*"SEASCAPE and historical hydro-power in the growing community. Grindsbyvattnet and assmunderödvatten lakes are of importance for landscape experience, nature conservation and cultural history. The lakes also constitute a freshwater resource of great value (possible reserve water for the municipality). Klevaån, which drains the two lakes, flowing in a deciduous forest lined gorge with large botanical values."*

page 94-95 Orust Master plan

### CULTURALLY AND HISTORICALLY SIGNIFICANT AREA

*."...Ålgårds mill is Orust oldest known mill"*

page 101-103 Orust Master plan

### CONSERVATION INTEREST

*"Conservation Interest - account level 3  
In this respect level is landscape perspective in focus. This includes greater landscape parties, which as a whole is considered to be of great value with respect for conservation and outdoor recreation and / or cultural heritage."*

PAGE 94-95 ORUST MASTER PLAN

## 3.4 BIO DIVERSITY AT ÅLGÅRD

The biodiversity at Ålgård is rich and diverse an inventory was made in 1995 between the months of may till October by Lars Olof Arvids, where he could document, a bast number of different species of birds, mammals, fish, amphibians and reptiles, sporeplants/cryptograms and flowery plants.

The inventory is not up to date but it has serve to identify more clearly the biological heritage of the area.



BIRDS



MAMALS

Where are you?, are you aware?



AMPHIBIANS AND REPTILES



SPORE PLANTS/CRIPTOGRAMS



FISH



FLOWERY PLANTS

Pictures\*various internet sources

## 3.5 CONCEPTUAL IDEA

The idea is to reconnect the **build environment** with nature, change the view of a building that is on top of **nature**, but as something that belong to it, should create a feeling of connexion, and that **technology** is not something that separate us from it, but instead it could be something to bring us closer to it.

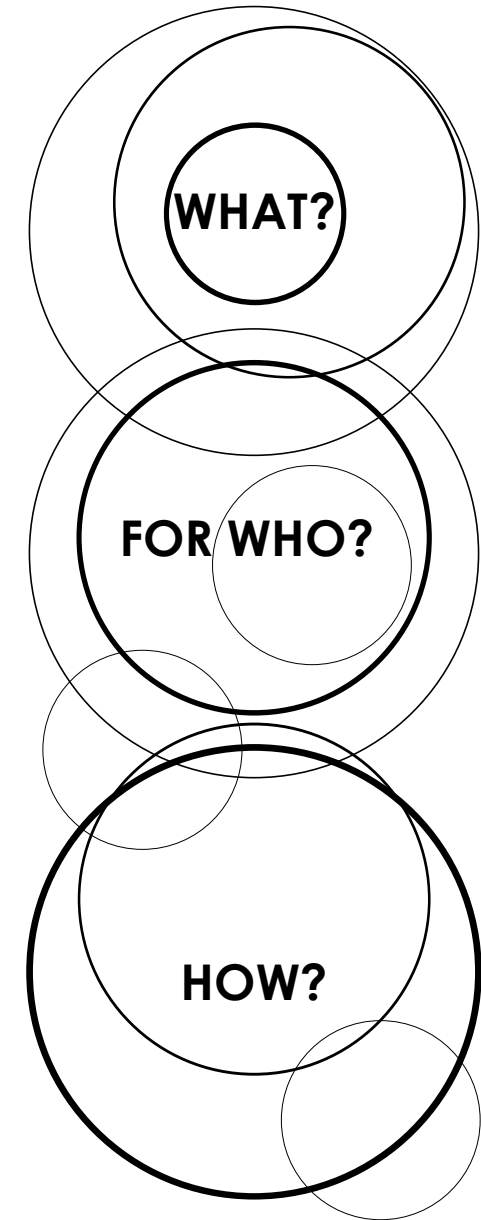
Part of the idea is to create interest towards designs like this in all kinds of people, it should be a flexible exiting and enriching experience for all, this thesis shouldn't have a specific target group, The **target group** should be **everyone**.

The place where this thesis is proposed, is the perfect scenario to reconnect with nature, Eco tourism principles meet all the characteristics for a bio inspired experience and address the need of a sustainable economic growth of the community. The idea to attract and inspire visitors implies that the experience should be memorable, Biomorphic forms, biophilic qualities and biotechnology are the pathways to reach this aim.

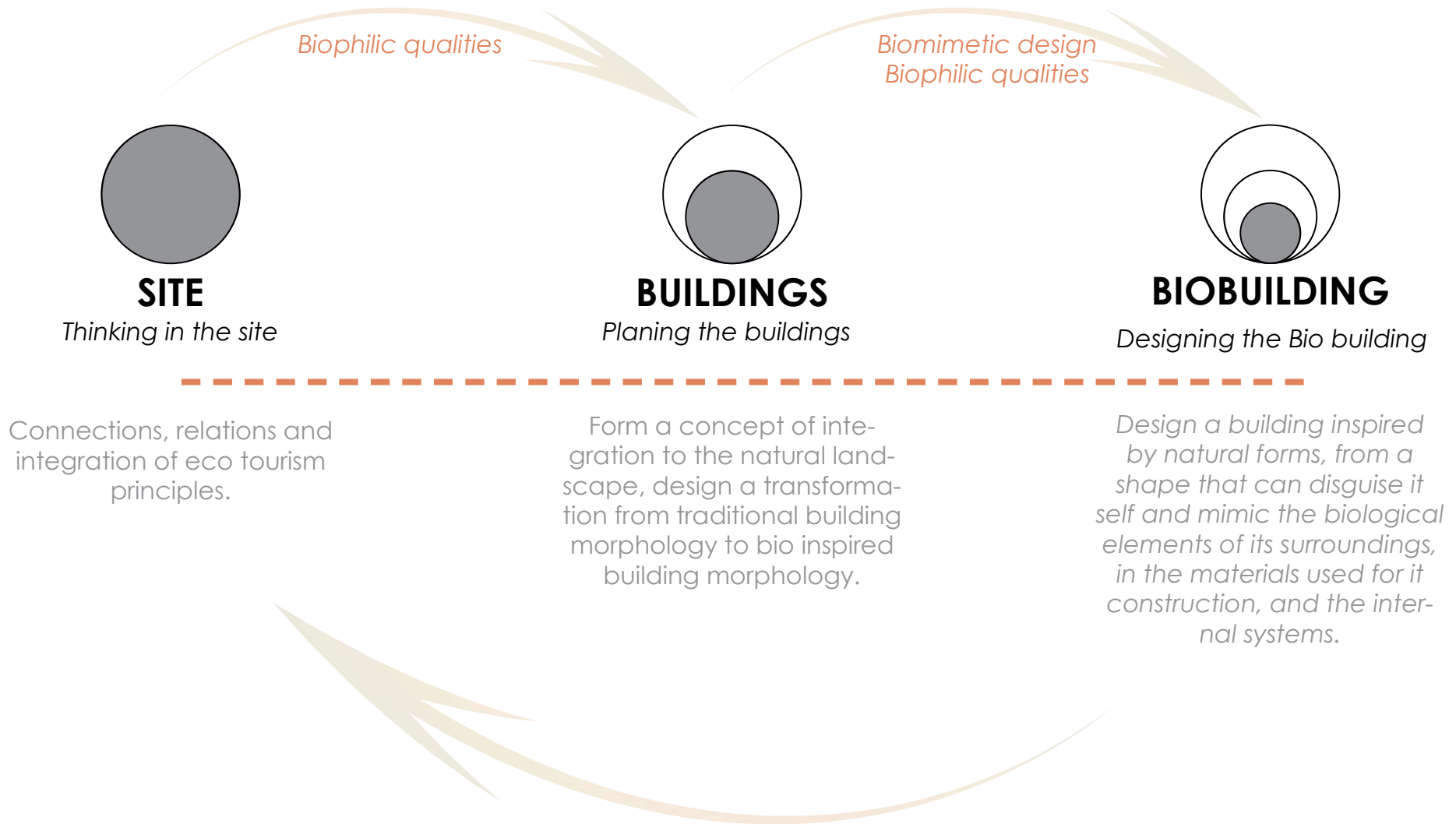
*Reconnection with nature  
Change the view of belonging  
to an artificial environment, to  
belonging to a natural environ-  
ment.*

*People who are and who are  
not interested in nature and  
sustainability.*

*Eco tourism experience  
Biophilic design  
Biomimetic Building*

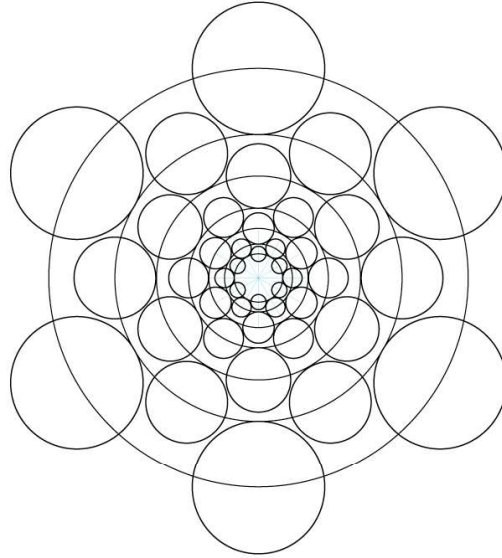


## Design steps



# CHAPTER 4

## SITE DESIGN



## 4.1 SITE DESIGN

### Most prominent Biophilic patterns

**P4** Presence of water **P7** Connection with natural systems **P8** Biomorphic forms **P9** Material connection with nature **P13** Mystery



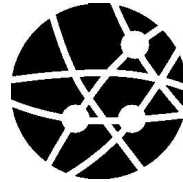
*Connect the site*

The main building as a central core and main activity center, should be connected directly to the rest of the site, by pedestrian friendly paths.



### Most prominent Biophilic patterns

**P1** Visual connection with nature **P4** Presence of water **P7** Connection with natural systems **P11** Prospect **P14** Risk/Peril



*Attract visitors all year round*

The site should be active all year round to make a more sustainable use of spaces and activate the local economy. The creation of cottages for over night stays, that are suitable and enjoyable during cold seasons, could be matched with activities in the main building.

### Most prominent Biophilic patterns

**P1** Visual connection with nature **P4** Presence of water **P7** Connection with natural systems **P11** Prospect **P14** Risk/Peril



*Teach and inspire*

Creation of workshops, art exhibitions, concerts, conferences, out door recreation, trading shops, sport activities, and turning the site as a laboratory for developing and testing new ideas and bio inspired technology, will make the site an center of attraction and an agent of behavioural change.



## Connect the site



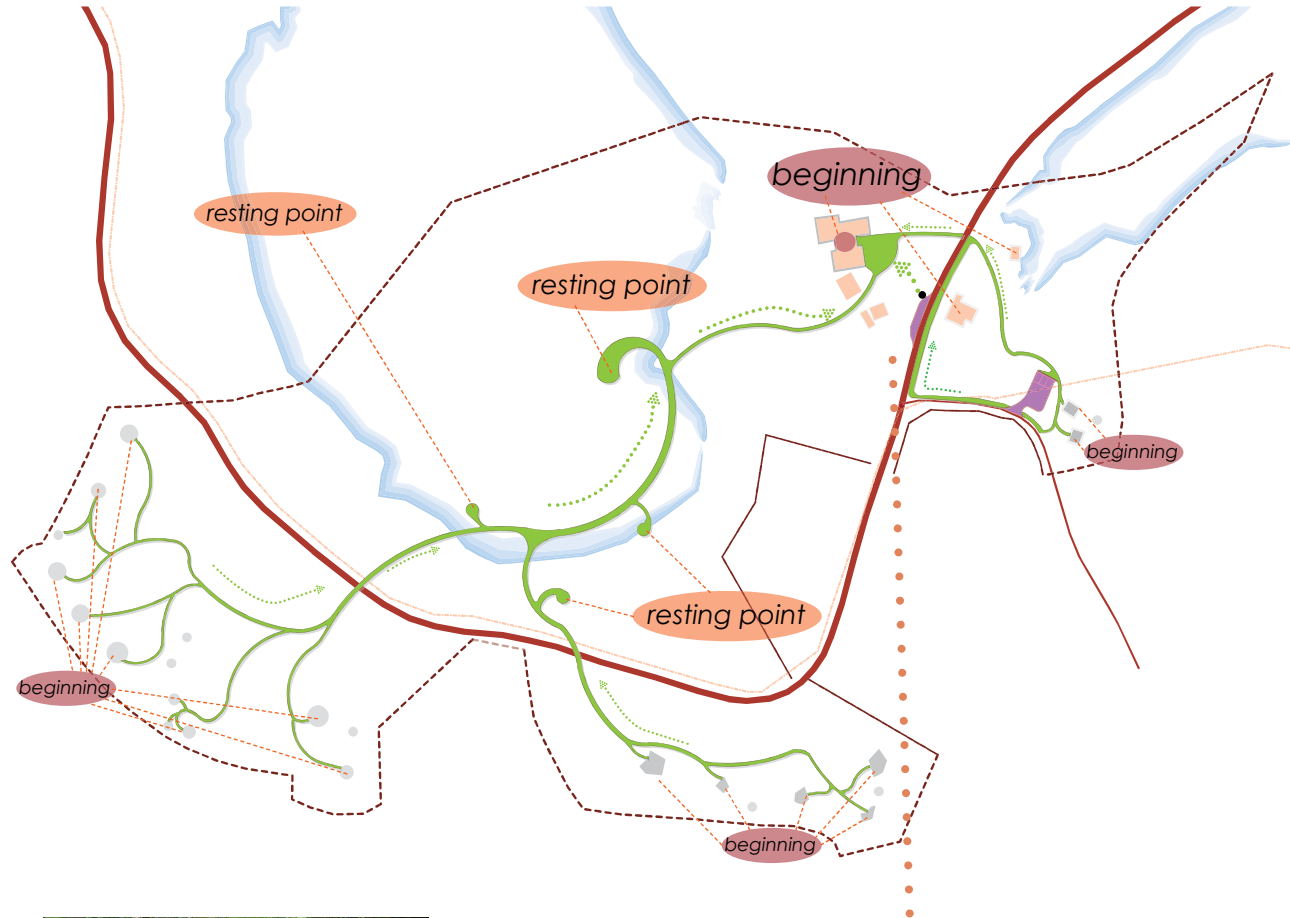
The bio-morphic shape of the bridge is inspired by the Fibonacci series. Is a numeric sequence that occurs in many living things and specially plants (14 patterns of biophilic design, 2014). The bridge grows like a living organism stretching its branches connecting the hole site.



The site is a pedestrian focused environment, connecting each part by a bridge that goes over the wetlands and the lake. Its bio-morphology gives a visual relation with nature while allowing the travel experience, pause, exploration and a more intimate relation with the natural systems, passing trough the wetland offers opportunities to experience closely a variety of animals and a characteristic vegetation.

Natural materials in paths and bridge are coherent to the whole experience, enhancing the restorative feeling of sense of the place.

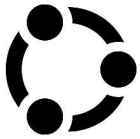
Each cottage is provided by individual paths that run down the mountain to finally connect to the bridge, the undulations of the paths follow the natural contour lines of the terrain and are designed to give a stimuli of mystery, expectation and a desire to further investigate the place, having as a reward the arrival to a new beginning of experiences at their own space.



Picture\*source mapsoft.net

A bus stop is proposed next to the main entrance and activity center.

