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MASTER RESEARCH THESIS

In
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Option
Architecture and Environment Technology

Theme

The Relation study between Biomimicry and Bioclimatic Architecture

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Last in order but not of importance, overwhelmed with humility and gratefulness, we are thankful to every person who helped in the making of this thesis directly or indirectly.

Dedications

I dedicate this thesis to my grandfather, whose memory will last like stars and whose precious smile and warm heart will not be forgotten.

First and foremost, to the pillars of my life, to my parents who have always been there for me, to whom I owe a great debt forever. No amount of words or actions is enough to pay you back for the sacrifices you made and the dreams you abandoned for us.

Next, to my twin sister my second the one who was always there for me and my brothers who are always next to me without you I couldn't be the one who I am now. I always feel blessed to have you in my life, thank you for being the wonderful people you are and for supporting me.

My sincere thanks to my grandparents, the BATROUNI and the DJENNADI family.

With great happiness and joy, I share this modest work with my beloved uncles, and aunts my close friends Yasmine IDIR, Nouara GUEBGUID, Chaima MANSSOURI, Childhood friends and to all the ones whom I know in my university journey.

Last but not least, I would like to express my warmest thanks to all those who were part of my journey, from whom I got the motivation and advice and who accompanied me during my graduate studies, may Allah bless you all.

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Introductory chapter

1. Interdiction:

“Architecture is a wall of constraints covered with poetry”

“Architecture is an environment made by man to serve his development and his knowledge.”

By Hamil Faid

Architecture has passed by several changes throughout time and space. Each period marked its passage by specific architectural productions. Each civilization developed an architecture that reflected its language and Customs. For thousands of years, human beings have developed architectural concepts to provide acceptable comfort in a specific environment, taking into account local climatic conditions, available building materials, as well as cultural and religious aspects. From the primitive hut to the House of today, the architecture reflects through its evolution the different solutions found by man to face the climatic vagaries.[1]

It is often accepted in scientific circles that the act of building is linked to protecting oneself from the unfavorable climate and vernacular and traditional architecture has given very reasonable answers. Vernacular architecture, which can be regarded as a sustainable and natural contract between man and nature, is the fruit of imagination, years of evolution, and climatic conditions by understanding and observing nature and learning from it

Nowadays Architecture tends to become an exaggerated field of application of technology at the expense of other complementary values, to satisfy our needs in terms of comfort. This architecture, neglecting the cultures and ways of inhabiting populations, the climate and the behavior of building materials in thermal exchanges, often leads to discomfort, structural transformations, and a considerable waste of energy, both for heating in winter and for air conditioning in summer, especially in housing, so those entire cities could be heated with the heat losses of these buildings. a parting nature with humans, the industrial revolution, and the uncontrollable growth of cities caused a climate-changing [2]

this in order to solve it, architects and urban planners with help of scientific studies are encouraged to implement bioclimatic architecture and sustainable design by looking back to nature

[1])Kendrew(1957 ،
[2] (Feuerstein, 2002)

Bioclimatic architecture is a discipline of architecture that combines the geographical and climatic environment with the lifestyles of the inhabitants to optimize comfort, health, while respecting the environment.

This architecture seeks to reduce the energy needs of a building during its life while taking into account the preservation of a healthy and pleasant urban environment. The urban environment plays a key role in human health and the well-being of all urban dwellers; it influences mental and physical health, as well as it generates physical and mental disorders that are interdependent essential elements of life[3]

It may be useful to examine examples where the same problems have been solved by other living organisms and ecosystems for billions of years. Biomimicry is by definition an applied science that draws inspiration from the solutions of human problems through the study of natural designs, systems, and processes. The appropriation of a systemic biomimetic approach in our modes of design, production, and organization is an even more promising breakthrough innovation for Sustainable Development.

2. **Problematic**:

- Why did architect integrate bioclimatic concepts into biomimetic approach?
- What was the effect of bioclimatic architecture on biomimetic architecture?
- How biomimetic approach gave the bioclimatic architecture new method of conception??

3. Hypothesis:

- The integration of bioclimatic concepts and the reduction of energy consumption would make it possible to obtain an ecological and sustainable project and to encourage and sensitize to have in mind to maintain the balance between architecture and environment.
- The effect of bioclimatic architecture on biomimetic approach:

[3] (CLAIRE, 1982)

Biomimicry consists in drawing inspiration from the remarkable properties of natural systems for the sustainable development of human societies. It can be an accelerator of innovation for us, calling for a rethink of how we design, organize, build and develop urban space in order to live healthy and sustainably in buildings.

- Nature-based solutions represent important opportunities to address the challenges of climate change within cities, so that nature, in its diversity of forms, processes and strategies, is an endless source of experimentation, inspiration and innovation for our human systems

4. Objectives:

Design biomimicry and a bioclimatic project that meets pleasant living conditions in the most natural way by taking advantage of the context and promoting energy savings and reducing energy expenditure and environmental impact

5. Approach Methodology:

In order to achieve the objectives, set out and to provide satisfactory answers to the questions raised in the issue, we have adopted the following working method, which will determine the direction of development of our research.

Our methodological approach is divided into several steps presented as follows:

- **Theoretical approach:**

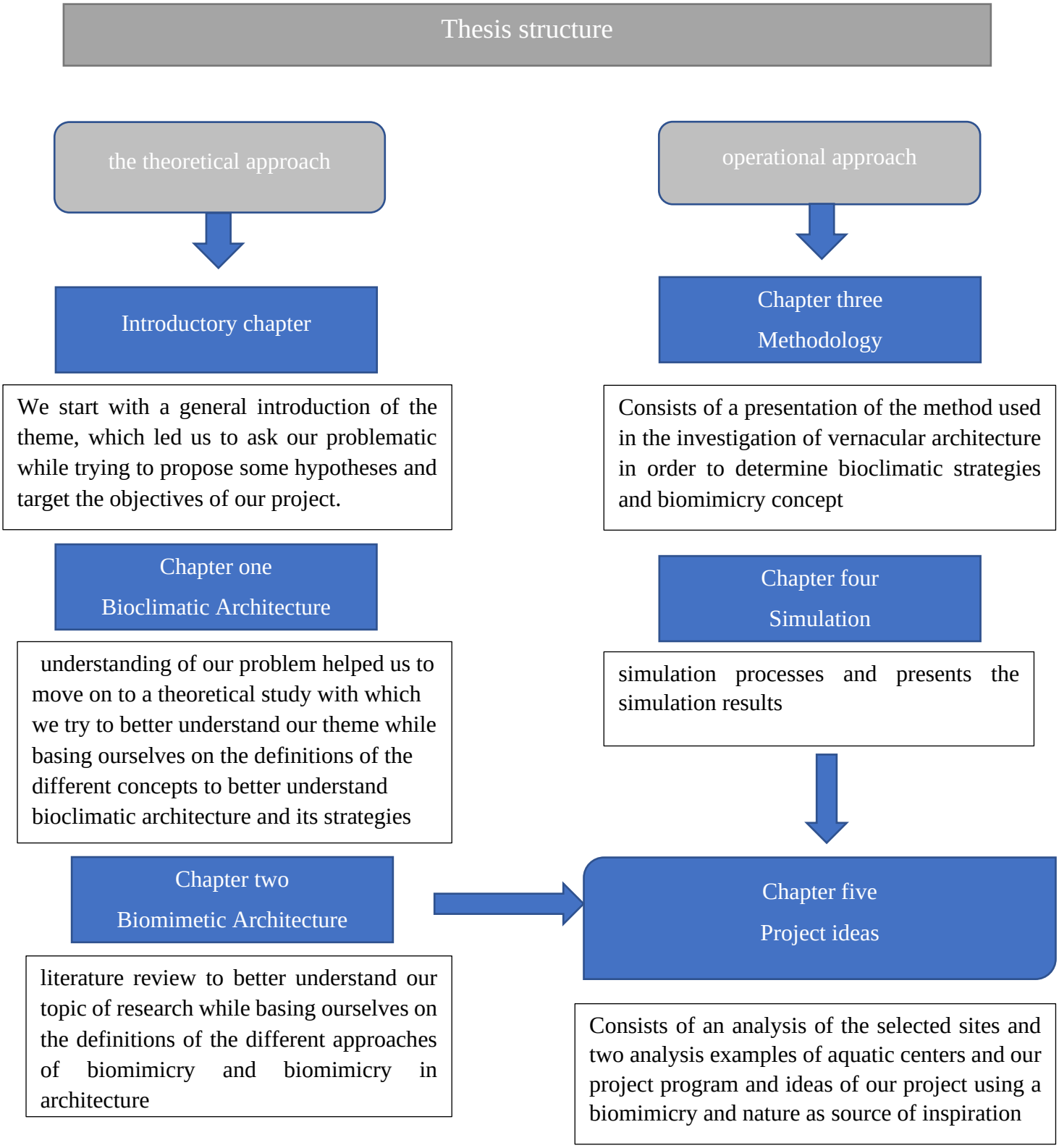
The research in this part includes the collection of documents, books, journals, research works, newspaper articles, proceedings of seminars or symposia in addition to the exploitation of articles on the internet for a synthesis of related notions

Operational approach:

Including simulation using computer software "Archwizard". It is used for the optimization and regulatory validation of the energy and environmental performance of the building from the sketch and until the completion of the work, in new or renovation, in direct connection with the digital model BIM.

And site study with examples and ideas of the project

Structure:


Thesis structure
the theoretical approach
operational approach
Introductory chapter
We start with a general introduction of the theme, which led us to ask our problematic while trying to propose some hypotheses and target the objectives of our project.
Chapter three
Methodology
Consists of a presentation of the method used in the investigation of vernacular architecture in order to determine bioclimatic strategies and biomimicry concept
Chapter one
Bioclimatic Architecture
understanding of our problem helped us to move on to a theoretical study with which we try to better understand our theme while basing ourselves on the definitions of the different concepts to better understand bioclimatic architecture and its strategies
Chapter four
Simulation
simulation processes and presents the simulation results
Chapter two
Biomimetic Architecture
literature review to better understand our topic of research while basing ourselves on the definitions of the different approaches of biomimicry and biomimicry in architecture
Chapter five
Project ideas
Consists of an analysis of the selected sites and two analysis examples of aquatic centers and our project program and ideas of our project using a biomimicry and nature as source of inspiration

Chapter 01: Bioclimatic Architecture

1. Interdiction :

Architecture since ancient times involved the exploitation of natural resources to serve human needs. There is a long tradition of building in harmony with the immediate environment and climate. Socrates, about 400 BC had some ideas about the climatic suitability of the houses and the way in which they had been built to ensure thermal comfort. Vitruvius, 1st century BC, also wrote about the need to consider climate as an element of building design, for reasons of Health and comfort. But unfortunately, the harmony between architecture and its physical environment had been broken in the 20th century by architects who tended to abandon climate variables in favor of high technology in the process of architectural design. It was the energy crisis of the 70s that changed attitudes and gave birth to what is now called "bioclimatic architecture".[4] (BioclimaticX, 2009)

2. Climat and Human confort :

2.1. Climat :

2.1.1. Definition

Climate is one of the main data of the morphology of architectural and urban systems [5]

Climate is defined as a generalization of "weather" conditions from day to day and year-round.[6]

it is the result of the interaction of several factors, including temperature, water vapor, wind, solar radiation, and precipitation in a particular place and over a period of time.

2.1.2. climate elements:

We can distinguish a set of elements, and climatic factors reported in category [7]

- Energy factors: radiation, light, and temperature
- hydrological factors: precipitation, and hygrometry.
- Mechanical factors: winds, and snow

[4] (BioclimaticX, 2009)
[5] (CLAIRE, 1982)
[6] (Kendrew, 1957)
[7] (Kendrew, 1957)

The climate of a region is determined by the regimes of variations of several elements including their combinations. The main climatic elements to consider in urban design in general and when designing a building in particular, and which affect human comfort are:

- the temperature
- the humidity
- the wind
- the precipitation (rain, snow.)
- Vapor pressure

Since climatic conditions can vary from day to day or from year to year, it is necessary to take into account variations from these averages for a clearer and more realistic view

2.1.3. Scales of climate elements

Any designer needs to know the climate of the place where he needs to build. That is the temperature and humidity regime of the air, the regime, and nature of precipitation, sunshine, the regime and nature of the winds. These elements can guide the architectural design and influence the comfort inside the spaces

From this principle we encounter different types of climates (zonal, general, local regional, and microclimate climates) in fact, it is the local radiative balances and the movement of low amplitude air that plays the essential role in the bioclimatic design.

2.2.Comfort:

2.2.1. Psychosociological comfort:

Visual: perception of space, contact with the outside, visibility

Non-visual: course of activities, intimacy.

2.2.2. Thermal comfort:

Thermal comfort is defined as a state of satisfaction with the thermal environment. It is determined by the heat exchanges between the body and its environment. thermal comfort corresponds to a range of temperatures that can vary depending on the sensitivity and activity carried out by the occupant (rest, light work, sports activity...).

The main factors that regulate the heat exchange between a person and his environment and that affect his thermal comfort are the following:

For the environment

air temperature and its fluctuations -Thermal radiation -Humidity- Airspeed

For the person:

His physical activity (heat production by the body) - His clothing.

2.2.3. Measures of thermal comfort:

(1) Winter comfort:

in winter, it is necessary to heat the indoor air to reach a felt temperature corresponding to thermal comfort, there are ways to limit its energy consumption to a maximum:

- Through the bioclimatic approach by applying the hot strategy which consists of capturing the calories brought by the sun (free intakes), storing them, conserving them, and distributing them.
- Via suitable heating equipment.
- By heating and regulating in a reasoned way.

(2) Summer comfort:

In summer, buildings can be subject to overheating, sources of discomfort. The bioclimatic approach allows, in this case too, to solve or minimize these problems by avoiding the use of air conditioning. The cold strategy is to protect against external and internal heat inputs, dissipate overheating, and cool the premises naturally

Thermal comfort can be achieved by a combination of parameters that must be integrated into the Architectural Design (The Shape of the building, orientation...)and in the implementation and choice of materials. During these phases, the primary choices take place and will have a direct effect on the thermal behavior and energy performance of the building.

3. Bioclimatic ARCHITECTURE:

An Architecture that has a connection with Nature. Building designs that take into account climatic and environmental conditions to help achieve optimal comfort inside. It deals with the design and architectural elements, avoiding a complete dependence on mechanical systems, which are considered support.

According to the Oxford Dictionary, bioclimatic is the relationship that connects the climate and the activities of living organisms, while architecture is the art or practice of designing and

constructing buildings. By merging them to form a bioclimatic architecture, he links the idea of a building design that takes into account its climatic and environmental state to help achieve favorable thermal and visual comfort of users.

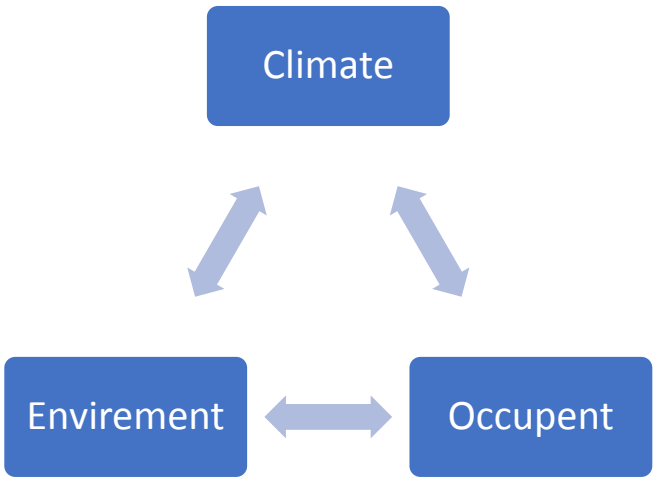


Figure 1. The Three Elements OF Bioclimatic Architecture

Source : the author

An architecture discipline that takes the best part of the conditions of a site and its environment, for a more comfortable architecture for its users.

