

# **WANDERERS**

## **POPUP HOTELS IN NATURE**

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## ABSTRACT

There is a rich history of mankind's relation with nature which is still used as a framework in today's architecture. The framework is built on the fact modern structures are still able to awaken emotions from the past. In ancient times survival has been different compared to modern times. Man survived with whatever it could gather in the direct environment to create shelter, causing structures to be built on different principles. Modern technology allows to create structures with new techniques and mimic structures of the past. Combining these techniques with techniques to make pop-up structures adds an extra dimension to the design objective.

**Keywords:** *Pop-up, hotel, historical, nature, biophilia*

# INTRODUCTION

Nature and man are often mentioned as two separate entities. Man has transcended nature and made a realm of its own and therefore is no longer part of nature. Manmade cities are the opposite of natural environments. Controlled, levelled, safe, and simplified to increase the efficiency at which mankind can operate in securing its survival, summed up in a word: luxury.

This luxury comes at a cost. Although life is easier lived in a city; easy living can deprive the human of certain mental and physical stimuli. Humans are still creations of nature. The mind is cultivated over millions of years of living among everything else that is not controlled by humans. The transition to the city started roughly 6 to 7 thousand years ago. And for most people on the planet, it has become the natural environment, whereas nature is the exception. The mind now lives among everything controlled by humans.

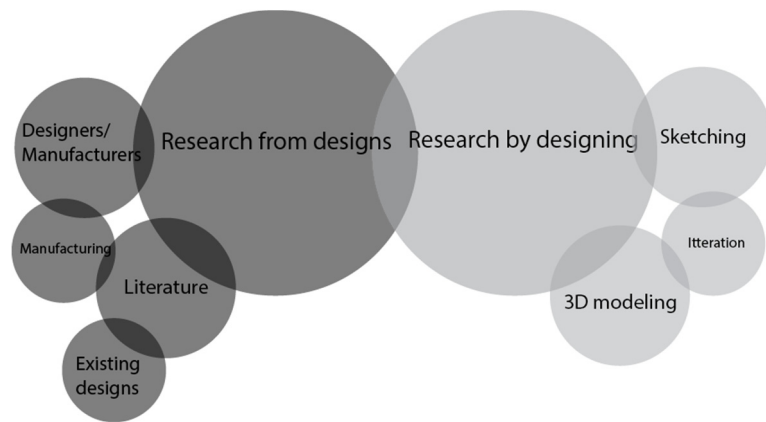
The following project and research do not revolve around the improvement of cities. It is an exploration of historical experiences applied to modern architecture. The knowledge of the mind and mankind's history can be applied to the way we design at different levels. From small details that are picked up by the unconscious mind to space altering adjustments that stimulate and intrigue the mind and body at a conscious level.

The project revolves around the stimulation of tourism in a Dutch region. A central region known as the Parkstad in the province of Limburg has been experiencing demographical shrink. The region is therefore appointed as an IBA (Internationale Bau Ausstellung) to counter the shrink. Several plans are in the works for a metamorphosis of the existing stock and plans to initiate new build projects to entice tourism and to entice permanent settlement in the region.

One new plan is to use the region's available natural areas for pop-up hotels. Hotels specifically designed to travel and be placed in nature. Despite the shrink, Limburg still does well in the tourism sector. Structures designed for portability are plentiful. And each portable design can be placed in nature physically. But not each portable structure is designed to work with nature, to connect the person with nature. Research on nature and man shows that there is a natural beneficial effect of nature on the human body and mind. Introducing a structure into this relation can break it or stimulate it. This research will focus on the following question:

Namely: Which design is architecturally emphasizing its connection between man and the surrounding nature? Which connection are there between man and nature? How can these connections be emphasized through architectural tools?

# METHOD



*Figure 1: Methods*

Research is conducted mainly through literature and experimental iterative design. To answer the thematic question, the majority of experiments are done virtually in CAD and CAM software. These include: Rhinoceros 3D & Grasshopper 3D. This software allows for precise modelling, parametric modelling, structural and component analyses. To achieve the results, the modelling and experimentation relied heavily on physics simulations. Complex structures with no mathematical logic cannot be made through calculated drawings.

# RESULTS

## HUMANS, SHELTER AND NATURE

Throughout history man's connection with nature has greatly changed and with it, its translation into structures. In early history structures were made for shelter, a bare minimum for means of survival. In modern times homes are still made for shelter, but we have transcended the historical ways of sheltering ourselves. It is no longer a bare minimum of protection. Modern shelters are now dealing with the great global growth of mankind. Therefore, they are built with efficiency and luxury to a point where an equilibrium is reached in different contexts.

The earliest forms of shelter were created out of a desperate need or found in exploration by the dweller itself. Raw natural materials. Rocks, branches, twigs, leaves etc. were the building materials of simple structures which left little distinction between shelter and the natural environment.

Modern or historic, when a structure is introduced into the man and nature connection, 3 relationships emerge from it.

- Stimulated senses by nature and structure from within the structure.
  - Protection
  - Refuge
- Stimulated senses by nature and structure from outside the structure.
  - Anticipation
  - Mystery
  - Planning
  - Exploration
- Stimulated senses by the interaction with the structure.
  - Body positioning
  - Handling
  - Balance
  - Touch

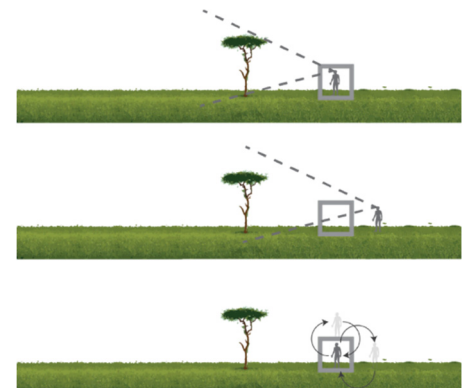


Figure 2: Connection types

While all 3 relationships are true for any structure, they are experienced in different quantities. A tent made by broken branches and covered with leather and leaves tries to achieve the same thing as a house made with steel and stone. Shelter is experienced differently when it sways with the wind as compared to when it remains completely indifferent to external forces. While a firm house is more protective of the body from external dangers, it is less capable of stimulating the mind. Modern houses provide a person with safety and comfort, so the person doesn't have to look for it. Stimulation by space and action is a direct remnant of the past.

# THE ORIGIN/HISTORY

## ORIGINS OF BUILT RELATIONSHIPS WITH SPACE AND NATURE

The understanding of the human relationship with shelter lies in human evolution, where for more than 99% of our species history we biologically developed in adaptive response to natural not artificial or human created forces (Kellert and Calabrese 2015). Many, if not all of our species' behaviour come from the natural instinct created throughout history. Mankind's greatest goal was and still is survival. Early man lived in nature until it found or improvised shelter.