A space for 3 parking lots close to cottages planned for disabled visitors and sidewalks that will serve as possible access to the main building for people with mobility restrictions or with baby wagons.



Attract visitors  
all year round

### Cottages Program

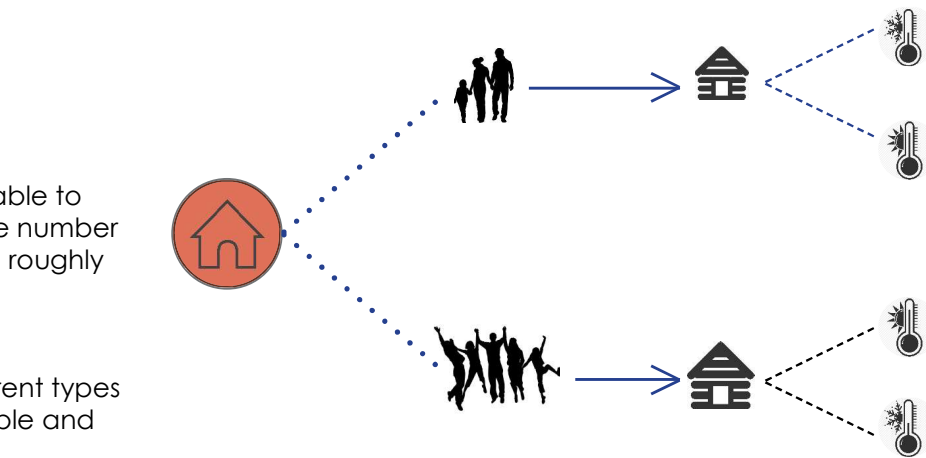
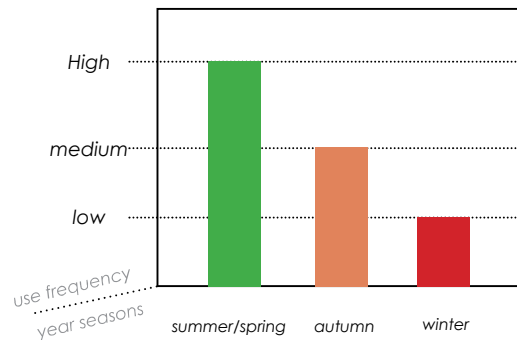
The amount of people that the main building is able to host has served as a parameter to determine the number of cottages to be placed in the site, determined roughly by the number of 60 people.

### Users

The size of the cottages are proposed for 2 different types of users, small cottages that can host 2 to 3 people and bigger cottages that can host 6 to 8 people.

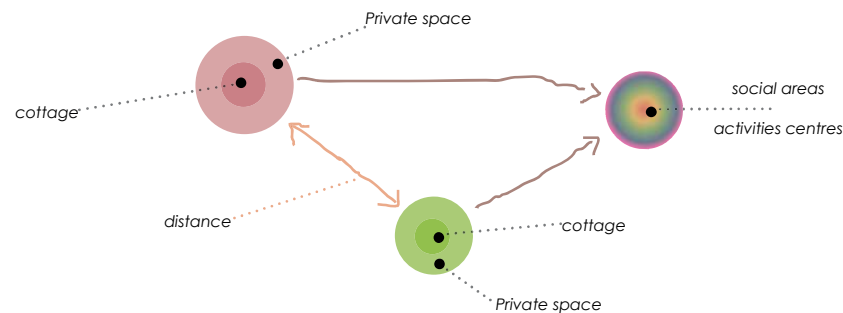
### Type of cottages

2 types of cottages are proposed, which will be different in their type of construction, materials and function, according to different needs between seasons of the year. The amount of cottages per type was established between the frequency of use during the year seasons, being summer and spring when more visitors are expected.

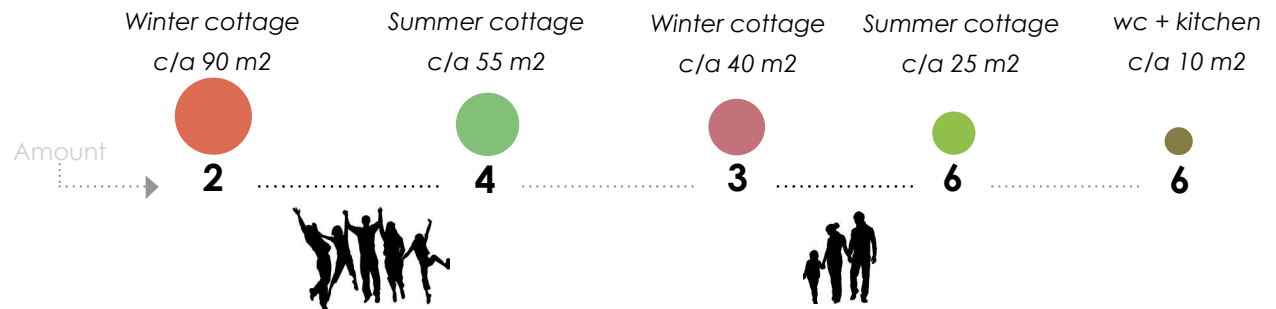


The winter cottages will include in their design kitchen and bathroom, while the summer cottages will share a common small facility with kitchen and bathrooms placed near the shearing cottages.

Their distribution will be mixed on each part of the site.



The cottages are separated one from another to ensure a flexible environment with a sense of belonging, where all kinds of people can feel free to develop diverse activities, but with the possibility to meet each other in social areas.



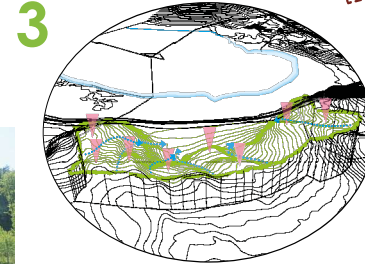
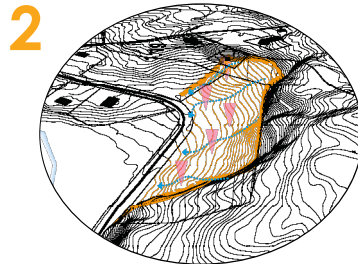
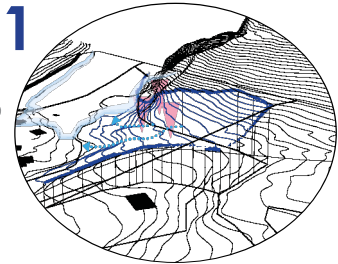
# Cottages Placement

The placement of the Cottages was planned to enhance the natural experience, taking into account desired psychological responses and buildings physical needs.

**Psychological responses**, the cottages are placed on high points on each part of the terrain, this has the objective to give good prospect conditions, humans prefer visually spaces where there is a feeling of surveillance and contemplation, this allows for planing, opportunity and hazard over the environment. A visual connection with nature is enhanced on high places taking advantage to the beautiful landscape.

**Building Physical needs**, the placements respond to a suitable topography, avoiding the natural paths of water flow, rocky areas and preferring places where a flatter area is available.

In the case of the first terrain the limit for coastal line regulation was also taken into consideration. The close distance between the cottages in this terrain and the main building make it suitable for visitors with special needs and visitors with small babies.



## Site Activities

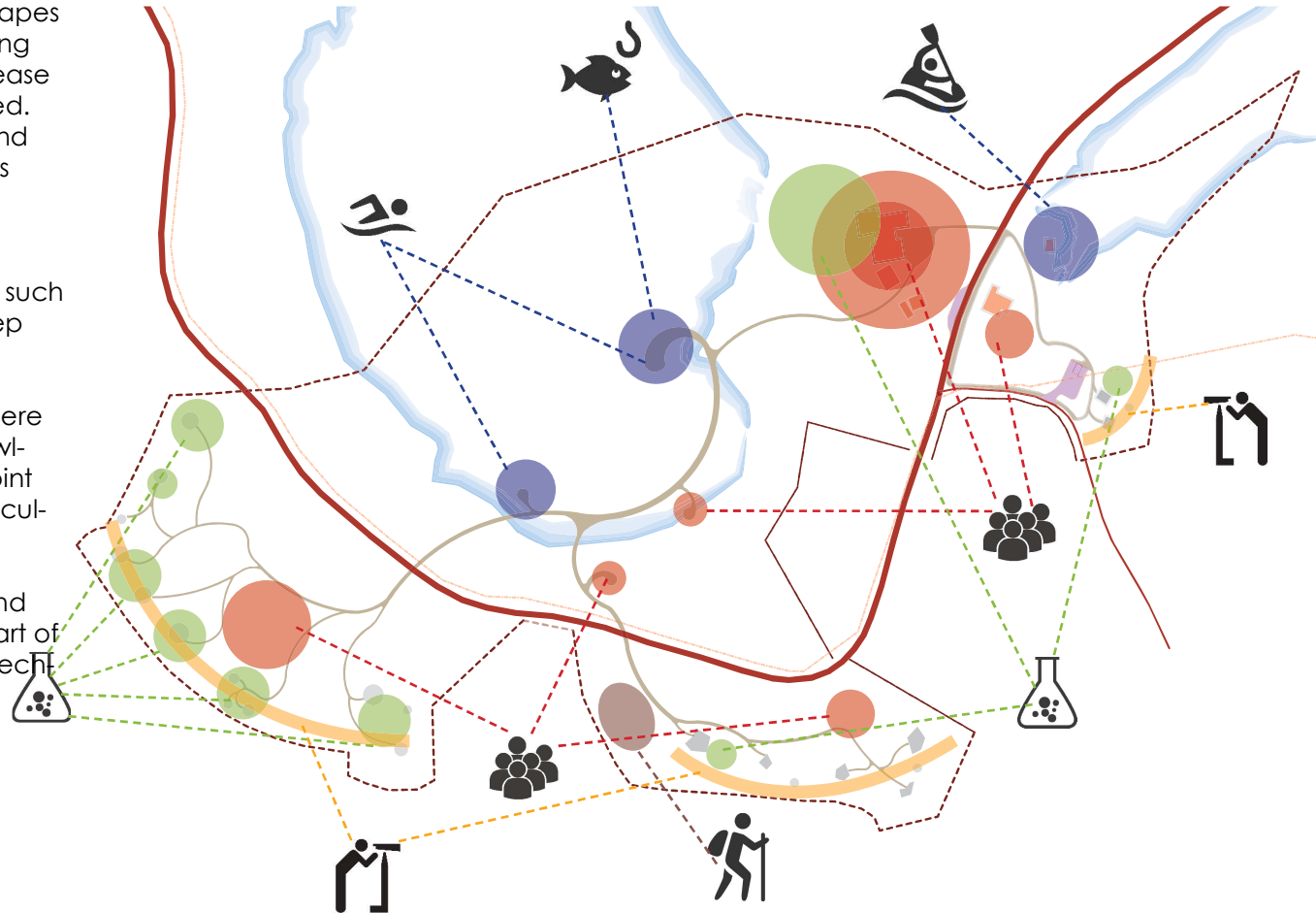


Ålgårds kvarn och såg is located in a valuable landscapes protected area, and has a rich biodiversity, by teaching about the variety of species found at the site, an increase awareness and connection with nature will be created. Creation of Buildings and environments that coexist and cooperate with natural flows will inspire workers, visitors and residents at Ålgård.

As part of the experience of integration to the natural flows, and conservation to the local culture, activities, such as canoeing, fishing, site seeing, and climbing, will keep the site alive.

Social gathering points are also an important part, where visitors can socialize and exchange experiences, knowledge and get inspired together. The biggest social point will be the main building, and will welcome all kind of cultural and recreational activities all year round.

The site is intended to be a laboratory of new ideas and testing of bio technology, the cottages on the third part of the terrain will be biggest testing lab, where new bio technology is put into practice.



Bird watching



Bridge swimming



Bio materials workshops



social meetings



Permaculture gardening



canoeing and fishing



Site seeing



Climbing walls



*Photo collage \* own source*



Teach and inspire

## Bio inspiration

As an idea for the site and cottages, design study models are created as bio inspiration to search the best blend with the natural landscape and to find a way to connect all parts of the puzzle.

Each part of the site has a distinctive characteristic, the study models reflect interpretation of bio morphic forms and sensations. It was also intended to understand the morphological structure of each element, to be reproduced in buildings and landscape design.

The process of building the models was intuitive, the intention was not to copy natural elements, but more to observe, get inspired and interpret, in that way the connection with nature would come from within.



Site View Inspiration I

Construction Process →

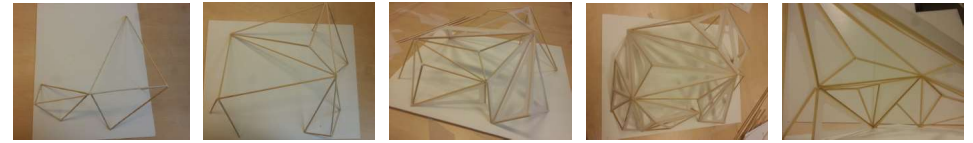


Photo-shoot in nature ←



Site View Inspiration II

Construction Process →



Photo-shoot in nature ←



Site View Inspiration III

Construction Process →



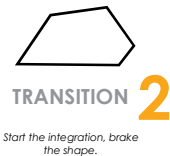
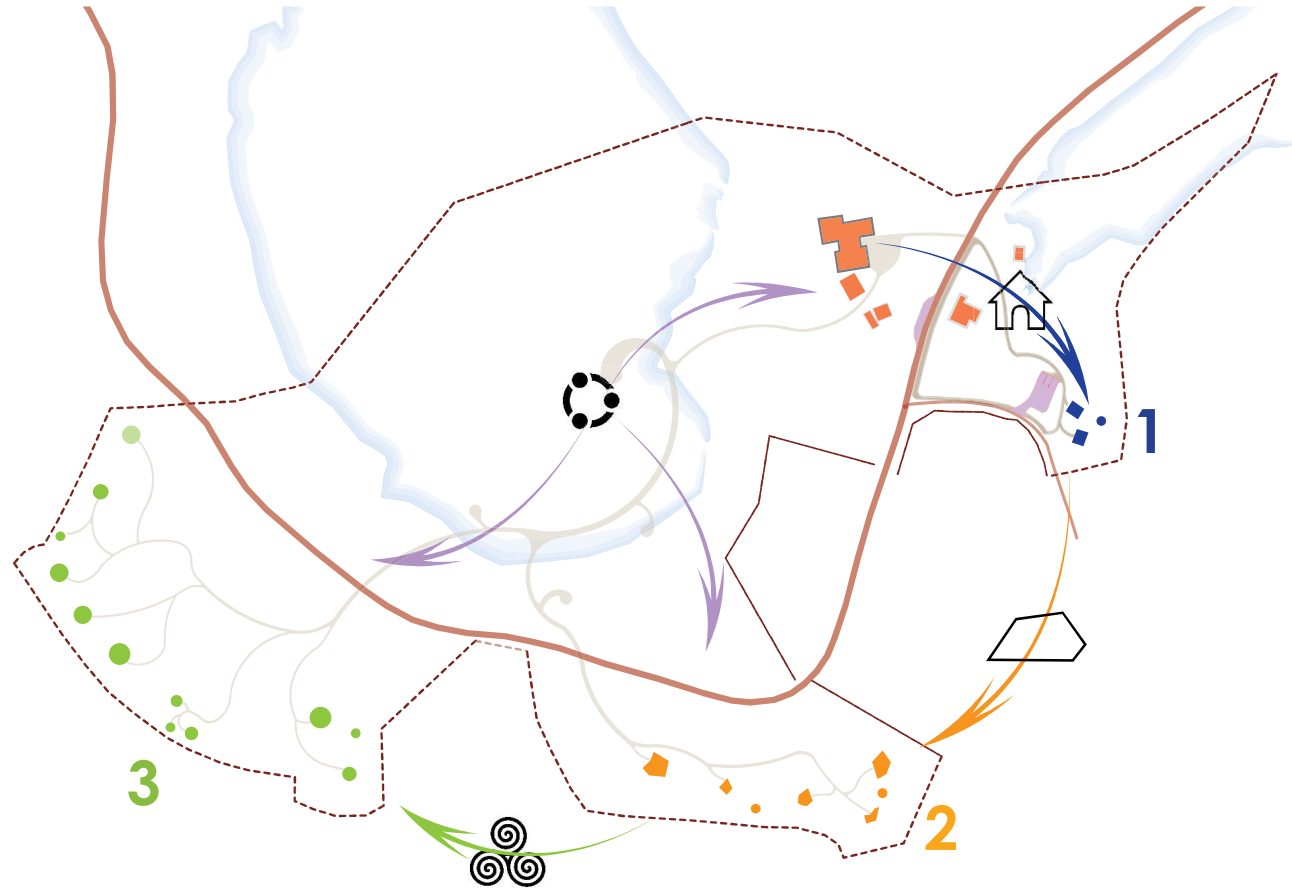
Photo-shoot in the nature ←

# The Story of a Journey

The concept of the bio cottages is intended to inspire a transition from man made building forms into natural building forms, from typically used building materials and infrastructure into natural building materials and bio inspired infrastructure.