3.1. The principles of bioclimatic architecture:

We speak of bioclimatic design when the architecture of the project is adapted according to the characteristics and particularities of the location, in order to take advantage of the advantages and to guard against disadvantages and constraints. The main objective is to obtain the desired atmosphere comfort in the most natural way possible by using the architectural means, the renewable energies available and by using as little as possible the mechanized technical means and the energies external to the site.[8]

3.1.1. Implantation *:*

The land on which the building is built: the slope, its exposure to the wind but also its altitude and of course its climate

[8] (BioclimaticX, 2009)

3.1.2. Orientation :

Attention will be paid to the orientation of the building: Givoni defines " the orientation of a building by the direction towards which these facades are turned. This factor is subject to many considerations, such as sight, possible losses, aeration, and the nature of the climate

The orientation will effect both elements Sunshine and the wind :

The Sunshine: They depend on the position of the sun which changes according to the seasons and determine the solar contributions. The exposure of the building, the orientation of the interior rooms, the location of the windows, and the vegetation should be determined according to the Sunshine. In summer, the sun is high in the sky and the solar day is long, while in winter the sun is low and remains visible for less time.

The Wind: causes significant thermal losses on exposed facades. A house can protect itself with the help of the relief of the terrain, the vegetation, the surrounding houses, but also thanks to its shape.

3.1.3. Compact shapes*:*

Minimize surfaces in contact with the outside (limit energy losses and optimize heat distribution)

3.1.4. Buffer zones:

Little or unheated spaces (garage, storeroom) on the North Side behave like thermal insulation, verandas in the form of a glazed annex leaning on the South Side favor the greenhouse effect

3.1.5. Sun protection:

The sun protection devices are intended to minimize overheating and control glare, fixed or mobile "cap" well-sized avoid summer overheating but let the winter sun penetrate.

3.1.6. Adequate Materials:

The use of materials that breathe (not waterproof), to ensure the regulation of the humidity of the housing and contribute to comfort.

3.1.7. Strong thermal inertia:

Insulation from the outside. Materials of high inertia, which function as masses of heat accumulation, serve to retain the incident Energy received during the day to restore it at night (concrete, stone)(vernacular architecture)

3.1.8. Thermal and energy sensors:

Often on the roof for maximum capture in order to cover part of the needs of the construction

3.1.8. Efficient heating:

Low-temperature heating (soft heat), especially by the floor, combined with efficient regulation, helps to limit energy consumption

3.1.9. Color:

- Use clear or vegetal floor coverings
- Use clear wall and roof coverings to decrease flow solar absorbed or cover them with vegetation,
- Insulte roofs

3.1.10. Openings:

as a rule, in the northern hemisphere, we propose:

Maximizing the south-facing glass surfaces, protected from the summer sun by horizontal caps,

Minimization of north-facing glass surfaces.

Reasoned and reflected glass surfaces for the East and West orientations to protect against summer overheating.

3.1.11. Insulation of the envelope:

When designing buildings (housing, equipment, hotels, others ...), the problem of heat loss must be seriously considered.

There are several types of losses which are: losses by the walls (wall and roofs), losses by glazing, losses by the various joineries and by air renewal, linear losses which depend on the construction methods of the building

4. Bioclimatic strategies:

Bioclimatic architecture has strategies and techniques seek to make the most of the sun in winter and to protect themselves from it during the summer[9]

4.1. Warm strategy: Application in winter:

- Capture solar energy: create openings on the sun side to receive energy.
- Store in the mass: the heavy materials placed inside the building provide thermal inertia that allows it to store energy. Keep by insulation: thermally insulate all the walls surrounding the heated volume in order to preserve the heat stored in the air and in the walls.
- Distribute: distribute heat accumulated in the air and in heavy walls, at night

4.2. Cold strategy: Application in summer:

- Protect from solar radiation
    - Protection of windows by shutters and blinds.
    - Deciduous vegetation in the South.
- Dissipate overheating by daytime ventilation
- Cool by night ventilation

4.3. Promote natural lighting

Natural light is divided into three sources of illumination:

- from the sky

- from the sun

- from the reflections of light on the interior and exterior surfaces. Their respective values change depending on the time of day, season, the height of the sun.
- Optimization of natural lighting inputs, reducing lighting power consumption.
- Ensures visual comfort in the House

[9] (Manzano Agugliaro, 2015)

4.4. The principle of a system of " basic ventilation":

Tt's the movement of the air in the building:

- The supply of fresh air in all so-called "dry" spaces in the rooms (bedrooms, games room, living room, office, etc...)
- The extraction of damp or polluted air in the so-called "humid" premises (room bathroom, kitchen, and toilet).
- The transfer of air from" dry rooms "to" wet rooms " via transfer openings.

In order get the better comfort and to apply the strategies in deferent climate and places designers and architects made strategies in each different zone of Giovani's Bioclimatic chart[10]

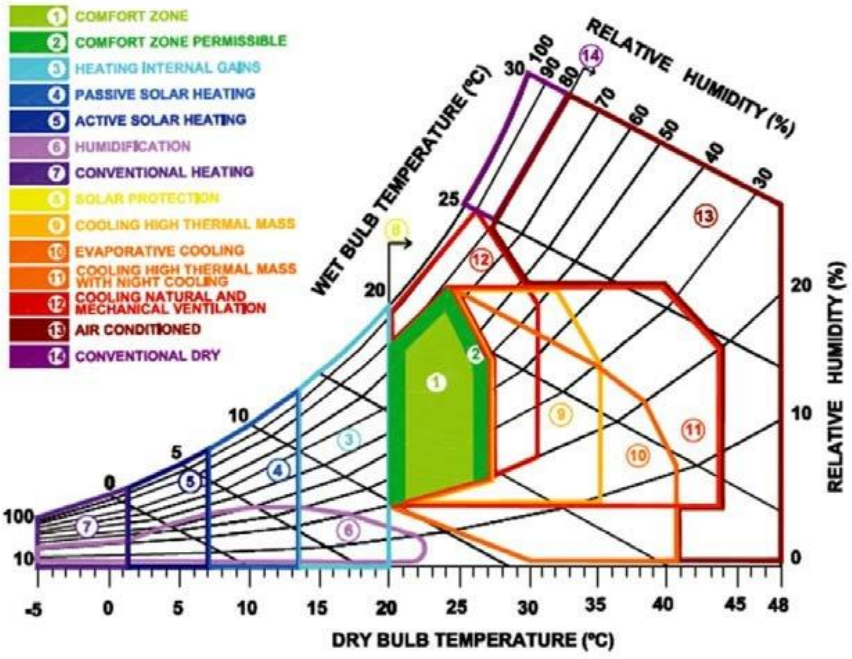


Figure 2 Psychrometric chart adapted from Givoni

A. Comfort and permissible comfort zones (Figure 3 Passive solar heating techniques in confort zone)
B. Heating techniques (Figure 4, Figure 5)

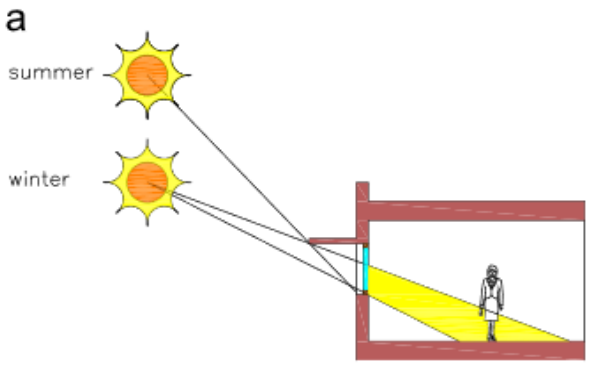
[10] (Morillón-Gálvez, 2004)

C. Humidification (Figure 6)

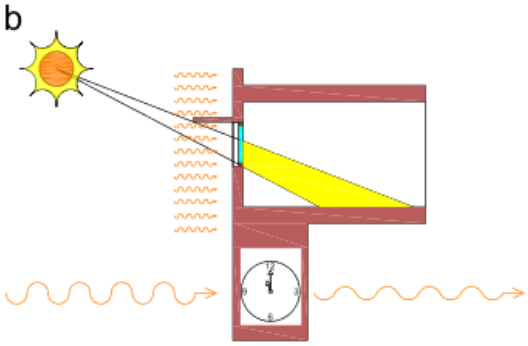
D. Solar protection (Figure 7)

E. Cooling systems (Figure 8,Figure 9,Figure 10)

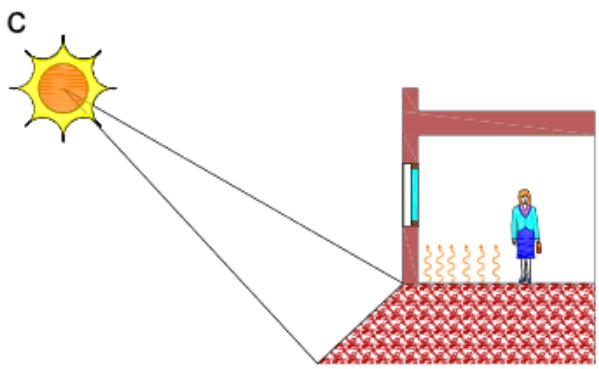
A) Comfort and permissible comfort zones



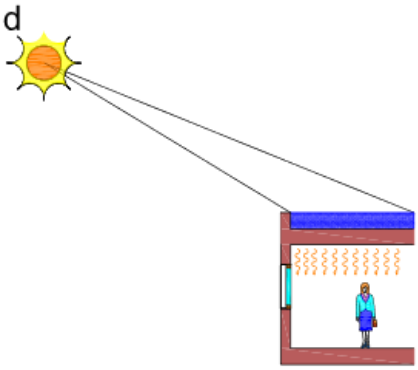
(a) The awning as a passive solar heating solution



(b) representation of radiation captures through openings for a space in the passive solar heating zone.



c) representation of capacitive flooring for a space in the passive solar heating zone

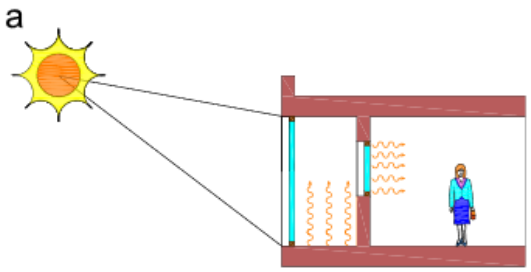


(d) roof pond for a space in the passive solar heating zone.

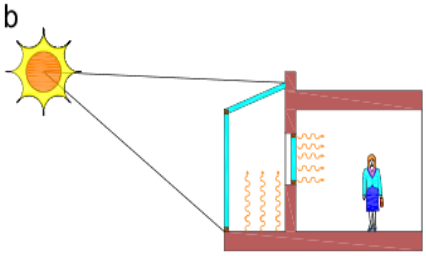
Figure 3 Passive solar heating techniques in confort zone

B) Heating

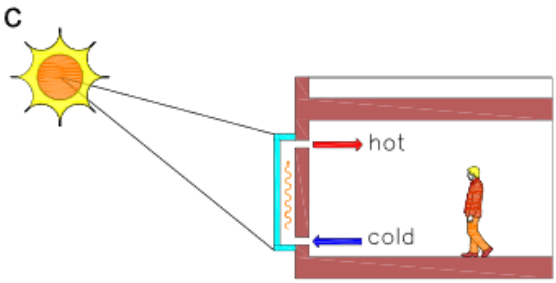
Heating internal gains:



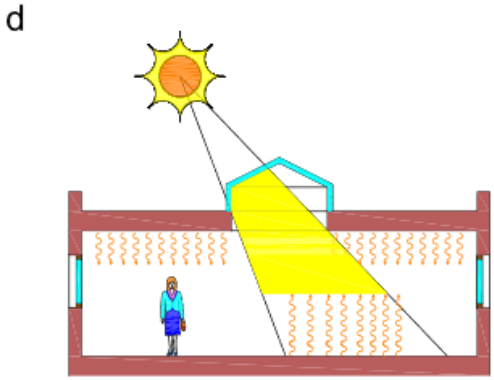
a) Representation of a glassed-in gallery for a space in the passive solar heating zone



(b) representation of an adjoined greenhouse for an area in the passive solar heating zone;



(c) representation of a Trombe wall for an area in the passive solar heating zone; the passive solar heating zone



(d) representation of roof openings for a space in

Figure 4 Passive solar heating TECHNIQUES IN HEATING internal gains

Active solar heating:

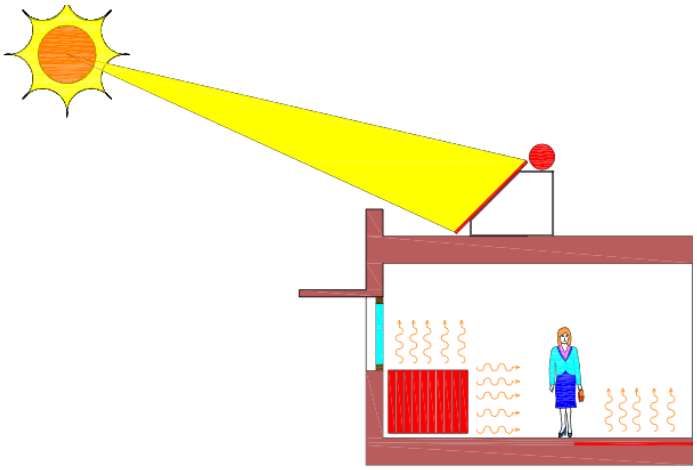
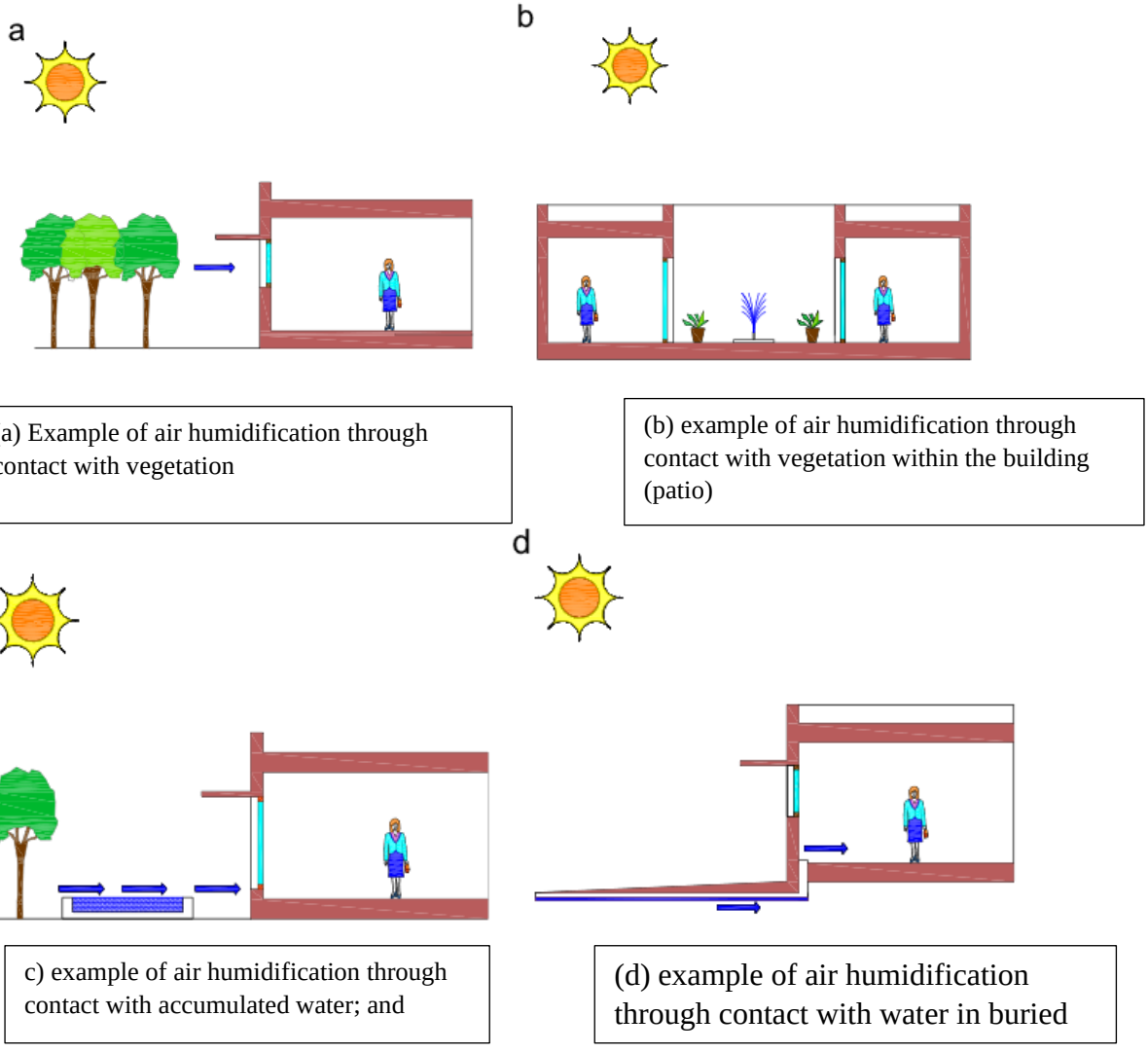


Figure 5 Active heating techniques.

