CONTENTS
FROM CLIMATE TO BUILDING
Sustainable Design SCALES

FOREWORD
Greenwashing? No, thanks!
Alessandra Battisti

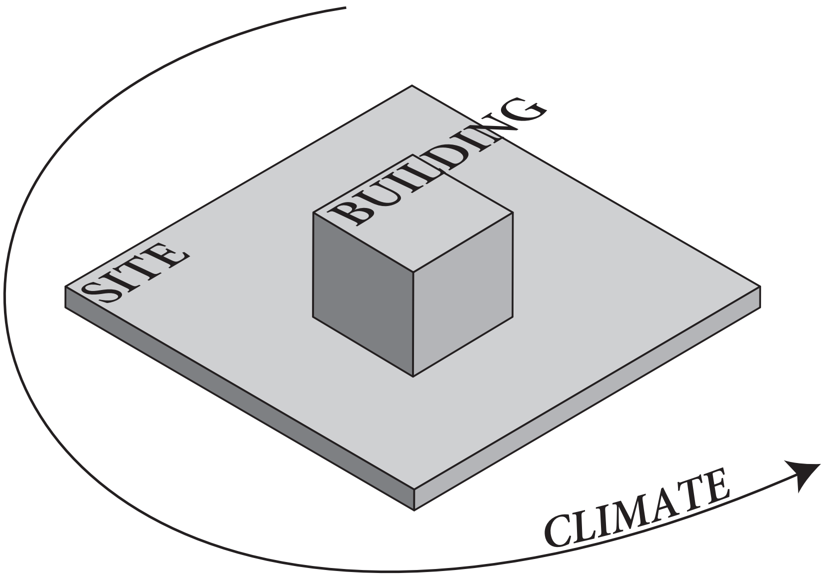
The crisis of Western lifestyle models compared to problems linked with climate change, and the new roles that cities and buildings must take on in the current globalisation scenario, favour an emerging culture, and mark a necessary turning point for our civilisation.
For many decades the fight against climate change has witnessed the most important nations of the world committing to agreements such as the 1992 Kyoto protocol and the 2015 COP21, which are gradually defining the objectives, strategies, and actions aimed at the improvement of life quality and safeguard of the planet. While adapting to the different cultural, environmental, territorial, architectural and regulatory contexts, the various design forms and languages which were launched following this direction, led to the realisation and the experimentation of projects oriented towards climate responsive design, following a holistic and ecological vision, and a systemic approach toward built environment analysis.
The work by Laura Pedata takes its cue from this very vision of the built environment transformation, collecting and classifying the challenges posed by climate change, and linking them through documents produced by field literature while proposing an integrated rereading, which carries as a common thread the project scales, where the fluxes of matter, energy, and information interact, and whose character and quality is defined by the relationship with different levels: from macro to micro.

A set of suggestions and specific interests on the topic are linked to this vision and are responsible for fuelling Laura Pedata's research. After eliminating any greenwashing approach, the research is oriented towards a design model which inks the best aspects of both emerging approaches of field literature: on one side the bottom-up approach linked to individual and community needs, and therefore closely linked to the problems of a fast-evolving society, with an emphasis on social inclusion; on the other, the top-down approach linked to development policies and physical and integrated actions.
The author warns us that we should refrain from reducing our interest exclusively to the building, but rather observe the whole urban structure and the territorial and political system where it's set: the natural, historical, and infrastructural network of connections represent the connector of environmental, landscape, and cultural resources of the territory. In this sense, the topic of sustainable design acquires the special connotation of a complex web made of relationships among different components of the built environment at different scales. To put it in the words of Perec, *"In short, spaces have multiplied, been broken up and have diversified. There are spaces today of every kind and every size, for every use and every function. To live is to pass from one space to another, while doing your very best not to bump yourself."*

The shift of scientific attention operated by Laura Pedata, which starts from dimensional considerations on phenomena and solutions to then deal with the quality and quantity of systems' relations, finds its foundation in the environment and context where a building is set, and in the overall environmental, cultural, and social parameters that surround it and make it unique.
In each phase of the discussion, there is an underlying firm consideration: the awareness that the researched matters and the proposed scenarios and future development solutions are complex problems. The general frame is therefore heterogeneous and it opens up interdependent and multiscale problems, which sometimes lack an obvious solution or clear and predictable results, but rather require a change in perspective and in terms of designers' and residents' behaviour.
Apart from the design tools and guiding instruments, the text also considers the application of coordination tools capable at least of placing the projects in a common framework, providing common guidelines, jointly monitoring the dynamics of needs and resources, diffusing knowledge on the already experimented success and unsuccess stories, projecting the discipline in a future where differentiation of design interventions becomes a common asset for everybody.
The book offers a project's systemic, interrelational, learning, coevolving vision, embracing the cultural consequences of sustainability adaptation and resilience concepts.
The author complements the selected methodological path, and the contribute of different disciplines - essential to understand the complex topic object of research - with a vision of research results which reproposes the consequences of the systemic paradigm, and finds in the connection between different disciplines a development process essential to manage not only the future of design but also the future connected to our way of Living on Planet Earth.

INTRODUCTION

Laura Pedata



> *"I began to see this functioning on all three scales – micro, mezzo, and macro – if you will, starting with clothing and extending to buildings, with cities as the scale that extends beyond buildings" (James Marston Fitch, American Building: The Environmental Forces that Shape it. Oxford University Press, 1966)*

SCALE is indeed a crucial aspect of architecture, especially when considering a building and evaluating its potential impact on the environment. As the readers will see in the first chapter, greenwashing spans from the scale of the single consumerist good to industrial products, to services, affecting also architectural artefacts, their individual technological components (glazing, window frames, structural elements, wall combinations, etc.) the combination of building elements (walls, roofs, foundations, etc.), and the operation of entire building complexes, neighbourhoods, and cities.

My training and background were of great influence on the perspective I offer on the topic, especially when it comes to the relationship between design and the environment. I received my graduate training in Italy at the Architecture school at La Sapienza in Rome, specialising in Environmental Design, in the years when the issue of sustainability and energy efficiency were finally becoming of great importance and EU policies were being defined. My thesis topic consisted in the study of receptive facilities in extreme climatic conditions in the UAE, exploring the potential of innovative applications of materials and components as shading devices; during the research, I had to deal with a completely different climatic condition from the Mediterranean climate and construction techniques I was familiar with and a relatively new urban condition. Later, I was exposed to US culture when I worked in a big Architecture office, where Sustainability acquired a completely new meaning, had different priorities and connotations, influenced by politics, legislation and financial interests. All these experiences in different parts of the world and dealing with different scales of Architecture enabled me to acquire an open and flexible understanding of Sustainability concepts applied to Architectural Design.

Most of the contents of this book and the case studies presented in the last chapter are a selection of the course material, and the work developed by the students during the Environmental Architecture Studio I lead since 2013 at POLIS University, in a challenging and stimulating learning environment such as Albania, where issues concerning sustainability are only recently beginning to become priorities in the Architectural field. In such an environment it is all the more important to expose young students and future architects to all the aspects of Sustainability in the field of Architecture from the very early stages of their training, to ensure that sustainable concepts and approaches become an integral and essential part of design thinking and not a set of added building components of delayed adjustment measures.

The book is divided into three chapters. After the first, introductory, chapter which gives a critical overview of the term Sustainability and its use in the design field, the second chapter contains the core concepts behind the publication and reflect the three sustainable design scales mentioned in the book title: CLIMATE, SITE/SETTLEMENT, and BUILDING. The last chapter offers a selection of sustainable design case studies around the world representative of four building-specific climate classification types, presenting an analysis on the functional and energy performance of the examined buildings and taking into account sun exposure, wind analysis, building materials and Mechanical Systems, functions, morphology and typology, and overall quality of space.

The book structure also offers an organised set of steps and a methodology to approach the design and the evaluation of Architectural projects aimed at prioritising environmental sustainability. The first chapter sets the base to engage the project, defining the background and the necessary definitions to approach the topic responsibly. The second chapter introduces one at the time, the three design scales and explains the interaction between the numerous related aspects that ought to be considered during the design process, illustrating the complexity of the topic. To conclude, the last chapter presents examples of the possible application of the methodology presented in the book.

1. Is it SUSTAINABLE? A critical overview of Green Design

This chapter is inspired by a small exercise that I usually present to my third-year Architectures students on the first day of the Environmental Architecture graduate studio. I show up to class with two pens: a disposable recycled paper pen I found in my goodies bag at the last architecture conference I attended, and the precious and expensive Montblanc pen I stole from my father many years ago….. I hold both pens in the air and I describe the material they are made of and how I came to possess them. Then I ask the class: Which one of these pens is more sustainable, and why? It is no surprise that the instinctive students point at the recycled paper pen, and the reason they believe it is more sustainable is that the material used is organic and it is recycled and recyclable. Sometimes I try to provoke their reaction and influence their decision by stressing the point that "my father gave me the Montblanc many years ago and that I take good care of it and make sure I don't lose it!

On the contrary, the paper pen is just one of the many pens I have on my desk and I don't mind losing it because I have more… Well, in the end, someone eventually realises that the Montblanc could be considered more sustainable if we take into account the fact that it is not a disposable pen, and therefore we might hold on to it and make it last longer. Of course, in reality, several parameters ought to be considered before giving a final verdict, and it is after all only the first lecture of the year, so in the end, my objective is not to get or give a sure answer, but rather to start stimulating the students' critical sense, opening up their curiosity, and widening their perspective.

This chapter wished to do exactly this, to stimulate a critical sense in younger (and older) generations of Architects towards issues linked to sustainability in Architecture, to turn their attention towards the big picture, and introduce the notion that our opinion and our qualitative and quantitative evaluation are strongly dependent on the position/distance from where we observe things: from different design levels and SCALES. To fully understand sustainability and validate all the "vague assumptions about green" practices and products (MAAS, et al. 2010, 10) we must embrace the complexity of the topic and be able to acknowledge both, the global and the local aspects of sustainability (i.e. climate, markets, resources, waste and transportation). SCALE is an important factor when dealing with architecture, its performance, and its impact on the environment, as each building component is related to the whole building fabric and influences the performance of the building and its impact on the immediate surroundings and, in turn, the environment. Similarly, the climate, the site and its geography, the surrounding buildings and the building morphology itself, influence the per-

Figure 1 – Image of a Montblanc pen. Source: Montblanc®.

formance and the efficiency of each building component. There is a scalar relationship between architectural and environmental scale, hence the need to approach the topic of Sustainable Architectural Design through the MICRO, MEDIUM, and MACRO SCALE.

