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Presented and defended by:
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Theme: The Adaptive Envelope as an efficient thermal regulator in a hot and dry climate.

The project: A Business Center in M'Sila

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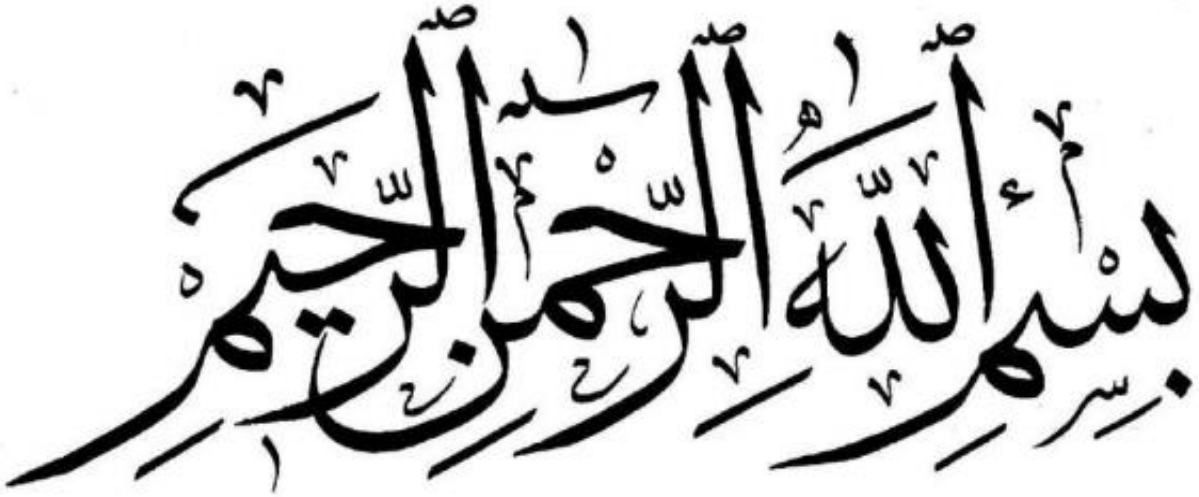
بسم الله الرحمن الرحيم

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From the bottom of my heart, I would like to thank my dear parents; my beloved mother and father, who have supported me throughout my academic journey.

I am also thankful to my dear brother and sisters. May Allah Subhanahu Wa Ta'ala protect them.

To my friends who shared all its moments with me in my university journey (yagoub dounia . Samir mehamedia).

I would also like to express my gratitude to my friend Oussama agoun.

DEDICATION

I dedicate this work:

To my dear parents,

To my beloved mother and my beloved father,

To my dear brother and my dear sisters.

Summary:

The world has witnessed a noticeable increase in awareness of environmental challenges, among which those related to the construction sector stand out, such as excessive energy consumption and increased environmental pollution. Buildings are recognized as major energy consumers, underscoring the urgent need for adopting sustainable solutions to mitigate negative environmental impacts.

This work aims to explore thermal comfort in buildings, encompassing their various characteristics, and highlight the importance of the architectural envelope in enhancing energy efficiency. It focuses on hot and dry climates, such as the climate of M'sila province, which shows a growing demand for cooling. Specifically, the thesis concentrates on improving energy efficiency through adaptive architectural envelopes and the use of evaporative cooling technology in business centers. This is achieved through a series of theoretical research including definitions and analyses of numerous studies, references, and scientific articles on the subject.

Ultimately, the overarching goal is to develop a comprehensive understanding for creating comfortable and sustainable environments in hot and dry climates, offering valuable insights for future architectural projects.

Keywords: thermal comfort, architectural envelope, evaporative cooling, business center,M'sila.