C) Humidification :



(a) Example of air humidification through contact with vegetation

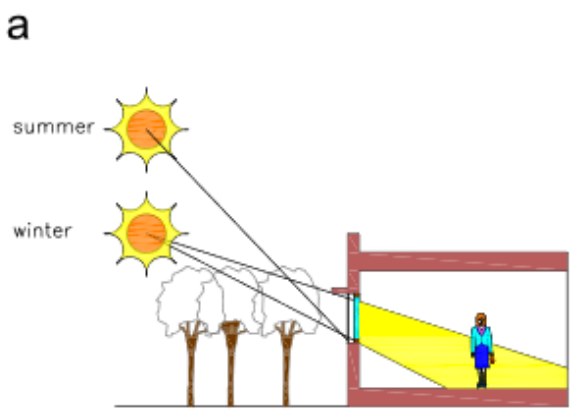
(b) example of air humidification through contact with vegetation within the building (patio)

c) example of air humidification through contact with accumulated water; and

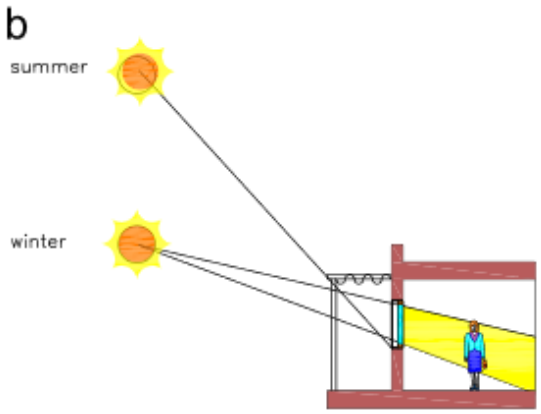
(d) example of air humidification through contact with water in buried

Figure 6 Humidification techniques

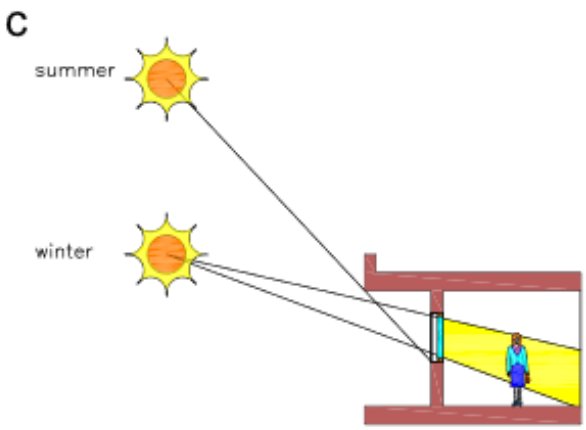
D) Solar protection :



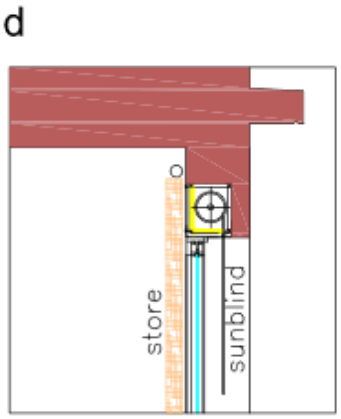
(a) Solar protection mediated by deciduous vegetation



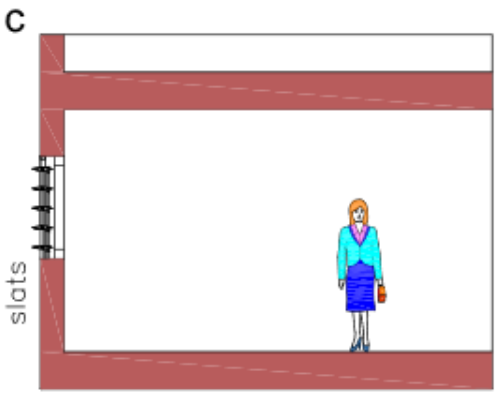
(b) pergola with deciduous vegetation canopy-mediated solar protection



(c) porch as a solar protection strategy



(d) sunblind (outside) and store (inside)



(e) horizontal slats.

Figure 7 Solar protection techniques

E) Cooling system

- Cooling through a high thermal mass:

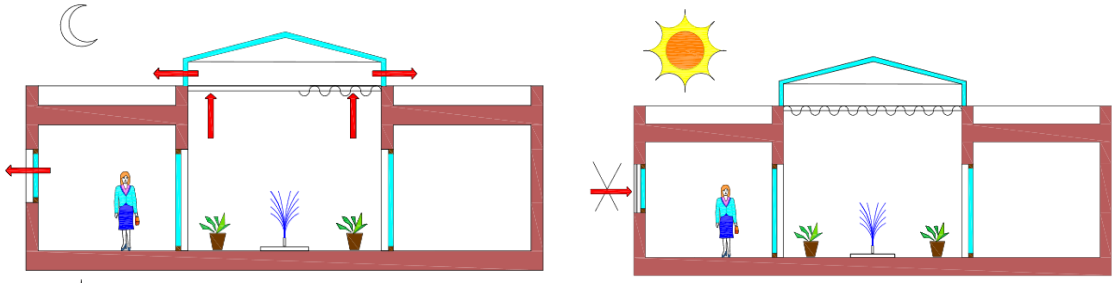
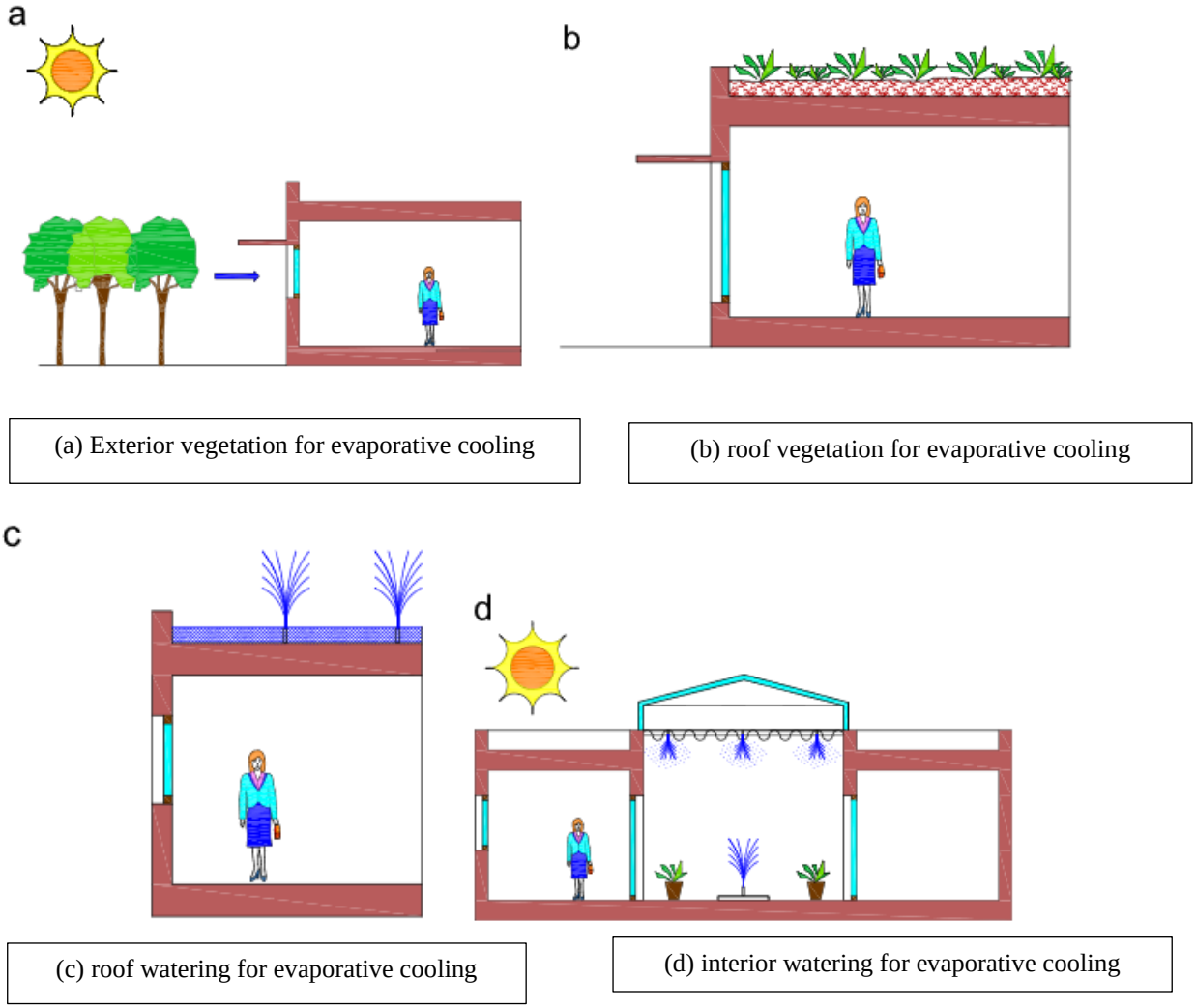


Figure 8 A Sevillian patio with a protective moving mechanism that avoids heat gains in the daytime and favors nocturnal dissipation.

- Cooling through natural and mechanical ventilation:



(a) Exterior vegetation for evaporative cooling

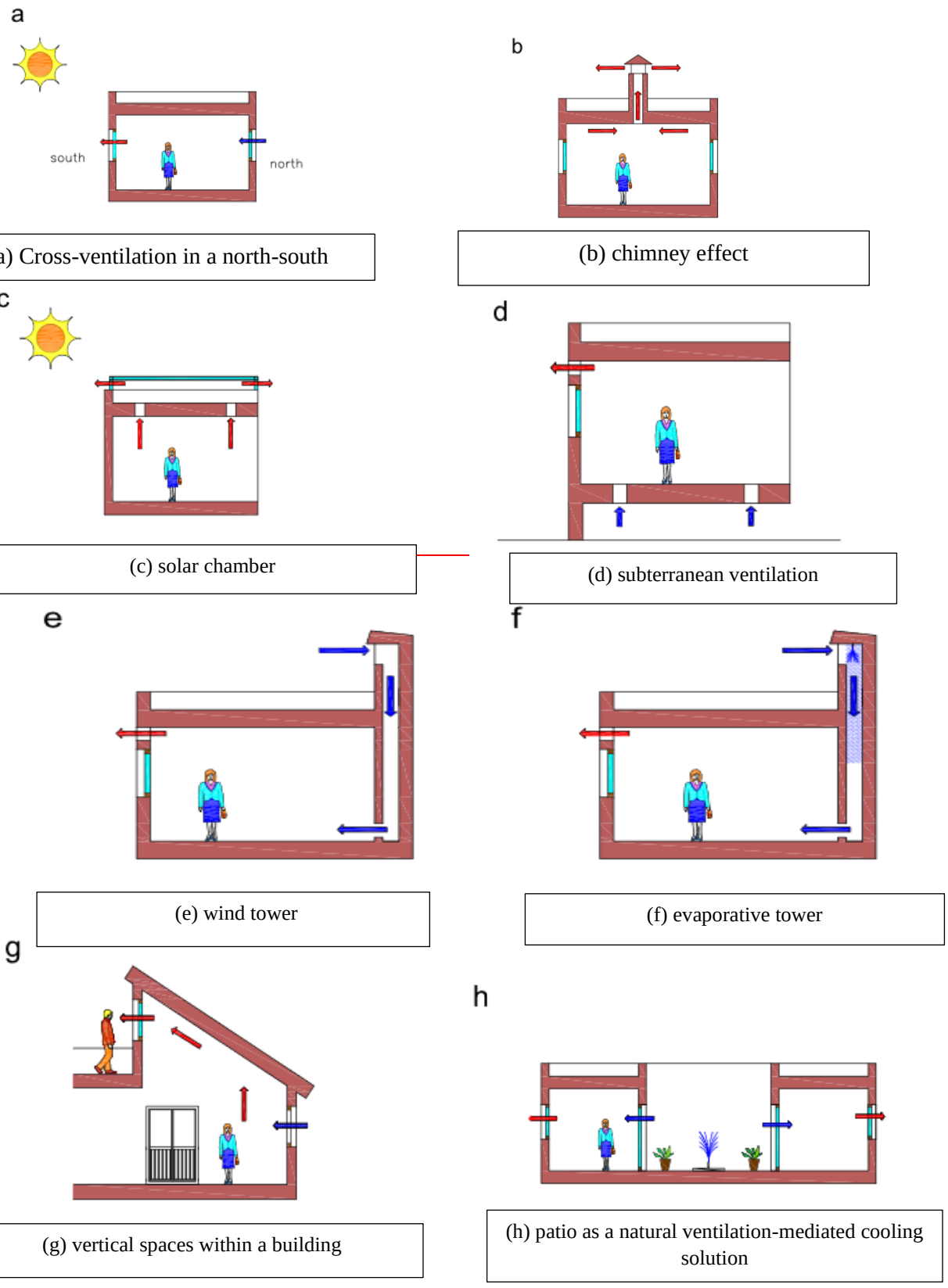
(b) roof vegetation for evaporative cooling

(c) roof watering for evaporative cooling

(d) interior watering for evaporative cooling

Figure 9 Evaporative cooling techniques

- Cooling through natural and mechanical ventilation:



(a) Cross-ventilation in a north-south

(b) chimney effect

(c) solar chamber

(d) subterranean ventilation

(e) wind tower

(f) evaporative tower

(g) vertical spaces within a building

(h) patio as a natural ventilation-mediated cooling solution

Figure 10 Natural and mechanical cooling ventilation techniques

5. Main trends in bioclimatic architecture:

5.1. Application of vernacular architecture strategies and adapting it to current architecture:

Bioclimatic architecture attempts to analyze traditional architecture based on the studies of climate and culture of a place with the architectural and construction solutions. Vernacular architecture has experienced a slow evolution during which it has gained social, cultural, religious, economic, technological, and climatic knowledge related to particular places to yield quite singular architectural designs. This type of architecture adapts to the climate of the place without using additional devices that consume energy and leave an ecological footprint summarizes some examples of adapting the strategies for vernacular architecture in current architecture

5.2. Experimentation of bioclimatic architecture in construction:

This trend aims to translate innovative bioclimatic strategies around the world

By doing tests that intended to achieve energy savings by using bioclimatic guidelines during the design and test the lighting and the ventilating and the energy of the building before building the building the simulation procedure to estimate the energy that will be consumed by the building and to minimize it by adapting bioclimatic strategies.

5.3. Application of innovative strategies to bioclimatic architecture:

These strategies are valid for both conventional buildings and very tall structures, which require a separate set of bioclimatic strategies for ventilation and lighting [. The strong influence of solar radiation has also been studied, as has the influence of vertical gardens (vertical landscaping), courtyard design, and the use of voids within the building to provide adequate natural ventilation to eliminate pollutants and maintain climate control. Similarly, ultrasonic spray nozzles have been used to introduce humidity and produce evaporative cooling

5.4. Bioclimatic architecture in urban planning:

A focus has been placed on integrating urbanism into the climate by analyzing the thermal sensations of people in public spaces and the thermal differences between rural and urban environments. All research related to this trend has been directed towards analyzing and adapting the environments near buildings, as these are also urban spaces and fundamental for

human habitat. Such research can subsequently facilitate the formulation of guidelines to follow during future urban planning. Thus, bioclimatic architecture could begin with bioclimatic urbanism, including tracing streets with intentional solar orientations and locating free garden spaces to create settings that favor comfort in public spaces that will be facilitated not only by architectural elements but also by deciduous vegetation elements.