Humans have evolved in the larger context of the natural environment, and we have developed to respond to these natural surroundings. In fact, our ancestors remained hunter-gatherers whose dwellings were seamlessly integrated into their natural surroundings until recently in human development. As a result, our development has been entrained by sensory interactions with nature and familiarity with the spatial properties of various natural landscapes. In the age of the Industrial Revolution, a transformative shift towards urbanization, fabrication, and isolation from nature ushered in a departure from traditional agrarian practices and the active interaction with the natural world that accompanied them (Green 2011).

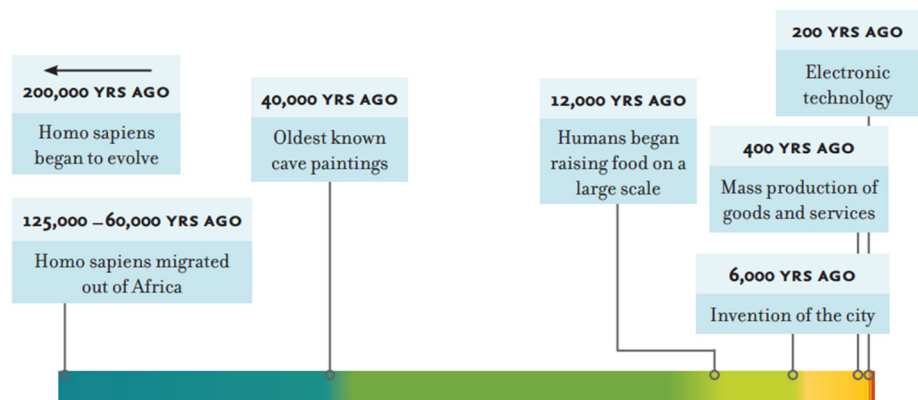


Figure 3: Development timeline (Kellert and Calabrese 2015)

## GENETIC MEMORY

The significance of history is carried by every human. The brain possesses the unique ability to pass experiences down generations, so the most important survival techniques don't have to be re-learned. Feelings of safety are closely tied to certain spaces of certain qualities. A small space feels protective because humans of the past sought out small spaces for their protective enclosed qualities and easiness of heating up while a large space can make a person feel exposed. Today's architectural biases by each individual has taken place as a repeated experience in the past. Today emotion is no longer viewed as a psychological state of mind in opposition to logical reasoning, but as reason's very biological foundation. Emotions are simply "affect" or electrical/chemical programs that shape or shortcut the way in which we perceive the world, basically as pleasurable or non-pleasurable events. In its simplest definition, emotion is the pre-reflective response of an organism to a stimulus, and translated into architectural terms it can be described as the pre-reflective response of the human organism to the built environment. All architectural design is emotional—both on the level of our coupling with the built environment (whether we like the design or not) and in how our design mediates or fosters our socio-cultural interactions with others (Pallasmaa, Mallgrave et al. 2015).

As human habitats change, so will the human adaptation towards, or recordings of that habitat change. The current human emotion towards nature is older than humans itself. The brain is a result of 500 million years of evolution and as such humans carry a lot of 'evolutionary baggage'. Although the 'three brains' are distinguished neuroanatomically and functionally, they are intricately connected; they work together, not independently. The 'older' brains are vital to our existence and cannot be considered excess baggage. Hence, we need to develop organizational contexts that support the balanced expression of all levels of our brain (Ehin 2000).

The human brain can be divided into 3 major areas:

- 1. The **Cerebrum**: The thinking brain
  - Rapid growth after the development of Genus Homo.
- 2. The **Cerebellum**: The feeling brain
  - The mammalian brain.
- 3. The **brain stem**: The instinctive brain
  - The pre-mammalian brain.

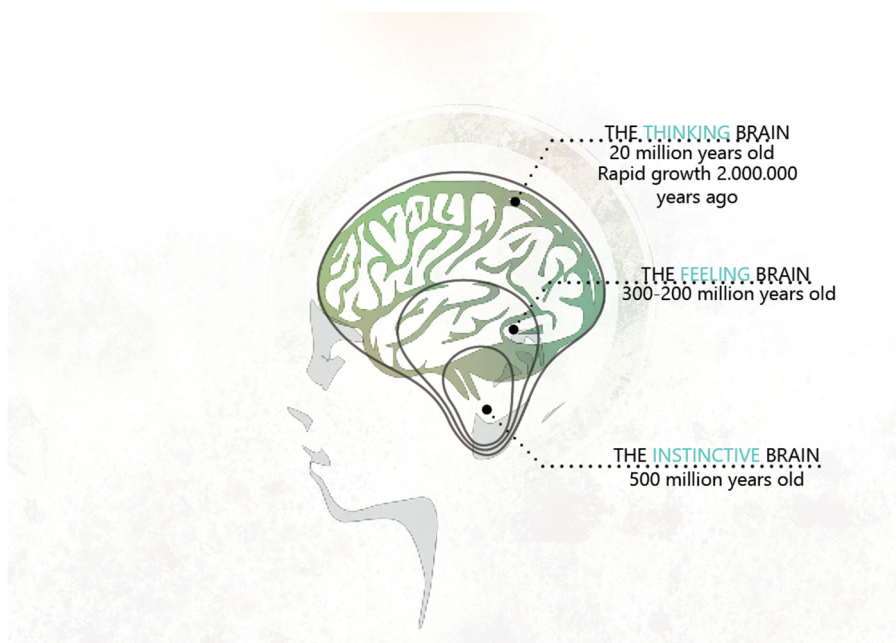


Figure 4: The 3 major areas of the human brain

The development of the brain in nature means its perception of modern living areas, i.e. the city, is going to be different. Rather than feeling at ease in a city, the mind and body are still coping with this unnatural phenomenon. Meta-analytic studies report that among individuals living in cities, the prevalence of all psychiatric disorders is increased by 38%, of mood disorders by 39%, and of anxiety disorders by 21%, as compared to inhabitants of rural areas (Lederbogen, Haddad et al. 2013). Humankind has never stopped adapting to its environment. However, the development of the city and the migration to the city happened abruptly in the larger time scale of things. The brain, or humankind is no doubt able to adapt to the city as well if it must, but this adaption isn't happening in the same time span as usual.

## TIME BLOCKS

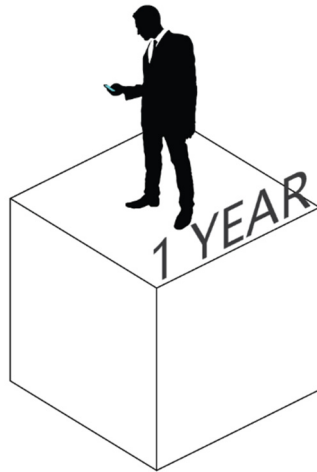


Figure 5: 1 year

### 1 Year: The present

Humans: An urban species.

Humanity is on its way towards new revolutions. The invention of artificial intelligence, the elimination of aging, and settling on nearby planets are some of the greatest changes humans are facing today.