The story is designed to be experienced by travellers that pass by the site, arrive to the site and leave the site, it will be a car experience, the idea is to physically see the transformation of building from the traditional building form into a biomorphic form, this story will be seen trough each part of the site.

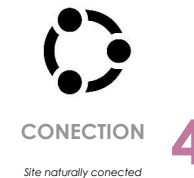
The existing buildings in Ålgårds mill and saw have great historical value, so the transition will begin there, the first terrain have a visual connection to the main buildings, for these reason and respecting the history and culture, these cottages will keep the traditional building form, the second terrain is characterized by rocky mountains with hard edges, so the form will resemble the hard edges of the rocks and of the traditional buildings, but the shape will start to brake, to continue to the third terrain where the buildings are completely merge with the landscape into biomorphic shapes, and finally the bridge over the lake will show the connection of each part to the "beginning" the main building.



Start the integration, brake the shape.



Buildings merged with the nature



Site naturally connected

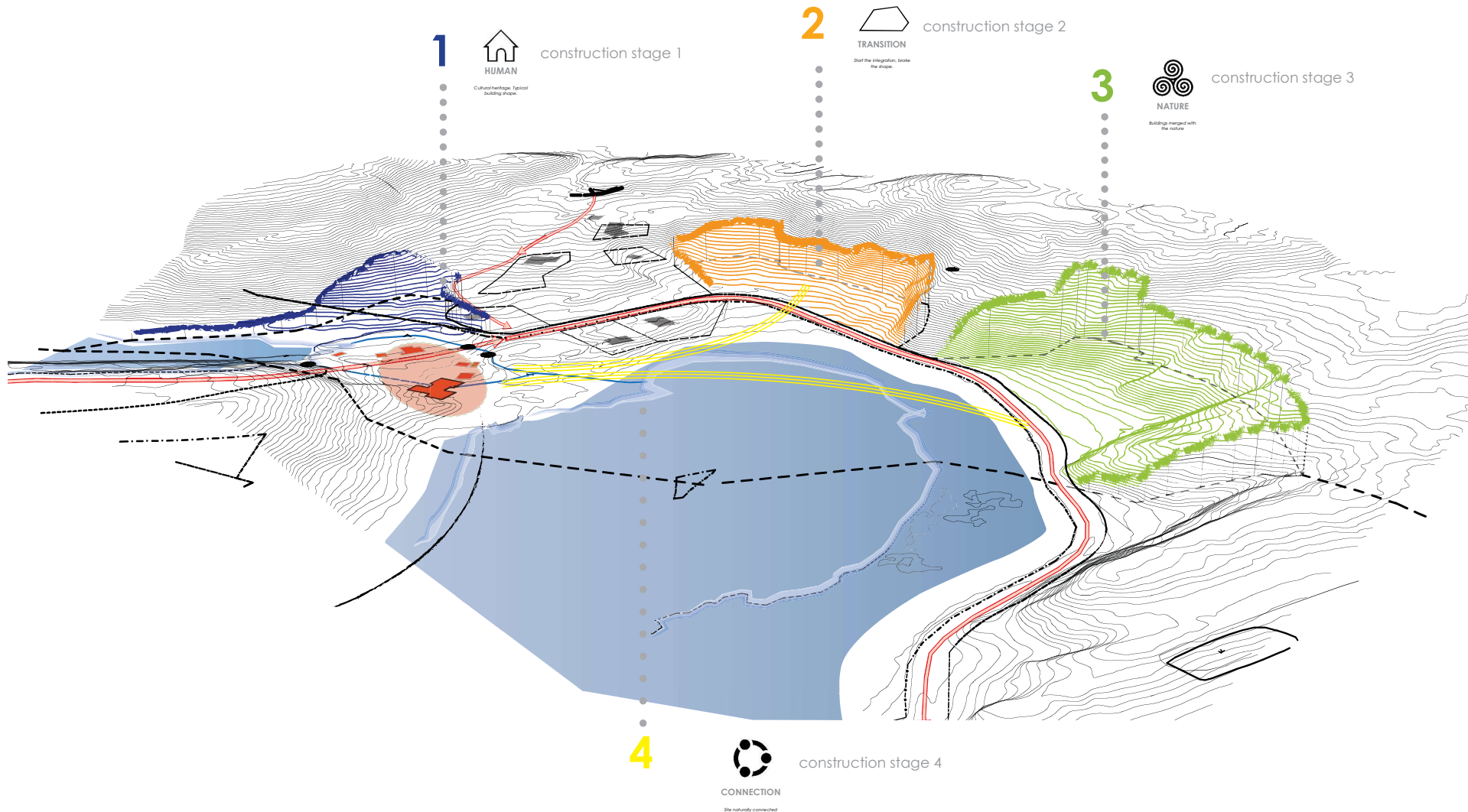


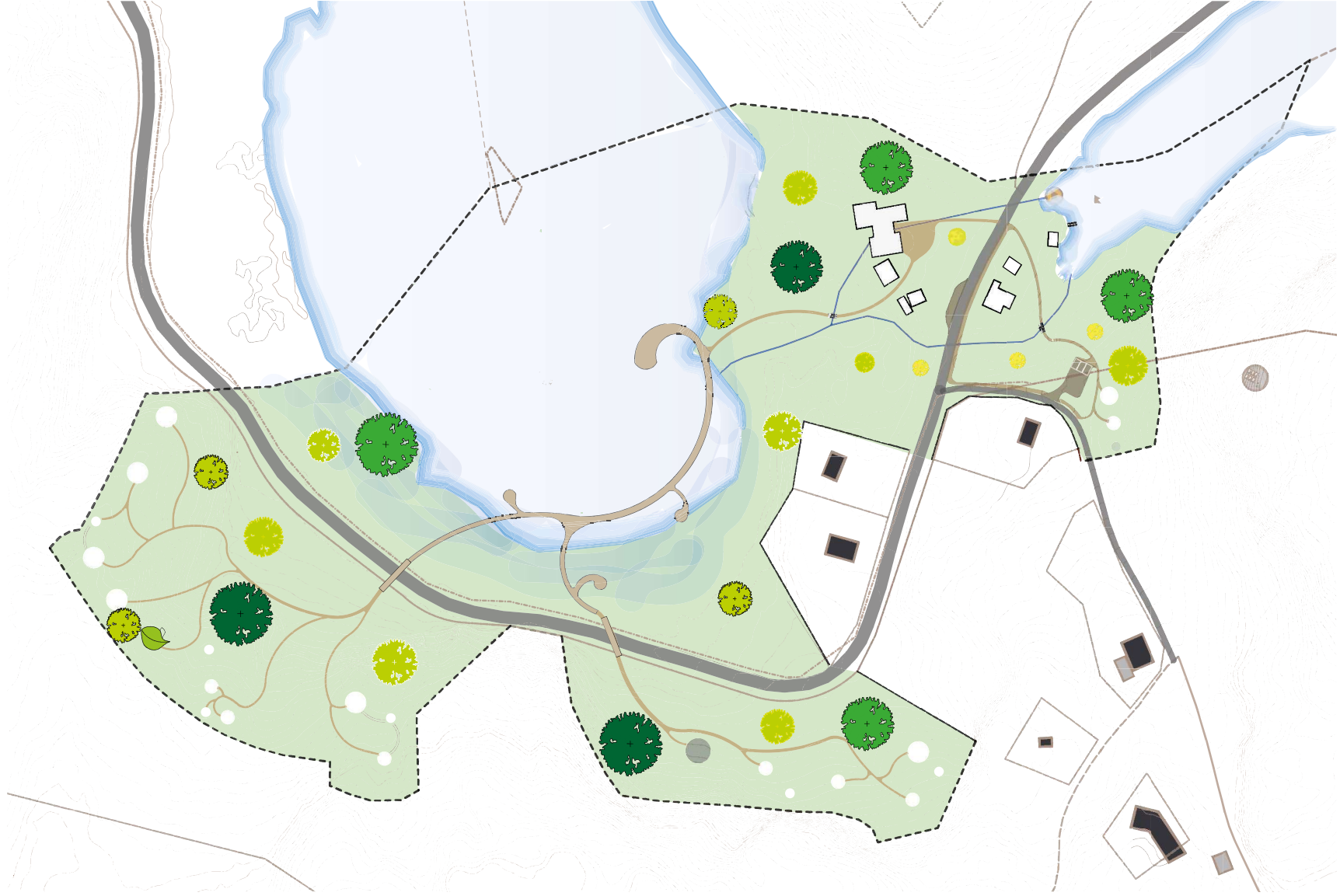


## 4.5 SITE CONSTRUCTION PROCESS

To create a gradual and affordable growth, A 4 step construction process is proposed, It begins from the terrain closest to the existing buildings, to the terrain farther away, this construction process is proposed in steps which are also connected to the story of building transformation from human shape into forms from nature.

The idea of this gradual growth is to create a growing economy with the first cottages in step 1, so that the next stage will be financed by it's predecessor and so on, until the site is fully constructed and running.



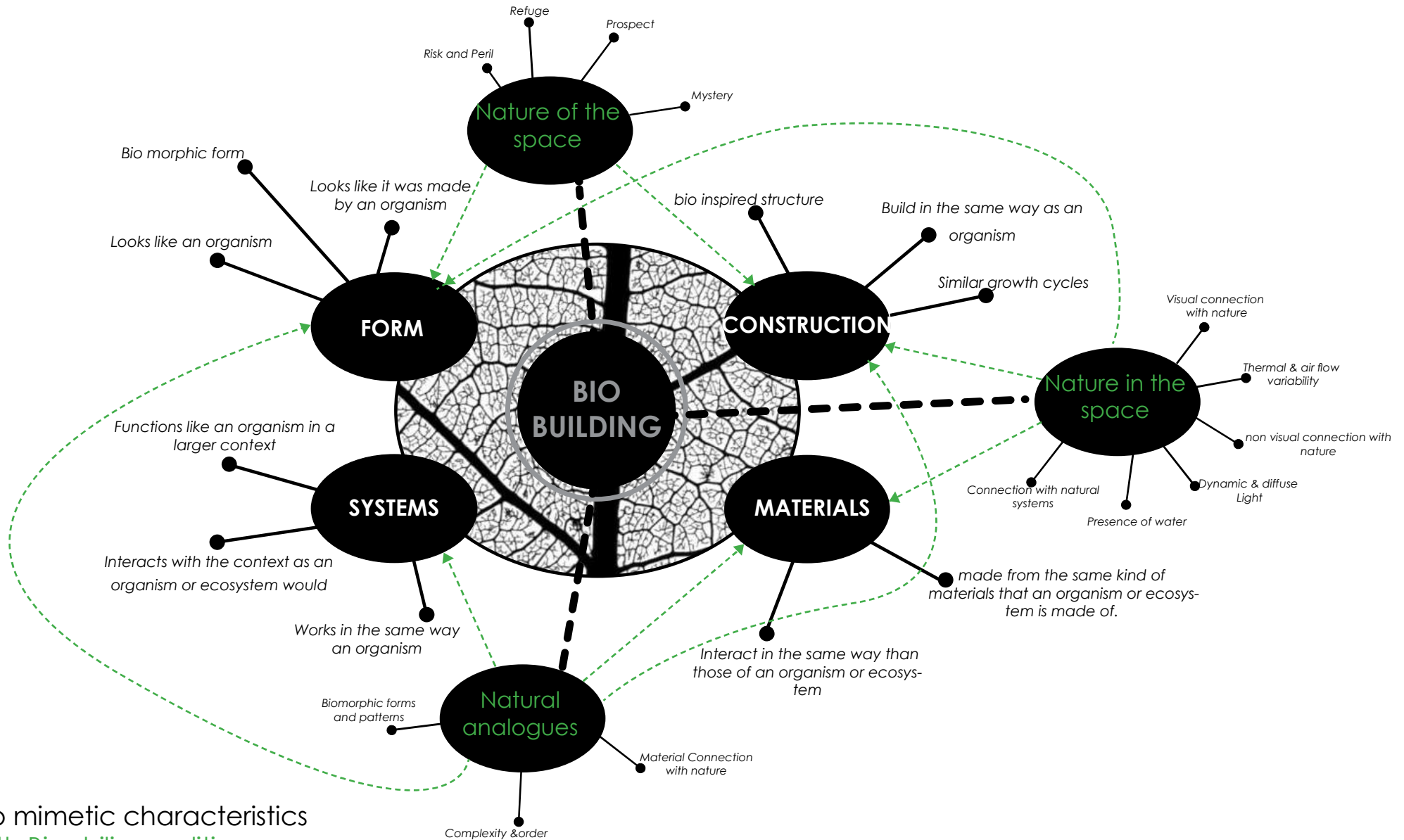


# CHAPTER 5

## BIO BUILDING



## 5.1 DESIGN ELEMENTS



Bio mimetic characteristics  
with Biophilic qualities

## 5.2 INSPIRATIONAL PROJECTS

*The following projects are the architectonic inspiration for the Bio building, I consider that no further explanation is needed as the visual information, and the produced sensations and interpretations are the objective.*