الملخص:

شهد العالم زيادة ملحوظة في الوعي بالتحديات البيئية، ومن بين هذه التحديات المتصلة بقطاع البناء، نجد فرط استهلاك الطاقة وزيادة نسبة التلوث البيئي. إذ تعتبر المباني من أكبر المستهلكين للطاقة، مما يعزز الحاجة الملحة إلى تبني حلول مستدامة لتقليل الآثار البيئية السلبية.

يهدف هذا العمل إلى استكشاف الراحة الحرارية في المباني، مشتملة على مختلف خصائصها وإبراز أهمية الغلاف المعماري على المباني ودوره في تحسين كفاءة استخدام الطاقة، ويركز على المناطق ذات المناخ الحار والجاف مثل مناخ ولاية المسيلة التي بدورها تظهر طلبا متزايدا على التبريد. على وجه التحديد، تركز الاطروحة على كيفية تحسين الكفاءة الطاقوية بواسطة الغلاف المعماري المتكيف واستخدام تكنولوجيا التبريد التبخيري في مركز الأعمال من خلال القيام بمجموعة من البحوث النظرية من تعريفات وغيرها، والقيام بتحليل العديد من البحوث، السندات والمقالات العلمية التي تصب في نفس الموضوع.

في الأخير، الهدف الأسمى هو تطوير فهم شامل لخلق بيئات مريحة ومستدامة في المناخات الحارة والجافة، مما يقدم رؤى قيمة للمشاريع المعمارية المستقبلية.

الكلمات المفتاحية: الراحة الحرارية، الغلاف المعماري، التبريد التبخيري، مركز الاعمال,مسيلة

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General introduction:

many researches specified that 40% of world energy are being consumed by buildings. The massive magnitude of energy consumption in buildings for cooling and heating by heaters and air-conditioner systems portrays a huge problem to the system. Available Statistics states that the Heat, Ventilation and Air Conditioning (HVAC) systems in standard buildings accounts for more than 50% of annual energy consumption globally. This, coupled with the threat of increasing global temperature and energy cost, induce the need to regulate the temperatures in these buildings[1].

According to these challenges, attempts are done in different scales to reduce cooling and heating load in whole of the world.in this study we focus in the importance of the architectural envelope lies in improving the thermal comfort, and enhancing the aesthetic aspect. The specialized study focuses on hot and arid regions, exemplified by the city of Msila. This region is characterized by a hot and dry continental climate in the summer and cold winters.

Problem Statement:

In contemporary architectural design, addressing the challenge of enhancing thermal comfort within built environments remains a critical concern. The architectural envelope, while being a fundamental aspect of building design, poses a multifaceted problem: the need to optimize its features to effectively contribute to improved thermal comfort. This challenge is particularly pertinent in regions with extreme climatic conditions, such as hot and arid areas like Msila, characterized by scorching summers and chilly winters.

The problem at hand involves a gap in understanding how specific architectural envelope configurations can effectively mitigate the harsh impacts of external temperature fluctuations, thereby ensuring optimal thermal comfort indoors.

Therefore, the central question is: How can architectural envelopes be designed to consistently achieve thermal comfort?

[1]Advances in the research of building energy saving- 1 January 2022.

Hypothesis:

- Adaptive architectural envelope to protect the facades of buildings, as it works in a sustainable way and is adapted to the hot and dry climate.

Study Objectives:

1. Presenting the characteristics and design requirements of the architectural envelope and its relationship to thermal comfort.
2. Highlighting the role of evaporative cooling technology in enhancing user comfort and achieving sustainability.
3. Accessing smart techniques and materials to ensure effective solar protection for buildings.
4. Identifying adaptive architectural envelopes as an element for solar protection and their role in achieving energy efficiency and sustainability.
5. Presenting the principles and design standards specific to business centers.