This chapter is divided into the following sections:

1.1. Greenwashing and…. the ‘green bubble’

1.2. Background and Definitions

1.3. The origins of Sustainability

1.4. Environmental Hazards & Approaches Towards a Comprehensive Solution

1.5. Principles of energy savings in Architecture and Urban design.

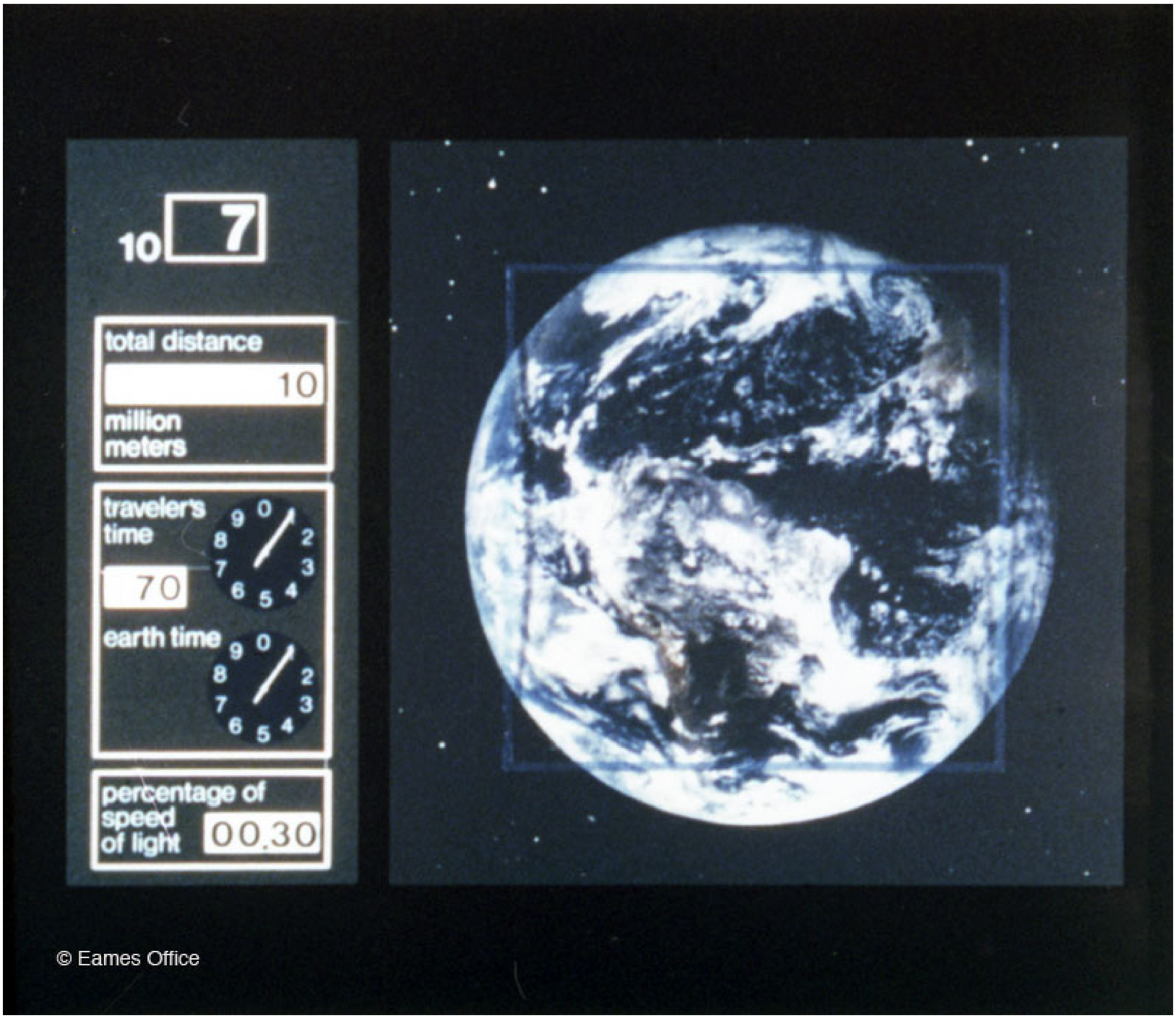


Figure 2 - image from the 1968 study film by Charles and Ray Eames, a rough sketch of the famous 1977 film “Powers of Ten”. The film features a linear view of our universe from the human scale to the sea of galaxies, then directly down to the nucleus of a carbon atom, giving a clue to the relative size of things and what it means to add another zero to any number. Source: https://www.eamesoffice.com/the-work/powers-of-ten-a-rough-sketch/, ©Eames Office.

2. SUSTAINABLE DESIGN SCALES

The vast, intermediate and building scale. In this chapter, I will briefly define the three scales of Sustainable Architecture projects. Starting with the vast scale of the CLIMATE, to then move onto the intermediate scale of the SITE and settlement, and concluding with the BUILDING and technological component scale.

This chapter is divided into the following sections:

2.1 CLIMATE

2.2 Site & Settlement

2.3 BUILDING

2.1. CLIMATE

> *"IF our designs for private houses are to be correct, we must at the outset take note of the countries and climates in which they are built. One style of house seems appropriate to build in Egypt, another in Spain, a different kind in Pontus, one still different in Rome, and so on with lands and countries of other characteristics. This is because one part of the earth is directly under the sun's course, another is far away from it, while another lies midway between these two. Hence, as the position of the heaven with regard to a given tract on the earth leads naturally to different characteristics, owing to the inclination of the circle of the zodiac and the course of the sun, it is obvious that designs for houses ought similarly to conform to the nature of the country and to diversities of climate." (Marcus Vitruvius Pollio "The Ten Books on Architecture. "De Architectura", Book VI, Chapter 1, passage 1)*[1]

2.1.1. Climate and SCALE

Just as the observations about regional adaptation are at the base of Vitruvius' study of the arrangement of private buildings, a sustainable approach to design today should be an approach informed by the context and the climate, based on a deep understanding of the character and qualities of the areas and sites (Reference to chapter 1.5.2). Therefore, following a scalar approach to sustainable architecture, the first dimension of the project is defined by the climate, or better its climatic contextualisation. Climate is characterised by a temporal, spatial and dimensional reading, which determine its magnitude and influence in different moments and for different aspects of the architectural project. Let us examine all three aspects.

1. From: Vitruvius: The Ten Books on Architecture. Vitruvius. Morris Hicky Morgan. Cambridge: Harvard University Press. London: Humphrey Milford. Oxford University Press. 1914. (available at http://www.perseus.tufts.edu/hopper/text?doc=Perseus%3Atext%3A1999.02.0073%3Abook%3D6%3Achapter%3D1%3Asection%3D1)

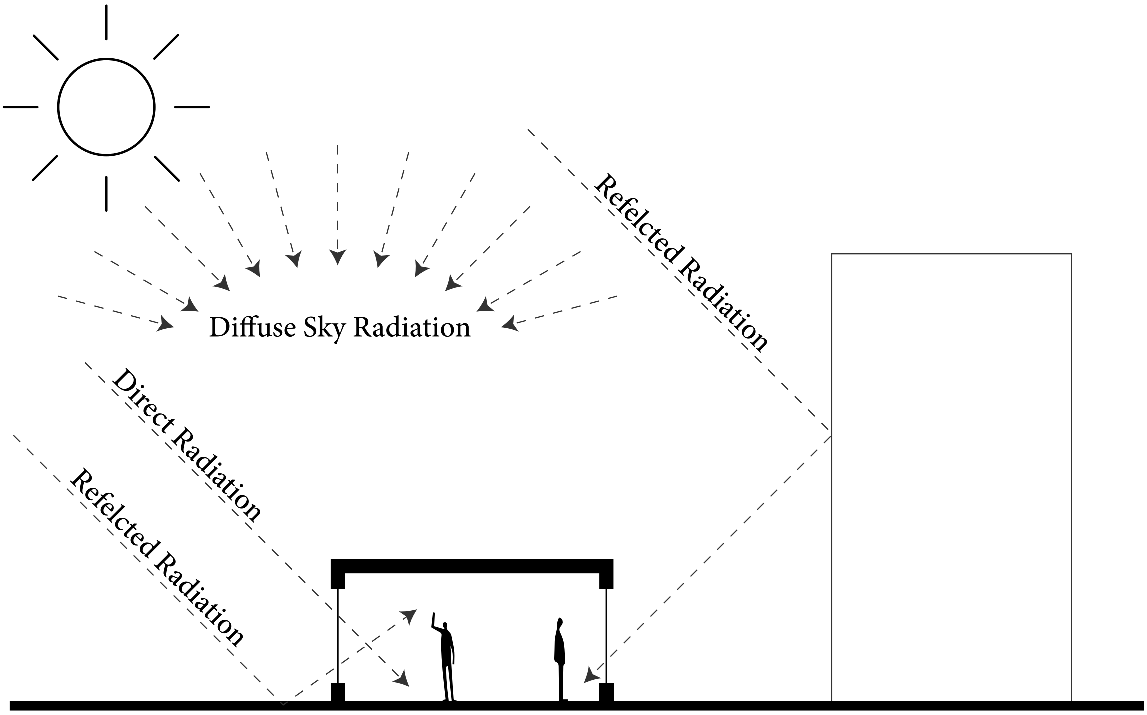
2. The word derives from ancient Greek klínein (to incline) and it describes the tilt of the earth's axis, which is the one that determines different climate in different zones of the earths' surface.