Hyunam- Iroje Architects



wNw Cafe- Vo Trong Nghia Architects



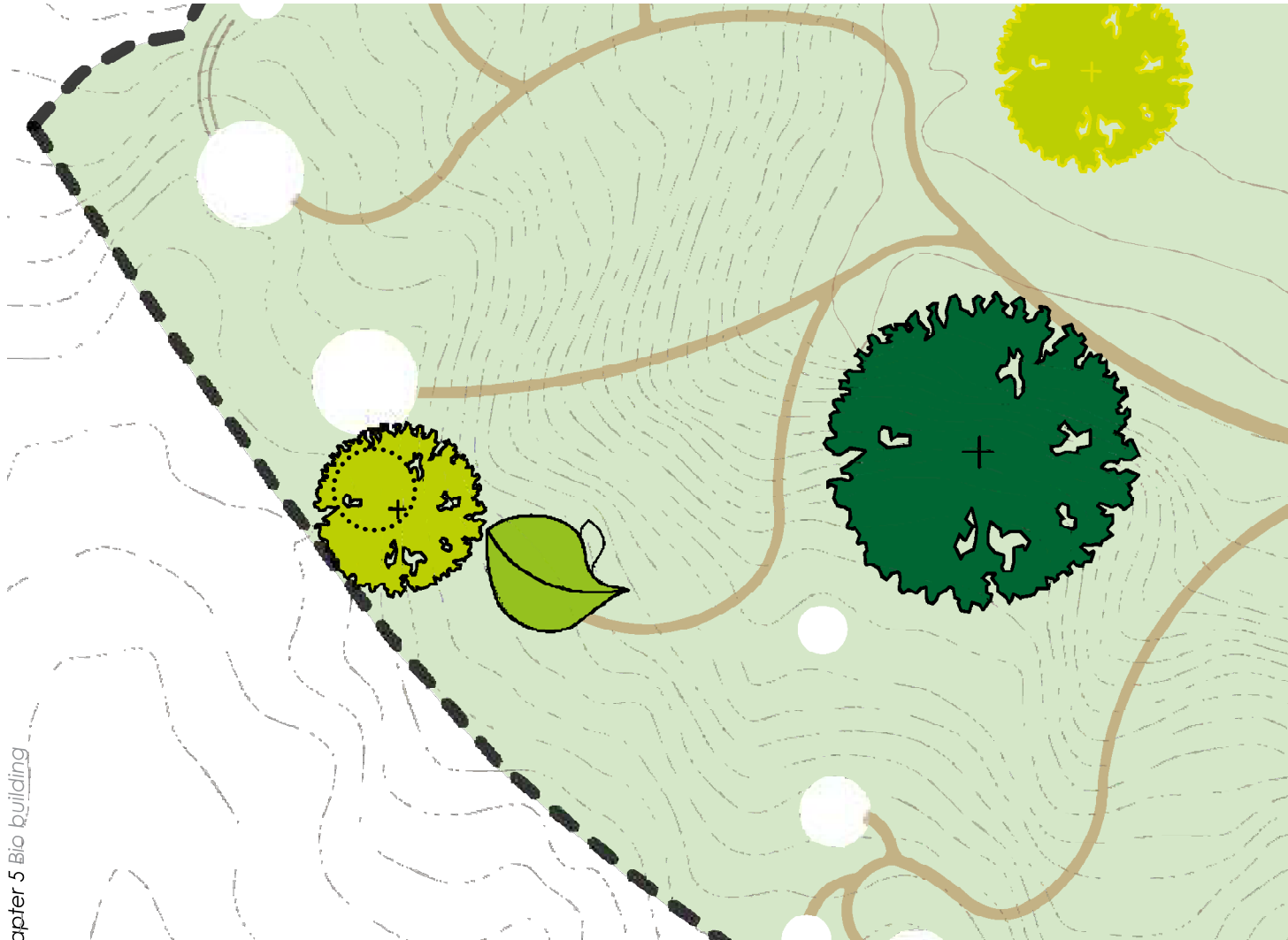
Hus Eft- Torsten Offesjo



Art installation- Andy Ku, Jenny Wu,  
Marcos Sanchez

## 5.3 THE BUILDING

The location of the biobuilding is proposed for the third part of the site, where Buildings are merged with nature.



Location- Nature

- Shapes of nature
- Bio materials
- Bio processes



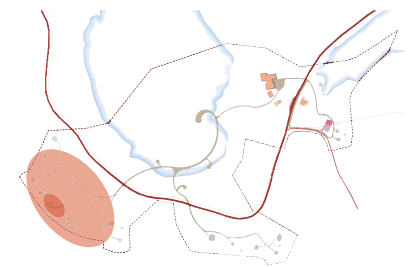
Size- 6/8 visitors

- Area- ca 90m<sup>2</sup>



Type- winter cottage

- wc + kitchen

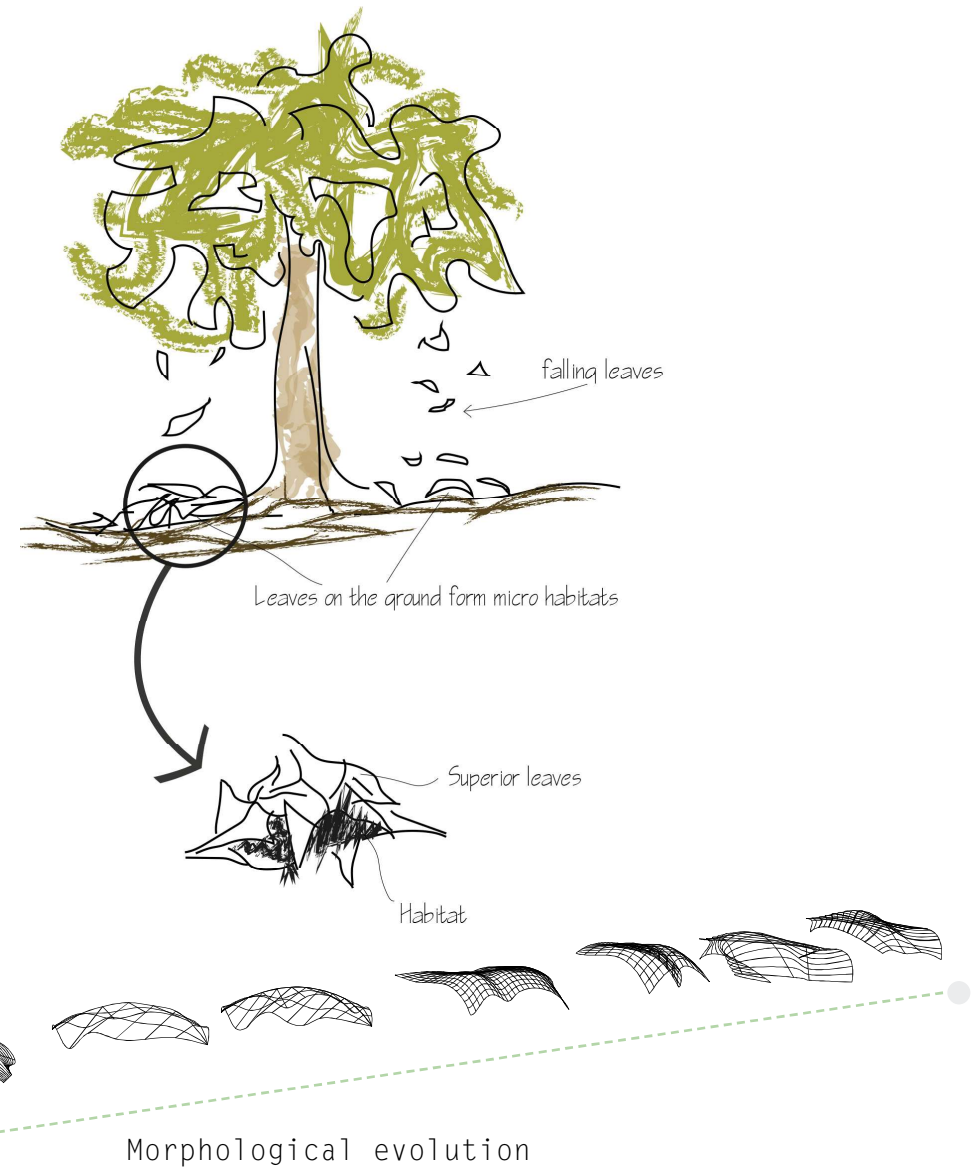


# FORM

**Concept,** This project is bio inspired by plants, more specifically, leaves from a tree. Humans have been using plants as role models since the beginning of the use of technology, trees share common problems with buildings, a trees stay in one place and depend on the local climate and influences of natural forces.

The idea of the form is to make a a building which resembles the shape of an organism or a part of one, in this case the shape of a leaf, inspired by observing the fallen leaves of a tree which when on the ground create micro habitats, for insects and other micro organisms to benefit, to later on decompose and turn into food for the ground.

**Morphological evolution,** the first attempt to mimic the shape of fallen leaves was the interpretation of a bunch of leaves that create a irregular shelter-like surface, with this option the structural concept would have conformed a complex structure not resembling the ones of leaves, for this reason the evolution moves on to a more obvious form of a leaf, here a number of test where made, to find the most efficient structural shape.





## Nature of the space

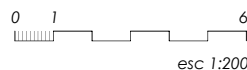
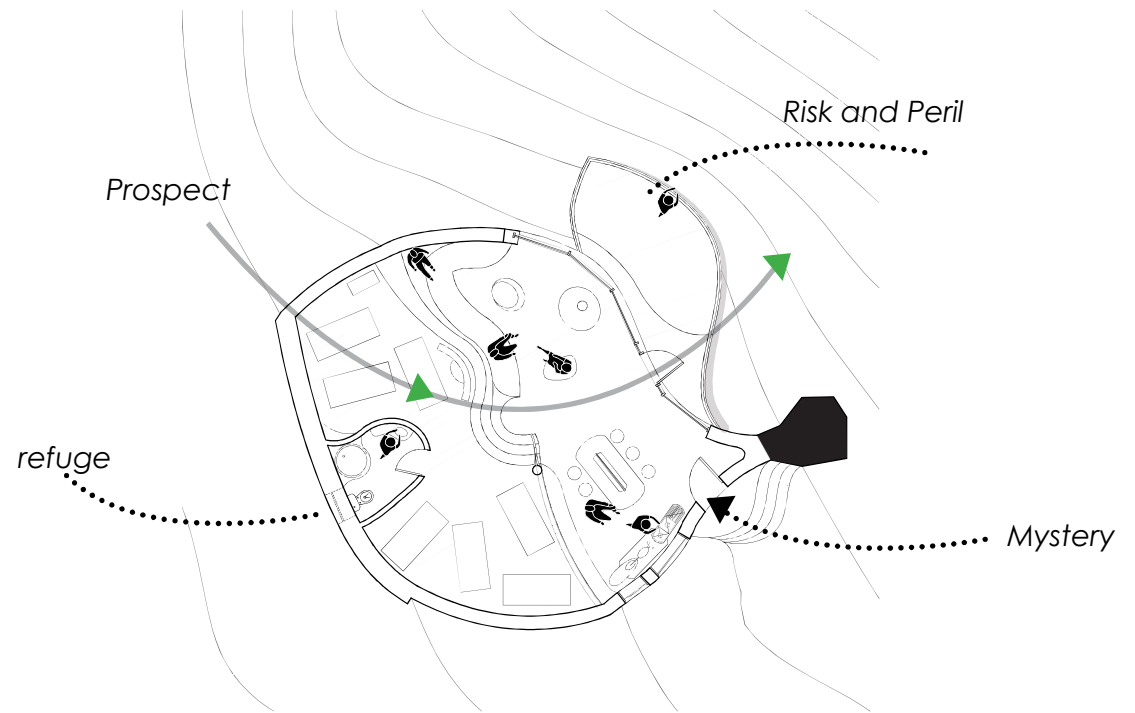
The biophilic qualities of “Nature of the space” are reflected in the design

**Prospect**, in the interior of the building the private area brings a sense of surveillance and planing over the social area, as the space is open and elevated, this gives a sense of safety and control, at the same time the view is extend to the exterior of the building, where the sense of prospect occurs simultaneously, this quality can be experienced from every part of the building.

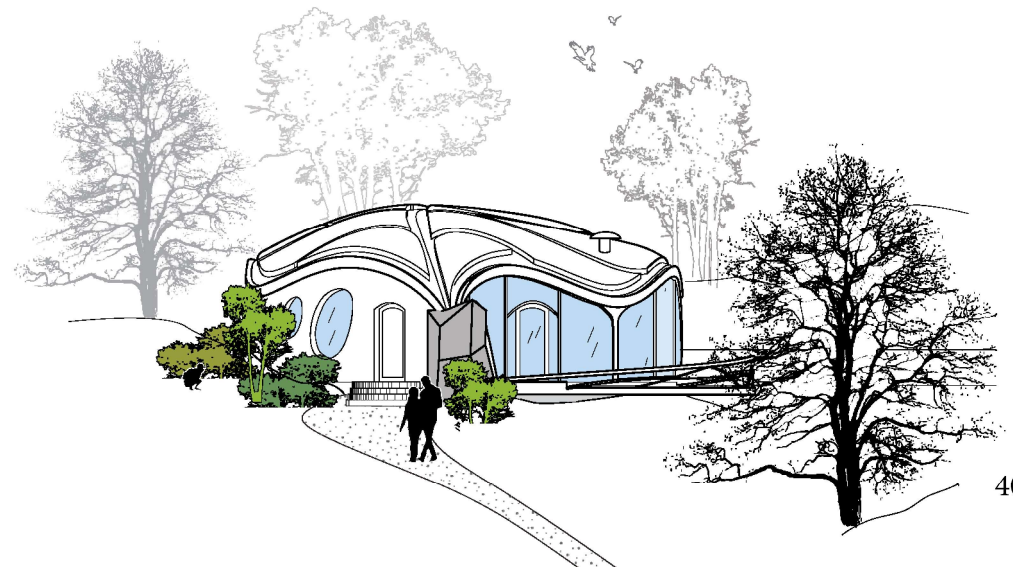
**Refuge**, opening towards the landscape, and closeness towards the back of the building give the feeling of refuge, providing a sense of retreat and safeness, making the feeling more perceivable in the private area.

**Mystery**, The entrance to the building is design to give a sense of mystery, due to the small and not prominent entrance, doesn't make obvious the experience of openness of the interior, furthermore it gives a feeling of going into a cave-like environment.

**Risk/Peril**, can be experience from the terrace, being this elevated from the ground towards the landscape, and not marking a clear edge, the feeling of exhilaration is provoked, while creating a completely safe experience.



East Facade



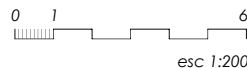
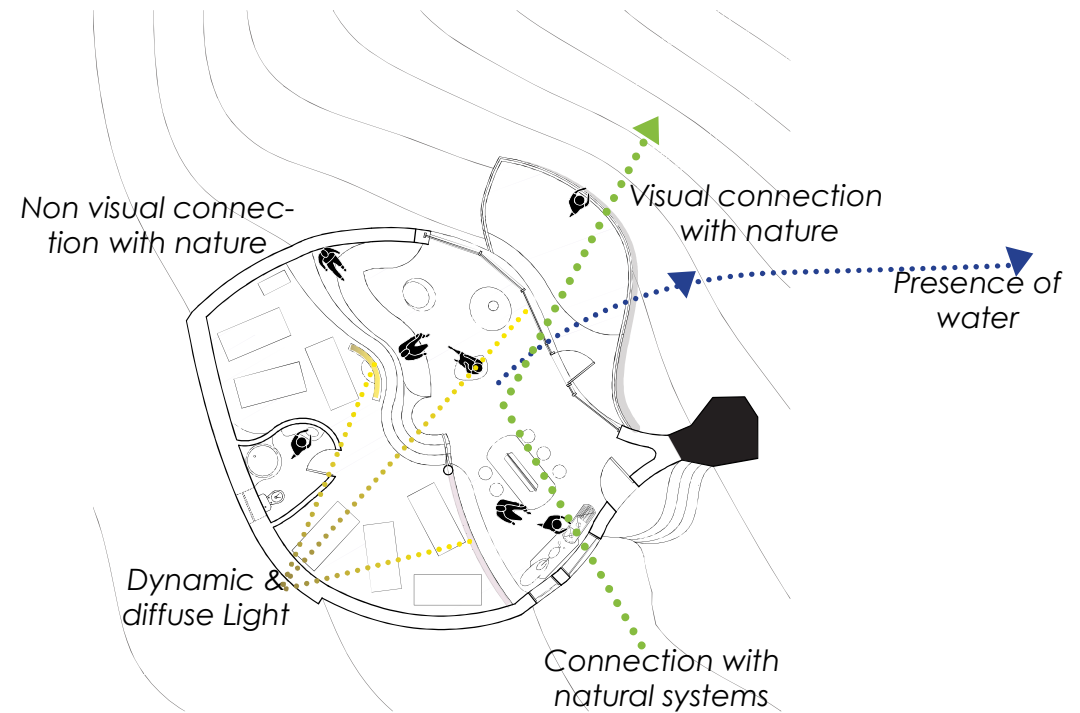
## Nature of the space

The placement of the Cottages was planned to enhance the natural experience, taking into account desired psychological responses and buildings physical needs.