5.5. Inclusion of bioclimatic lessons in study plans:

Bioclimatic architecture integration has proliferated in architectural study plans during the last two decades. Initially, bioclimatic architecture appeared as an elective course or graduate program or in courses for architects and the training of researchers, specialists, and professors but has subsequently become integrated into the structures of study plans. Within these study plans, bioclimatic architecture is presented at three levels: the first level, in which the student must obtain and learn all of the relevant climate variables; the second level, which addresses the techniques and concepts of bioclimatic design by applying them to a project in order to properly assimilate this knowledge; and a third level, which includes the urban scale or bioclimatic urbanism. All of the levels initially address the climatic variables of the countries where they are located by progressing from the general climate to the local climate and finally the climate near the building

5.6. Technological energy-saving developments to support bioclimatic architecture

This scientific trend attempts to create tools that can record microclimate data and analyze any aspects of thermal behavior in a building interior. These developments encompass cell-based designs to incorporate data from habitable interior spaces], propose climatic classifications based on psychrometric chart] or use the bioclimatic data from a location and its influence on human beings to formulate future urban plans

6. CONCLUSION:

This chapter has reviewed the link between climate and comfort and the bioclimatic architecture and the different strategies of bioclimatic architecture. The necessity of bioclimatic strategies for energy expenditure minimization and the dependence of the achieved energy savings on the severity of the climate in which the building is located has been observed. These principles can be applied in any part of the world, assuming that the same strategy can work in a different area with a similar exterior climate. Additionally, this chapter has demonstrated how vernacular architecture represents a development basis for the strategies to be applied; therefore, its study should be emphasized more strongly.

Chapter 02: Biomimetic Architecture

1. Interdiction:

Biomimicry is the science that studies nature, imitating, or drawing inspiration from its models and methods to solve human-generated problems. This approach is not new, but it is only recently that researchers have really looked at the issue of biomimicry. In the scientific, technical, or industrial fields, the field of applications of biomimicry is wide and varied: from agriculture to industry to architecture, the prospects for innovation look promising[11]

2. Understanding biomimicry:

« The more our world functions like the natural world, the more likely we are to endure on this home that is ours, but not ours alone. »

By Janine M. Benyus

“How do we make the act of asking nature’s advice a normal part of everyday inventing?” [12]

The term biomimicry appeared as early as 1980 and was popularized by biologist and environmentalist Janine Benyus, the author of biomimicry: Innovation Inspired By Nature.

Biomimicry (bio = life and mimesis= imitate) is a new discipline that studies the best ideas of nature and then imitates them and applies their concepts and processes to human problems. Studying the leaf to invent a better solar collector is an example. A good definition would be "'innovation inspired by nature"

Interview with Janine Benyus :

Biomimicry is defined in his book as a new science that studies nature in order to imitate it or to draw inspiration from it to solve human problems. Benyus suggests looking at nature as a model(form), measure(behavior), or mentor (ecosystem)

1) Nature as a model: biomimetic studies the models of nature then imitates or draws on their characteristics to solve human problems

[11] (Benyus, 2002)
[12] (Benyus, 2002)

2) Nature as measure: biomimetic proposes to use the standards of ecology to judge the "correctness" of our innovation (after 3.8 billion years of evolution, the nature has been learned that works what appropriate what lasts)

3) Nature as a mentor: biomimetic is a new way to consider and appreciate nature. It introduces an era based not on what we can extract from the natural world but what we can learn from it

3. Biomimicry in architecture:

We are all surrounded by nature looking around us it initiates life in the creatures, gave us solution for design. Architects, scientists and artists have been modeling and imitating nature.

Innovative solutions have been thought by architects in several problems; the models inspired by nature can cause creativity and innovation in the architect's mind

Architecture has long regarded nature as a source of inspiration. many words including BIO- have been associated with architecture thus creating great confusion and terminological ambiguity. These apparently close terms have different meanings but can e grouped under the generic term BIO-INSPIRED

This refers to taking inspiration from nature to create new objects or processes that are not naturally present there

- **Biomorphic architecture:** corresponds to a design directly influenced by the organic forms of animals plants and the human body[13] .He has its roots in the art nouveau movement. It is about imitating nature y making formal and symbolic associations.
- **Bionic architecture:** is a building design movement whose expression and the constructive configurations are borrowed from nature. The bionic movement is focuses on the transfer of forms of life. Its aim is the synthesis of nature in modern construction technologies[14]The bionic practices of architecture give birth to new forms effective from the point of view functional and original in their aesthetic quality; but without taking into account the principles of nature or necessarily sustainable development.

[13] (Feuerstein, 2002)
[14] (Pioz, 2015)

- **Biomimetic architecture**: is a contemporary philosophy of architecture that seeks lasting solution s in nature[15] without wanting to replicate them forms; but y identifying the rules that govern them. This is activity interdisciplinary approach to sustainable development that seeks to draw inspiration from the principles of nature that allow organism to live sustainably in their environment and to survive sudden upheavals. Natural organisms are resilient; optimized adaptable based on system and values that enable life.

4. Objective of biomimetic architecture*:*

No longer consists solely of giving shape and measure to space but also to develop synergistic relationships between the constructed and its environment. The heuristic approach of biomimicry consists in bringing to architecture Vitalism beyond the mere mechanistic vision of life[16].

Biomimetic architecture could be at the origin of a transformation of the role of the architect evolving from the control of nature towards a lasting participation with nature.

5. Biomimetic Approach:

If we consider the process of biomimetic design as a whole from the initial idea to the final product two approaches have been identified[17] :

1. The first part of a human need or a design problem then examines the ways in which organisms or ecosystems found in nature solve this problem. this approach is effectively carried out the designers who after have identified the initial objectives and parameters of the design seek solution in the plant or animal world (Figure 11)
2. the second step is to identify a particular characteristics a behavior or function in an organism or ecosystem and then to look for solution (Bottom up or biology influencing design)[18]. this approach is where knowledge of biology influences human design. It is conducted by people with scientific knowledge of nature and who look for possible applications to relevant to the design (Figure 12)

[15] (Pawlyn, 2011)
[16] (Gruber, 2011)
[17] (al, 2009)
[18] (Innovation Inspired by Nature Work Book, 2007)

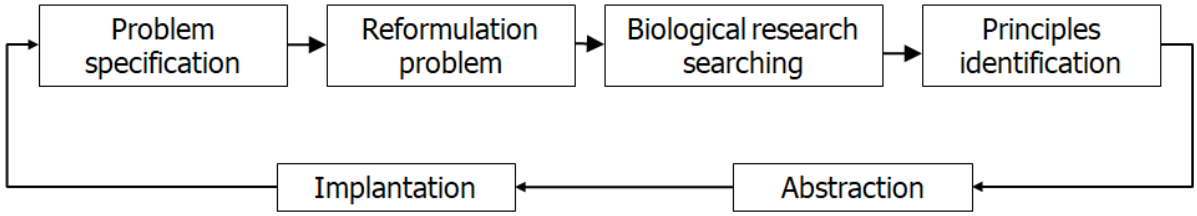


Figure 11 Problem-oriented process

Source the author

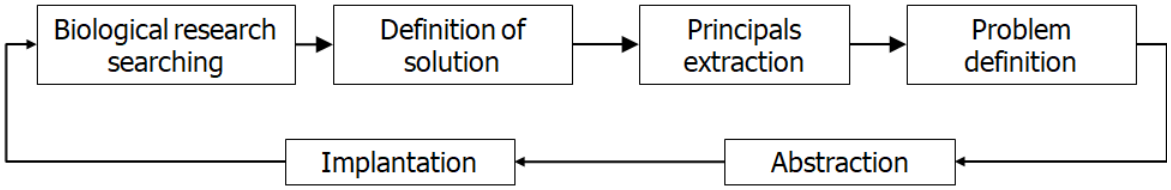


Figure 12 Solution-oriented process

Source the author

6. Levels of biomimicry in architecture:

Biomimetic design processes in architecture reveal three levels possible imitation: the level of organism, behavior or ecosystem[19]

A. The organism level refers to specific being such as a plant or animal and can involve imitating part of the organism or the whole

B. The behavior level refers to behavior or a being and may include the translation of an aspect of the behavior of the organism and possibly its relation to a context wider

C. The third level is the imitation of an entire ecosystem and the principles that allow the function to be performed successfully

Within each of those three levels five additional dimension of imitation exist:

The design can be biomimetic for example in terms of what it looks like (shape), how it's made (construction) , how it works (process) or what does it do (function)[20].

[19] (Zari, 2007)
[20] (Zari, 2007)

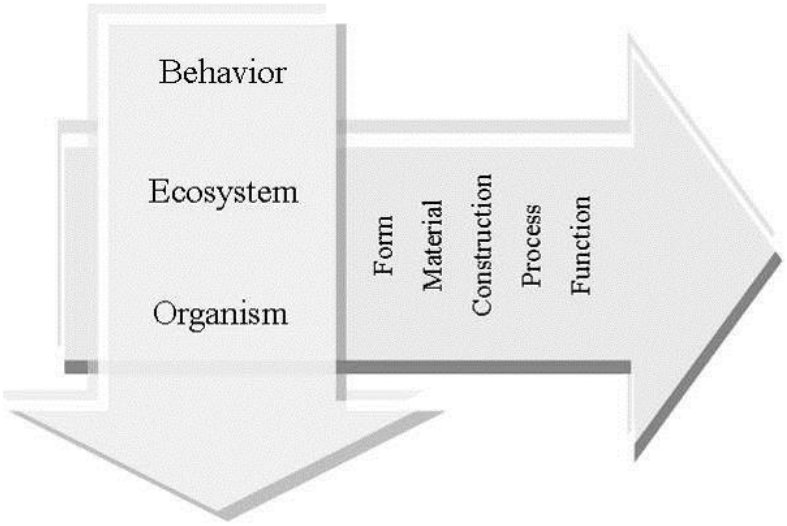


FIGURE 13 : LEVELS AND DIMENSIONS OF BIOMIMICRY

Source : google image

Example:

Behavior level (Mimicry of how an organism behaves or relates to its larger context)

Form : looks like it was made by an organism.

Material: made from similar materials that an organism builds with.

Construction : made in the same way that an organism would build in.

Process: works in the same way as an organism mound would.

Function: functions in the same way that it would if made by organism

1. **Organic level :**

The organic level corresponds to a form or a surface biomimicry. It is to be inspired and to imitate the forms found in nature. Organizations have evolved for million years; their morphology has adapted perfectly to the environment in which they live. For example, the Namibian beetle steno Cara has inspired a number of biomimetic architectures such as the Hydrological center of the university of Namibia, designed by Micheal Pawlyn of KSS Architects or the Teatro del Aqua an unbuilt project designed by Meachel Pawlyn . Indeed, the shell of this beetle is composed of a secession of micro bosses attracting water and waxy grooves that circulate it. these characteristics directly inspired those architects to design the fog sensors for their buildings (shape and materials) Figure 14

Figure 14 The Namibian Stenocara beetle, and The Hydrological Centre of the University of Namibia, designed by Matthew Parkers of KSS Architects

Source : (Estelle Cruz, 2016)

Other examples of biomimetic architecture are to be classified at the level of the imitation of an organism. This is the case of the Swiss Re Headquarters, built by Foster & Partner's (2003), whose design was inspired by the Euplectella aspergillum, more commonly known as the Venus Flower Basket Figure 15. This marine organism consists of multiple layers of glass forming a very resistant skeleton despite the smallness of the filaments that structure it. This skeleton is composed of fiber lattices forming square cells that are reinforced by other fibers placed diagonally and thus describing spirals. The external structure of the Swiss Re Headquarters mimics the skeleton of the Euplectella

Figure 15 The Swiss Re Headquarters inspired by the Basket of Flowers of Venus

Source : www.arch2o.com

More recently, two remarkable biomimetic architectures have been built in Singapore. The Esplanade Theatre by DP Architects and Michael Wilford features a cover inspired by the skin of Durian fruit Figure 16.It is composed of aluminum panels that filter natural light and that changes direction according to the position of the sun. This biomimetic design reduces the total energy consumed in the building by 30 % and the use of artificial lighting by 55 %.

Figure 16 the Esplanade Theatre inspired by the skin of Durian fruits

Source : pintrest.com

Also in Singapore, the design of the ArtScience Museum was inspired by the lotus flower Figure 17.The special arrangement of the petals that make up the building makes it possible to recover rainwater for recycling and allows natural light to enter in several directions thus reducing the use of artificial lighting

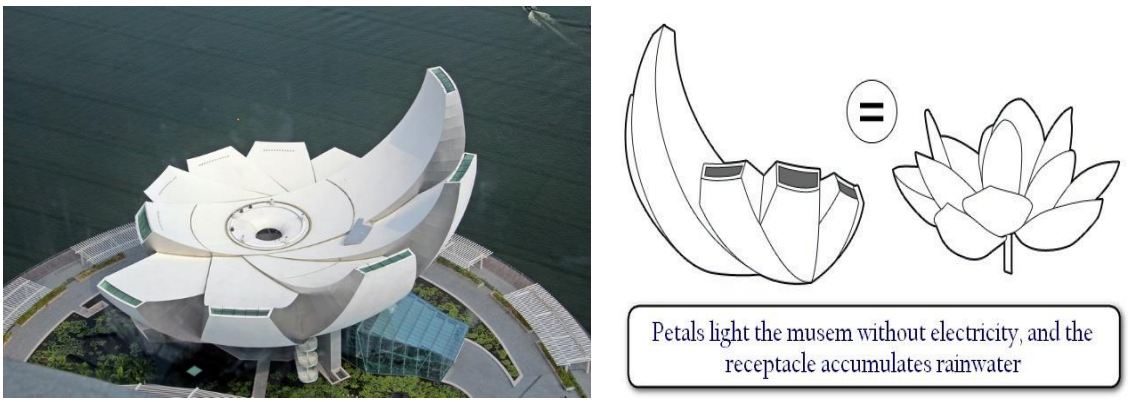


Figure 17 the Artscience Museum inspired by the lotus flower.

Source : http:/homeklondike.site

2. Behavior level :

The behavior level corresponds to a biomimicry of process or function. It is a question of observing how nature does to "realize a function" in order to imitate it. It is not the organism itself that is imitated but the way it behaves. The work of architect Mick Pearce perfectly illustrates the behavioral level of biomimicry. Its most notable building is the Eastgate Building in Harare, Zimbabwe. It is partly based on ventilation and temperature control techniques

observed in termite mounds in order to create a stable thermal environment inside the building (Figure 18). This passive ventilation system significantly reduces energy consumption. A comparative study conducted with six other buildings showed that the Eastgate Building uses 35 % less energy than a conventional building with air conditioning, an estimated savings of about $ 3.5 million over five years[21]

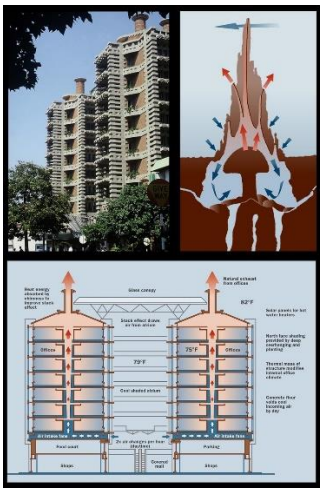


Figure 18 : The termite mound ventilation system.