Climate, meteorological conditions and weather are referred to different time dimensions of atmospheric conditions: climate[2] is based on average atmospheric conditions over long periods (30 to 40 years); meteorological conditions refer to the character of the weather over a few days, a week, or an entire season; while weather is usually referred to the atmospheric conditions in a specific hour or a few days. Climate also has a spatial dimension, and we can operate a scalar reading of the latter based on the size of the area involved. In fact, we can identify three scales of the climate's spatial dimension, namely: the microclimate, the mesoclimate, and the macroclimate. The microclimate describes the smallest unit of space and is influenced by the meteorological conditions of layers of air about 2 metres above a location and the direct surroundings. It is influenced by vegetation, surface materials and character of the terrain, airstreams, altitude and building density and materials. The mesocliamte refers to a condition over a few hundred metres to a few hundred kilometres from a specific location, and is characterised by natural and cultural features such as mountains, valleys, coasts, islands, and cities, like in the case of the regional climate. The urban climate is another example of mesoclimate. The macroclimate defines very large geographical areas and the atmospheric conditions over long periods; it is influenced by solar radiation, altitude, land and sea distribution, and global air circulation. Areas on the Earth with similar climates are grouped in climate zones, and the interaction between the different macroclimates of the Earth defines the Global climate. When we are dealing with the macro and mesocliamte, climate elements can be measured over longer periods defining averages, while for the microclimate, we must take exact measurement because the climate factors are constantly changing.

Climate is described in terms of climate factors and climate elements. Climate factors include latitude, sea and land distribution, local and regional wind patterns, and altitude. The latter are influenced by the combination and the occurrence and behaviour of climate elements. Climate elements represent measurable properties of the climate system such as air temperature and its daily/seasonal fluctuations, air pressure, evaporation, precipitation, air humidity, wind and solar radiation (HAUSLADEN, LIEDL and DE SALDANHA 2012). When evaluating building strategies, it is not enough to look at individual climate elements and parameters in isolation, as the occurrence of two or more values at certain times may be more relevant. Moreover, rather than work from calculations of average values related to climate elements, one must analyse fluctuations over the course of a month or between day and night, but also the occurrence of extreme values that can cause bioclimatic strategies to fail.

The choice of location for a new settlement and its orientation and layout depends on the climate in the wider area, the local climate and the microclimate. While the microclimate is the one that affects the climate inside the building, the regional and local climate are the climatic scales that throughout history have influenced the material and formal choices in architecture.

Solar Load Components



Behavior of incident solar radiation on a surface

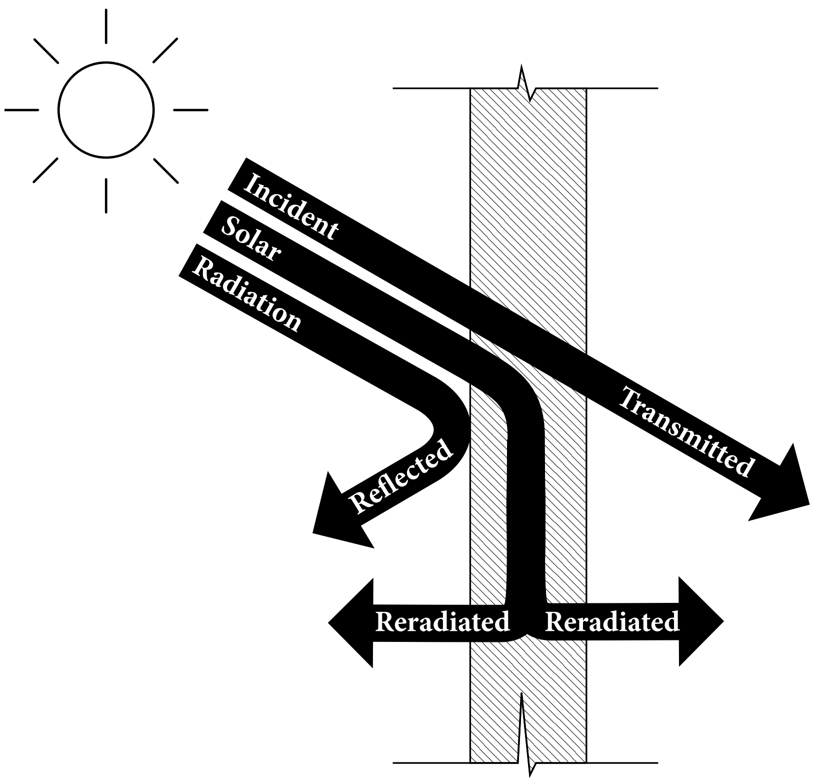
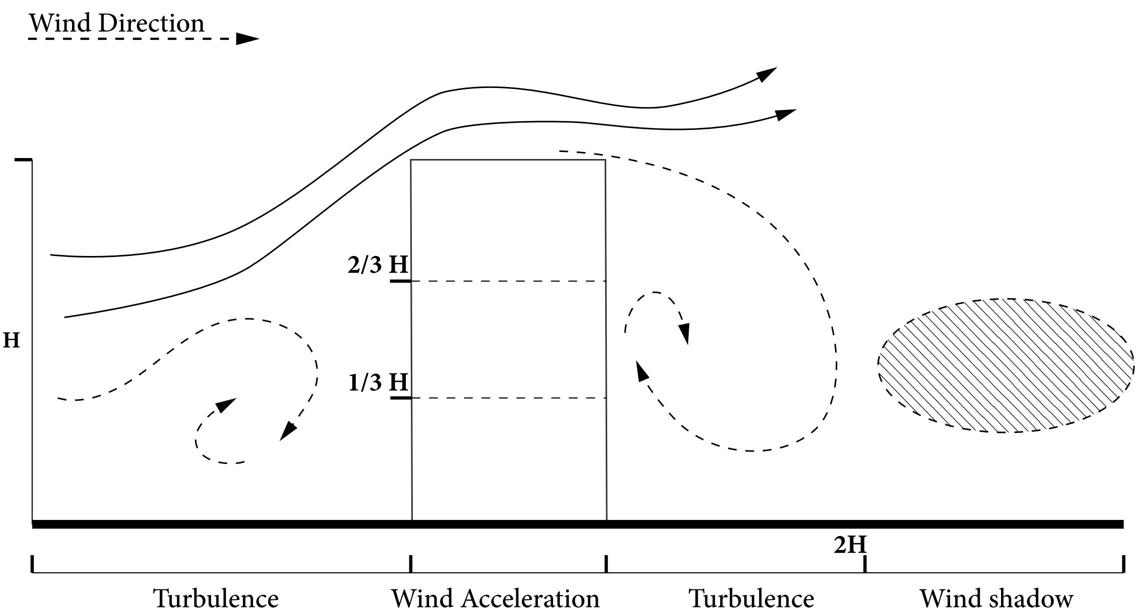


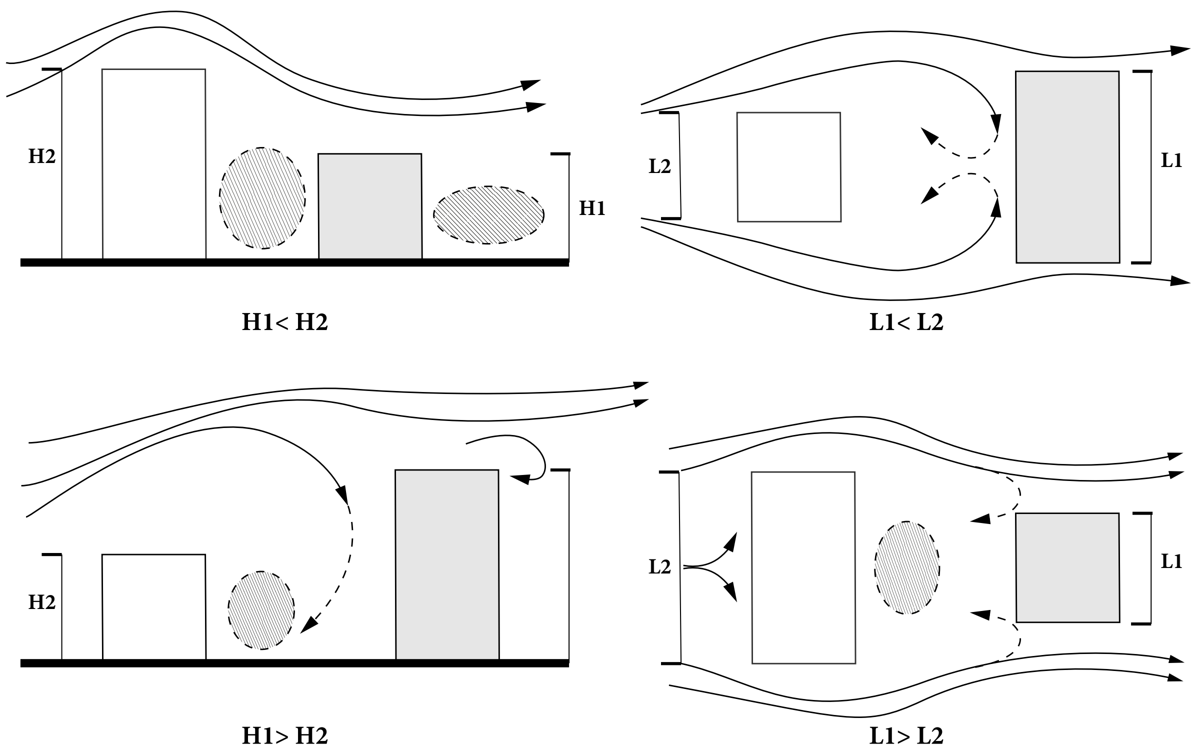
Figure 31 – Components of the Solar Load on a given surface. Source: redrawn by the Author

Figure 32 – Behavior of incident solar radiation once it reaches a surface. Source: redrawn by the Author