**Visual connection with nature and Connection with natural systems**, is experienced through the extensive views towards the landscape, where seasonal changes and cycles of life are visible, producing a calm and relaxing feeling, a connection with natural systems is also experienced with the systems inside the building where natural processes and rain water fulfil the needs of the building.

**Dynamic & diffuse light**, is produced through entrance of light from the big opening and kitchen windows, the light pierce deep into the building and it is directed towards the end, A translucent wall made of bio plastic, create a dynamic light in the interior, as well as a Bio light (produce by bacteria) which is more visible in the night.

**Presence of water** viewed at a distance into the landscape create a relaxing, restorative feeling, improving the mood and self-esteem.

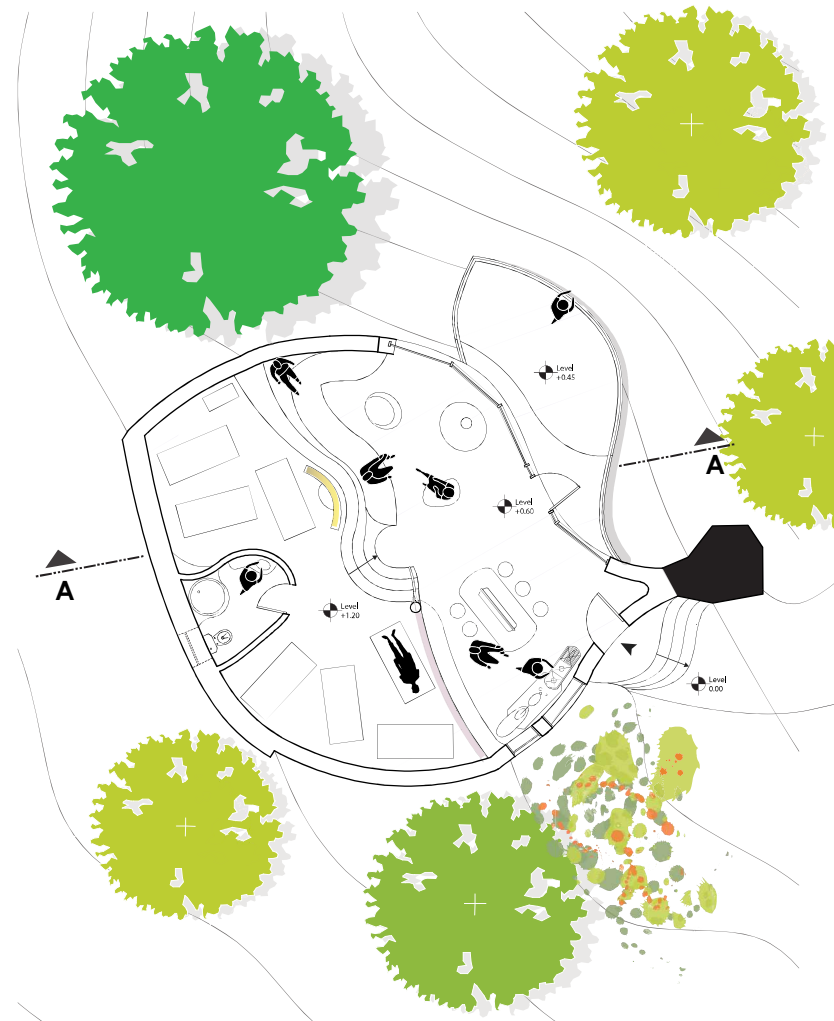
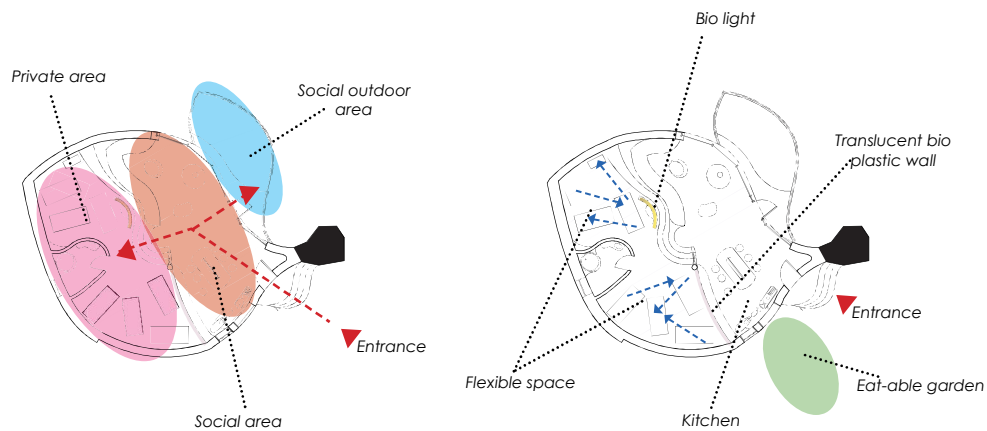


South Facade



## Building's organization

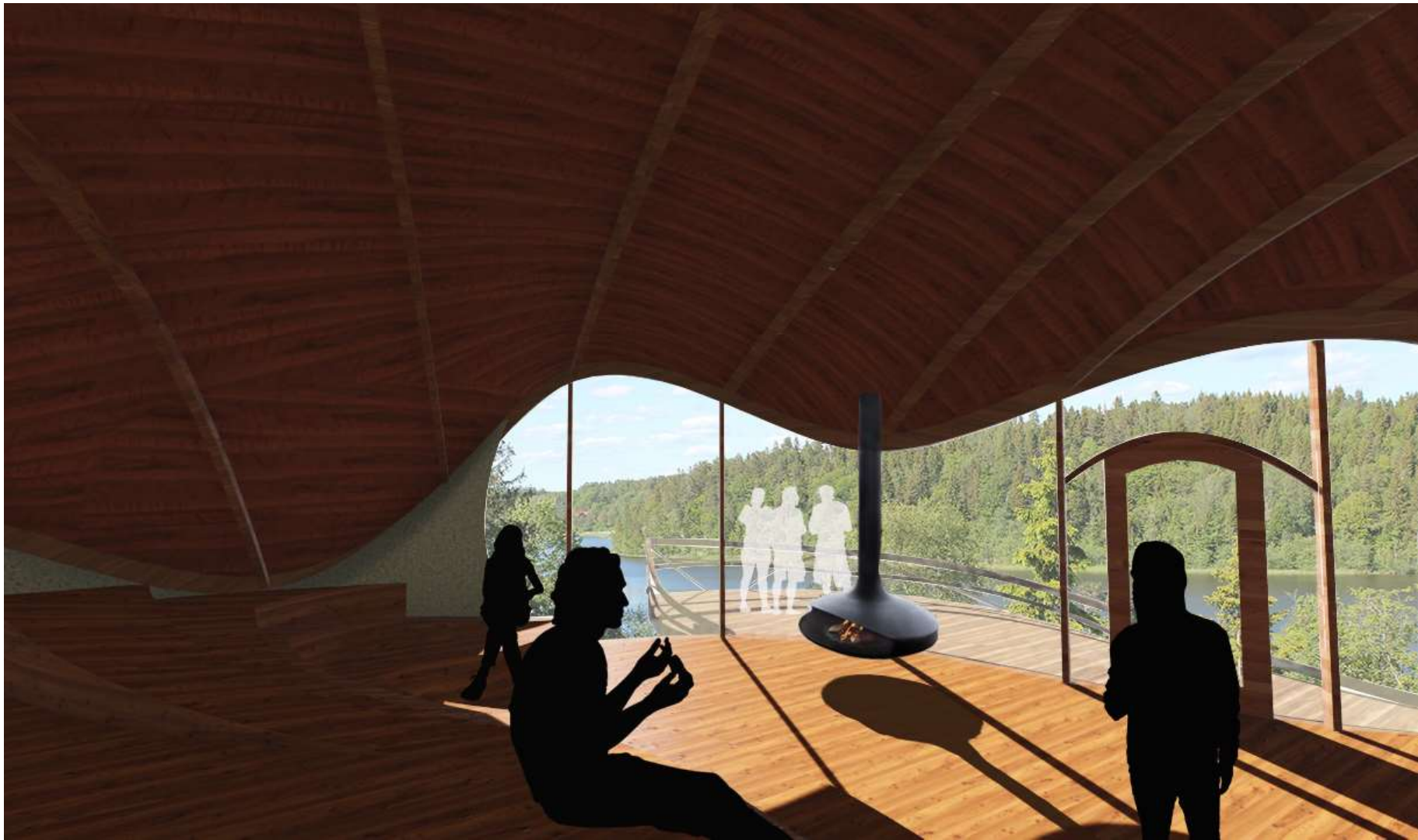
- Open layout to private and social area with difference in ground levels achieving a natural separation of areas.
- Flexible private area, the visitors are free to arrange the space as rolling mattresses are proposed instead of normal beds.
- Entrance next to the eat-able garden and kitchen.
- Central circulation, provide an easy flow.
- Terrace for out door relaxation
- Inspiring atmosphere by Bio-light night lightning and translucent Bio plastics wall separation.



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esc 1:200

Plan





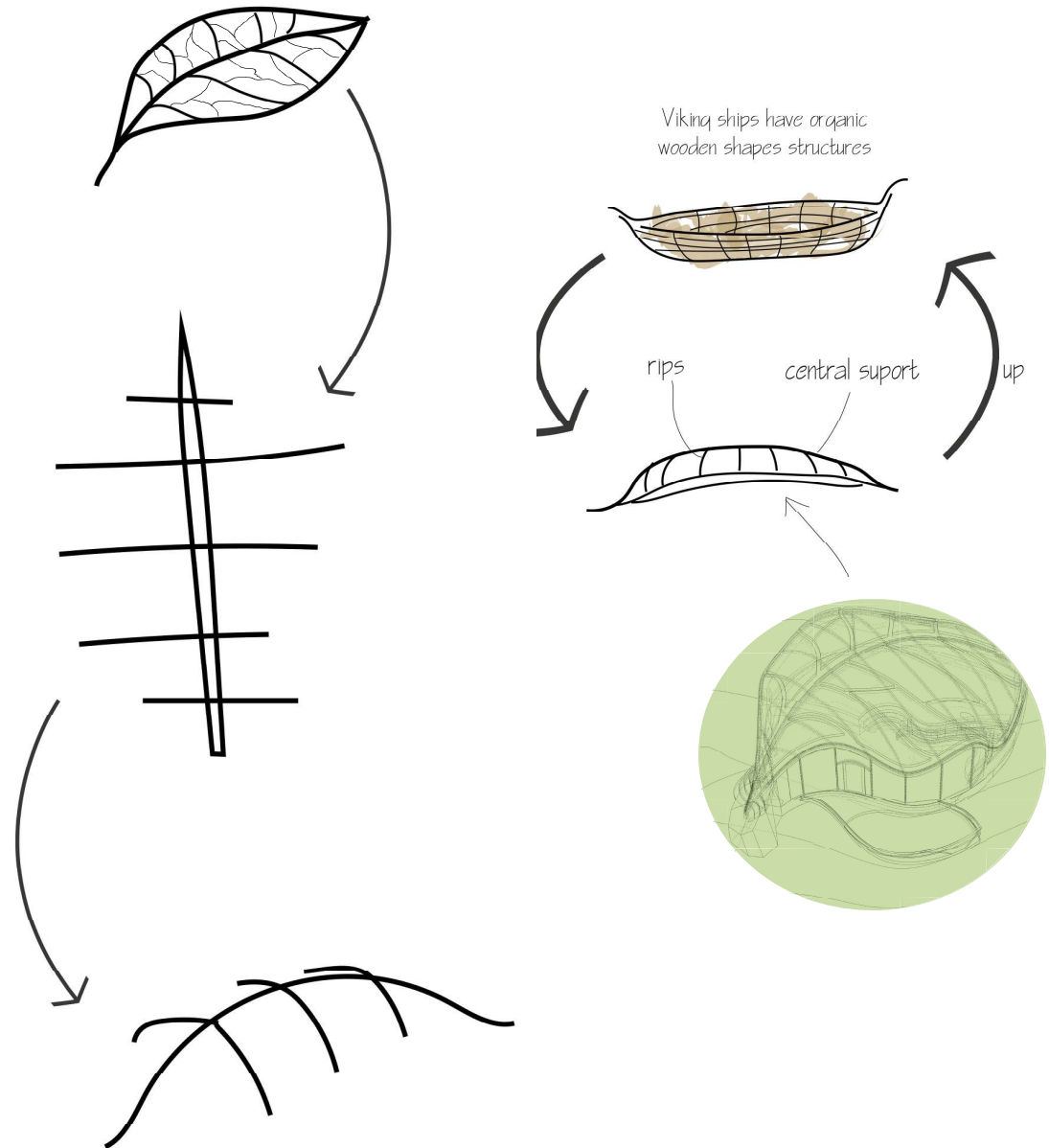
Interior view

## CONSTRUCTION

**Concept** When we observe a leaf external anatomy we can see that its structure is conformed by a base (leaf stalk) where a central (midrib) support grows, from which lateral “veins” are extended towards the edge, and sub lateral veins emerge, finalizing with a blade that covers the surface. When we look more closely at the internal anatomy, we can see that a leaf is conformed by a number of layers, which have different functions, the layers on each surface (epidermis) that contain all the other layers, are conformed of tough skin cells that protect the leaf.

In the same way the building mimics a leaf, in its internal and external structure.

As part of a economical sustainable construction and as part of recovering ancestral wisdom, the bio building takes into consideration traditional building techniques and makes a connection to the local building expertise, the area of Orust is known as a wooden boat producer, (industry which is now in decay) the shape of the roof wooden structure is also inspired by the shape of Viking ships, a experienced boat kraft man knows how to work the wood, in that way local economy and ancestral knowledge can be reactivated. The bio building is constructed in the site and most of it's materials are local.