Study Methodology:

To achieve the specified objectives, the descriptive-analytical approach is employed as follows:

1. **Descriptive Method (Theoretical):** Relies on gathering information and data from various sources such as books, documents, scientific articles, and official websites. This method aims to understand the concepts of the architectural envelope and business centers and their role in enhancing comfort and sustainability.
2. **Analytical Method:** Focuses on analyzing real-life examples of local and global business centers, in addition to studying some actual models of adaptive envelopes. Through this method, the efficiency and effectiveness of these examples in achieving the study's specified objectives are explored.

The structure of the thesis:

General Introduction: The general introduction encompasses a broad overview of the research, including the introduction, the problem statement, hypotheses, objectives, research methodology, and the structure of the thesis.

Chapter One: Theoretical Study

I. Thermal Comfort → Understanding the Concept of Thermal Comfort and Its Characteristics, as well as the Factors Influencing It.

II. The Architectural Envelope → Understanding the Concept of Architectural Envelope, Its Types, with a Focus on Adaptive Envelope and Its Role as a Solar Protection Element and Achieving Thermal Comfort

IV. Business Centre → Understanding Business Centers: Their Concept, Evolution, Classifications, along with Exploring the Standards and Design Considerations for These Business Centers

Chapter Two: Analytical Study

resenting an Analysis of Examples Related to Business Center Projects, Along with Analyzing the Project Site and Identifying the Proposed Program.

Chapter Three: Practical Application

This chapter presents the introduction of the project's elements, along with the design concept, followed by the graphical presentation of the project including plans, elevations, and all related aspects of the project design.

General Conclusion: This includes a general summary of the research topic.

Fig: Thesis Structure Diagram
Source: author (2024)

CHAPTER I

THEORETICAL STUDY CONCEPTS AND DEFINITION

Introduction

The theme of our study is entitled the architectural envelope between aesthetics and thermal comfort and our project a business center. This chapter presents the concepts of the theme, it is divided into three main headings: thermal comfort; the architectural envelope and the business center. This chapter explains the notions of thermal comfort, their parameters, heat exchanges between the human body and the environmental atmosphere. In the second main title we presented the architectural envelope, its types and their functions and performances. In the third major title we presented the business center their definitions and the spaces it contains.

I. Thermal comfort

I. 1. Definition of thermal comfort

Thermal comfort has several definitions depending on the consideration of the human being either as a self-regulated thermal machine, a physical object or an active person affected by their sensations[2]. Let us quote: thermal comfort is Satisfaction with the thermal environment expressed by the state of mind, which is evaluated subjectively[3]. - by Jean-Yves Charbonneau: “like the satisfaction expressed with regard to the thermal environment of the surrounding environment. » (Charbonneau, J-Y, 2004). - thermal comfort is satisfaction with the thermal environment expressed by the state of mind, which is evaluated subjectively. (Givoni, B. 1978). -for Claude Alin Roulet: Thermal comfort is a state of stability and general well-being. In addition, there is numerous research work that concerns thermal comfort not only in buildings, but also in workplaces or means of transport. The factors that influence people's perception of thermal comfort vary between psychological, physiological and environmental factors. As well as the habituation, behaviors and expectations of people in their living environments. So, the human body is not only a passive receiver of external stimuli.

I.2. The parameters of thermal comfort

To determine a thermal balance, we have the most important criteria in participating in thermal comfort are parameters linked either to the individual or to the thermal environment. the metabolic activity and the resistance of clothing are parameters linked to the individual.

[2]Moudjalled, B. 2007
[3]ANSI/ASHRAE Standard, 2017 cited by: BESBAS, y.2017

Although the air temperature, the average radiant temperature, its relative speed, and the hygrometric degree of the air are parameters linked to the thermal environment[4].

I. 2.1. Parameters linked to the individual:

I. 2.1.1. Metabolism:

That is to say the quantity of heat produced by the human body. (Mazari,M 2012) These are all the chemical reactions that occur in the body, and produce heat to keep it at around 36.7°C. When a person is moving, a working metabolism corresponding to their particular activity is added to the basic metabolism of the body at rest. The commonly used unit is the MET (Metabolic Equivalent of Task) which corresponds to the average energy expended by a person during physical activity.