Looking closer to the human-nature relationship the most recent notable change has happened in 2010 when humans have become an 'urban species'. More than 50 percent of all people live in a city (Wallman 2013). As an urban species, a city dweller, the direct connection with nature is mostly lost. Most people don't need to know about the natural world to survive. Green comes in a relatively small footprint in the form of streets filled with trees and public parks, placed there by human design.

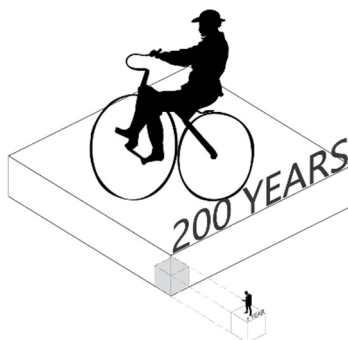


Figure 6: 200 years

### 200 years: Industrial revolution

The catalyst of urban expanse.

A cause for the rapid growth of the footprint of humans and thereby the city is the most recent major revolution: the industrial revolution. From the late 18<sup>th</sup> century, to the late 20<sup>th</sup> century humans have made several breakthroughs. New technologies in agriculture meant more food, new discoveries in medicine meant less sickness. Humans liberate themselves from their dependency on the surrounding ecosystem. The city offered opportunities and higher wages which drew young people to the city further increasing the gap between nature and city.



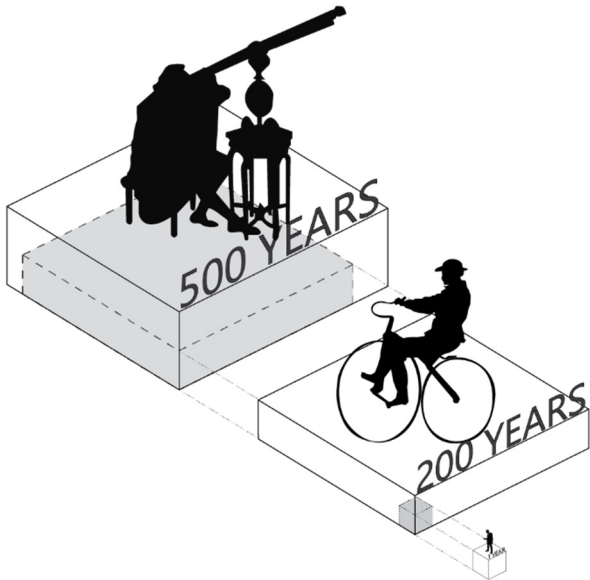


Figure 7: 500 years

Until the scientific revolution most human cultures did not believe in progress. They thought the golden age was in the past, and that the world was stagnant (Harari 2011). When it was believed the powers of nature were controlled by gods, scientific tests and discoveries dismantled nature into understandable concepts. Humans discovered power.

## 500 Years: The scientific revolution

Breaking free from ignorance.

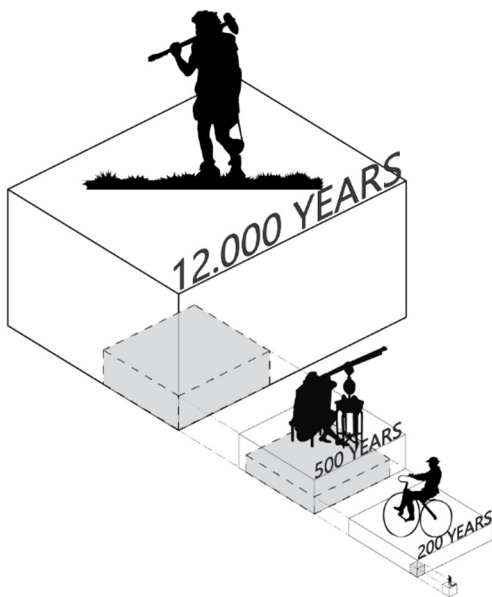


Figure 8: 12.000 years

Perhaps the greatest change to have overcome the humans. Up until this point, humans lived as foragers. Small communities managed to survive by gathering and hunting. Wherever they were, they were part of the natural ecosystem. During this new revolution humans learned to take control of nature. To grow crops, protect it and take care of it. Although humans were still completely in the vicinity of nature, the relationship changed. No longer part of a single ecosystem, humans were now responsible for an artificial system.

## 12.000 Years: The agricultural revolution

From foragers to settlers. The breaking point.

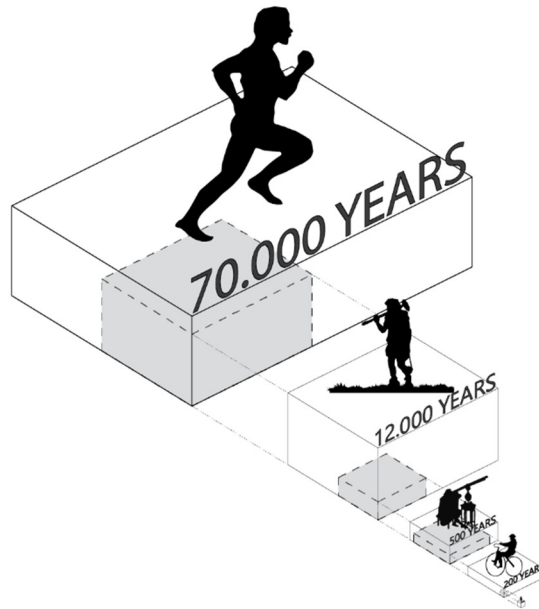


Figure 9: 70.000 years

## 70.000 Years: The cognitive revolution

Humans transcend biology. The start of culture.

A sudden spur in human intelligence revolutionized the way humans communicated and solved problems. As human intelligence was growing so did human behaviour. Still part of the natural ecosystem, however human behaviour has been different enough to speak of culture. Humans live nomadic lifestyles as foragers and hunters.

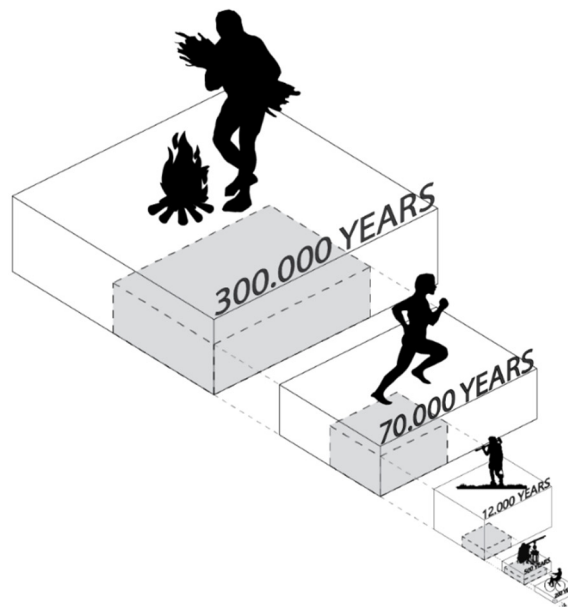


Figure 10: 300.000 years

## 300.000 Years: The rise of Homo Sapiens

The wise ones.