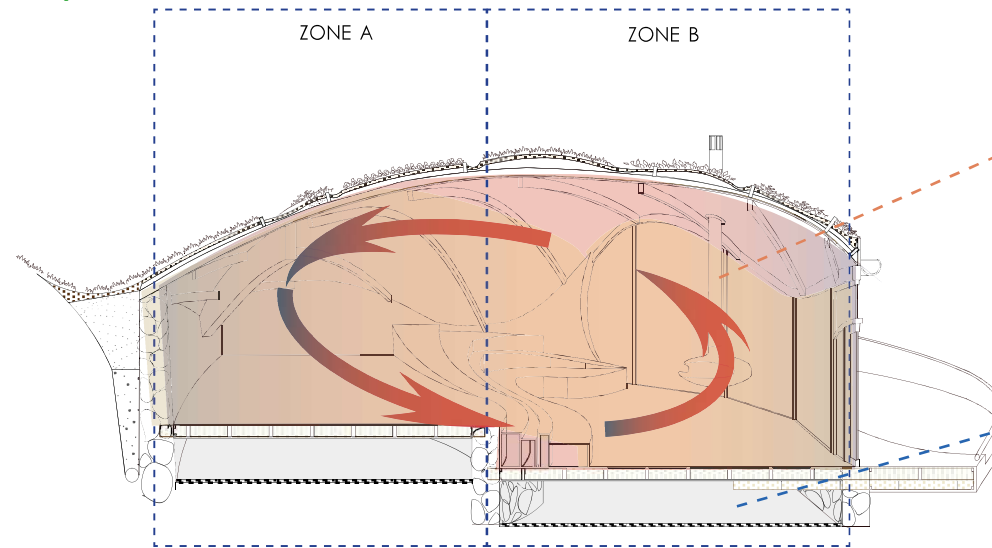
# Building's Anatomy

## Thermal zones

Difference in height and closeness to openings between the 2 thermal zones, create different temperatures, the zone A will experience a more stable temperature, while the Zone B will have perceivable fluctuation according seasons of the year and times of the day, however, as both thermal zones share the same space, zone A will be directly influenced by zone B.

## Low air infiltration & Thermal comfort

The building is designed to have a reduce thermal bridging, focusing openings and choosing materials which allow air tightness, this as a result creates a building that needs minimal heating, keeping a comfortable temperatures all year round.



## Heat source

A metal stove that is feed by wood from the forest, is placed close to the window openings to transform the cool air into warm air, the stove as being made of a material that has high rate of thermal conductivity will heat the space quickly, the round shape of the building allows a circular air flow, keeping the entire building warm.

## Air chamber

Act as buffer insulating the building from humidity and cold that rise from the ground, small openings on the structural walls allow air exchange preventing moulding.

\* This solution is considered as a risky construction, but it can be design for moisture safety according to existing engineering knowledge (e.g. introducing moisture barrier or increasing air chamber height)

## Green roof .....

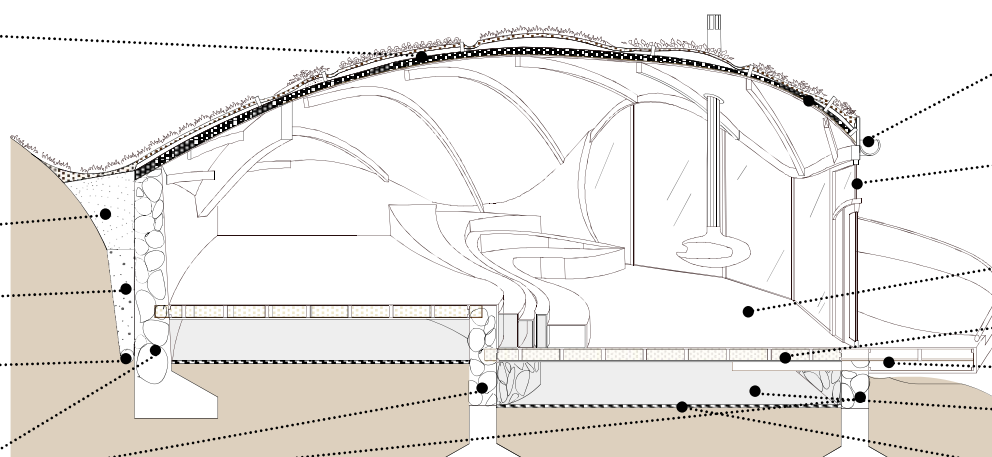
Native shallow- rooting plant species  
Growing medium  
Draining grave  
Bark of birch tree layer  
Water proof, hemp textile and wax  
Hempcrete insulation  
Wooden ceiling

## Sand filling.....

## Gravel filling.....

## Pierced water pipeline

## Stone and lime containing walls.....



## Wooden gutters

## Triple glass windows

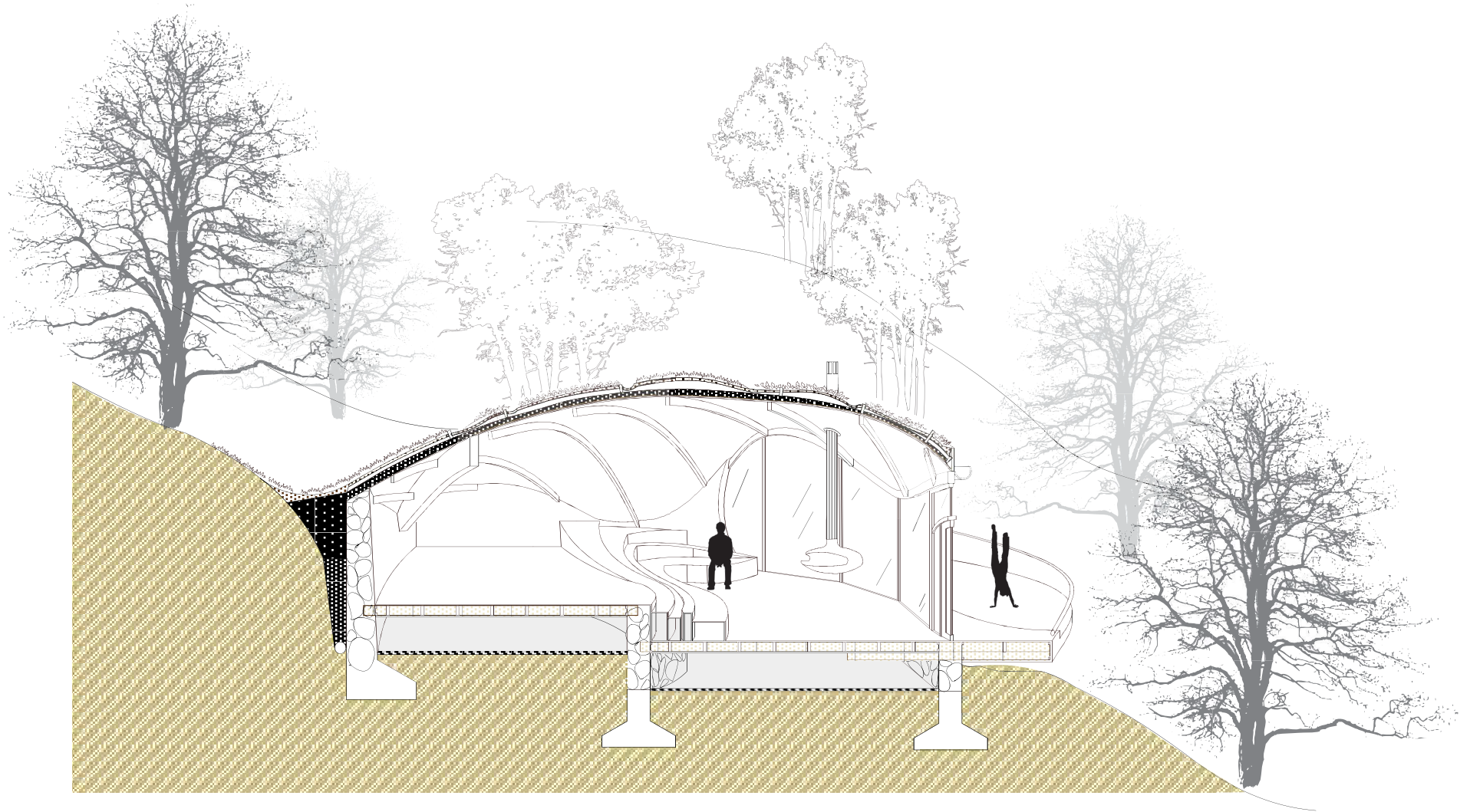
## wood flooring

## Hempcrete insulation

## Timber structure

## Air chamber

## Compressed grown



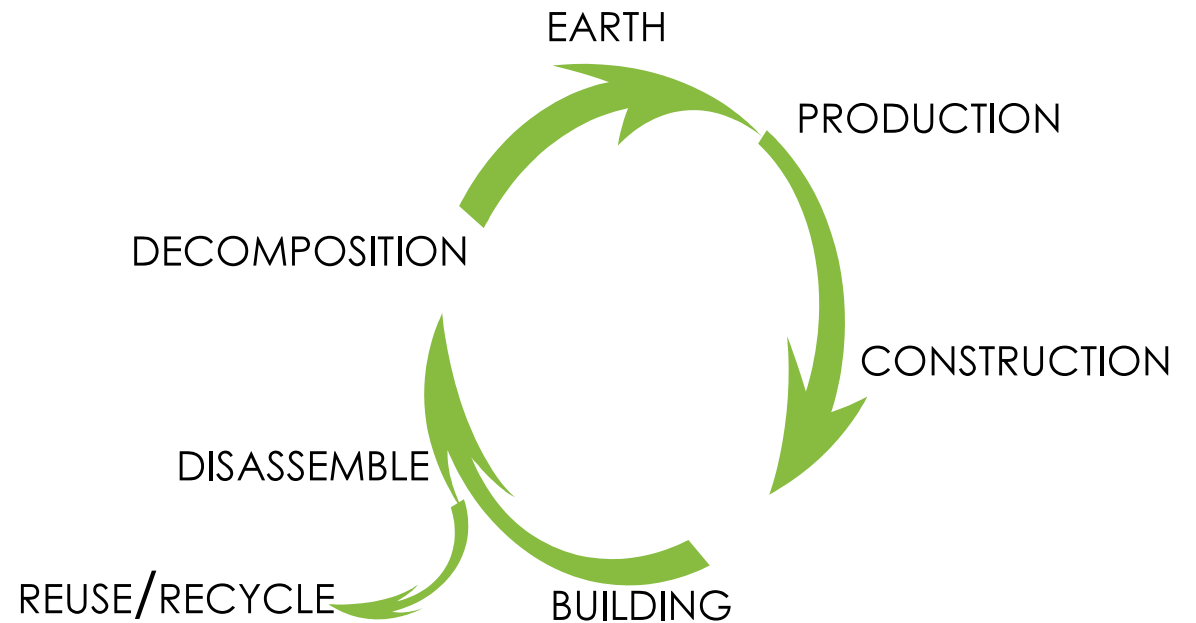
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esc 1:100

## Section A-A

## MATERIALS

An extensive research of biomaterials was made, the selected materials are able to respond in a positive way to their local environment, climate and morphological building needs, while also creating a comfortable and healthy indoor climate as well as a healthy outdoor environment to it's visitors, being this humans or any member of the ecological community.

All the materials in the building mimicry the cycles of an organism, Hempcrete and Bioplastics are innovative materials, which are now presented.



## Materials in the building

### Roof ceiling upper part

Wood, water proof layer

### Green roof

Bark of birch tree layer, draining gravel, growing medium, native shallow- rooting plant species

### Wooden gutters

Carved wooden gutters and metal anchorage. (example see pg.

### Walls composition

Skeletal timber structure, hempcrete filling, lime render and earth plaster.

### Wood load bearing structure

### Dividing wall bio plastic

Blocks of Bio plastic.

### Containing and structural wall composition

Local stone and lime mortar.

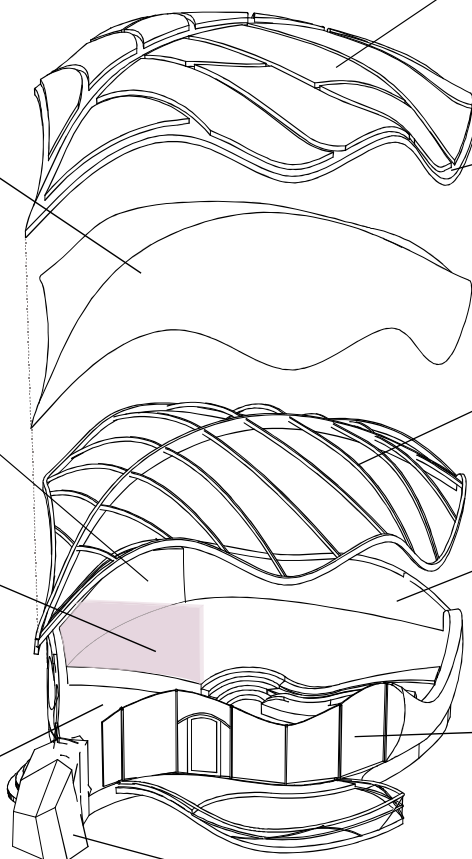
### Lifted floor

Wood flooring and joints, hempcrete insulation, stone support, gravel.

### Triple glass windows

### Structural stone Element

Local stone and lime mortar.



## Hempcrete in the building

**HEMPCRETE** *Bio building application: Walls and insulation in floors.*

Hempcrete is a bio-composite building material consisting of a mixture of industrial hemp shiv and lime-based binder mixed with water, that is done on site.

This material is chosen to be part of the Bio building due to it meets the characteristics needed for the desired building's performance and its sustainability as a product.

### Hempcrete in the building

The Bio material needs to create a *low energy performance building*, that can adjust to its shape, resist humid climate, and provide enough thermal insulation for the cold winters.

Hempcrete has *high thermal resistance* Due to *reduced thermal bridging*. It provides *low air infiltration*, the material is relatively dense and it is able to surround the building's wooden structure composed by a structural timber frame, and accommodate to its shape, making the walls quite *air tight*, it has "hygroscopic characteristics" which makes *breathable walls* this means that the walls can take on and give off water in response to changing humidity levels in the air, this produces *indoor air quality and wall durability*. The material is *fire and pest resistant*, the lime that conforms the mix protects the wall from moulding which makes it perfect for this humid location.

Hempcrete is a *lightweight and durable material* that can stand in the building during its entire life cycle, and after that it can be *recycled* to be used in another building or *used as a fertilizer*. (uk-hempcrete.com, 2015) This meets the ideals of cradle to cradle

This material can be modified in its mix proportions to change its

properties to its use in walls, roofs and floor insulation.