Source : Illustration of Daniel Gallant/ foundry Zero

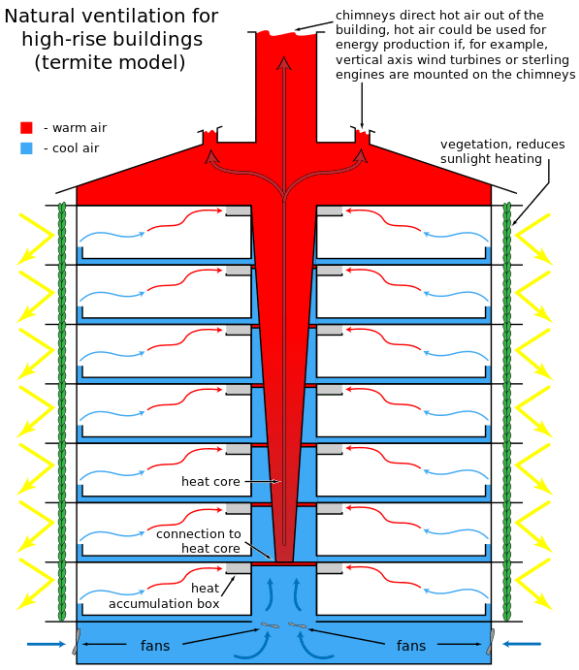


Figure 19 : : APPLICATION OF TERMITE MOUND OPERATION TO THE NATURAL VENTILATION OF the Eastgate Building.

Source : pintrest.com

[21] (Thebaud, 2016)

Other examples of architectural biomimicry at the behavioral level include the work of the architectural firm A. Bechu & Associés . The architects studied with biologists the thermal regulation system of emperor penguins and applied it to the design of the Skolkovo Innovation Center[22] . Just like penguins on an ice platform forming a circle to share their warmth, a hundred villas are grouped ten by ten in a vast clearing surrounded by a waterway.

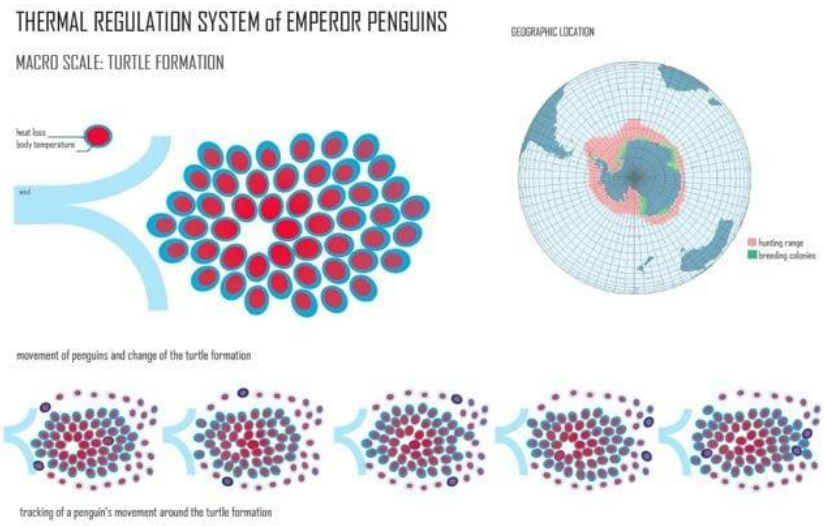


Figure 20 : thermal regulation of emperor penguing

Source : Asknature.org

Figure 21 : the Skolkovo Innovation Center

Source : Agence d'Architecture A. Bechu & Associés

[22] (Bechu Anthony, 2019)

3. Ecosystem-level :

The ecosystem-level corresponds to a biomimicry seeking to imitate ecosystems present in nature. It is about understanding how the relationships between species and their environment produce an ecosystem that is stable over time and therefore sustainable. Indeed, in nature, all waste generated by animals and plants is a contribution to other animals and plants. A building that could mimic this natural process could function autonomously and sustainably.

There are several cases of imitation of nature at the ecosystem level, but the city of Kalundborg in Denmark[23] as the first example of industrial symbiosis, is a perfect illustration Cooperation, recycling, and exchange of material or energy flows have allowed companies based in the industrial park to minimize their environmental impact by improving their productivity. On a similar principle a Californian company, ReGen Villages, created by lecturer searchers from the University of Stanford, has partnered with a Danish architecture firm EFFEKT10 to design a 100% ecological village in Holland. This village, whose construction began in 2016, will operate in a closed circuit and will be completely autonomous and environmentally friendly. It will be able to produce its own energy, its own agriculture and even recycle its waste.

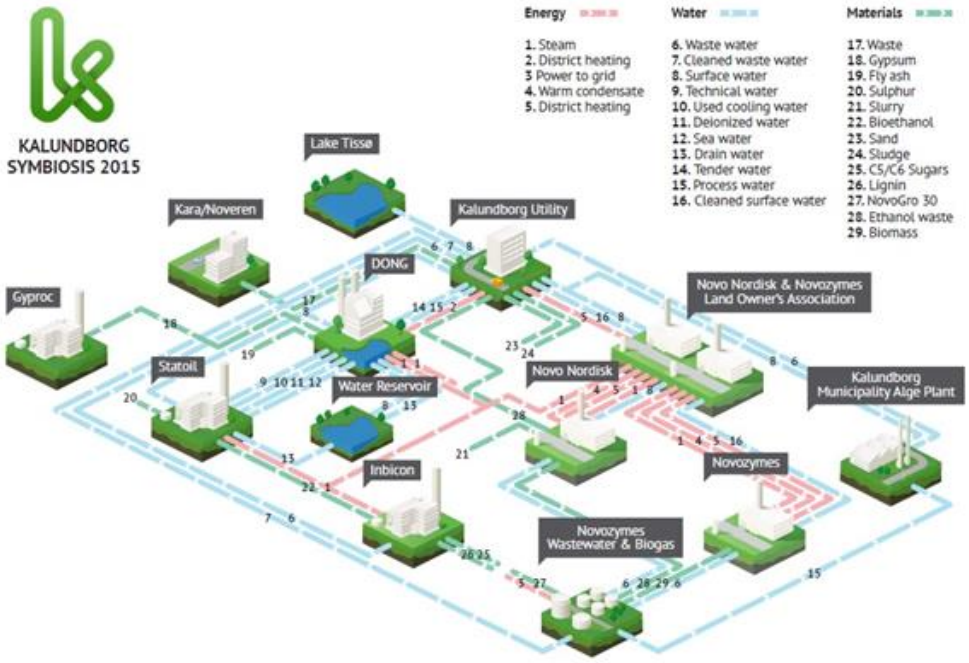


Figure 22 : the industrial ecology of the city of Kalundborg, copenhagen

Source : (Gulipac, 2016)

[23] (KALUNDBORG, 2016)

Biomimicry is considered here as a way to increase the sustainability of an architectural project. Mimicking principles of an ecosystem can be incorporated into the design from the earliest stages of design and used as an assessment tool throughout the design process as described in the Biomimicry Charter 2007 and in Zari (2007).

Regardless of the level of implementation of biomimicry, there are strategies frequently observed in nature that are the basis for the persistence of ecosystems. These strategies are to be considered when applying the biomimetic approach in an architectural design process.

The framework of biomimicry in architecture: The examples presented in the previous section show that the method traditional in architectural biomimicry is an interdisciplinary approach combining biology and architecture. This method, originally called "Bau-Bionik", was invented in 2003 by the biologist Werner Nachtigall and an architect named Göran Pohl.

As a result of combined efforts between the two disciplines, the method translates the principles of what can be used to compare nature and architecture. But the main question that arises is how biology can be used as a source of inspiration and how to translate it into architectural solutions.

The problem is that nature cannot be directly copied. Care must be taken not to interpret too directly[24] . Nature's inspirations for architecture do not work if they are not properly abstracted through interdisciplinary work. Nachtigall defines the biomimicry approach to architecture and design as a three-step process: Research → Abstraction → Implementation[25]

By observing the cognitive process of biomimetic design, identification and abstraction are the main and most difficult steps in a biomimetic project There are two difficulties, for an architect, that we define by two transitions: 1. What to look at in nature? and 2. How to interpret the principles of nature into a design task ?

Figure 23 distinguishes in the process two transitions and three main sections: the search for the biological basis, the abstraction of the results and the implementation in design and technology.

The two transitions of biomimicry in architecture: identifying /Interpreting and Abstracting / Transferring the strategies of nature in design.

[24] (Göran Pohl, 2015)
[25] (Fayemi, 2014)

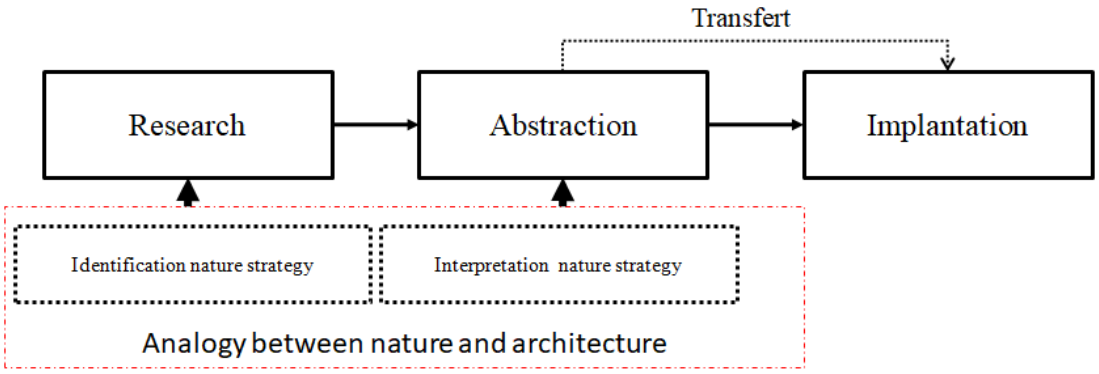


Figure 23 : the transition of biomimicry in architecture

In view of these two transitions, it is possible to distinguish two postures of use of biomimicry in architecture: an indirect posture, in which the architect reuses innovative tools, resulting from biomimetic work, generally in computer science, and a posture in which the architect directly integrates a biomimetic activity in his architectural design process.

7. Indirect biomimicry in an architectural design activity:

In several bio-inspired architectural design activities, architects build design methods for themselves giving rise to forms and technical processes that can be completely different from what is found in nature. These design methods are generally based on computer techniques, such as particle systems, genetic algorithms, or multi-agent systems whose functioning is bio-inspired.

Bio-inspired computing is a field of research that breaks down into subfields including connectionism, social behavior and emergence. It is close to artificial intelligence or artificial life, and related to the fields of biology, computer science and mathematics. Briefly, it is about creating innovative algorithms to solve known problems, such as optimization problems, for example, inspired by phenomena observed in nature.

8. Direct biomimicry in an architectural design ACTIVITY:

The case presented below, unlike the previous one, presents a direct collaboration between the architect and the biologist. The collaborative design activity consists in designing technical forms or processes by transposing natural forms or natural technical processes into the architectural technical form or process

Direct biomimicry seems to be able to lead to innovations, but its use in architecture nevertheless poses great difficulties because collaboration with biologists is necessary and the maturation time is long. What is conceivable in the industry to manufacture a new product is much less so in architecture, given the generally limited time allowed to design a project. However, as the industry has developed tools to support biomimetic design processes

Conclusion:

The aim of this chapter was to present a state of the development of biomimicry in architecture and to show its potential in terms of innovation. We described the methods usually proposed for biomimicry and, based on case studies, showed that there are several possible postures for designing bioinspired architecture: an indirect approach in which the architect reuses tools designed with biomimetic methods, and a direct approach in which the architect participates in a biomimetic activity in collaboration with biologists. The latter posture seems to be more capable of producing innovation in architecture.

Chapter 03: Processes and Methodology

Introduction:

This chapter will give the theoretical background needed to understand the implementation. The first section will define the biomimicry elements and the processes of the literature review and it will take a look at bioclimatic element and the link between the biomimicry and bioclimatic architecture. The second section will present the study case and the most information related to our choice of the study case and the measures that have been token in order to study the elements

The third section will be the observing nature and try to learn trying to understand the link and the steps that have been used in the study case

1. Methodological processes:

This section will explain what the processes of modeling and simulation are, and motivate why there is a need for them. It will also look at what options there are for generating simulation code

At the conception of a project, architect must take consideration of many elements and make sure to make a comfortable project. In order to make the architect use simulation software to facilitate their work and by studying other science like biology and technology and looking to nature

2.1. Bioclimatic elements:

We are going to identify the principles elements of biomimetic architecture by the measurements that had been token with the study of the material that been used

2.2. Biomimetic elements:

In order to identify the principles elements of biomimicry architecture and its philosophy and to understand better this methodology, with the book that had been consulted and the simulation that will be used we are going conclude the biomimetic strategies that been used

And visiting and observing nature in order to learn from it determine the elements used near us (case of study vernacular architecture)

3. Case of study

Traditional architecture is a testament to the diversity of cultures and ways of life. It is transmitted from generation to generation, it is specific to a community, a region, a country. We have much to learn from this architecture that reveals the ingenuity of men to adapt their habitat to their climate, their environment, and their way of life. Today the traditional habitat is recognized as a testimony value of the past, heritage to be preserved and transmitted.

Traditional Kabylia architecture represents the knowledge and know-how of our ancestors and the human-nature symbiosis, which allowed them to survive and adapt to a hostile nature, from which they made their first source of life.

Kabylia villages have become urbanized, the rural aspect has dissipated, local materials have been replaced by concrete, brick and steel, which are industrialized materials and which attack the natural landscape.

Figure 24 Kabyle village

Source : the author

3.1. Presentation:

The house has a bipartite division in length and bipartite in height, with tripartite division. This internal division is generated by a squat wall that divides the room in the direction of width. This inner wall starts from the wall opposite the entrance and stops about 1 m from the door.

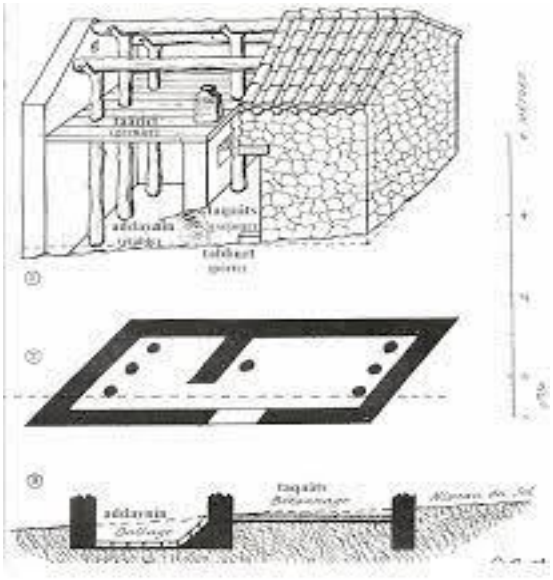


Figure 25 Kabyle house

Source : pintest.com

The dimensions vary, depending on the means of the family, in surface [(3 to 4 m) x (7 to 12 m)] and in height from 2.50 m to 3 m below the ridge.

3.2. Situation:

It is located on the highest ridge of the municipality of Beni Ksila at an altitude of 670 m. It was founded around the beginning of the 1500s and occupied until 1989 and has an area of 12.82 hectares.