With the up rise of the Homo Sapiens a lot of 'advanced' survival techniques had been figured out. Shelter, Fire, tools were used daily. The most advanced species jumped to the top of the food chain.

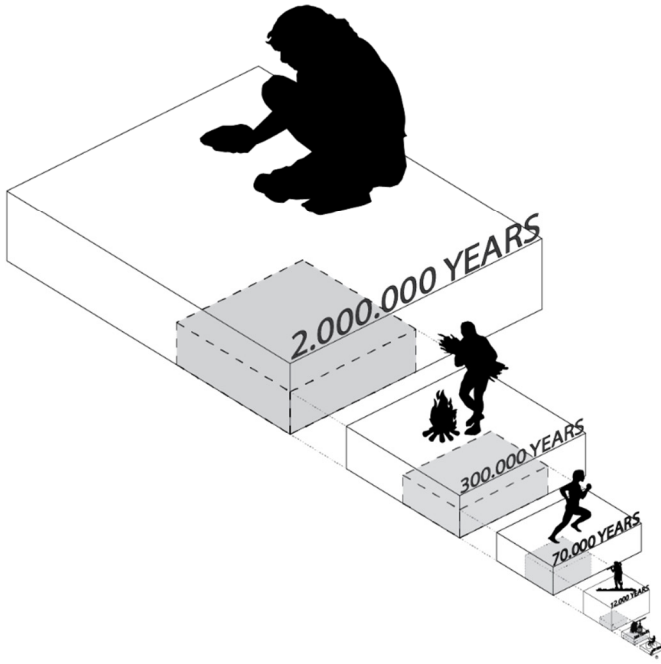


Figure 11: 2.000.000 years

The earliest purpose-built shelter has been discovered in sites near Chicibu, Japan dating to 500,000 years ago. The shelter would have been built by the ancestor of the Homo Sapiens, Homo Erectus. This discovery dictates that mankind has been sheltering itself with built structures for at least half a million years.

**2.000.000 Years:**  
**The first humans**  
 Genus *Homo*.

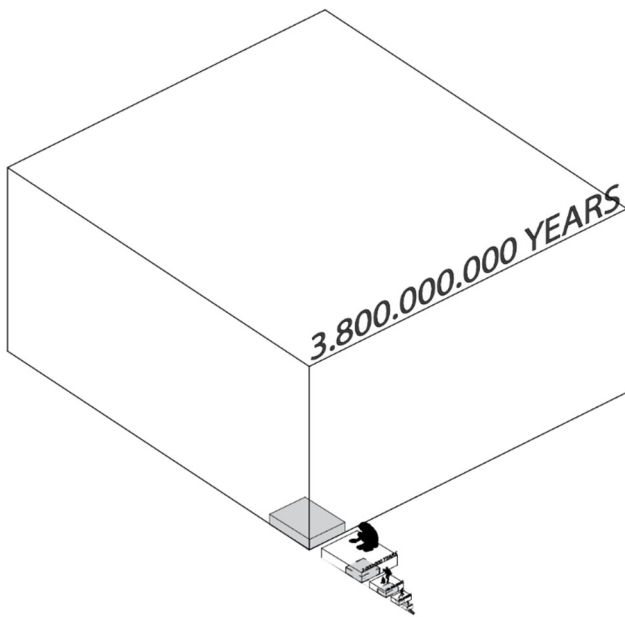


Figure 12: 3.800.000.000 years

The start of life. From one celled organisms to the Genus Homo, 3.8 billion years of development of which 500 million years is still carried with Homo sapiens. Mankind's earliest survival instincts, still present.

**3.800.000.000**  
**Years: life**  
 The emergence of  
 organisms:  
 Beginning of  
 biology.

## HISTORIC LIVING CONDITIONS

To make a person remember, the present needs to resonate with the past. Understanding these conditions can be achieved through historic shelter. The stone age had mankind reside in caves, huts made from sticks and leaves or bones and leather. Humankind's physical relationship with historical structures such as tents, huts, treehouses etc. are different from contemporary relationships with a structure. A contemporary home is designed for ergonomics: spaces are pleasurable to be in, transitional spaces are easy to use, doors are high and wide. A person's posture remains the same when transitioning from one space into another. Historical forms of shelter didn't have these luxuries. Huts were made with low entrances to slow down any intruding human or wild life (Kahn 1973) (Figure 14). Caves varied in height and required crouching to navigate (Figure 13), sitting by a fireplace in the smallest space kept its dwellers warm. Tents offer a thin barrier between outside and inside. During high wind speeds and rain, the thin skin transfers the movement of the wind and the sound of rain inside.

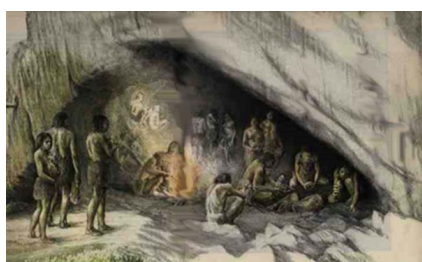


Figure 13 a-b: Painting of cave setting.  
Right: Schematic section.

**Natural formations** force anyone to go there to watch their balance, to analyse the space while exploring it. The cave is not formed to the human body. There is no promise of comfort. Comfort has to be found. Walls and floors, and ceilings are not defined, they blend. Their functions are not pre-determined by a designer, they are defined in the moment by the dweller. The space isn't experienced by the mind alone, but by the feet and hands as well.

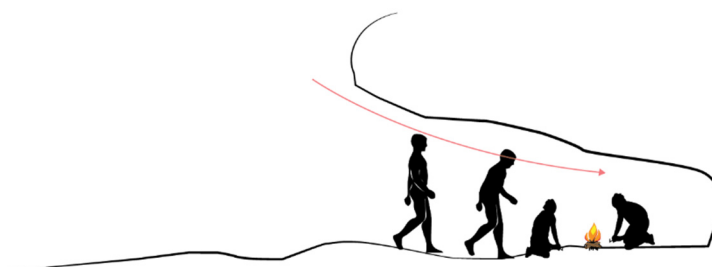
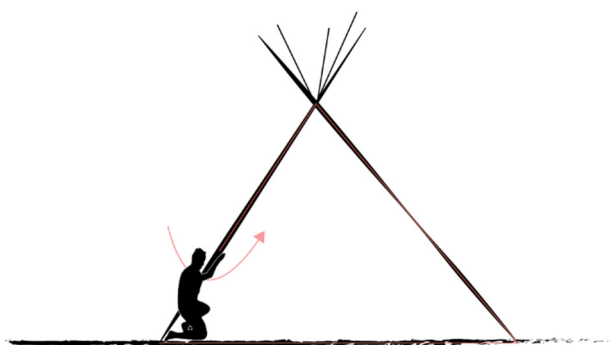


Figure 14 a-b: Replica of historical hut.  
Right: Schematic section.