After a short drying period the shuttering is then removed leaving a massive wall, which can then be rendered or plastered. (Zampori, 2013)

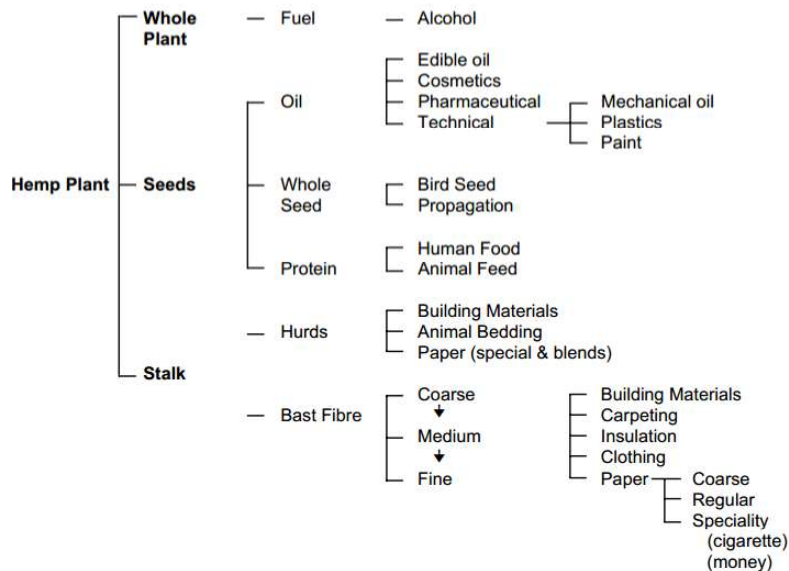
The difference in the Material used in the Bio building for walls and for floor insulation is the balance between the mix, as the walls require structural strength the binder is increased by about 25% of the mix volume, in opposite, the material used in floors is meant to have the material insulating properties, the binder is kept at a lower 10% for less rigid, more insulating fillings.



## Hempcrete in the building

### Hempcrete as a product

Hemp (*Cannabis Sativa*) as main component of the product has a high production efficiency and a wide range of industrial uses.



It has a high rate of growth (70 to 140 days), Hemp does not demand special herbicides because other plants cannot keep up with hems growth rate and the canopies block the sun light making hemp to a natural weed suppressor.(Hemp Industries Association, 2015)

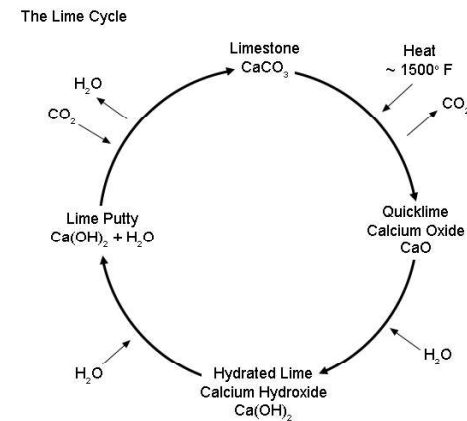
The shading from the canopies also helps to protect the soil from dehydration and the soil is held together as well as aerated by the roots after harvest.(Allin, 2012)

The wide range of uses of industrial hemp and the natural fast growth of the plant make this product to be low energy consuming

and less water intensive, three times less water intensive than cotton.

Lime

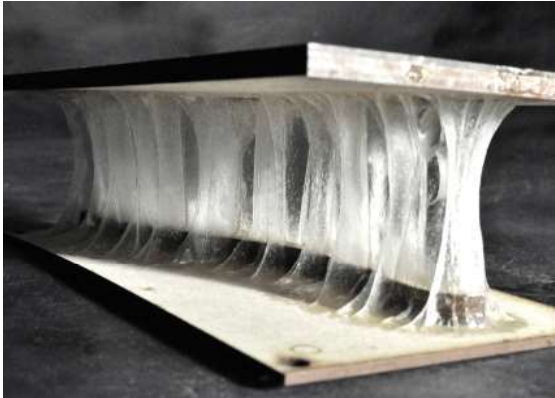
The hempcrete binder has 2 types of lime, Hydrated and hydraulic lime, the product is extracted from quarries. The quarries are mined and the material is burned, releasing to create quicklime, . Water is then added to create slaked lime, , during an exothermic process. If the final product is dry it is called hydrated lime which together with hydraulic lime is the two main components of the hempcrete binder. The slaked lime then reabsorbs the same amount of it one released in the atmosphere and starts to harden and return to its initial form.



source thesustainablehome.net

## Bio plastic in the building

**BIO-PLASTIC** *Bio building application: Interior dividing Wall*



Bioplastics are not just one single substance, they comprise of a whole family of materials with differing properties and applications.

According to European Bioplastics a plastic material is defined as a bioplastic if it is either biobased, biodegradable, or features both properties. (European bioplastics, 2015)

This material is chosen to be part of the Bio building due to it serves as a teaching tool, its beautiful and inspire consciences about new material solutions, Plastic is one of the most industrial used materials in the world and it is a great waste generator and polluter.

The bio plastic wall in the bio building is meant to be self made, the density of the material allow the light to go trough it and it's hard enough to maintain itself when placed into modules and bonded together with the same material.

The bio plastic used in the Bio building belongs to the group of "Plastics that are both biobased and biodegradable" PLA and PHA or PBS, starch based plastics

Bio plastic is a material that can have many uses, and applications, and depending on that, their characteristic changes as well as their components, in the building industry Bioplastics have been used in new tech buildings, but the material is still very new and many more applications will be develop, some examples of bio plastics in the building industry have used 3d printed blocks and thermoformed in sheets, the materials can also be self made.

The mix with potato starch, vinegar and water, the characteristics of the material will vary according to its composition and mix as well as it colour (More transparent or more "whitish") more dense making is a stronger materials that can easily make a structure that can support it self, and a more transparent making is a more flexible material.

The bio building interior walls will be made on site, with a dense mixture, to create a translucent wall, that can let the light go in but can bring privacy between the kitchen and the private area.

## SYSTEMS

**Concept** a leaf act as the powerhouse of plans, and its their principal source of food production, the structure of a leaf converts the energy of the sun into chemical energy, that the plant uses as food.

Biomimetics in the bio building apply integrated systems to promote resource efficient solutions, it combines prototypes and specific developed solutions to create an interaction with the surroundings, it rewards cooperation between systems and make the building a native entity to the hills of Orust.

The Biobuilding it's a living organism from outside to the inside, it functions as a leave, runs with energy of the sun, it conducts the rain water from the roof like veins to the inside, and its waste serve as food to another natural cycle.

The functions of the building allow its visitors to learn about natural systems and cycles of nature, and gives the opportunity to experience how could it feel to live inside a living machine, and how a bio era could look like.

In the Interior system elements taken form a prototype "**Microbial Home**" designed by Phillips, are proposed to be implemented.

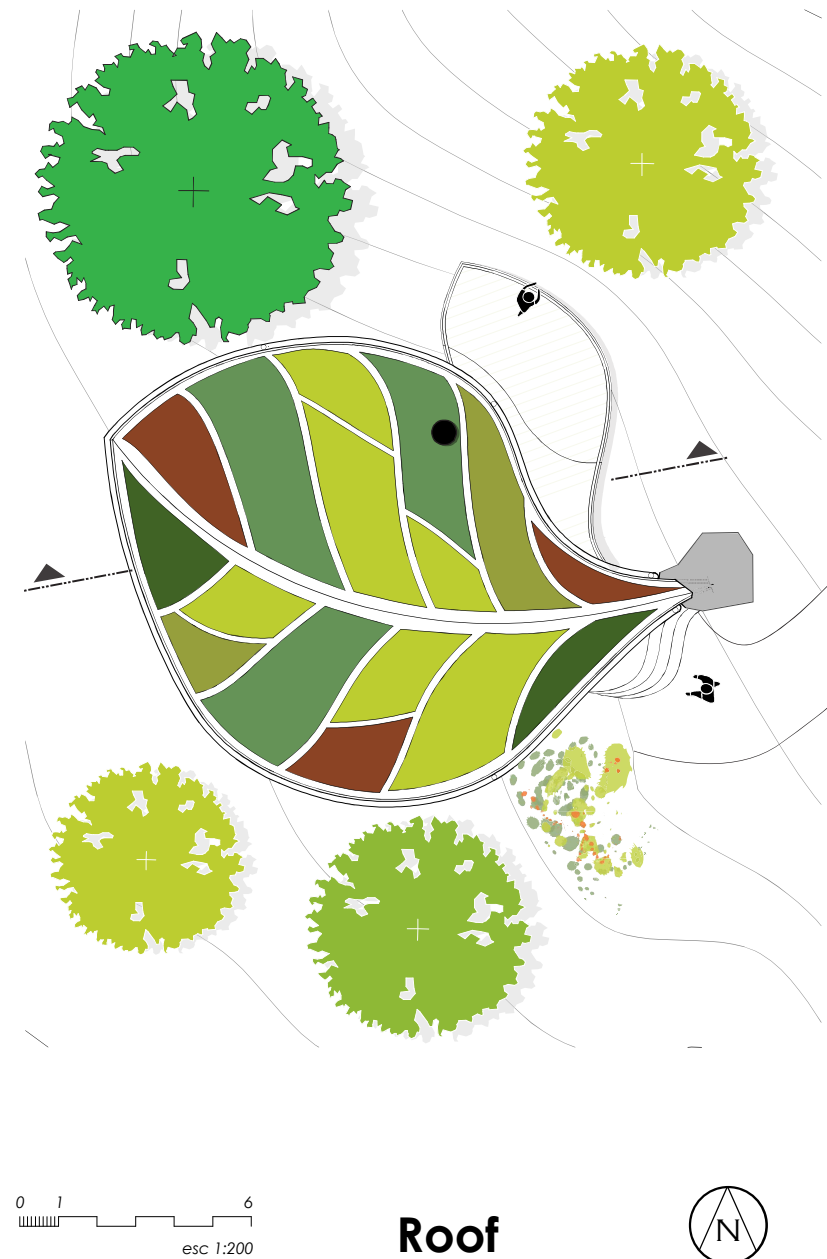


## Vein system roof

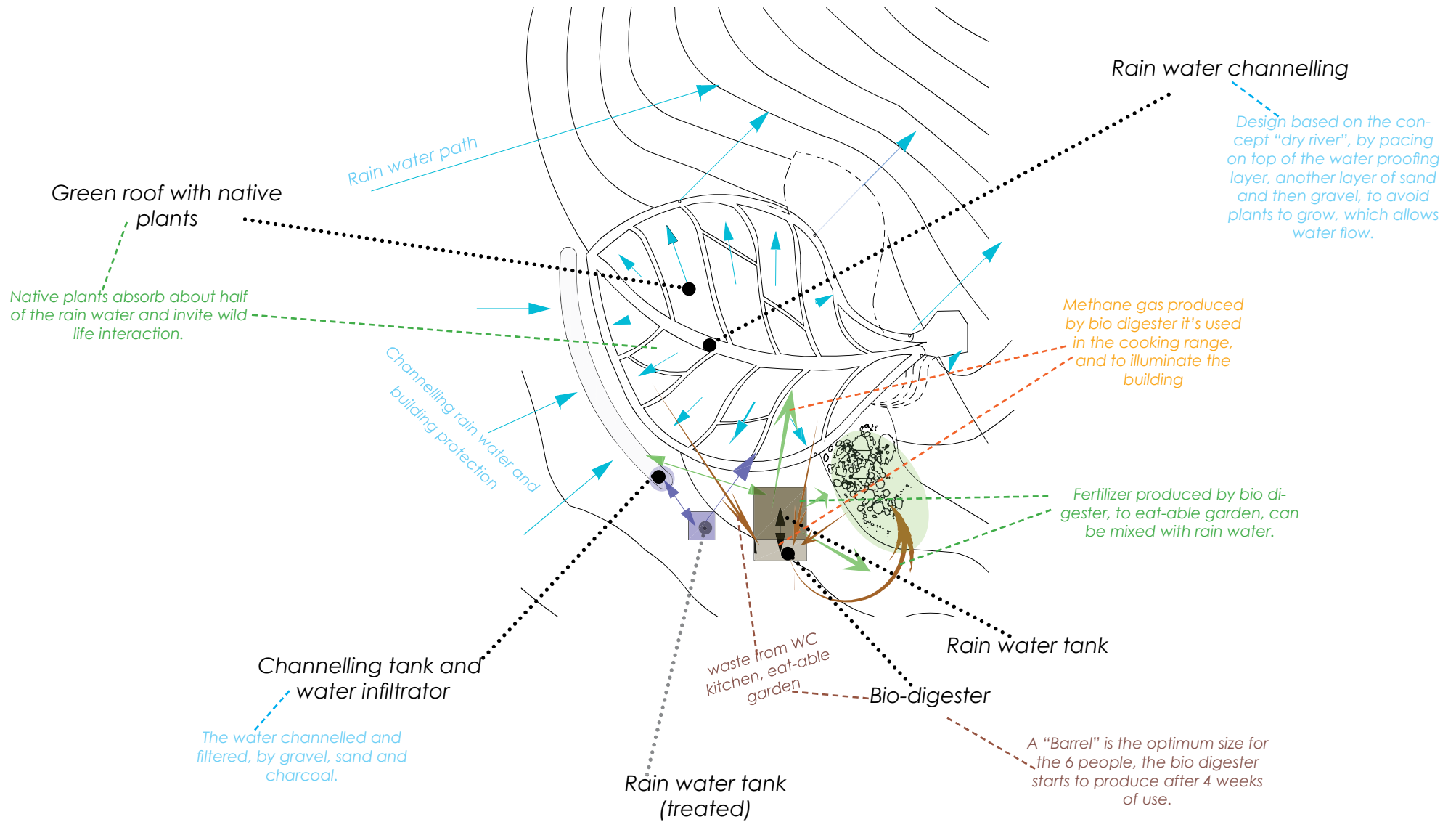
The roof is designed to work as a multi-service element with 2 main functions, collecting rainwater that runs down through its veins for the building internal needs, and to absorb rain water by the different green parts conformed by native plant species.

To induce the thought that the building is made by an organism (a tree), the roof is proposed to mimic the changes of colours of a leaf thus the landscape, during seasons of the year, as leaves are composed of many colourer pigments, green chlorophyll makes the green to sprout during spring and summer growing seasons, and it breaks down by shorter days and cool temperatures in the fall, making it possible for the other pigments to show. a green roof with native plants will produce the desired outcome. Furthermore the design of the green roof is intended to resemble the structure and vein system of a leaf.

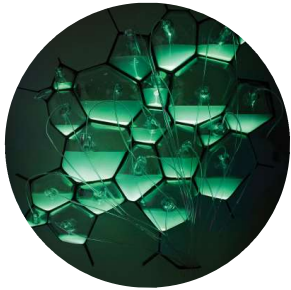
Native plant species absorb the water and invite wild life interaction, the plants change their aspect with the seasons together with the landscape.



## Exterior System



# Interior System



text & picture\* source Philips - microbial home

The concept explores the use of bioluminescent bacteria, which are fed with methane and composted material (drawn from the methane digester). Alternatively the cellular light array can be filled with fluorescent proteins that emit different frequencies of light.

Bio light

WC

The waste is directed to the Bio-digester, and it functions with treated water from rain, and it's lightened by the produce of the Bio-digester.

Rain water tank  
(treated)

Rain water is filtered and ready to be used in the kitchen and WC.

Rain water tank

Serves to water the eat-able garden.

Bio-digester

It's feed by WC, kitchen and garden wastes, and in return, produces fertilizer for the garden and methane for cooking and lighting.

Kitchen system



text & picture\* source Philips - microbial home  
Designed as a repositionable kitchen island, including a chopping surface with vegetable waste grinder, a gas cooking range, a glass tank that shows energy reserves and glass elements showing pressure, volume and readiness of compost sludge.



text & picture\* source Philips - microbial home  
Consists of an evaporative cooler and vegetable storage system built into a dining table. With a twin-walled terra cotta evaporative cooler at its center, the compartments and chambers vary in wall thickness and volumes, and are designed to keep different types of food at different optimal temperatures."