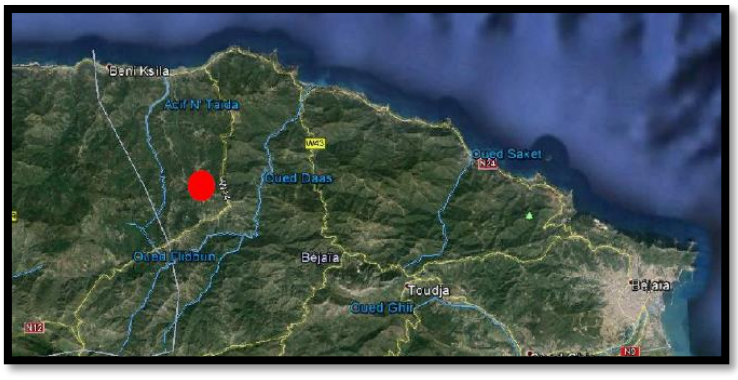


FIGURE 26 : DJEBLA SITUATION

Source : google Earth

3.3. Justification:

Algerian architects do not take nature as a concept or learn from it even thou with all the technology and the development. So, the only thing to study is the vernacular architecture used by our ancient cause they were looking to nature and learning from it because they had no other thing to learn from it and by using local material and adapting to nature

3.4. Plan and facades:

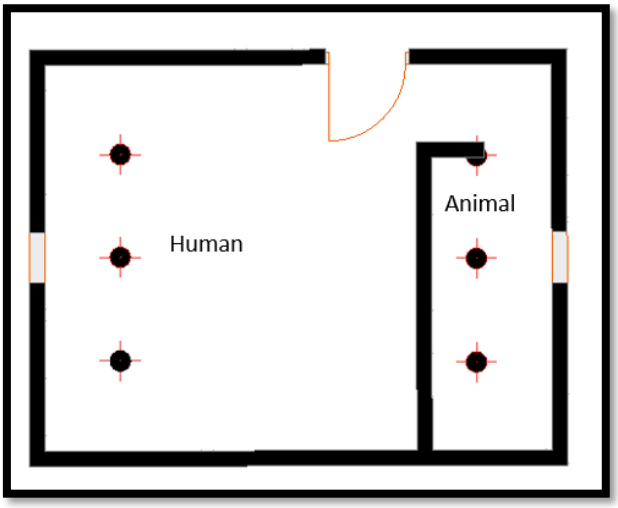


Figure 27 Kabyle house plan

Source : the author

FIGURE 28 : VIEW OF SUCCESSIVE FACADE OF DJEBLA

Source : the author

FIGURE 29 : FACADE IMAGE OF KABYLE HOUSE

source : the author

4. **Measure**:

Measurement of illuminations:

Measurement campaigns were carried out under clear skies during the winter and as well as the summer period at three distinct times of the day namely 10: 00 am , 12: 00pm , and 02:00 pm . Since the exhibits occupy all the houses, it is, therefore, fair to measure the horizontal illuminations for the space of working inside the house.

sadly, we couldn't do all the measures in a short period and the cause of the site was tourist village and cause of covid 19 I had only a change to go for one visit and take the measure and maximum information that can be gotten

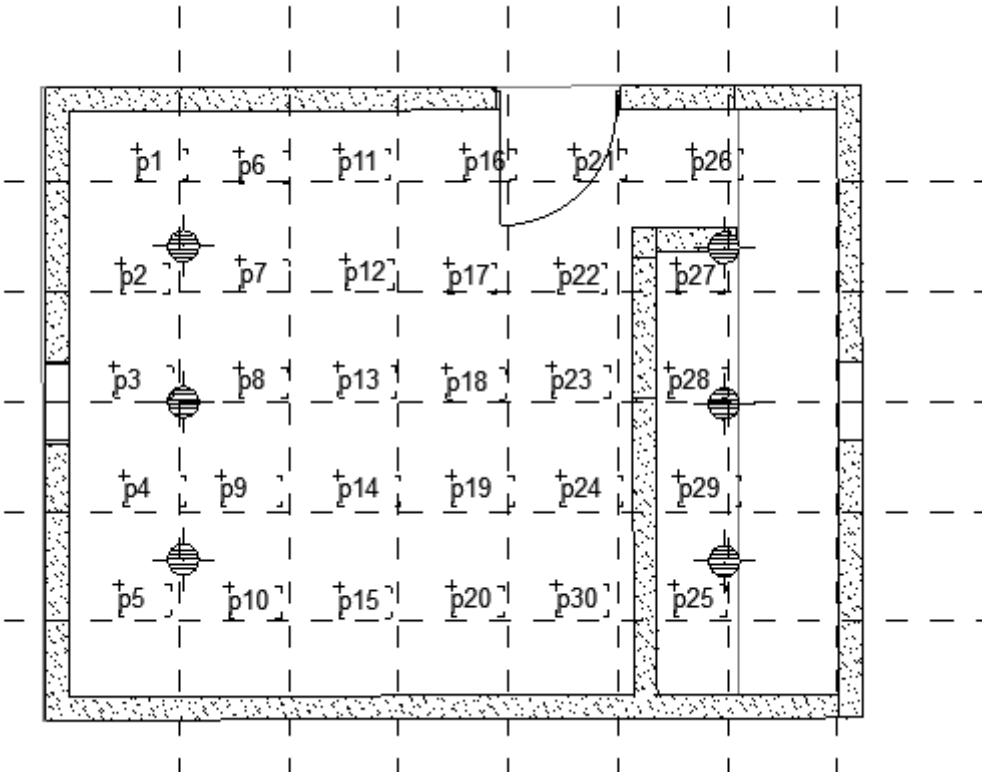


FIGURE 30 : THE MESH MODEL OF KABYLE HOUSE

Source : the author

The Figure above shows the mesh model used for the distribution of the different measurement points. There are 30 points (P1, P2...P30) that cover the entire house surface, three of these points occupy the central part of the room and the others occupy the perimeter about 0.7 m from the wall.

The result:

The 17th of May 2021:

At 10:00 AM

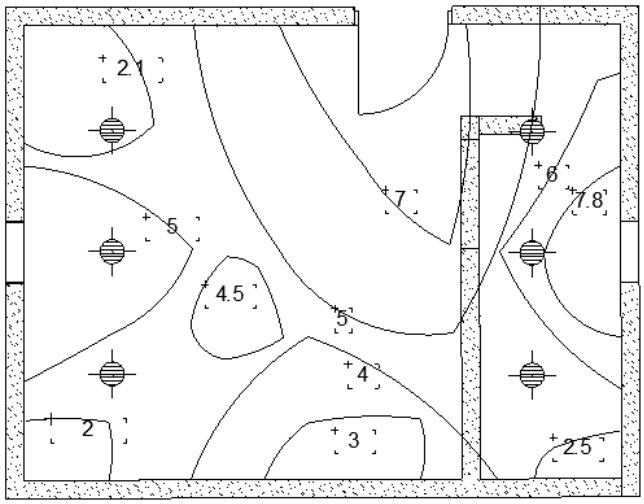


FIGURE 31 : RESULT OF MEASURE 17TH MAY AT 10:00 AM

Source author

At 12:00 PM

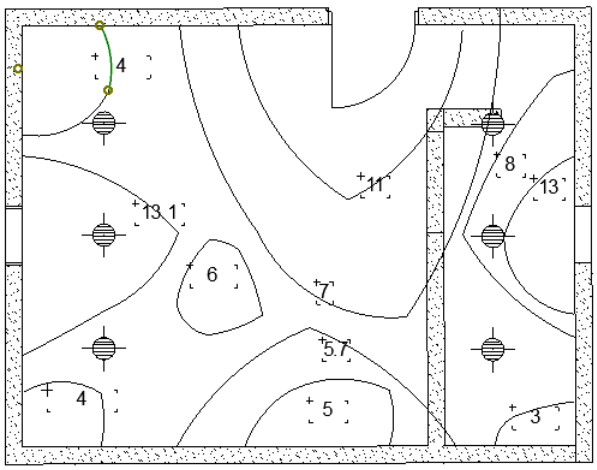


FIGURE 32 : RESULT OF MEASURE 17TH MAY AT 12:00 PM

Source : the author

At 04:00 PM

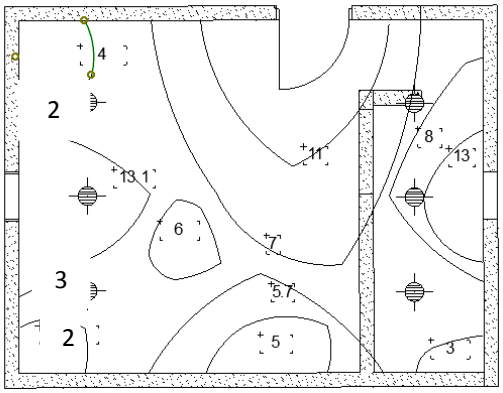


FIGURE 33 : RESULT OF MEASURE 17TH MAY AT 04:00 PM

Few pictures of natural lighting:

FIGURE 34 : NATURAL LIGHTING IN KABYLE HOUSE

Source : the author

The results acceptable according to natural lighting

All these data allow us to have a quantitative appreciation of the natural light that illuminates the house. Indeed, these numerical results reflect in real-time the performance of the light device. However, a purely quantitative approach alone would not be sufficient for the purposes of our research, which is why other methods absorbing and material studies

5. Bioclimatic and Biomimicry elements:

Bioclimatic elements are:

Vernacular architecture was always been a source and a study case of bioclimatic studies in material studies and ventilation system heating gains and cooling system

Biomimetic element:

Looking to nature and learning from environment and the things that surround them

6. Conclusion:

By visiting and observing nature we tried to abstract what we saw and wat we felt thinking about biomimetic and bioclimatic architecture in a time of our ancient

Image	Biomimicry inspiration	Bioclimatic element
 FIGURE 35 : LOCAL MATERIALS Source: author	Taking a standing tree as source inspiration  FIGURE 36 : TREE INSPIRATION Source : google image	Using local material with no energy effecting nature and taking it from nature
 FIGURE 37 : KABYLE ROOF MATERIAL Source : author	Inspired by the leaf of the trees and how animals get covered  FIGURE 38 : INSPIRATION FROM NATURE Source : Google image	Local material Sun protection system
 FIGURE 39 : LOCAL STRUCTURE FOR KABYLE HOUSES Source : author	Inspired by trees and birds at the same time  FIGURE 40 : BIRDS NUTS Source : the author	Local material Winter and summer protection

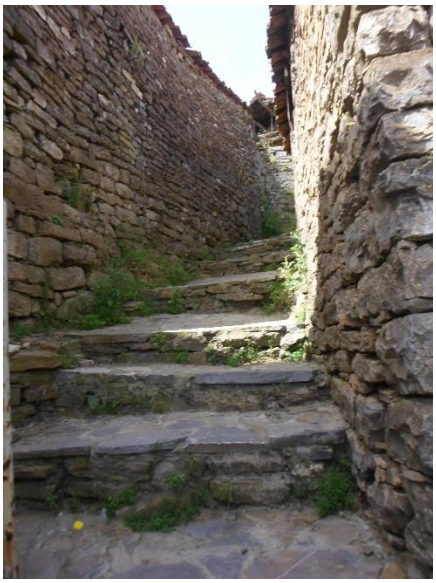
 FIGURE 41 : LIGHTING SYSTEM IN KABYLE HOUSES Source author		Ventilation system Cooling system Lighting system
 FIGURE 42 : SIMPLE LOCAL MATERIAL USED Source : author		Local materials Adapting to the site No energy lost

TABLE 1 : CONCLUSION TABLE OF THE MEASURE

Source: the author

chapter 04: simulation

1. Introduction:

Digital simulation has become a reliable and very important tool in the design and planning of any lighting project.

The software that will be used is quite complete and very efficient. Of course, the purpose of this research is not the design, but the verification of an already existing device.

Our actions are to take the biomimicry element and bioclimatic element

The utility of this software lies in the fact that it allows us to simulate the natural lighting of the study case and the energy needed. This will allow us, after comparing the results, to know whether bioclimatic strategies and biomimetic inspiration had been using by our ancient.

For this simulation, the day of measure May 17th 2021 take and the longest day of the year march 21st , June 21st and September 21st

2. Choice of simulation:

In order to do natural lighting studies and energy building needs we used Archwizard to get efficient result and to confirm the studies of the previous chapter

3. Processes of simulation:

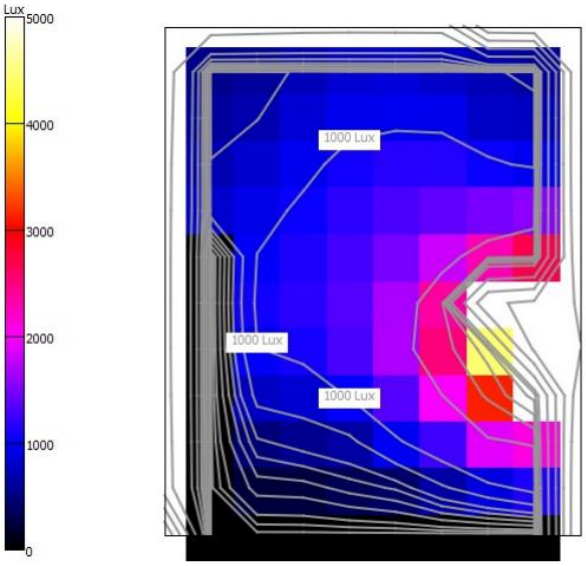
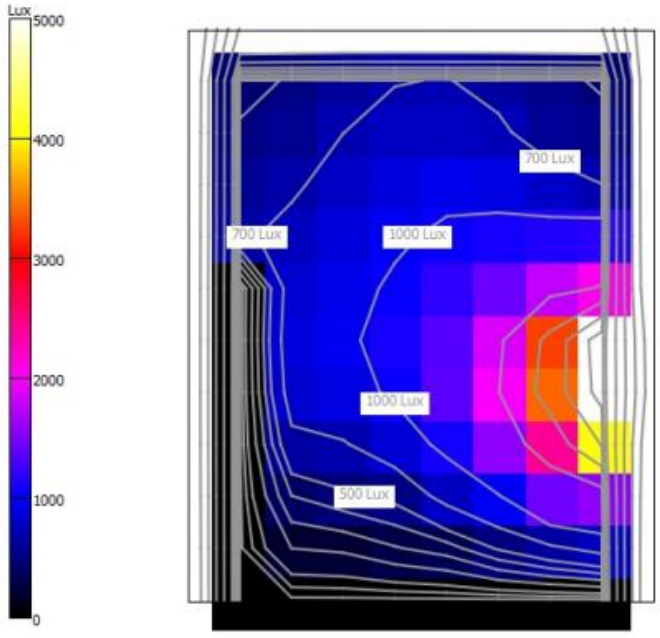
This section will deal with the green building key features available in AW Bioclim

Steps of simulation:

1. Importing a 3D model in a bioclimatic environment;
2. Assigning bioclimatic data to a model;
3. Optimizing daylighting and Solar gains;
4. Minimizing the thermal energy “needs”;
5. Quickly interpreting the building’s bioclimatic performance with relevant indicators.