**Tents** possess the unique ability of exposing the dweller with the exterior space. Its fragile materials don't defy nature but barely cope against it. Tents, especially in modern context, have the charming effect of bending with gravity. At the same time it connects the dweller with the softest elements ever used in human structures. Paper, grass, wool, hair, and leather are some of the materials used in these historic shelters. Materials that let us preserve our warmth upon touch, unlike modern materials that conduct heat effectively.



**Trees** have also played a vital role in human affairs as sources of food, building material, paper products, heating supply, and other uses. The appearance or simulation of treelike shapes, especially columnar supports, is a common and often coveted design feature in the built environment. Some of our most appealing structures contain tree forms and shapes that frequently include leaf capitals. when revealed in multiples, they can sometimes suggest a forested setting (Kellert 2005).



*Figure 15 a-b: Treehouse setting.  
Left: Schematic section.*



# BIOPHILIA, THE COLLECTIVE FRAMEWORK

Biophilia is humankind's innate biological connection with nature. It helps explain why crackling fires and crashing waves captivate humans; why a garden view can enhance our creativity; why shadows and heights instil fascination and fear. Biophilia is described by 14 patterns in 3 groups (Browning, Ryan et al. 2014):

## NATURE IN SPACE

### Visual Connection with Nature:

A view to elements of nature, living systems and natural processes.

### 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.

### Non-Rhythmic Sensory Stimuli:

Stochastic and ephemeral connections with nature that may be analysed statistically but may not be predicted precisely.

### Thermal & Airflow Variability:

Subtle changes in air temperature, relative humidity, airflow across the skin, and surface temperatures that mimic natural environments.

### Presence of Water:

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

### Dynamic & Diffuse Light:

Leveraging varying intensities of light and shadow that change over time to create conditions that occur in nature.

### Connection with Natural Systems:

Awareness of natural processes, especially seasonal and temporal changes characteristic of a healthy ecosystem.

## NATURAL ANALOGUES

### Biomorphic Forms & Patterns:

Symbolic references to contoured, patterned, textured or numerical arrangements. that persist in nature.

### Material Connection with Nature:

Material and elements from nature that, through minimal processing, reflect the local ecology or geology to create a distinct sense of place.

### Complexity & Order:

Rich sensory information that adheres to a spatial hierarchy similar to those encountered in nature.

## NATURE OF SPACE

### Prospect:

An unimpeded view over a distance for surveillance and planning.

### Refuge:

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

### 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.

### Risk/Peril:

An identifiable threat coupled with a reliable safeguard.

## 14 PATTERNS AND ITS EFFECTS

14 PATTERNS	STRESS REDUCTION	COGNITIVE PERFORMANCE	EMOTION, MOOD & PREFERENCE
<b>Visual Connection with Nature</b>	Lowered blood pressure and heart rate.	Improved mental engagement/ attentiveness.	Positively impacted attitude and overall happiness
<b>Non-Visual Connection with Nature</b>	Reduced systolic blood pressure and stress hormones.	Positively impacted cognitive performance.	Perceived improvements in mental health and tranquillity.
<b>Non-Rhythmic Sensory Stimuli</b>	Positively impacted heart rate, systolic blood pressure and sympathetic nervous system activity.	Observed and quantified behavioural measures of attention and exploration.	
<b>Thermal &amp; Airflow Variability</b>	Positively impacted comfort, well-being and productivity	Positively impacted concentration.	Improved perception of temporal and spatial pleasure (alliesthesia)
<b>Presence of Water</b>	Reduced stress, increased feelings of tranquillity, lower heart rate and blood pressure.	Improved concentration and memory restoration. Enhanced perception and psychological responsiveness.	Observed preferences and positive emotional responses
<b>Dynamic &amp; Diffuse Light</b>	Positively impacted circadian system functioning. Increased visual comfort		
<b>Connection with Natural Systems</b>			Enhanced positive health responses; Shifted perception of environment
<b>Biomorphic Forms &amp; Patterns</b>			Observed view preference
<b>Material Connection with Nature</b>		Decreased diastolic blood pressure. Improved creative performance.	Improved comfort
<b>Complexity &amp; Order</b>	Positively impacted perceptual and physiological stress responses.		Observed view preference
<b>Prospect</b>	Reduced stress	Reduced boredom, irritation, fatigue	Improved comfort and perceived safety
<b>Refuge</b>		Improved concentration, attention and perception of safety	
<b>Mystery</b>			Induced strong pleasure response
<b>Risk/Peril</b>			Resulted in strong dopamine or pleasure responses

Similar to biophilic design, famed architect Frank Lloyd Wright coined the term *organic* design, defined here as features in the built environment that foster the direct, indirect, or symbolic experience of nature (Kellert 2005). Biophilic design is in essence a similar framework as the organic framework. Wright's structures reflect an intuitive understanding of nature's appeal. Features that enhance this affinity for nature in Wright's residential designs include the following:

1. High ceilings and a sense of spaciousness in main living areas.
2. Extensive natural lighting and vistas of the exterior landscape.
3. Living spaces high above the terrain that provide extended views.
4. The play of natural light seen through clear and decorative glass.
5. Fireplaces within low-ceiling interiors creating a feeling of refuge.
6. Large overhanging eaves and cantilevers engendering a sense of connection to the exterior landscape.
7. Conspicuous terraces offering distant views and a feeling of peril and excitement.
8. Winding paths and concealed entryways fostering feelings of safety and security.
9. Buildings integrated into the landscape through the use of long horizontal planes.
10. Visual connections between interior rooms, many with outside views, and few closed interior places (or what Wright called "destroying the box").

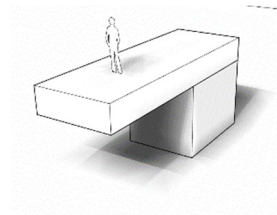
These points each describe a different type of connection with nature through a building. Like the framework of biophilia mentions, so does organic design mention the feeling of risk and peril, mixed with feelings of security. The house or building reflects on a more traditional sense of shelter than contemporary architecture. Sheltering is the concept that recognizes this dynamic relationship, the ways our bodies and emotions respond to different measures of time. When we live in a place, we modify it for comfort, choice, and a sense of well-being. Sheltering, therefore, is not simply about a building but about a course of repeated actions in relation to the building (Knowles 2006), which is the third group of biophilic design, nature of space.

Wright's point on organic design, 'low ceiling by a fireplace', is a direct reference to the old ways of shelter and survival. When humans were only able to heat up small spaces.

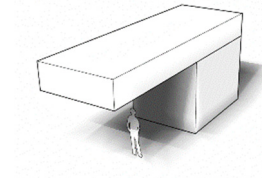
Treehouses were made for safety. Using height as a barrier and keeping one-self out of potential harm (Figure 15). A contemporary dwelling in a multi-storey apartment, or a 'standard' multi-storey doesn't and can't offer the same stimuli of senses a treehouse offers. Corbusier's Villa Savoye hints at biophilic design, its base is skinny and transparent, its top is massive, like a tree or the tree hut itself.