Eat-able garden

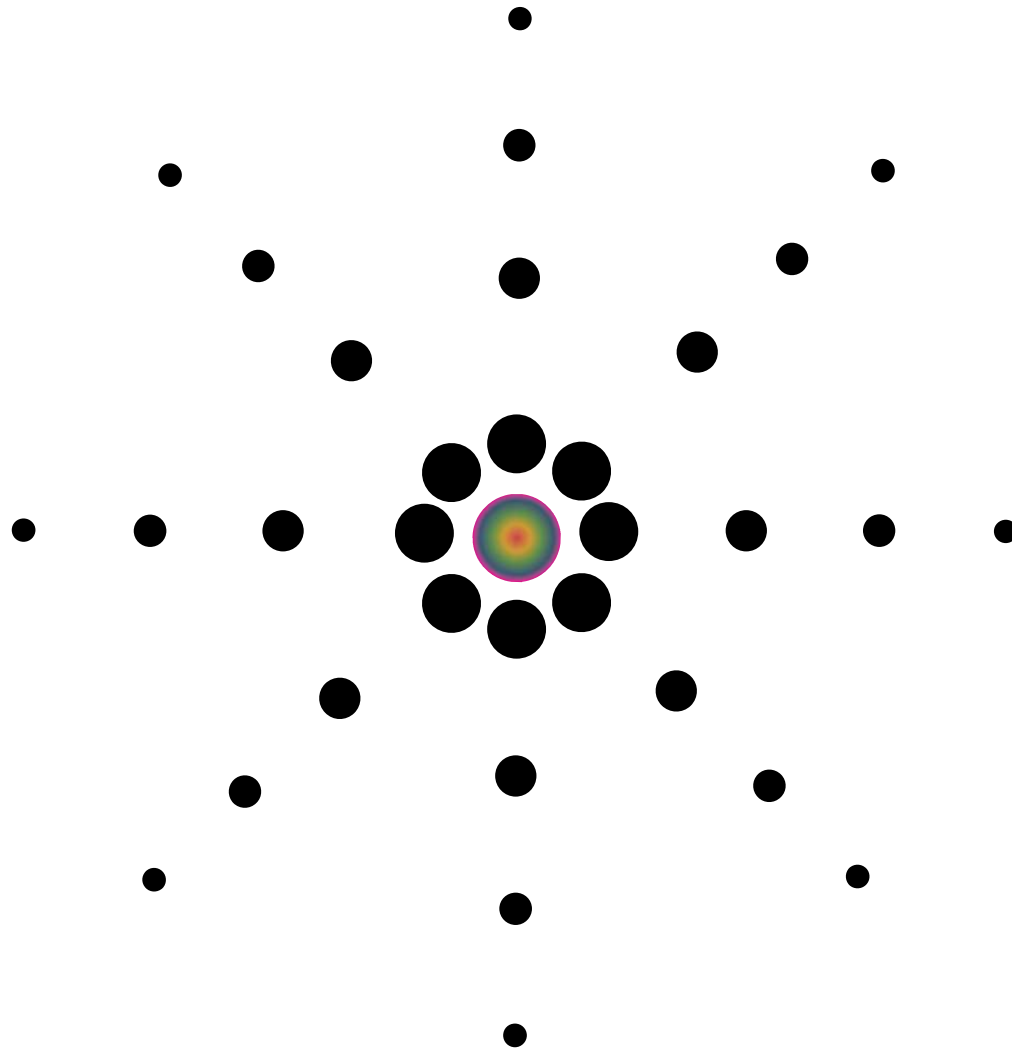
Produces food for the table, it's watered by the rain water tank, and fertilized by the bio-digester.

## THE BIO BUILDING Bio inspired design at algard mill and saw



# CHAPTER 6

## CONCLUSION



## 6.1 CONCLUSION & REFLECTION

### The project's critical reflection

**Ecco tourism in Swedish context** By looking at tourist examples in Sweden, we can see that the view of connection with nature in this context is either go into the forest ready to “get dirty” and be disconnected from your daily life and comfort or have an exotic luxurious experience in nature, each example targets a certain group of people. Although the experiences are interesting, nature and sustainable living are not always integrated, that experience is probably not something that people could take home for further reflection, so in my opinion this design proposal, could fill a void and bring something new, exiting and enriching into the subject.

**To achieve a change of perception**, I've learned that first it's necessary to seed interest, people need to have a feeling of accomplishing something, that “this is better than that”, that we are going to gain something from it. As the design explores a change of perception, the best way, is to interest people by a unique concept and to teach trough a physical experience, something that it can be perceived, a biomorphology is always attractive, as we have a biological preference for it, by showing the transition from traditional building form into a bio morph, and produce positive psychological responses, learning will be didactic and easy to understand and to be attracted by it.

**The site was design to make people feel better**, and to notice what is going on in the surroundings, nature is not static, it moves like us, breath like us, we are nature. If you see it then you understand it and if you feel it then you like it.

**Learning improves our self esteem**, by this experience people will feel better about themselves and have a feeling that they gained something form it, “knowledge and awareness”. This as

a result, changes the perception that sustainable living does not mean doing some little thing on the side, further more, it means the way we act towards nature.

**The bio building is a reflection of bio technology**, inspires a view of how it is possible to fulfil our needs looking and learning from nature, and the way we are rewarded if cooperating with natural flows.

**Connecting technology and nature** is exiting and interesting, It is a subject that needs a lot of improvement, although it has been present since the beginning of history. Some of the elements of the bio building for example the prototype of bio light, inspire in a clear way a **bio based future**, but it's true that its implementation is not around the corner. Hopefully in a near future, but by simply proposing this kind of prototypes in designs, we can influence in people's minds and increase interest to further develop this kind of biotechnology, and hopefully get closer to a bio future.

**Combine efforts between professionals is key to a successful project**, from this experience, I understood the importance of cooperation between different areas of knowledge, specially for a project with these characteristics. It is not possible to fully develop a bio inspired design without other professionals, cooperation is also the pathway of a bio based future .

**Inclusive design** is to have an open dialogue with client, users and people involved in the project, which is a decisive component in a successful design.

## How can architectural design get inspire by nature to encourage a bio based future?

Architecture can nourish from nature's wisdom, it can incorporate more efficient solutions taken from natural organisms, everything nature does, it is efficient and beautiful, it gives a response to a certain need.

As I see it **nature is the wisest architect**, and is logical for us, to look at it and learn from it. The necessity of a more efficient future it is here, materials and energy are becoming scarce, and people's well being are in jeopardy, all of this can be avoided if we go deeper into understanding the laws of nature and mimic its solutions.

Architecture can inspire by naturally occurring elements and organisms, as well as by our own instincts, our own biology, actually, architecture can be an extension of our own self, it can be rule by our own desires and feelings, it can express our essence, which is nature itself, and nature itself is a part of the whole. So architecture which is inspired by nature, is connected and works as part of an ecosystem.

A design can get inspired from nature which is materialized (animals, plants, water, rocks, landscapes, etc.) and from na-

ture which is instinctive (sensations, feelings, cognitive responses, etc.) Both types of inspiration are meant to be interpreted. Both types of inspiration (ideally) should guide a design to be more logical and coherent to our own existence and future.

Both types of inspiration encourage a bio based future, as the intention of a bio inspired architectural design, promotes well being and sustainable development.

Architecture that is inspired by nature, also needs bio inspired technology. Technology that mimics nature, is the response to a bio based future.

A bio based future encouraged by architectural design can take different pathways, and there is no specific line or style to do it, the only way to reach this design approach is the implementation of nature's wisdom. Architecture can benefit from observation, existing research and philosophies that address this subject.

## How can design criteria derived from such approach be implemented in a design project?

The implementation of architecture inspired by nature into this design project was accomplished by the utilization of bio inspiration tools which served as aids of design. The implementation of different philosophies and scientific research as well as listen to the own instinct.

In this specific case, the tools of design, were chosen because their philosophy fulfils design requirements and needs of this specific project. Bio inspiration tools can be applied in any kind of architectural and design project. A great part of these design tools are subject to interpretation, which makes each project unique, but following the same principals.

Biophilia and biomimetics, were in my opinion a perfect mix to use as design principals, they cover sensorial and bio morphological elements, as well as financial benefits.

To combine the physical and emotional/sensorial part of nature into this design, means to change the traditional approach (which is lacking of many important aspects of design), into a

natural approach.

**Bio architecture in a design project?** A design project like this, is a difficult one, and to find solutions to help reach the projects goals, is not an easy task, although there are many options and path ways to go, as well as design criteria to follow, the way to a Design inspired by nature, which can act as part of the ecosystem as a plant would do, in every way (with today standards), its nearly impossible to achieve for common people. Our technology and knowledge in that matter is still in the beginning. Design criteria like biomimetics into designs, can have an amazing future, such design approach is closely linked to technology, and while technology evolves, our understanding, and ability to mimic nature will be closer for modern societies.

This project is a very small test of how design criteria derived from such approach is implemented in a design project.

# APPENDIX



## Traditional building techniques

In my search for understanding traditional buildings techniques I had the opportunity to talk with an expert in the area, which explained that traditional buildings are also another world to understand, and to find solutions within this area it's necessary to set a limit in how far in time I wish to go, due to, of course, the building techniques and materials that were used evolved through out the years.

After a long talk she gave me some interesting insight of what can be used, and an idea of how could it be constructed.

**Interview** Annika Lindberg- Historiska Hus i Norr AB

Medieval natural stone walls can be set as an example for the *containing walls*, this medieval walls were built with rounded blocks that are laid out in shifts in lime mortar edged with smaller stones in between. Approximately 1.5-1.7 meters thick, in this type of walls, with this high (see picture 1) the thickness can be reduced depending on the hight, the life of this walls as we can experience is very long and no .

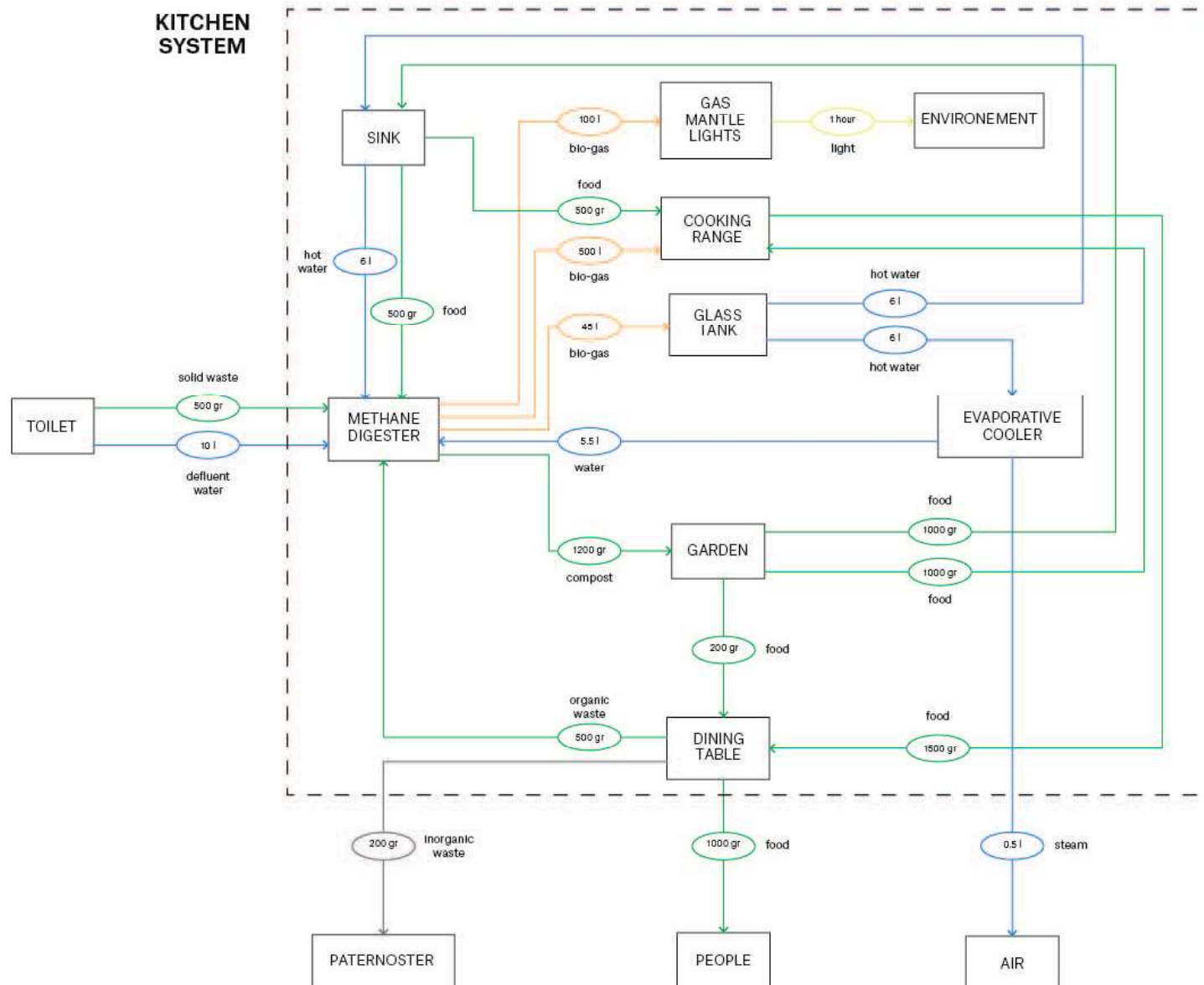
*The gutters of the building* can be made with carved wood, this technique can be found back to the renaissance era, in which all the gutter system was made in wood, after that, metal anchorages were introduced, this last combination is still being used in some modern houses due to its beauty in looks, (see pictures 2,3) the life of this gutters is about 20 years after that it's recommended to be changed.

*The wood used for the roof structure*, could be made using a very thick in internal structure type of tree, Due to the cold climate the best and more strong trees can be found in the north of Sweden, and should be minimum 400 years old, to resist the length of the roof.

It is clear that all of this materials can go back to the nature after the buildings life of can be recycled or reused.



## BIO-DIGESTER ISLAND + LARDER SYSTEM MFA



### ESTIMATION OF DATA TO LET THE SYSTEM WORK FOR ONE HOUR

#### LEGEND

- WATER FLOW
- FOOD AND ORGANICS FLOW
- ENERGY FLOW
- ELECTRICITY FLOW
- INORGANIC MATERIAL FLOW

#### DATA SOURCES

QUANTITY OF METHANE PRODUCED TO MAKE THE LIGHT AND THE STOVES WORK:  
<http://ecovillaggiopicino.altervista.org/co-me-realizzare-un--digestore-per-generare-gas-metano/>

QUANTITY OF METHANE TO WARM UP WATER:  
[http://www.erediceconiadriano.it/acqua\\_calda.html](http://www.erediceconiadriano.it/acqua_calda.html)

AVERAGE CONSUME OF WATER FOR COOKING AND KITCHEN IN GENERAL:  
<http://www.tonix.it/consumi.htm>

QUANTITY OF COMPOST PRODUCED BY A CERTAIN AMOUNT OF ORGANIC WASTE:  
<http://files.meetup.com/6773662/Guida%20compostaggio.pdf>

WEIGHT OF PLASTIC BOTTLE  
[http://www.provincia.fe.it/download/MORDI\\_1\\_Acqua.pdf](http://www.provincia.fe.it/download/MORDI_1_Acqua.pdf)

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