I. 2.1.2. Clothing:

Clothing provides thermal resistance to heat exchanges between the surface of the skin and the environment which "constitute a barrier to convective and radiative heat exchanges between the body and its environment, they reduce also the sensitivity of the body to variations in temperature and air speed" (Givoni, 1978) Each type of clothing is measured by a relative value expressed in Clo.

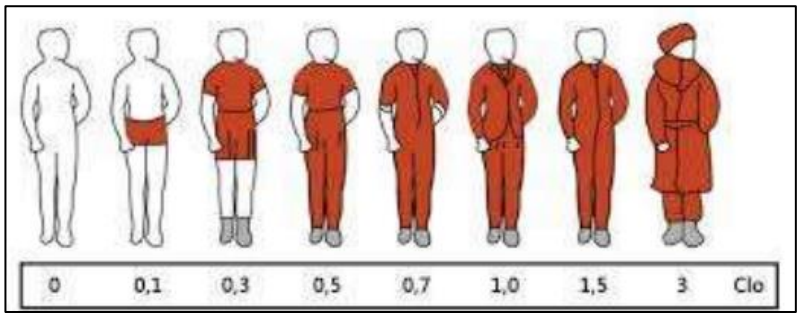


Figure 01: values expressed in Clo of clothing
Source:Mazari, M 2012

I. 2.2. Parameters linked to its environment

I. 2.2.1. Air temperature (Ta)

This parameter is measured by a thermometer in a room (Liebard and Herbe, 2005) at a height of approximately 1.50 meters from the floor. The most influential factor on human comfort according to "architectural recommendation" (1993) is the temperature of the area.

[4]Liébard, A. and De Herde, A. 2005, cited by: FERRADJI, K.2017

The air temperature is acceptable when it varies from 22°C to 27°C. The temperature of air directly adjusts the exchanges by convection which is one of the main terms of the heat balance[5].

I. 2.2.2. Relative air speed

If the air speed is less than 0.2 m/s. HAS; it is ignored and if it is greater than this value the user of the space begins to feel the movement of the air, because this factor is very important due to its effect on the exchange of heat by convection and the Increased evaporation on the skin surface.

I. 2.2.3. The mean radiant temperature (mrt):

The mean radiant temperature (MRT) is defined as the uniform temperature of an imaginary enclosure (or environment) in which radiant heat transfer from the human body is equal to the radiant heat transfer in the actual non-uniform enclosure (or environment)[6].

I. 2.2.4. Relative air humidity

Relative humidity is a ratio of the maximum amount of water vapor air can contain at current temperatures and the actual amount of water in the air. When relative humidity falls between 40-70%, thermal comfort isn't significantly affected. However, when HVAC units aren't operating optimally, humidity levels can rise to uncomfortable levels. Temperature and humidity are invariably linked, as higher relative humidity levels make temperatures seem warmer while lower levels of humidity make them seem cooler[7]

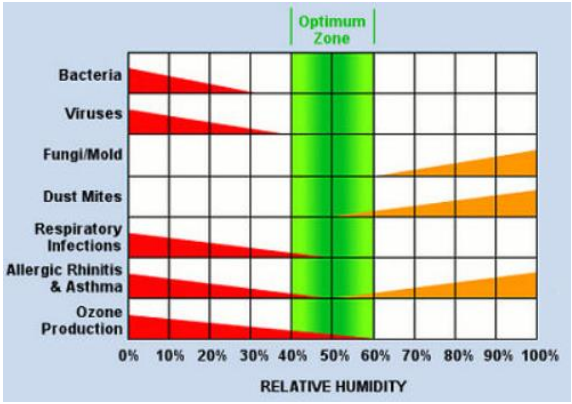


Fig 02: The hygienically optimal ambient humidity range

Source: https://www.energyvanguard.com

[5]Bellara, S. 2005
[6]University of California, Davis , (2012),Evaluation of Cool Pavement Strategies for Heat Island Mitigation.
[7]https://www.buildingsiot.com/blog/thermal-comfort-temperature-and-humidity-control-in-buildings-bd.