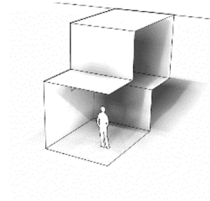
Terraces or living spaces high above the terrain (**Prospect**)



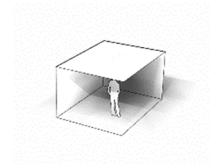
Cantilevers connecting to the space around (**Mystery, Refuge, Risk & Peril**)



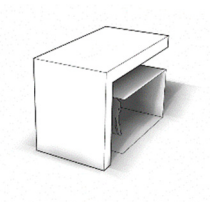
Visible connections between rooms, high ceilings (**Mystery, Prospect**)



Low ceiling spaces for a feeling of refuge (**Refuge**)



Winding paths and concealed entrances (**Mystery, Refuge**)



*Figure 16 a-b-c-d-e:  
Elements for interaction*

## NATURAL ANALOGUES

To connect man with nature via a structure is a paradoxical task. The absence of said structure would be the closest achievable connection with nature. However, a building or small building can still be made in a way an observer, can have indirect connections with nature.

The most simple way of indirectly connection with nature is to display images, or paintings of nature, either as a framed object or painting directly on the exterior or interior of the building. The usage of biomorphic forms and patterns can make spaces or structures feel interesting and comfortable, captivating, and absorptive. Ornaments like flowers on columns or facades are more direct forms of biomorphic forms and patterns. Mathematical sequences have also been used in architecture for a long time. Fibonacci series (0, 1, 1, 2, 3, 5, 8, 13, 21) and the golden ratio to divide and place elements.

Another indirect connection a structure can offer is through the use of natural materials. A study shows that the presence of wood in different quantities on the interior had different psychological and physical effects on a person. A room covered in 45% wood had the effect of lowering the diastolic blood pressure and significant increases in pulse rate, while feeling subjectively more comfortable. While large ration of wood, 90% of coverage, showed a decreased brain activity (Tsunetsugu, Miyazaki et al. 2007), which could be fitting for a doctor's office or a place of relaxation, like a spa or a pop-up hotel in nature.

There are countless ways to involve nature in the structure itself. Patterns or materials do suffice to feel a connection, but are not as effective of an adventurous feeling. For this the workings of space are more important.

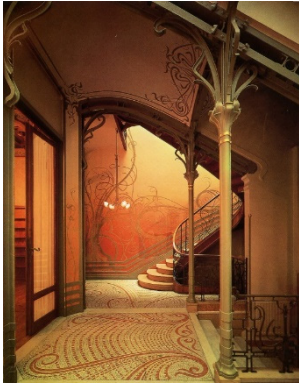


Figure 17: Hotel Tassel



Figure 18: Manuel Gea Gonzalez hospital



Figure 193: Old hut in forest.

## NATURE IN SPACE

Nature in space is the literal presence of nature around to be perceived by an agent, humans. The pop-up hotel is specifically to be placed in nature. Nature in space is therefore automatically achieved. However, nature is not the same around the globe. The hotels will be placed in different contexts and weather conditions.

A pop-up hotel could be transported anywhere on the globe. In terms of practicality and business the hotels are bound to the proximities of the built environment like cities or villages. The debut location of Limburg features both cities and natural land: cultivated land and natural land (Figure 20).

Visual preference research indicates that the preferred view is looking down a slope to a scene that includes copses of shade trees, flowering plants, calm non-threatening animals, indications of human habitation, and bodies of clean water (Heerwagen and Orians 1992). Which is a close description of the landscapes found in the Parkstad.

When eye movement is compared between a natural setting and an urban setting it is found that eyes are more restless when looking at a low-fascination photograph (urban) than looking at a high-fascination photograph (nature). The low-fascination photograph yielded more fixation. The lower number of fixations for high fascination scenes indicates they were viewed with less effort (Berto, Massaccesi et al. 2007).



Figure 20 a-b-c: Parkstad Limburg

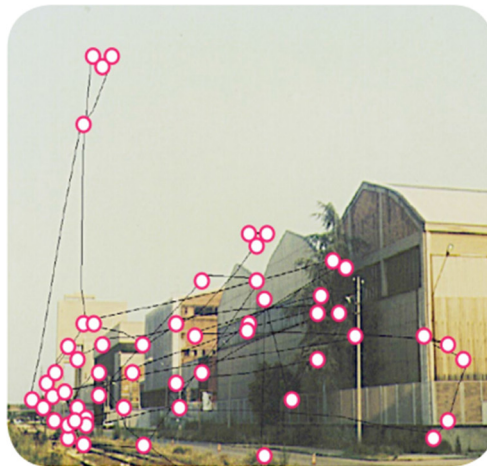
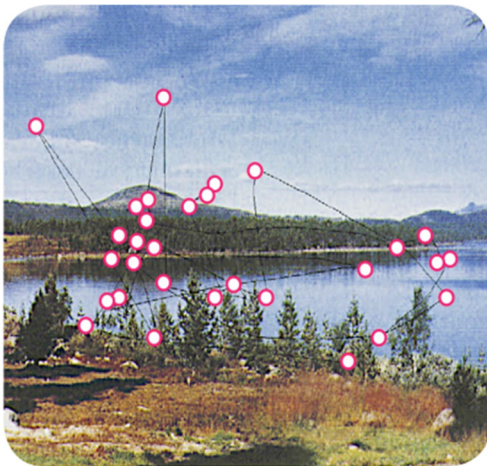


Figure 21: Eye movement when looking at natural space and urban space (Berto, Massaccesi et al. 2007) (Mieras 2014)

## CONTEMPORARY STRUCTURES

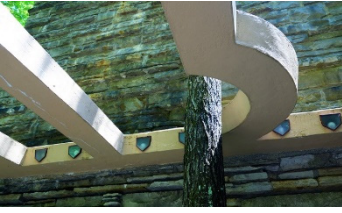


Figure 22 a-b-c: Falling water



Figure 23: Farnsworth House

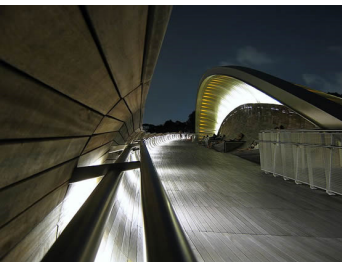


Figure 24: Henderson bridge

Risk and Peril is what is felt during adventurous settings, in which adventure is defined as: 'a bold, usually risky undertaking; hazardous action of uncertain outcome'. The illusion of risk and peril can be created in architectural designs as Wright describes organic design. Falling Water is one the most well-known examples of Wright's organic designs. The building features vast amounts of glass, the house has no walls facing the falls, and corner turning windows without mullions cause the corners to disappear. This provides extended vistas of the horizon and the forest. The cantilevers extend away from the house into the wild creating feelings of peril and excitement.