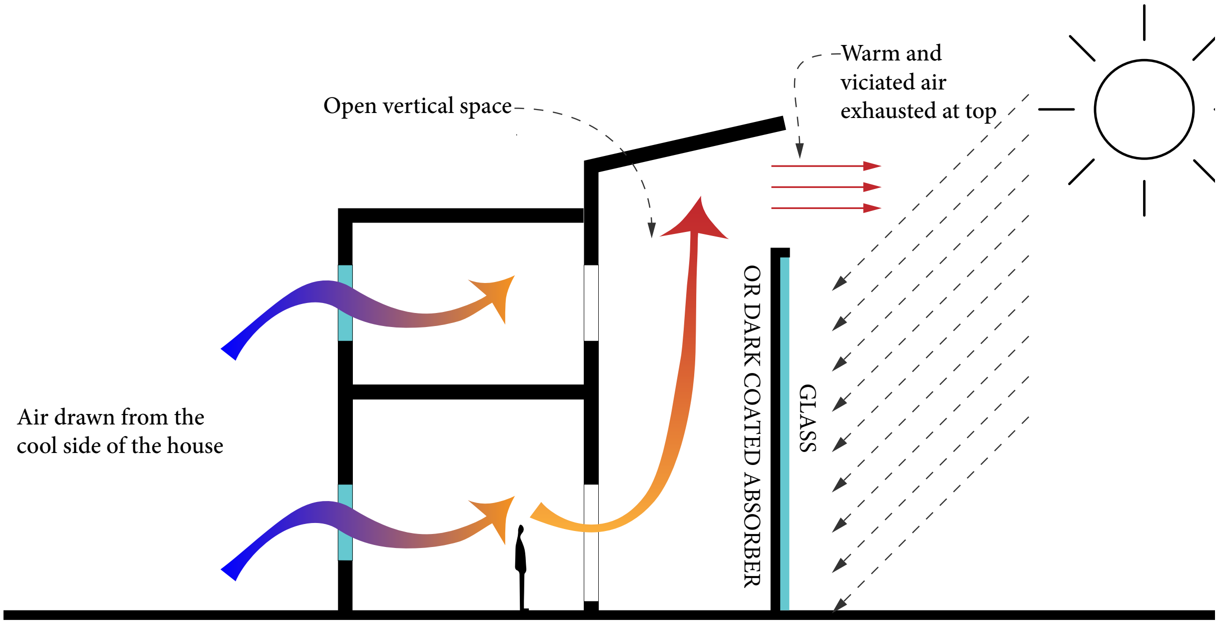
Wind Behavior in Presence of an Obstacle



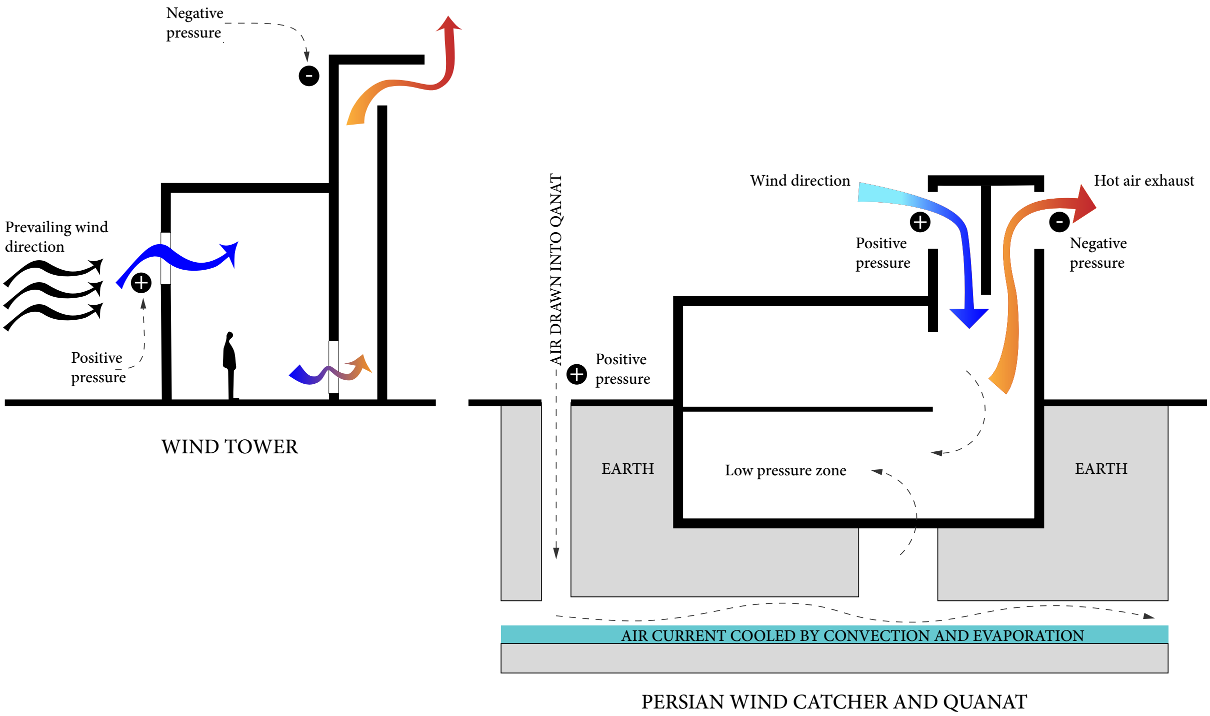
Wind Behavior Depending on Form and Dimension of Surrounding Buildings



Solar Chimney



Wind Towers



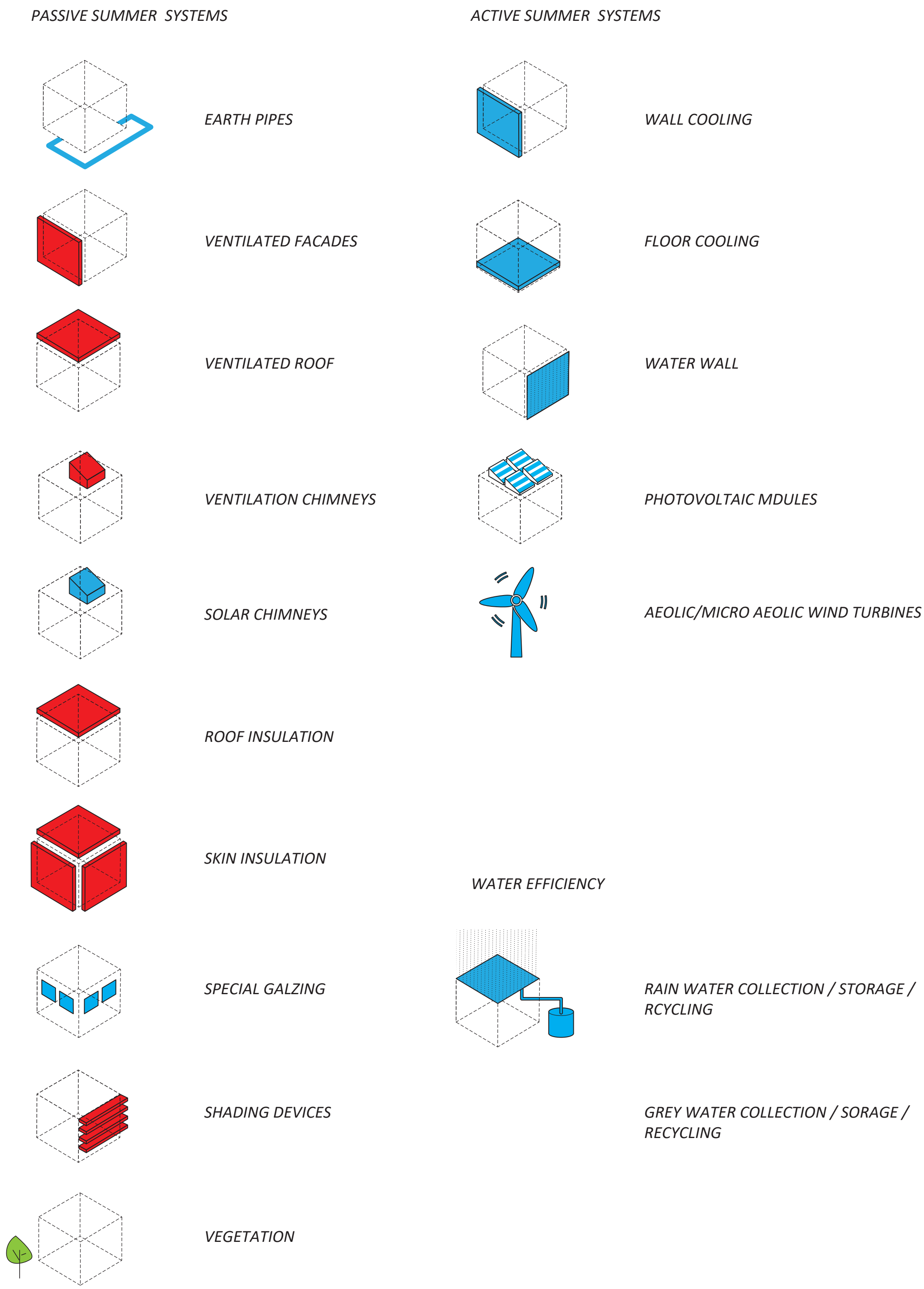


Figure 66 - List of Passive & Active Strategies and Technological Solutions for Energy Efficiency. Source: Author.

3.2. Temperate

Locations characterised by seasons with transitional periods and without extreme values in terms of outdoor air temperatures and air density. Climate characterised by warm summers and cold or cool winters. The critical factor is the heating energy demand. The cooling energy demand can easily be met by passive measures such as night cooling. The cooling and dehumidifying energy demand are very low. (HAUSLADEN, LIEDL and DE SALDANHA 2012, 32, 61)

References: https://www.architectmagazine.com/project-gallery/biological-house_o; http://eentileen.dk/forside

The case study selected for the Temperate climate zone is the Biological House, by Een til Een (one to one) (2016), located in Middelfart, Denmark.

N.B. For the case study Biological House by Een til Een (2016), located in Middelfart (Denmark) at Lat. 55.4972° N, Long. 9.7472° E, the weather file adopted to operate environmental analysis with Ecotect V. 5, was Copenhagen (Denmark) located at Lat. 55.6761° N, Long. 12.5683° E.