SIMULATION RESULT :

The May 17th 2021 :

At 10:00 AM	 Figure 43 simulasion result for may 17th 2021 10:00 am Source Archiwizard
At 12:00 PM	 Figure 44 simulation result 12:00 pm Source Archiwizard

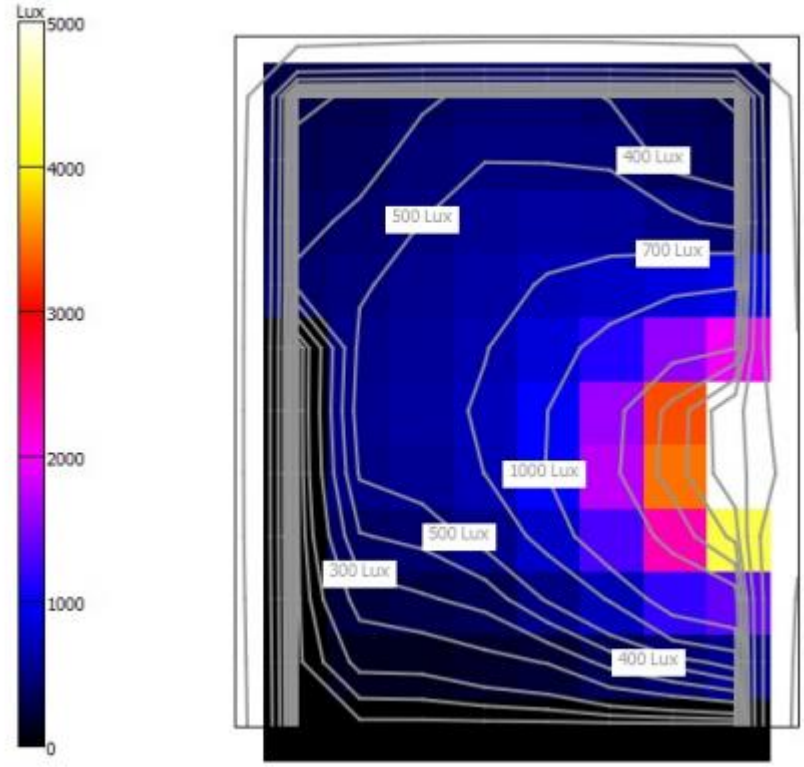
At 04:00 PM	

Figure 45 simulation result of May 17th 04:00 pm
Source Archiwizard

Table 2 : result of simulation of May 17th 2021

Source the author

The result are almust similure to the measure that had been taken (defrence of 10%) in each of point

Simulation :

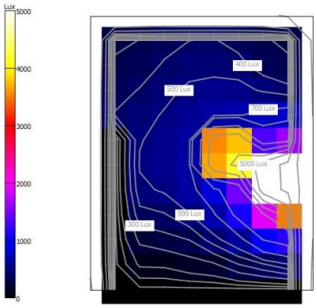
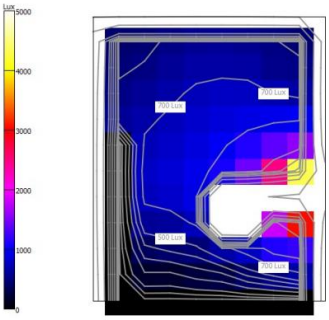
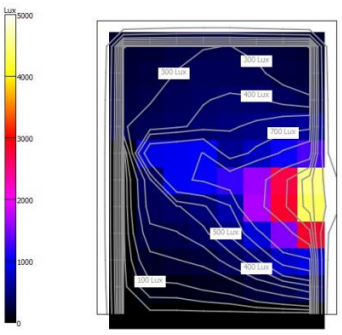
Time	March 21st	June 21st	September 21st
8:00 AM			

FIGURE 46 : SIMULATION RESULT OF MARCH 21ST 08:00 AM
Source : Archiwizard

FIGURE 47 : SIMULATION RESULT OF JUNE 21ST 08:00 AM
Source : Archiwizard

FIGURE 48 : SIMULATION RESULT OF SEPTEMBER 21ST 08:00 AM
Source : Archiwizard

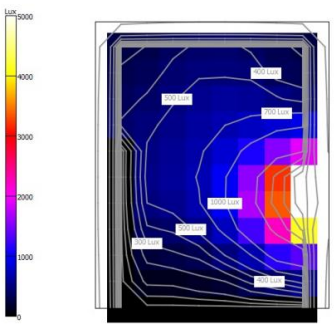
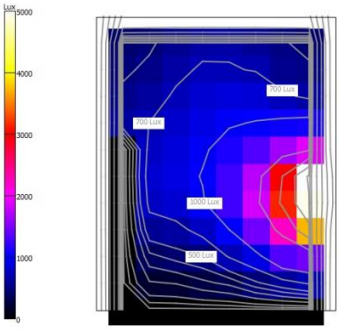
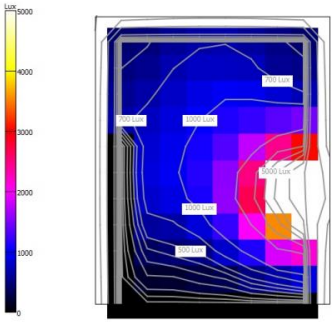
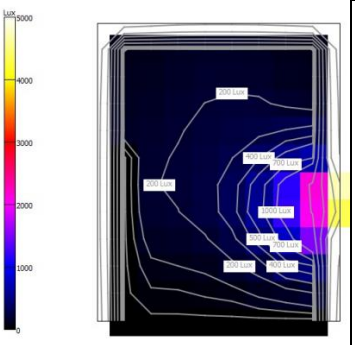
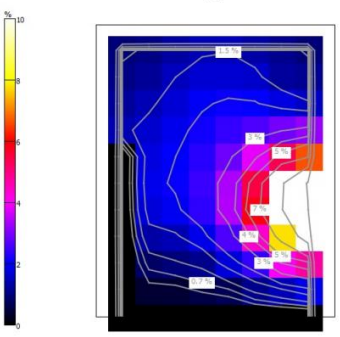
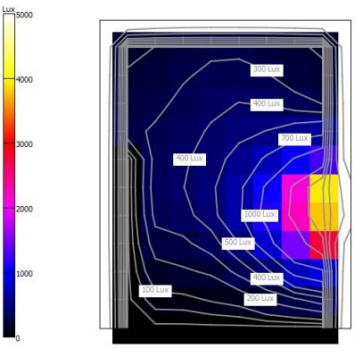
12:00 PM	 FIGURE 49 : SIMULATION RESULT OF MARCH 21ST 12:00 PM Source : Archiwizard	 FIGURE 50 : SIMULATION RESULT OF JUNE 21ST 12:00 PM Source : Archiwizard	 FIGURE 51 : SIMULATION RESULT OF SEPTEMBER 21ST 12:00 PM Source : Archiwizard
04:00 PM	 FIGURE 52 : SIMULATION RESULT OF MARCH 21ST 04:00 PM Source : Archiwizard	 FIGURE 53 : SIMULATION RESULT OF JUNE 21ST 04:00 PM Source : Archiwirad	 FIGURE 54 : SIMULATION RESULT OF SEPTEMBER 21ST 04:00 PM Source : Archiwizard

Table 3 : simulation results for March June September 21st

Source: the author

After this result we can say that in each season the vernacular house is a way lighting in a way that people can have their normal work and live their normal life

Energy need:

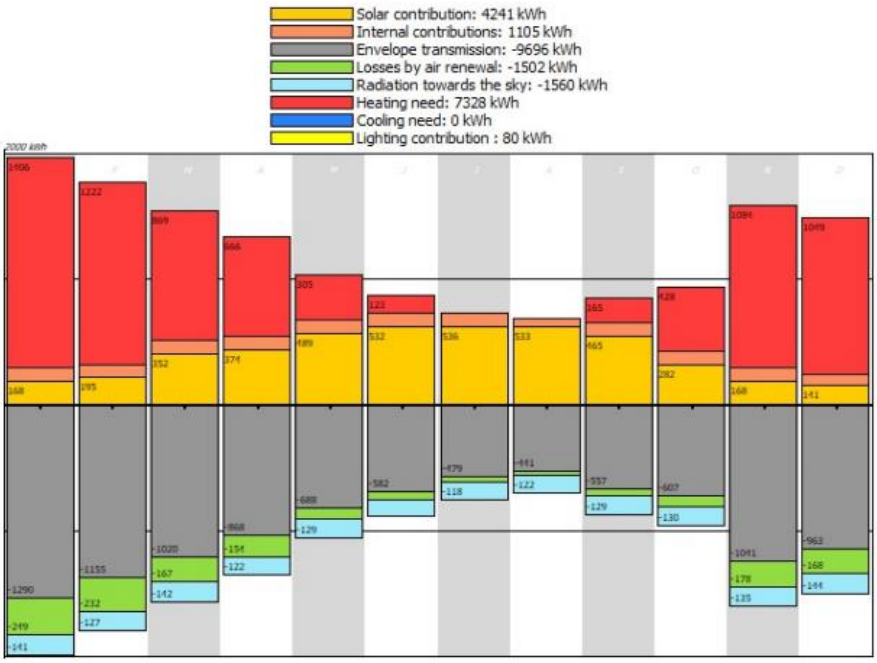


Figure 55 Building - Energy balance

Source Archiwizard

The figure Figure 55 Building - Energy balance shows us the energy needed by the house that are:

Total heating need : 7370 kWh : 326 kWh/m²

Heating need peak : 4742 W : 209 W/m²

Total cooling need : 0 kWh : 0 kWh/m²

The house is well oriented cause of that we have no cooling need over the year the only problem that it had was the heating system that had been fixed by using the Kanun which helps to warm the house during the winter and integrating the animal space into the house helped too

4. Recommendations:

THE USE OF ECOLOGICAL BUILDING MATERIALS:

- For large spans we offer glued laminated timber.
- For the other constructions we proposed the use of "Monomur" bricks which have a high durability.
- For the coating of buildings we have ecological paint.
- **WASTE MANAGEMENT, WASTEWATER, STORMWATER RECOVERY:**

FIGURE 56 : WASTE MANAGEMENT OF WATER

Source author

5. Conclusion:

The aim of this chapter was to confirm the result of the previous one and to prove that vernacular architecture in Algeria was inspired by nature and used bioclimatic strategies in its building .

suggest recommendations by studying the previous examples to apply in our project

Chapter 05: Project

1. Introduction:

Each architecture project was built and implanted by answering the following question

Why ? where ? and how ?

Our project is an aquatic center inplanted in Bejaia exactly Oued Zitouna in Aokas

WHY: the inexistence of aquatic center in Algeria

Where : Bejaia , Aokas , Oued Zitoune

How : after studying the site and taking its advantages we going to try to adabet bioclimatic architecture and biomimetic concept on it

2. Examples analyses:

2.1. Water cube :

National Aquatics Centre, the landmark building of Beijing 2008 Olympic Games, is located inside the Beijing Olympic Green. It is axially related to the National Stadium on the north part of Beijing Central Axis and reinforces the historical and cultural features of Beijing city. The National Aquatics Centre will be the venue for swimming, diving, synchronized swimming and water-polo final during the Olympic Games

2.2. Les Bains des Dock :

es Bains des Docks is an aquatic centre in Le Havre, France, designed by French architect Jean Nouvel. comprises 12 pools, including a 50 x 21 metre outdoor pool, several leisure pools, a sauna, hammam, spa and fitness room

Examples	Water cube:  FIGURE 57 : WATER CUBE Source : Pinterest	Les Bains des Dock :  FIGURE 58 : LES BAINS DES DOCK Source : Pinterest
Situation	China	France
General information :	•Project/facility type: Aquatic Centre. •Location: Beijing, China . •Commencement: 24 December 2003 •Completion: 28 January 2008, •Owner: Beijing State-owned Assets Management Col, Ltd. •Building Size: 177mx 177mx 29m high. •Project cost: US$1 250 000 million. •Architect: PTW Architects with China State Construction International Design Architectural Design and internal planning. •Engineer: Arup with China State Construction International Design	• Name : les bains des docks. • type of equipment: inter-municipal aquatic complex. • Location: france, le havre▪ • Client: community of the agglomeration havraise (codah) • Project manager: the architect: jean nouvel • Monitoring the project: urban planning agency of the region of le hav • ▪The work period: started in 2004 and will open to the public in july 17, 2008 • Inspiration: the roman baths • The role: an element for leisure, sport and therapy • Surface: 5000m²
The reason of choosing the example	Case study is chosen according to the following criteria: 1- Building known for its intelligence, and made a leap in history of buildings. 2- Building covers the three eras of Smart Architecture generations 3- Buildings have already been implemented	Case study is chosen according to the following criteria: 1- Building known for its simplicity and its spaces 2- Building covers the three eras of Smart Architecture generations 3- Buildings have already been implemented.
Advantage	The advantages of this biomimetic approach at the environmental level are: • Energy costs reduced by 30% • Artificial light requirements reduced by 55% • Guebenhouse effet Project	The retained project concepts make "Les Bains des docks jean new": • Heated water inside and out allows the use of all pools in every season • . the basins themselves will be covered with white glass paste

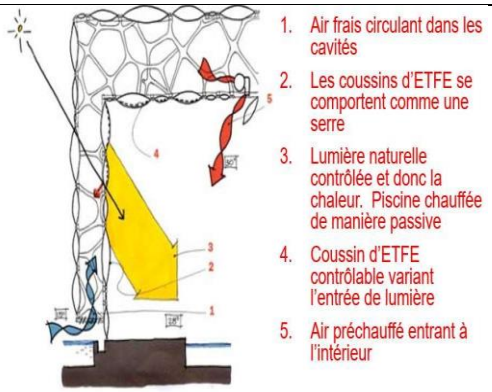
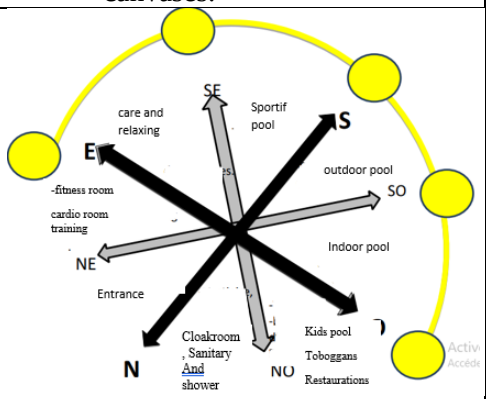
	• Transparent water experiment for screwsiters • Rainwater and recycled water collection using efficient filters and a backwashing system • The energy saved by means of ETFE is equivalent to covering the roof only with solar panels • 20% of solar energy is trapped and used for heat	which will react to light of the sun creating slight refractive effects • .set of openings cleverly making it possible to see certain interior spaces. • Jean Nouvel having been seduced by light and playing with colors, with lines and the volumes. • natural overhead lighting in all spaces creates a calm and soothing atmosphere. • All ceilings are fitted with an acoustic system consisting of false ceilings in stretched canvases.
Conclusion	 FIGURE 59 : WATER CUBE AIR TREATMENT SYSTEM Source : archidaily.com	 FIGURE 60: LES BAINS DES DOCK Source : author

TABLE 4 : TABLE 4 : TABLE OF ANALYSING EXEMPLES

Souce : author

3. Program :

Our program isn't an official program it's a conclusion of exemples analysis and a book in a name :" concevoire et conctruire un centre aquatique" by : Flavien Courtoi

	Sub space	**Surface**		**Area Total**
Reception	Reception hall	Reception	200 m	480
		Sanitary	30 m	
Coordination		Diresctor's office	30m	
		Office secatery	30m	
		Office	80m	
		Sanitary facilities M/F	60m	
		Printing and photography	18m	
		Archeive	20m	
Interior pools		Gathering space	100m	1095
		Personal changing rooms	70m	
		Anti doping area +doctor	80	
		Doctor +treatement room	80	
		Message room	45	
		Sanitary M/F	20*3	
		Pool 1	525	
		Pool 2	125	
		Maintenance equipment room	30	
Heath care	Tier	Fitness room	170	610
		Cardio-training room	100	
		Showers	20*2	
		Care erea	100	
		• hair salon	100	
		• Gym	100	
Thecnical	Local thecnical	Generator	34m	144
		Technicien workshop	13	
		Public storage	30	
		Water treatement and boiler room	45	
		Air conditioner	22	
Exterior pools	Discovery part	Baby swimmming pool + children with water games	250	1630
		Adult pool	650	
		Pool with slides and penta slide	300	
		River slowing	200	
		Air traitements	30m	
		Product storage	30m	
		Water treatement	50m	
		Air conditioner	30m	

		Technician workshop	16m	
		Food storage	30	
Parking			600	

Total built : 5195 Total space 5795

TABLE 5: PROJECT SURFACE

Source : author

4. Site analyze:

1. Choice of the field of intervention:

The choice of the city of Bejaïa was not made in a haphazard way. Indeed, Bejaïa conceals certain tourist potentialities, it is considered among the cities most visited by the tourists in Algeria, thanks to its strategic geographical situation, its diversified natural resources.

Our intervention site situated at Oued Zitouna exactly at which is located in the town of Aokas which is a small-town rich in natural tourist resources. Indeed, the ZET in question enjoys several advantages including:

- It is located on the outskirts of the city at a distance of 2 km from the city center.
- Accessibility from the national road N °: 09.
- Panoramic views over the Mediterranean Sea and the mountain range.
- Its location in a tourist town, which has golden beaches
- And surrounded with beautiful mountain

2. Situation :

2.1. Location

In a small town of Aokas is located about 30 km from Bejaïa, it is connected by a road artery which, for its importance and for the lack of alternative roads, results to be of very great traffic. The journey time, starting from Bejaia airport, is approximately 15 to 20 minutes and is carried out very easily.