Mies Van Der Rohe's Farnsworth house features similar elements. Floating horizontal elements, partially closed and partially open, repeating the refuge and prospect elements of biophilic design: once a necessary construction for survival, now an adventurous getaway.

Along the Henderson bridge in Singapore one can find overhead protective alcoves with seats underneath. The back is completely covered and protective while the entire front is left open it becomes a mixture of feelings, refuge and prospect.

Contemporary structures show that it is possible to trigger instinctive feelings from the past, even if there are no direct risks in the environment. Biophilic design is a spectrum, there will always be an instinctive trigger attached to any structure, but it will happen in different quantities. Modern structures focus on stimulating the mind, there is no reason to challenge the body. Challenging or stimulating the body is considered an inconvenience. This inconvenience has been with all organisms for millions of years, longer than humankind has learned to avoid it.

The Deconstructionist movement claims that structures no longer need to be logical. Modern structures can be built as imaged thanks to technological advancements. Technology, which can be considered nature's opposite pole, is also one of architecture's greatest chance at connecting structures to nature.

## MIMICKING OLD SHELTER, COMBINING CAVE, TENT, AND TREEHOUSE

Although historic experiences can be achieved with contemporary structures, most contemporary shelter still have a low stimulation of the senses by the interaction with the structure. Contemporary structures are made with a grid in mind. Contemporary structures are designed with a layout which determines the usage inside by the user. To a large extent the user can tell which space is meant for which function, the space has instruction embedded into it. The house is subdivided in smaller rooms each designed for an exact function. To mimic old shelter, modern shelter has to be broken down. The idea of safety reduced to bring the interior and exterior closer together. Interior instructions removed so the dweller must create function and comfort. The stimulated senses can be enhanced by mimicking old sheltering techniques.

- Stimulated senses by nature and structure from within the structure.
  - Protection > reduce (mimic tent)
  - Refuge
- Stimulated senses by nature and structure from outside the structure.
  - Anticipation
  - Mystery > increase (mimic treehouse)
  - Planning
  - Exploration
- Stimulated senses by the interaction with the structure.
  - Body positioning > stimulate (mimic cave)
  - Handling
  - Balance

## SPACE WITH NO INSTRUCTIONS

The rectangular grid is one of the most defining elements of modern structures. With it modern shelter separates shelter into exact divided objects, floor separate from walls, walls separate from ceiling. It is immediately apparent what surface is used for which purpose. Natural shapes and forms are often sinuous, flowing, and adaptive in responding to forces and pressures found in nature. Natural features are thus rarely revealed as straight lines and right angles characteristic of human engineering and manufactured products and structures. The large-scale modern built environment has often been characterized by standardized and rigid shapes. People nonetheless generally prefer designs that resemble the tendency of organic forms to resist hard mechanical edges, straight lines and angles (Kellert 2005).

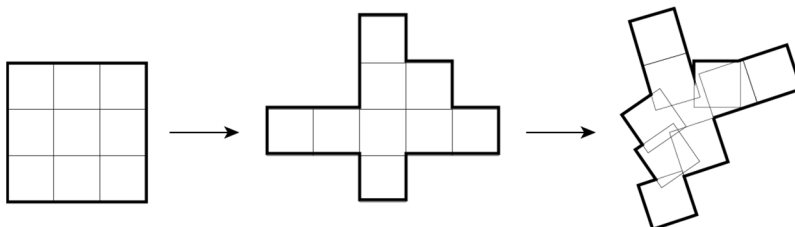


Figure 25: Breaking the grid

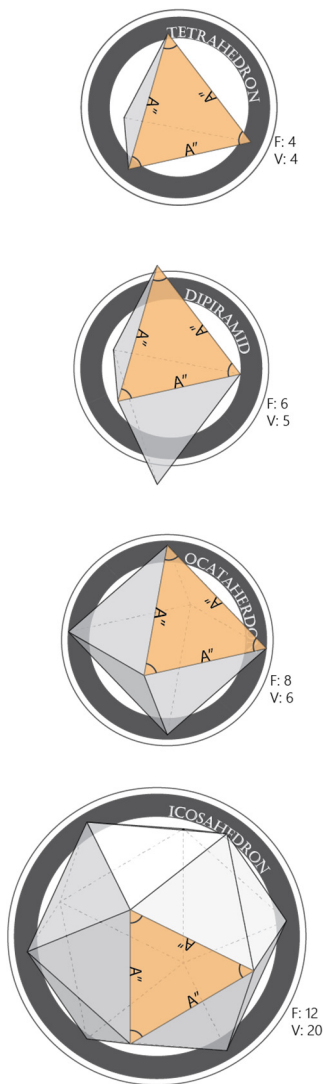


Figure 26: Deltahedra

Scrambling the grid ultimately preserves straight lines, but each straight line is broken by the other. If considering a space, a non-symmetrical space and non-logical shape would resemble the workings of a natural rock formation, i.e. the cave. Mimicking the randomness of a cave realistically can be achieved through meshing techniques. Organic architects often use a geometric module (e.g., a triangle) as main compositional element. In this way, different parts of the building are given a similar form, which results in an overall coherence. It can even lead to random structures, as in deconstructivism (Joye 2007).

The triangle is the basis of any polygon, polyhedron, and any mesh. Through meshing, any shape can be tessellated. Its freedom is regulated by the freedom of the triangle. A mesh made from scalene triangles is the most flexible mesh, but also has the most unique elements. A mesh/polyhedron made from all equilateral triangles, also called a deltahedron, is less flexible but is made from one unique element. In the equilateral triangle Frank Lloyd Wright came closest to fulfilling his desire to create a geometry which would emulate Nature (Eaton 2015). In terms of manufacturing and building this is optimal.

There are an infinite number of different deltahedra, of which only eight are convex, meaning that none of the neighbouring faces are coplanar, the smallest being the tetrahedron and the largest being the icosahedron. Non-convex deltahedra consist of one unique element but there is no repeating angle between each triangle, they are random. The freedom of design is only limited to physical laws.

Inside a non-convex polyhedron, a person would have limited signals as to what each surface is meant to do. Similar to nature, there is a natural interaction between a person and the environment because the interaction is discovered and learned. When that person moves to another location, the person will interact again, but with a different space, the person adapts. Traveling between multiple non-convex deltahedra offer this change of space through its infinitely flexible possibilities. The person can relive a part of history, an accelerated change of space.