Biological House

Middelfart (Denmark)

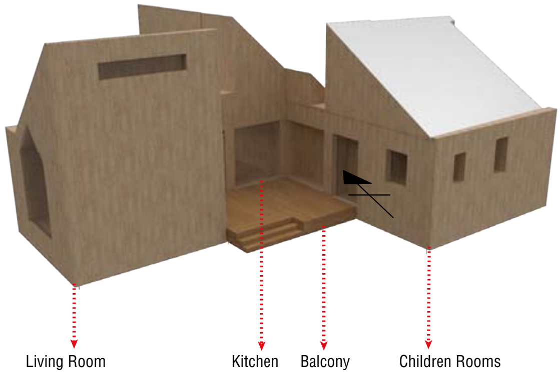
Environmental Design Studio 2018
Instructor: Laura Pedata
Assistant: Enrico Porfido
Students: Aurora Çepele; Bertila Çekrezi

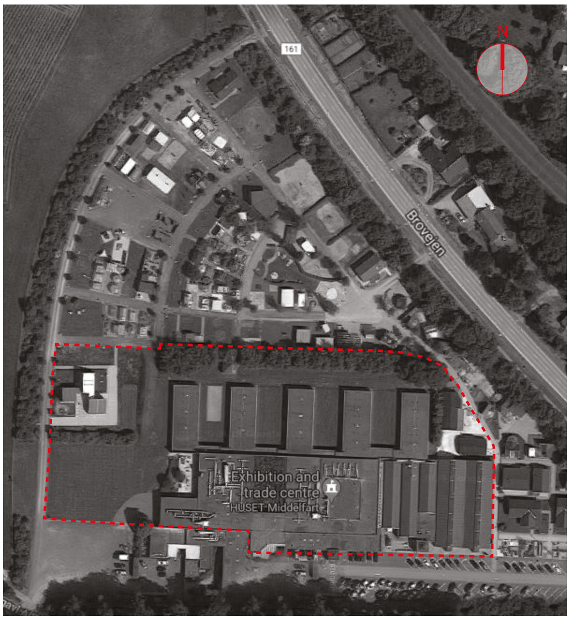
TEMPERATE CLIMATE

Project Name: Biological House
Architect: Een til Een (one to one)
Year: 2016
Building Type: Single Family House
Context: Suburban
Location: Middelfart (Denmark)

CLIMATE/SITE - Project overview biophysical/bioclimatic analysis

WORLD LOCATION: LAT. 55.4972° N, LON. 9.7472° E



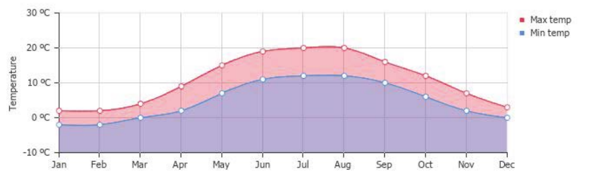


AERIAL MAP

The house is part of the BIOTOPE, which is an exhibition park and resource centre that's designed to showcase the latest in sustainable construction technologies. It is flexible, modular home that can be assembled quickly becasue it is built with innovative digital manufacturing processes. Since the home sits on top of steel piles it can be disassembled and rebuilt in another location, with a different comfiguration.

CLIMATE DATA

Average minimum and maximum temperature over the year

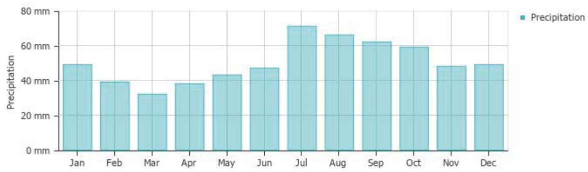


On average, the warmest month is August, and the coolest month is January.
The average annual maximum temperature is: 11.0° Celsius (51.8° Fahrenheit)
The average annual minimum temperature is: 5.0° Celsius (41° Fahrenheit)

Average humidity over the year

On average, January is the most humid, and May is the least humid month.
The average annual percentage of humidity is: 79.0%

Average monthly precipitation over the year (rainfall, snow, hail)



On average, July is the wettest month and March the driest month.
The average amount of annual precipitation is: 603.0 mm (23.74 in)

* Data from nearest weather station: Skrydstrup, Denmark (42.0 KM).
Source: https://weather-and-climate.com

The building is located in the Temperate Region.
The zone is classified as Cfb - C (Temperate), f (without dry season), b (warm summer) - in the Köppen climate classification.
Denmark is a lowland country, is located about 50 m below sea level, so that its territory is dominated by temperate marine type of climate all year round, influenced by the location in the middle of several seas, with western winds blowing warm air across most of the country. Day and night temperatures don't fluctuate that much, while wind gusts and shifts in wind direction can drastically change the weather any time of year.
The weather in Denmark consists of 4 seasons. Spring starts in March, where you can get about 4 hours of sunshine a day and ends in May where the sun shines about 8 hours a day.

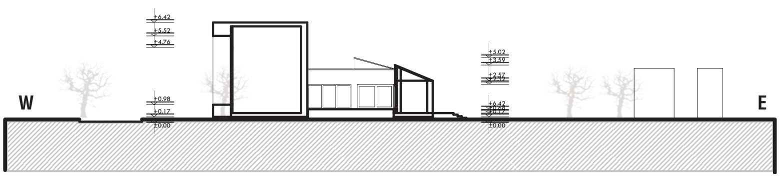
Biological House

Middelfart (Denmark)

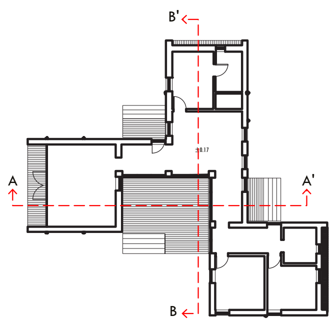
TEMPERATE CLIMATE

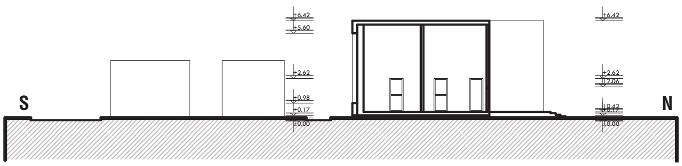
CLIMATE/SITE - Project overview biophysical/bioclimatic analysis

FIGURE GROUND PLAN - original scale 1:500



SITE CROSS SECTION A-A' - scale 1:500





SITE CROSS SECTION B-B' - scale 1:500

Biological House

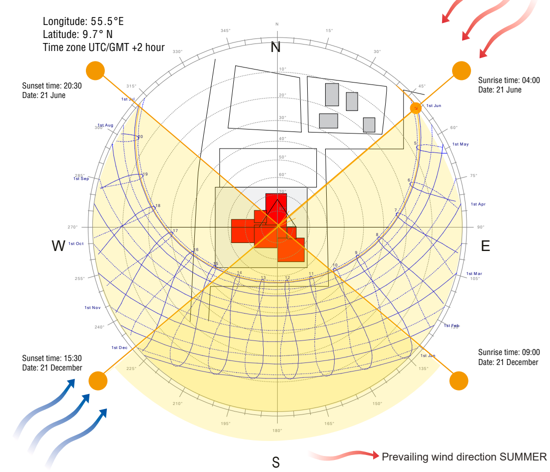
Middelfart (Denmark)

TEMPERATE CLIMATE

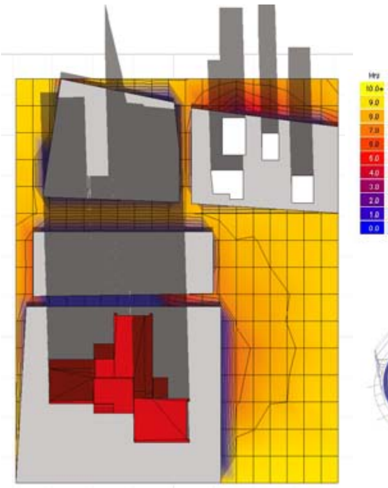
SITE/BUILDING - bioclimatic analysis

WIND DIRECTIONS (www.windfinder.com)

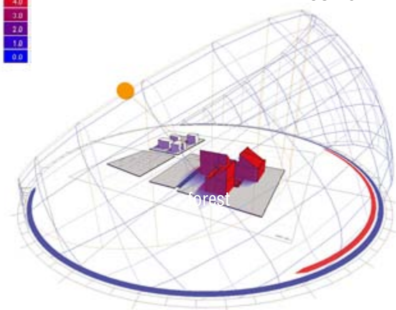
SOLAR EXPOSURE AND VENTILATION
21st June (SUMMER) - 21st December (WINTER)



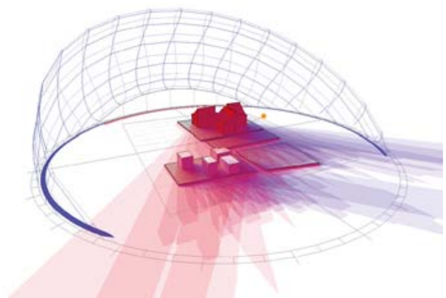
SUN CHART for Middelfart (Denmark)



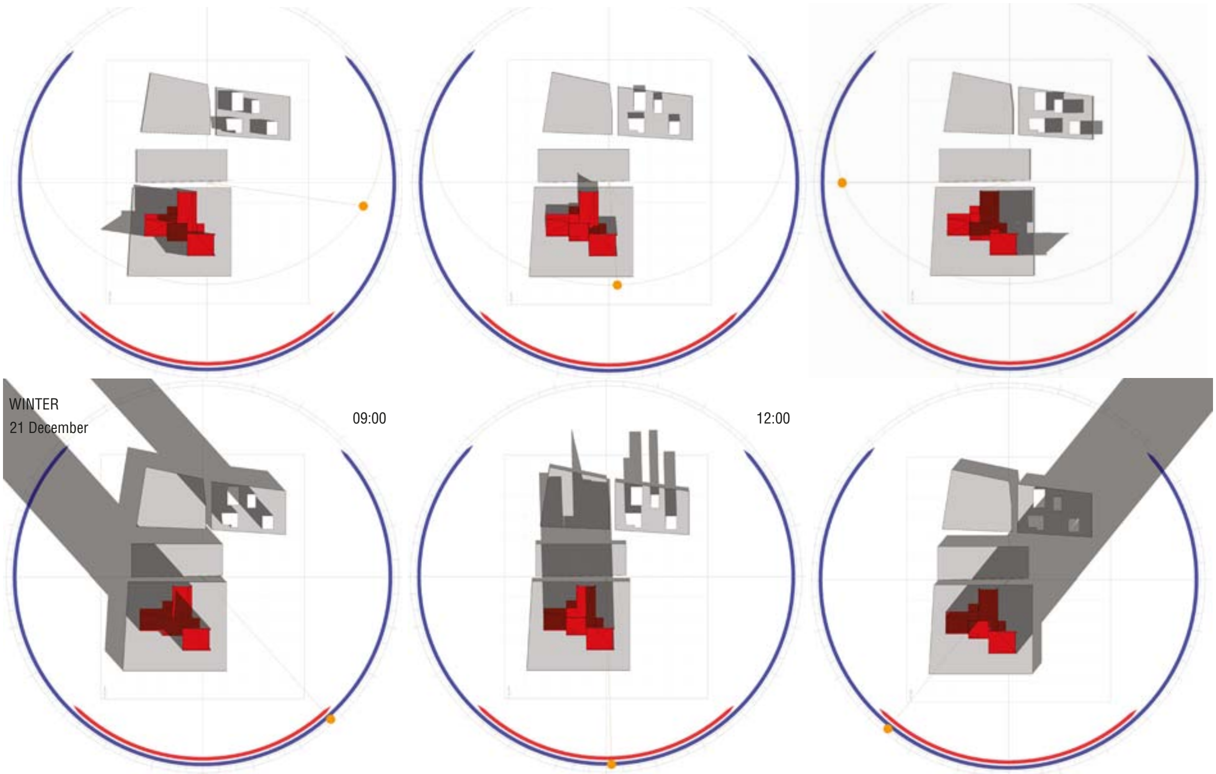
SOLAR ACCESS TO THE SITE - INSOLATION GRID
(Total sunlight hrs/ value range 0-10 Hrs - Ecotect v5)