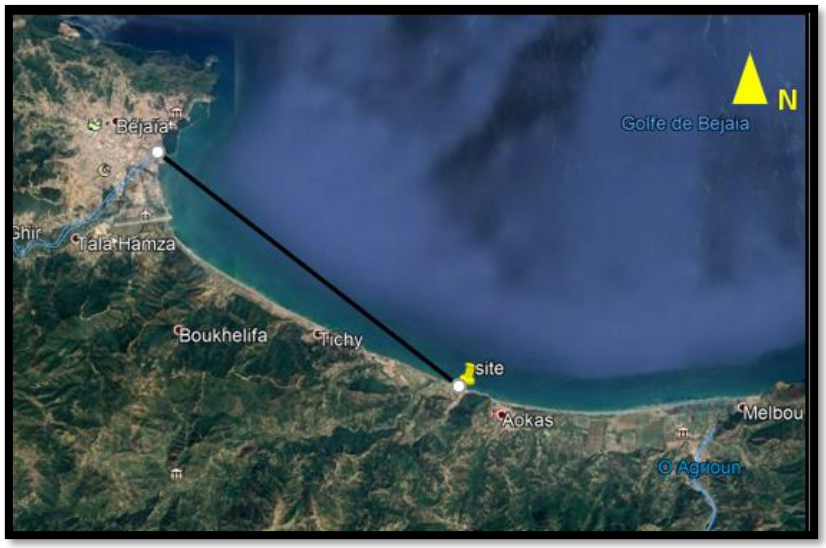


FIGURE 61 SITUATION

Source google Earth

2.2 Site location and the limit:

The site is located west of the town of Aokas, 2 km from the town's capital.

With 40000 m^2 surface

Limited as follows

To the North by: the Mediterranean Sea.

To the south by: the national road N ° 09.

To the west by: comping zone.

To the east by: sea breeze of Aokas

Figure 64 : site environment

Source google Earth

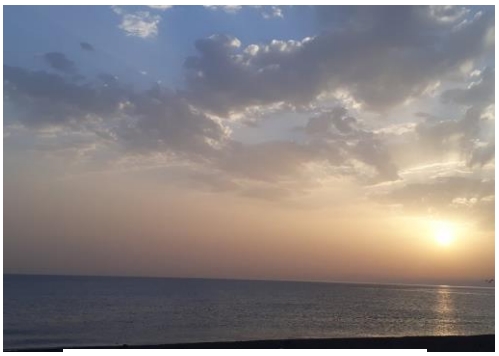


FIGURE 62 : SITE LIMIT NORTH MEDITERRANEAN SEA

Source : the author

FIGURE 65 : SEA BREEZE OF AOKAS

Source : the author

FIGURE 66 : COMPING ZONE

Source : the author

FIGURE 67 : THE NATIONAL ROAD N ° 09

Source: author

2.3. site analysis :

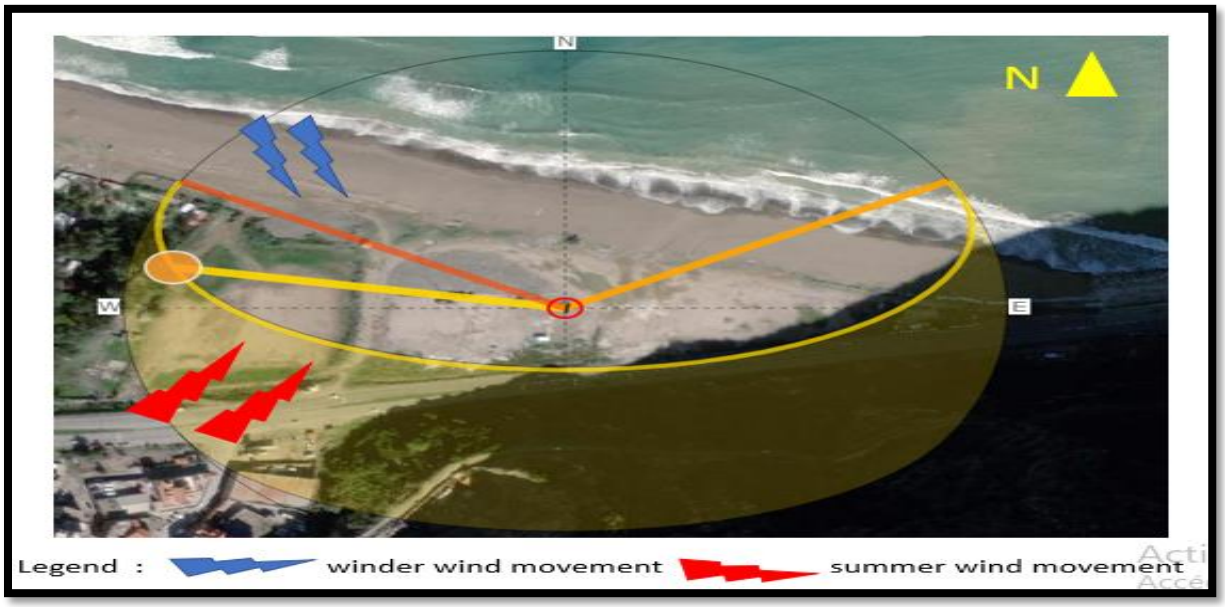


FIGURE 68 : SITE STUDY

Source : the author

Figure 69 site limit

Source google Earth

2.3 topography:

le terrain est de faible pente de 2%

FIGURE 70 : TOPOGRAPHY

Source google Earth

3. Strength and weaknesses:

Our site is located in a strategical place where you can get beautiful views of nature sadly here in Algeria unbuild places aren't well treated

<table>
<tr><th>Strengths</th><th>Weaknesses</th></tr>
<tr><td> 
FIGURE 71 : SUN RISE VIEW
Source : the auther</td><td> 
FIGURE 72 : THE MISTREATING OF THE SITE
Source : the author</td></tr>
<tr><td> 
FIGURE 73 : SITE VIEW
Source : the author</td><td> 
FIGURE 74 : THE UNPLANNING OF EQUIPMENT
Source : the author</td></tr>
<tr><td> 
FIGURE 75 : SITE VIEW
Source : the author</td><td> 
FIGURE 76 : UNCLEANING AREA
Source : the author</td></tr>
</table>

TABLE 6 : STRENGTHS AND SITE WEAKNESS

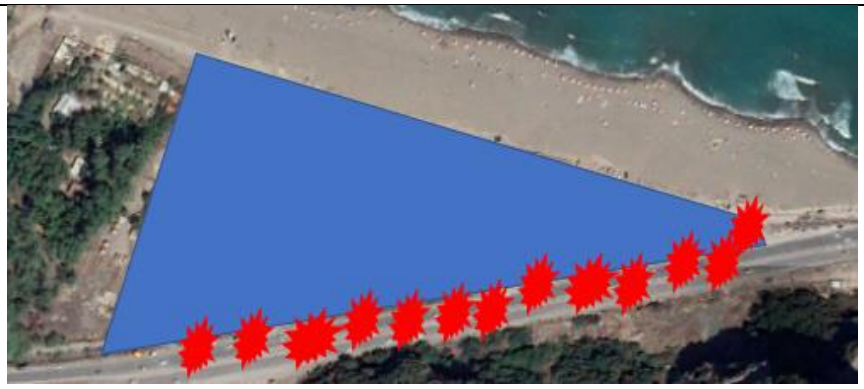
Source : the author

Project display:

The objective of this work is to propose an aquatic center where nature will be taken as source of inspiration by using biomimicry concept and bioclimatic strategies that will help the promotion of tourism in this region by attracting the important flows of national and international tourists. Everything, taking into consideration the respect and preservation of the environment.

5. project ideas:

the idea was emplaning to the site and getting inspiration by the nature and the environment of the site

Steps	Ideas
1 : avoiding the noise caused by the road N9	 FIGURE 77 : SITE Source : author
2 : the axes North to better	 FIGURE 78 : THE AXES PROJECT Source : the author

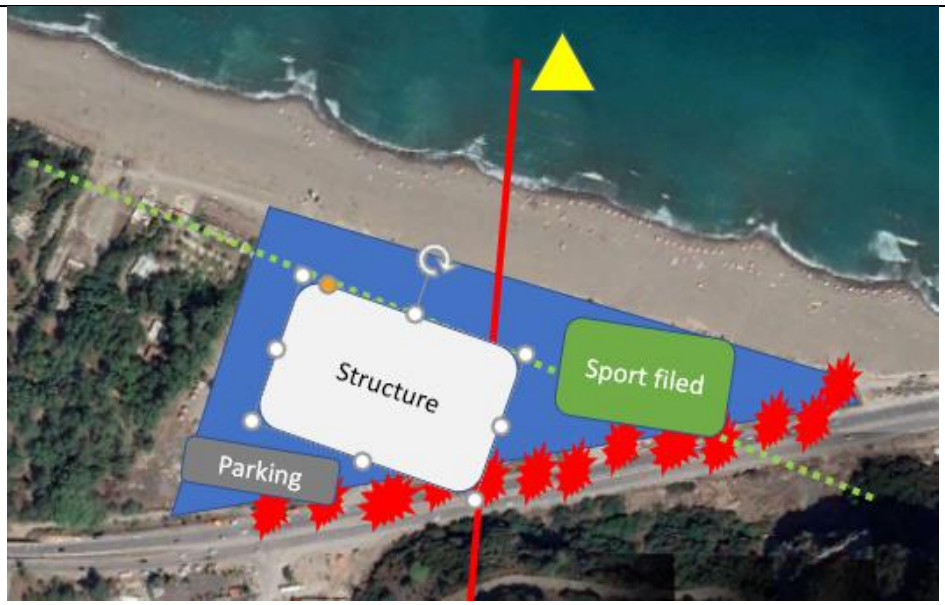
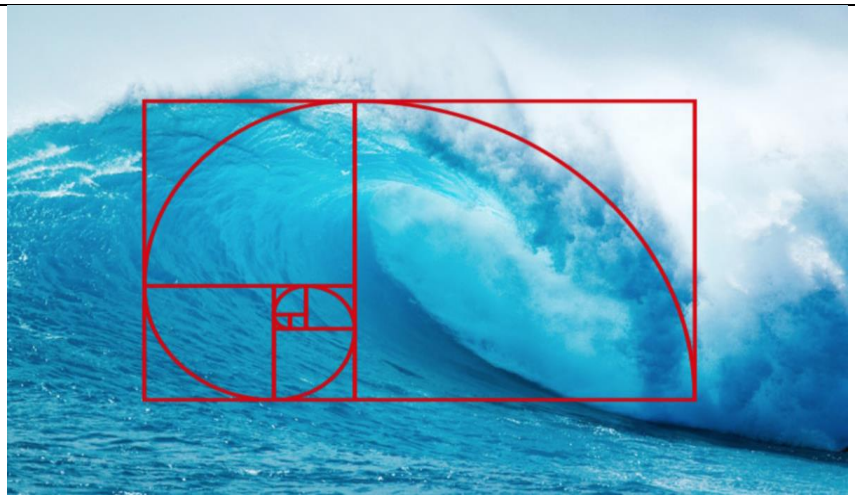
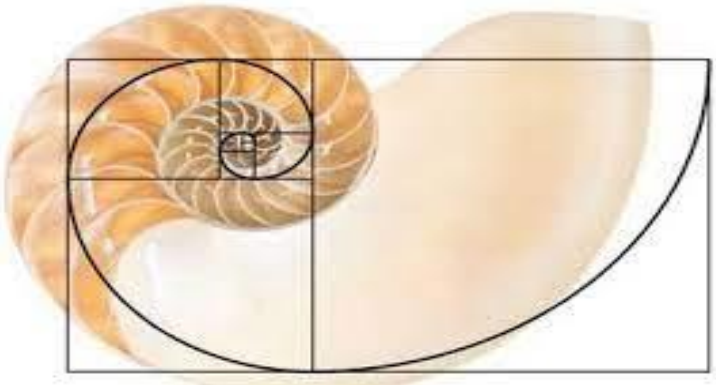
3 :borders of 100 m	
4 : golden ratio	
5: shells nautilus	

FIGURE 79 : SITE BORDERS
Source : the author

FIGURE 80 : GOLDEN RATION
Source : google image

FIGURE 81 : SEE SHELL
Source : Pinterest

TABLE 7 : PROJECT IDEALIZATION

Source : the author

Getting nautilus shape 3d is our biomimicry direct memicing the form and our project will be based by its nature and water and self heating system

The 3d estimation:

FIGURE 82 : PROJECT 3D

Source : the author

General conclusion

General conclusion

General conclusion

Biomimetic architecture is an architectural design trend that can lead to innovations to design a sustainable built environment which is the main use of bioclimatic architecture. Several international architectural projects successfully prove the feasibility and possibility of designing sustainable architecture by applying architectural design principles

The relation between biomimetics and bioclimatic is the goal of our thesis is:

the possibility of designing a biomimetic architecture with bioclimatic strategies specific to a humidity region such as Bejaia

Research and study possible ways to improve the architectural design of any project facilities in Algeria.

The structure of this work is based on three parts: theoretical research and practical or analytical research.

1-Theoretical research that contains theme chapters bioclimatic architecture and biomimetic architecture first study the bioclimatic strategies and principles then biomimicry and its the 3 levels of desining (Organism Level. Ecosystem level), Then the stages of biomimetic design with notable examples of this type of architecture.

2-practical or analytical research: This contains a study of vernacular architecture in Algeria to have its results and its use of biomimicry and bioclimatic strategies In another chapter, we did a simulation study on the example to better understand nature and human links that been used in vernacular architecture

3- analytical studies on the examples of cultural centers to have design standards and a planar program.

In the end, it was concluded that biomimetic concept and bioclimatic architecture are working with each other adapting to nature and learning from it both are taking nature as the first step of research

designing an aquatic center by adapting biomimicry and bioclimatic architecture in a Mediterranean area like Bejaia but in:

- Consideration of climatic conditions and environmental resources of Mediterranean regions by adapting bioclimatic strategies in Bejaia

General conclusion

- the study of the physical environment of the regions by making the right choice of the idea affecting not only the form of the project, its relationship with the immediate environment, and the requirements of an aquatic center can successfully design a building that can attract public attention

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General conclusion

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RÉSUMÉ :

Dans notre travail, nous étudierons la relation entre l'architecture biomimétique et l'architecture bioclimatique. L’architecture bioclimatique est d'adapter le bâtiment à l'environnement pour un meilleur confort et minimiser les utilisations énergétiques et dans une architecture durable, en apprenant de la langue vernaculaire et en le prenant comme une meilleure source d'adaptation à la nature

Le biomimétisme inspire l'innovation dans différents domaines. Il a un impact significatif dans le domaine de l'architecture, où il peut conduire à des innovations pour concevoir un environnement bâti durable. L’architecture est influencée par de nombreux aspects des sciences naturelles et sociales. Parmi ces influences, l'inspiration de la biologie est actuellement dominante. Le cadre de la conception du biomimétisme a évolué et évolué vers différentes approches innovantes en grande partie en raison du développement de l'informatique et de son utilisation en architecture.

Mods clé : l’architecture bioclimatique, l’architecture biomimétique, la nature, confort, biologie, innovation

Abstract:

In our work, we will study the relation between biomimetic architecture and bioclimatic architecture. bioclimatic architecture is adapting the building to the environment to better comfort and minimizing the energy uses and into sustainable architecture, learning from vernacular and taking it as a better source in adapting to nature

Biomimicry inspires innovation in different fields. It has a significant impact in the field of architecture, where it can lead to innovations to design a sustainable built environment. architecture is influenced by many aspects of the natural and social sciences. Among these influences, inspiration from biology is currently dominant. The framework of biomimicry design has evolved and evolved into different innovative approaches largely due to the development of computer science and its use in architecture.

Keywords: bioclimatic architecture, biomimetic architecture, nature, comfort, biology, innovation

الملخص

في عملنا ، سوف ندرس العلاقة بين العمارة المحاكاة الحيوية والهندسة المعمارية المناخية الحيوية .حيث ان العمارة المناخية الحيوية هي تكييف المبنى مع البيئة من أجل راحة أفضل وتقليل استخدامات الطاقة وفي بنية مستدامة ، والتعلم وأخذها كمصدر أفضل للتكيف مع الطبيعة

المحاكاة الحيوية تلهم الابتكار في مختلف المجالات. لها تأثير كبير في مجال الهندسة المعمارية ، حيث يمكن أن تؤدي إلى ابتكارات لتصميم بيئة مبنية مستدامة. تتأثر الهندسة المعمارية بالعديد من جوانب العلوم الطبيعية والاجتماعية. ومن بين هذه التأثيرات الإلهام من الأحياء .الدي تطور في إطار تصميم المحاكاة الحيوية وتطور إلى أساليب مبتكرة مختلفة ويرجع ذلك إلى حد كبير إلى تطور علوم الكمبيوتر واستخدامه في الهندسة المعمارية.

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