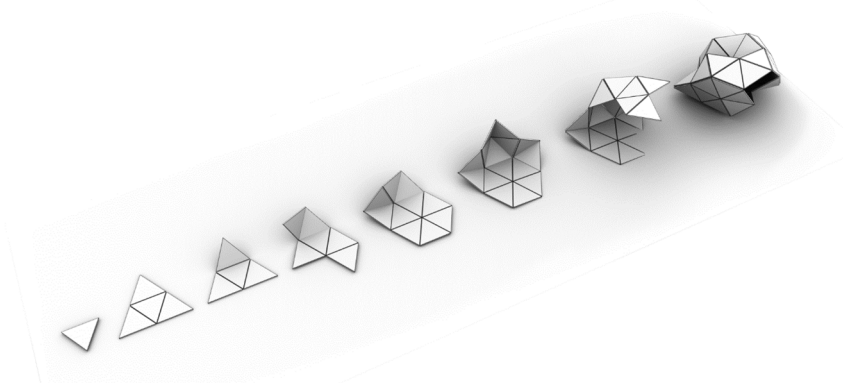


Figure 27: Build up with equilateral triangles

The flexible geometry, through its flexibility, can adapt to its environment. Rather than the environment adapting to geometry like cities and modern buildings. The idea of the historic mankind, nature, and structure relationship is intact, where mankind and structure bend and flex to fit into nature. To enhance the biophilic design aspects, porosity can be applied to the triangles. A fully perforated mesh allows for a lot of light to pass through, creating play of light inside the structure, to the likes of playful light created by trees and plants. A fully perforated mesh adds to the idea of prospect, being able to observe the surrounding, however it takes away the feeling of refuge.

A mixture of opening and closing mixes the aspects of prospect and refuge, to see and not be seen. This way, space offers the feeling of protection and feeling of prospect. This mixture plays into the risk/peril aspect of biophilic design. There is enough exposure to external forces so the dweller always feel on guard, much like the fragility of a tent.

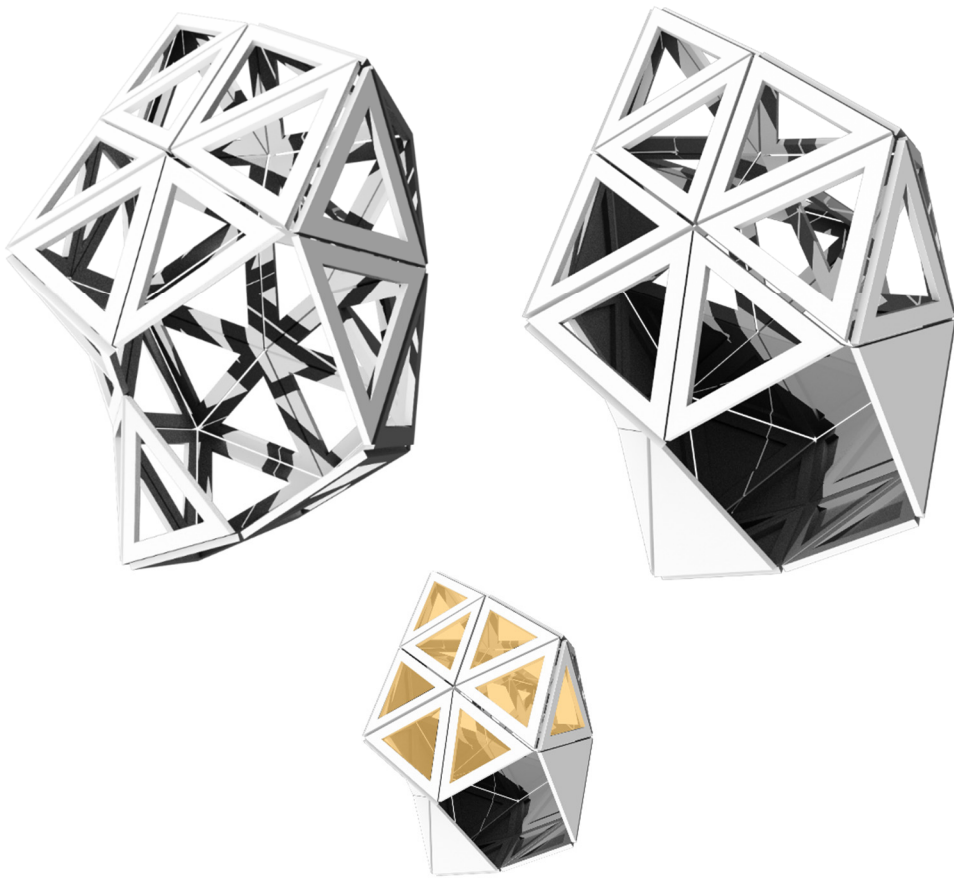


Figure 28 a-b-c: Light and shadow with perforated and closed faces

The characteristics of a tent can be applied perforated areas. Fabric, both translucent and transparent, will provide a thin shield for insulation and the penetration of light, as well as the non-rhythmic sensory stimuli through interaction with wind and rain. Lifting the entire structure in the air with an artificial tree creates the likes of a nest. Mankind in all likeliness imitated birds in building structures. Birds nests are some of the most biophilic structures known to mankind.

**To like purpose Vitruvius.** *In the first Age of the World (saith he) Men lived in Woods, Caves, and Forests, but after they had found out the Use of Fire, and by the Benefit thereof were invited to enter into a certain kind of Society, ... Some of them began to make themselves Habitations of Boughs, some to dig Dens in Mountains; other some, imitating the Nests of Birds, made themselves places of Lome and Twigs, and such like Materials, to creep into, an shroud themselves in.*

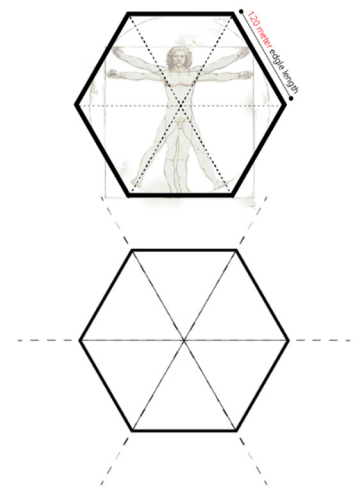


Figure 28: Sizing of triangles to body size

# CONCLUSION

There is a potential mankind can detach itself completely from nature, through more evolutionary development. Considering there are 500 million year old remnants of natural environments in ourselves, the timespan required for this new adaption to happen is countless generations long. It is safe to say that in present times all designs still need to take into consideration the elements that connect us to nature. Not only structures but cities need to put nature first and structure second. The pursuit of luxury, optimised transport, optimised living, optimised economies will outpace the human mental capacity to cope with them, as it has been so far.

Many modern structures implement some form of biophilic theory, building on prospect and refuge theory, and this has great effect on the human mind. To have an effect on the human body as well, we have to consider it to be a vital part of the experience. Humans still get satisfaction exposing themselves to the discomforts of nature. Hiking or more extreme forms of voluntary exposure to the difficulties of nature show we do not always avoid discomfort by will. In discomfort, we create.

And this can be design goal for structures. A milder experience for individuals that did not have a chance to experience the extremes of nature. Combined with a flexible building system that allows for multiple designs, a business can be built that stays refreshing.



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