SHADOW RANGE 09:00-15:00
SUMMER SOLSTICE (21 JUNE)



SHADOW RANGE 09:00-15:00
WINTER SOLSTICE (21 DECEMBER)



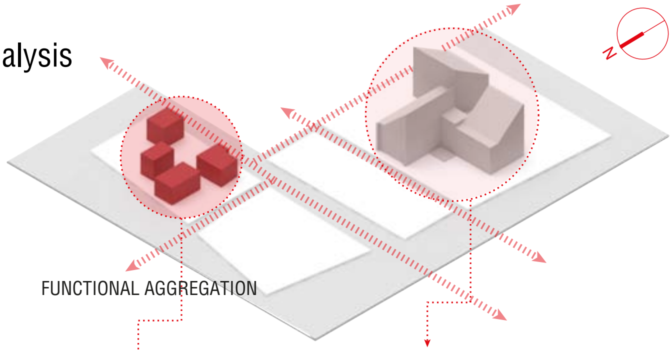
SHADOW ANALYSIS/SITE (Ecotect v5)

Biological House

Middelfart (Denmark)

TEMPERATE CLIMATE

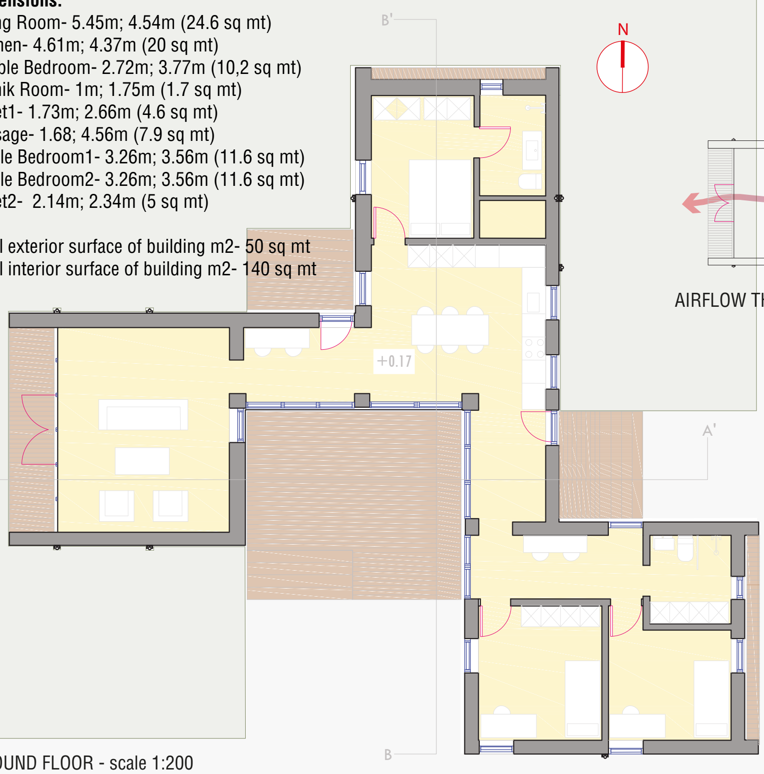
BUILDING - functional/morphological analysis



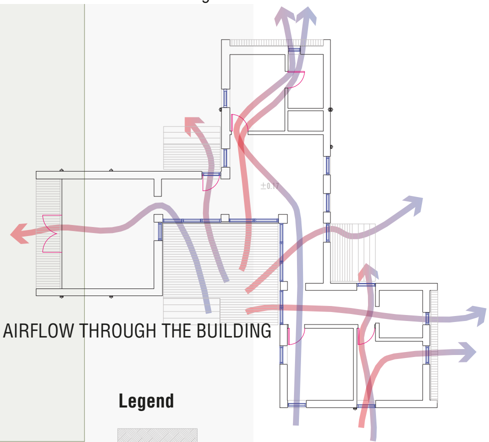
Main function: Single family house
Nr. of floors= One
Nr. of people/target= One family (parents & two children)

Dimensions:
Living Room- 5.45m; 4.54m (24.6 sq mt)
Kitchen- 4.61m; 4.37m (20 sq mt)
Double Bedroom- 2.72m; 3.77m (10,2 sq mt)
Teknik Room- 1m; 1.75m (1.7 sq mt)
Toilet1- 1.73m; 2.66m (4.6 sq mt)
Passage- 1.68; 4.56m (7.9 sq mt)
Single Bedroom1- 3.26m; 3.56m (11.6 sq mt)
Single Bedroom2- 3.26m; 3.56m (11.6 sq mt)
Toilet2- 2.14m; 2.34m (5 sq mt)

Total exterior surface of building m2- 50 sq mt
Total interior surface of building m2- 140 sq mt



GROUND FLOOR - scale 1:200

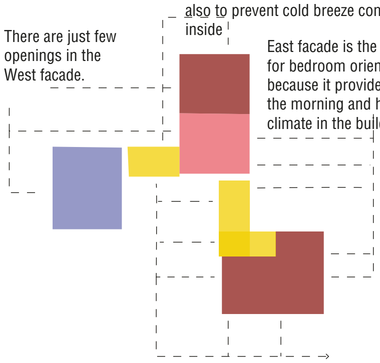


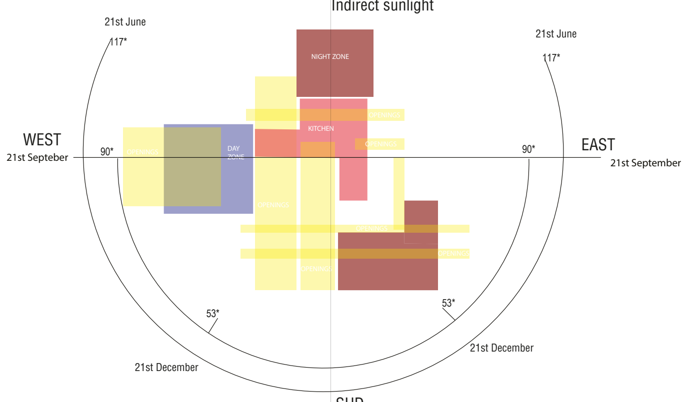
AIRFLOW THROUGH THE BUILDING

Legend

- The road
- Greenery
- Pedestrian
- Conditioned Space (140 sq mt)
- Unconditioned Space (190 sq mt)

OPENINGS





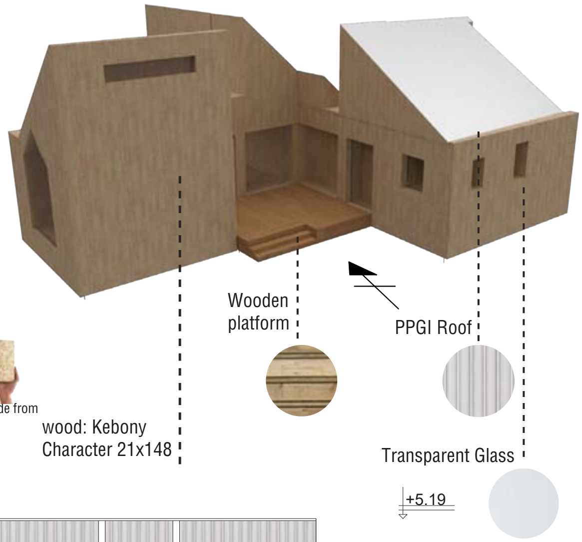
LAYOUT OF THE INTERIOR SPACES/ORIENTATION

Biological House

Middelfart (Denmark)

TEMPERATE CLIMATE

BUILDING/ENVELOPE - bioclimatic analysis



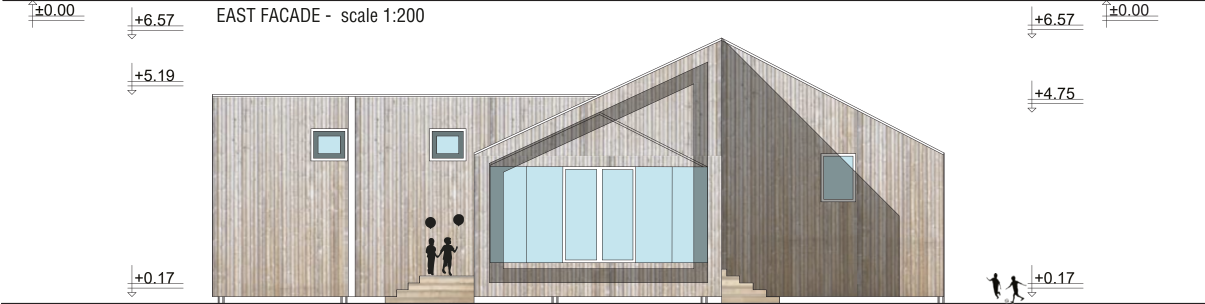
ENVELOPE CHARACTERISTICS
Total exterior surface: 400 m²
Total exterior opaque surface: 366.25 m²
Total exterior glazed surface: 129.45 m²
Opaque/Glazed surfaces ratio: 2.8
MATERIAL SPECIFICATIONS:

Clading: Sustainably-sourced softwoods is converted through an innovative process developed in Norway, into durable hardwood panels, by heating the wood with a bio-based liquid, basically polymerising the wood's cell wall.

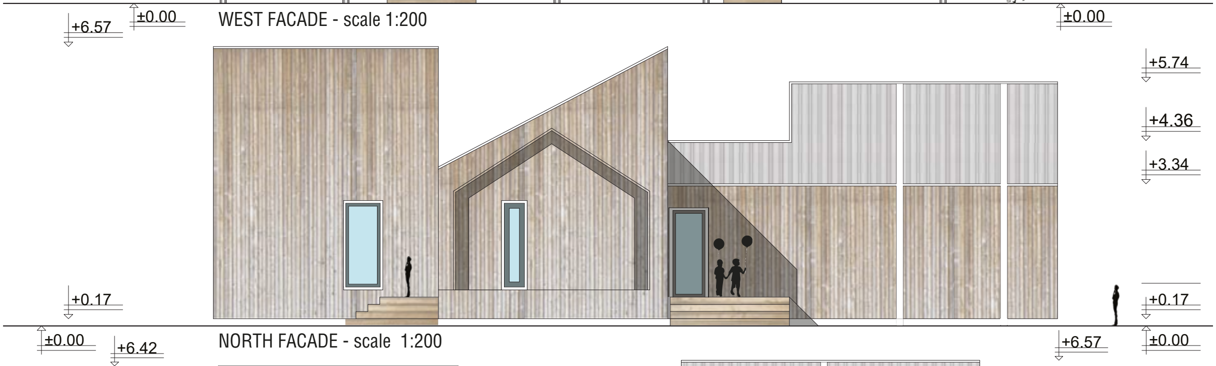
All the other construction materials aremade from taking organic waste like grass, straw and seaweed, upcycling them into valuable building mediums

From left to righr: Board made from eelgrass, Board made from tomato stems, Board made from woodchip, Board made from seaweed, Board made from upcycled straw

EAST FACADE - scale 1:200



WEST FACADE - scale 1:200



NORTH FACADE - scale 1:200

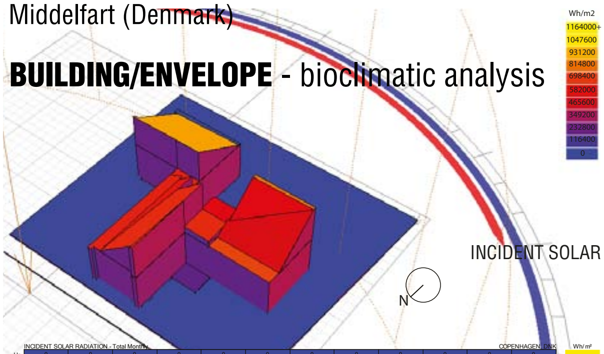
SOUTH FACADE - scale 1:200

Biological House

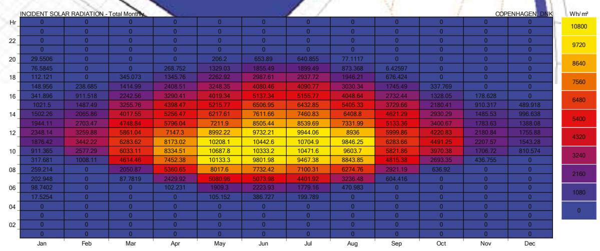
TEMPERATE CLIMATE

Middelfart (Denmark)

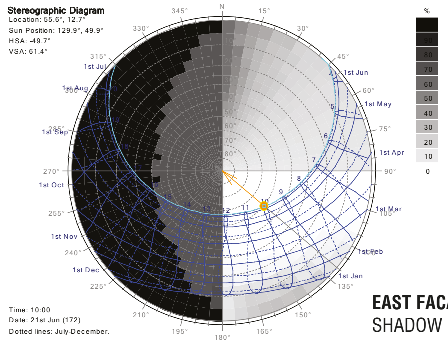
BUILDING/ENVELOPE - bioclimatic analysis



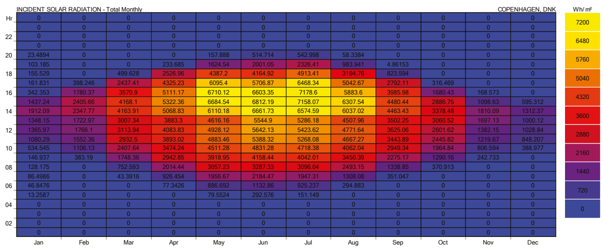
INCIDENT SOLAR RADIATION BUILDING SURFACES



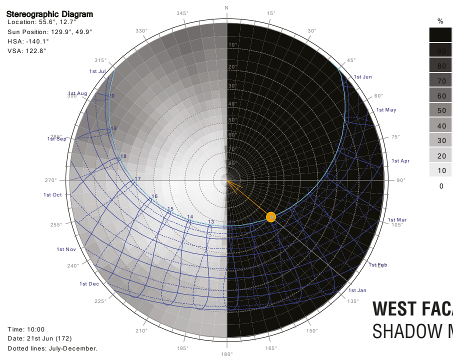
EAST FACADE - Total surface: m^2
MONTHLY INCIDENT SOLAR RADIATION GRAPH



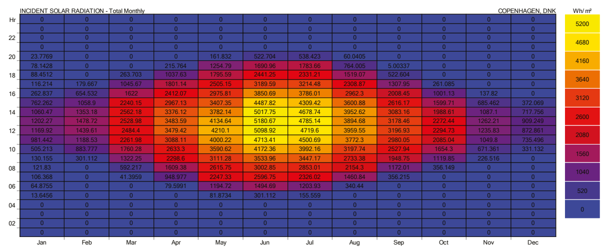
EAST FACADE
SHADOW MASK



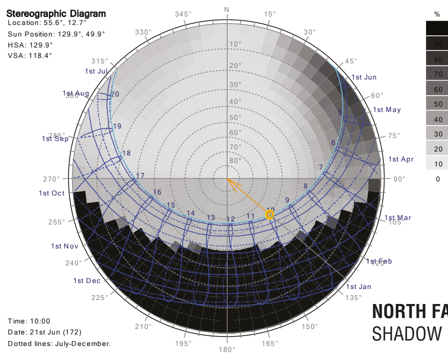
WEST FACADE - Total surface: m2
MONTHLY INCIDENT SOLAR RADIATION GRAPHT



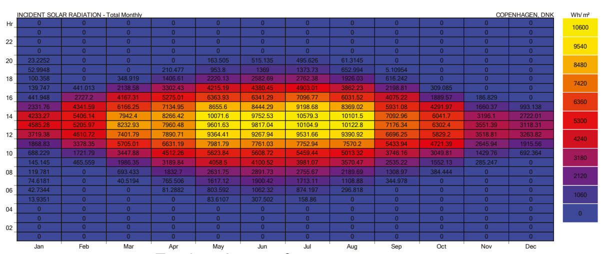
WEST FACADE
SHADOW MASK



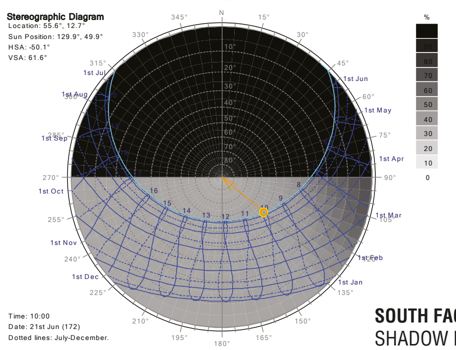
NORTH FACADE- Total surface: m^2
MONTHLY INCIDENT SOLAR RADIATION GRAPH



NORTH FACADE
SHADOW MASK



SOUTH FACADE - Total surface: m^2
MONTHLY INCIDENT SOLAR RADIATION GRAPH



SOUTH FACADE
SHADOW MASK

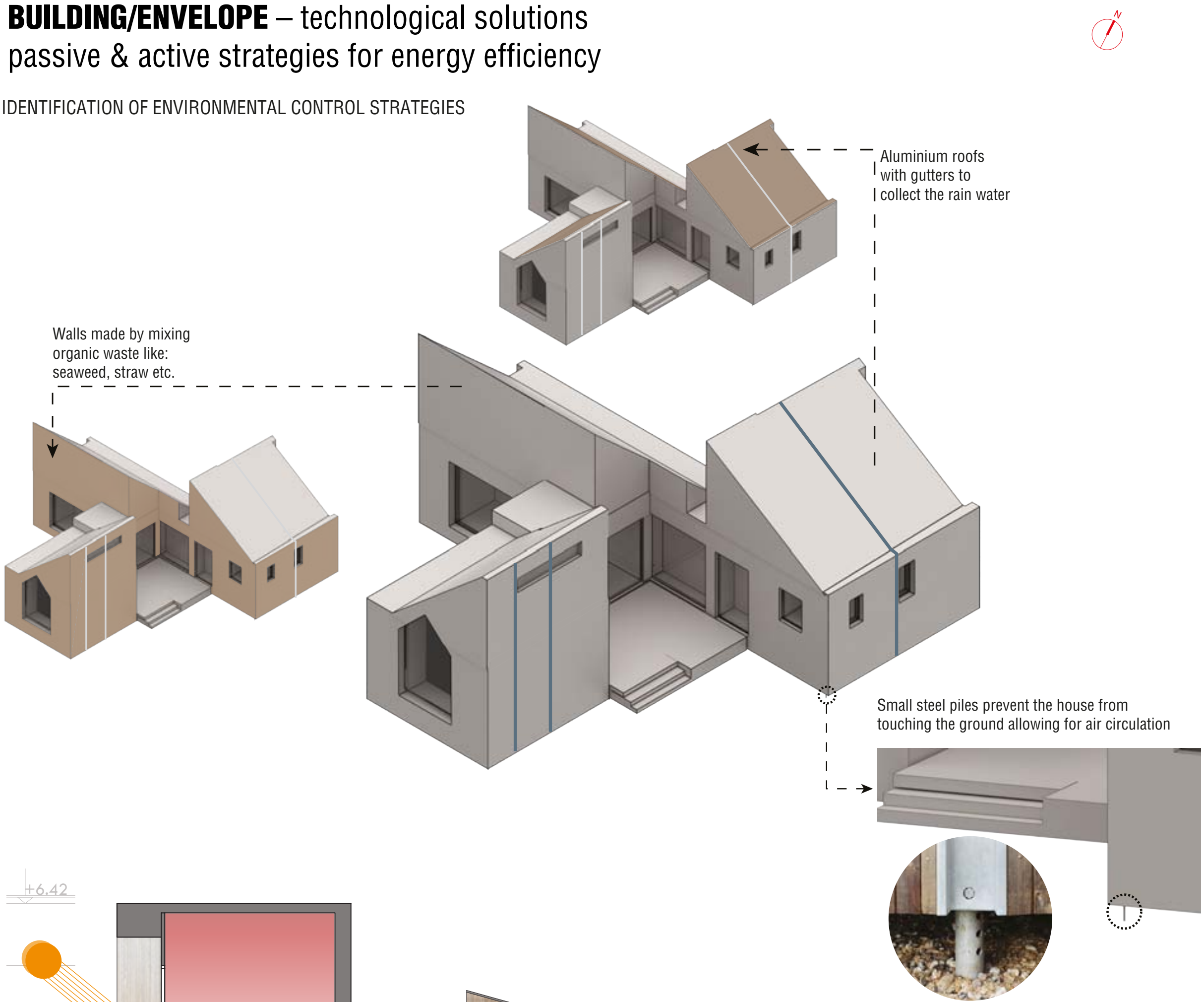
Biological House

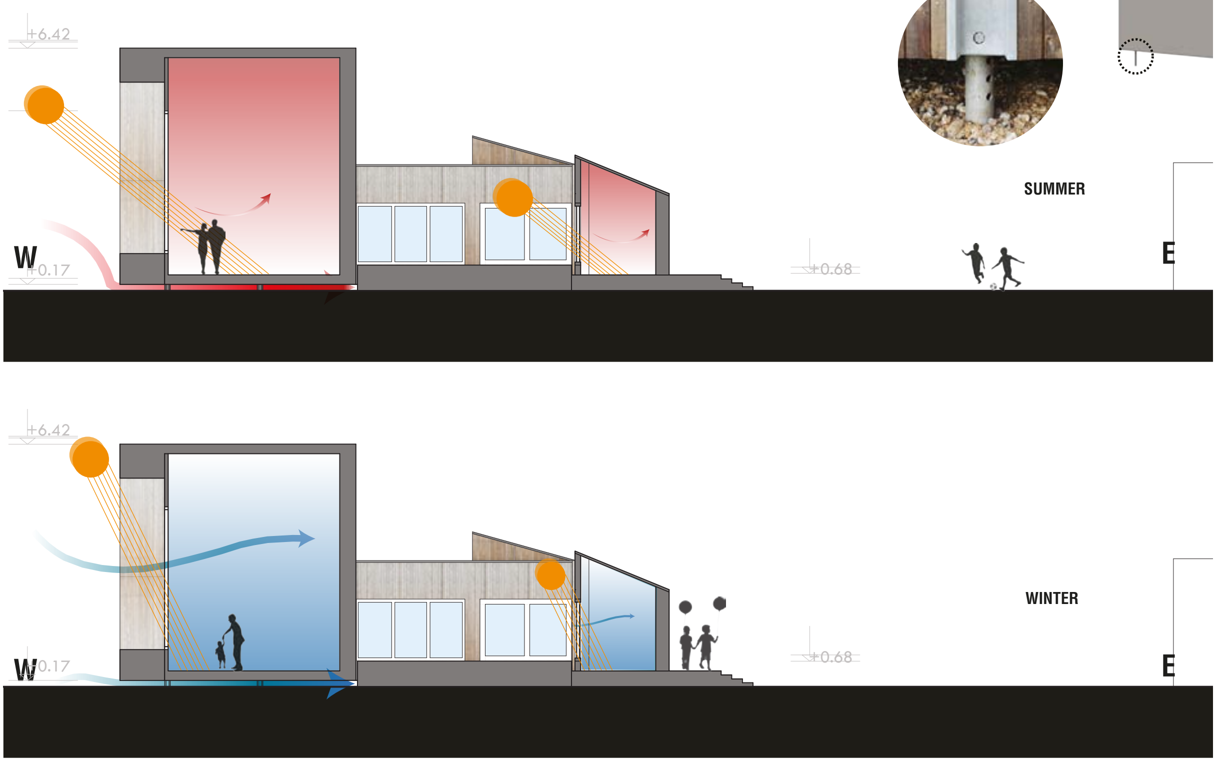
Middelfart (Denmark)

TEMPERATE CLIMATE

BUILDING/ENVELOPE – technological solutions
passive & active strategies for energy efficiency

IDENTIFICATION OF ENVIRONMENTAL CONTROL STRATEGIES



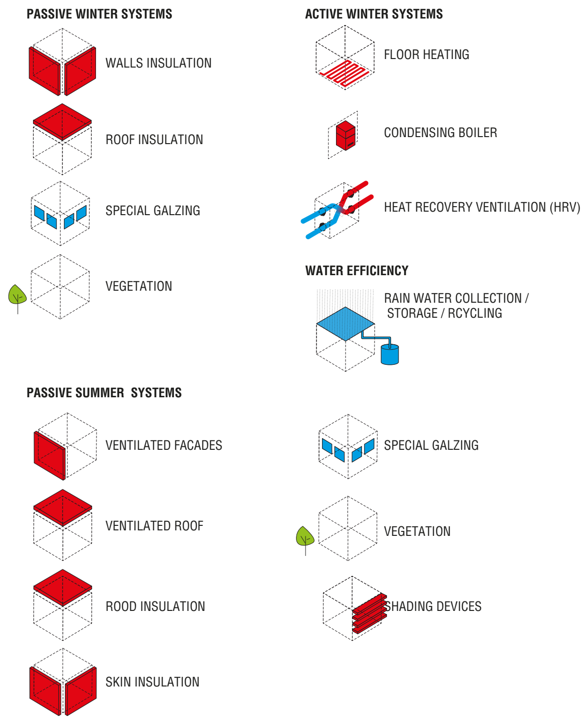


BIOCLIMATIC SECTION SUMMER/WINTER - scale 1:200

Biological House
Middelfart (Denmark)

TEMPERATE CLIMATE

BUILDING/ENVELOPE – technological solutions
passive & active strategies for energy efficiency



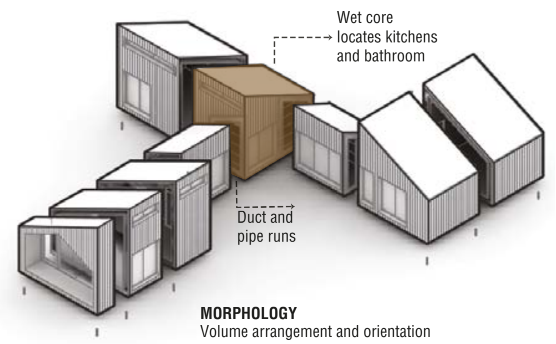
FACADES

PASSIVE WINTER SYSTEMS	N	S	E	W	Roof
INSULATION WALLS	●	●	●	●	
INSULATION ROOF					●
DIRECT HEAT GAIN SYSTEMS	●	●	●	●	
SPEACIAL GLAZING	●	●	●	●	
VEGETATION				●	

ACTIVE WINTER SYSTEMS	PRESENT				
HEAT RECOVERY VENTILATION (HRV)	●				
FLOOR HEATING	●				
BIOMASS BOILER	●				

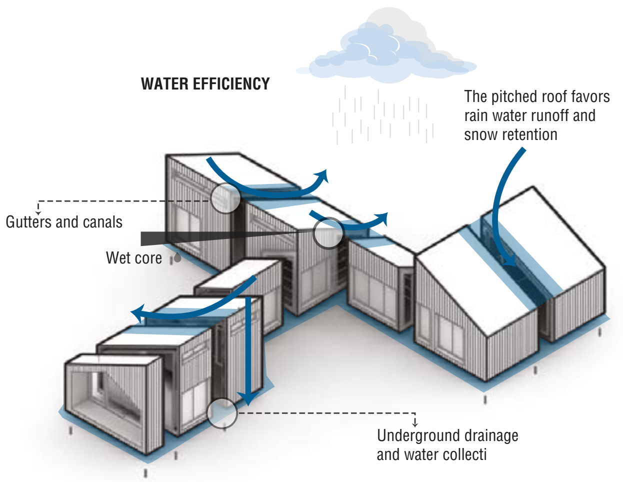
PASSIVE SUMMER SYSTEMS	N	S	E	W	Roof
VENTILATED FAÇADE	●	●	●	●	
VENTILATED ROOF					●
ROOF INSULATION					●
SKIN INSULATION	●	●	●	●	
SPEACIAL GLAZING	●	●	●	●	
SHADING DEVICES				●	
VEGETATION				●	

PASSIVE & ACTIVE SYSTEMS FOR ENERGY EFFICIENCY
SUMMER & WINTER



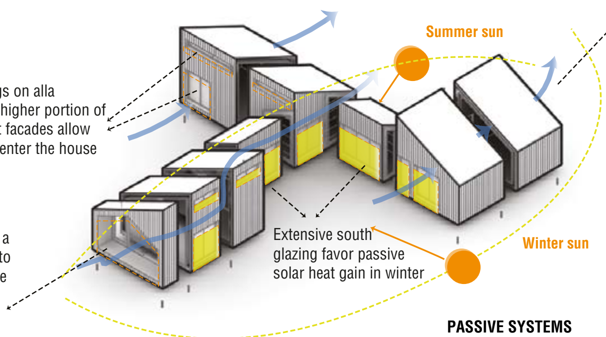
MORPHOLOGY
Volume arrangement and orientation create a courtyard protected from wind in winter and shaded in summer

WATER EFFICIENCY



DAYLIGHTING
Numerous openings on alla facades and in the higher portion of the south and west facades allow for natural light to enter the house and save energy

NATURAL VENTILATIN
Openings placed on opposite sides favor cross ventilation



SHADING
The west facade is characterized by a deep window, this allows the glass to be shaded during summer, when the angle of incidence of the sun is higher, while the rays can penetrate deep into the building in winetr.

PASSIVE SYSTEMS

PASSIVE AND ACTIVE SYSTEMS FOR ENERGY EFFICIENCY SUMMER AND WINTER