I.3. Heat exchanges between the human body and the environmental atmosphere

Modes of heat exchange are: convection, conduction, radiation, respiration and evaporation. Heat moving from the warmer body to the cooler body until the temperatures of two bodies become balanced[8].

I.3.1. Heat transfer by conduction

This occurs by direct contact and heat flows naturally from the warmer place to the colder place. The thermal conductivity and the thickness of the material crossed is inversely proportional8.

I.3.2. Heat transfer by convection

This is the exchange of heat between the body and the ambient air. This heat exchange depends on the difference between the temperature of the body and the temperature of the air, of the skin or clothing and the movement of air around the body.

I.3.3. Heat transfer by radiation

Is the mode of heat exchange at a distance between two bodies by electromagnetic waves. There are two categories depending on the emission band: short wavelength exchanges (solar radiation) not taken into account in buildings, and long wavelength exchanges (infrared radiation) with the walls surrounding the subject. If the radiation received by the body is lower than its own emission, the body cools down, and heats up in the opposite case.

I.3.4. Heat exchange by evaporation

Heat exchange due to the change in state of water and an important means of evacuating heat in hot environments by evaporation sweat on the skin surface.

I.3.4. Heat exchange by respiration

The respiration process is accompanied by a transfer of mass and heat. These exchanges depend on the differences in humidity and temperature between the ambient air and the exhaled air, and the fan flow rate.

[8]ASHRAE, 1997 cited by: Moudjalled, B. 2007

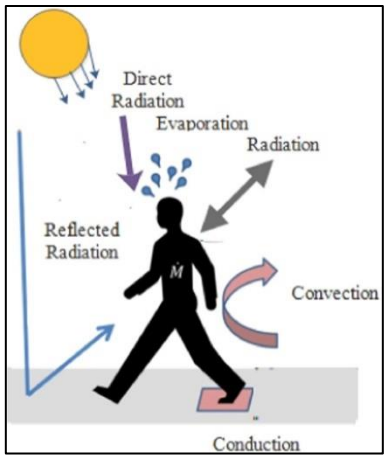


Figure 03: The thermal interaction between the human body and its environment

Source: https://www.researchgate.net

II. The evaporation cooling system:

II. 1. Definition of evaporation cooling system:

Evaporative coolers, often called "swamp coolers", are cooling systems that use only water and a blower to circulate air. When warm, dry (unsaturated) air is pulled through a water-soaked pad, water is evaporated and is absorbed as water vapor into the air. The air is cooled in the process and the humidity is increased. The evaporator cooling technology is an energy-efficient alternative to compressor-based cooling. In dry and arid regions, evaporative cooling can meet most or all building cooling loads using one-fourth the energy of conventional equipment. It can also be applied cost-effectively when integrated with conventional chiller systems, which can greatly improve a facility's load profile. Unfortunately, evaporative cooling requires an abundant water source and is only effective when the relative humidity is low, restricting its efficient use to dry climates.[9]

II. 2. History of evaporation cooling:

Since the early days of human civilization, evaporative cooling, or the evaporative processes, has been used to cool down living environments. Egyptian murals have been found, dating as far back as the year 2500 BC, that depict how porous clay vessels filled with water were placed beneath an air inlet to provide some cooling when the air passed through them. They could not have made use of electric fans or other modern techniques, but elements of evaporative cooling were implemented in the design and architecture of their housing, to provide a form of climate control. Besides that, evaporative cooling using wet

[9] A. Bhatia, B.E.2020. Principles of Evaporative Cooling System

rags in combination with a wind tower (wind catcher) is a traditional Iranian architectural element to provide cooling in buildings.

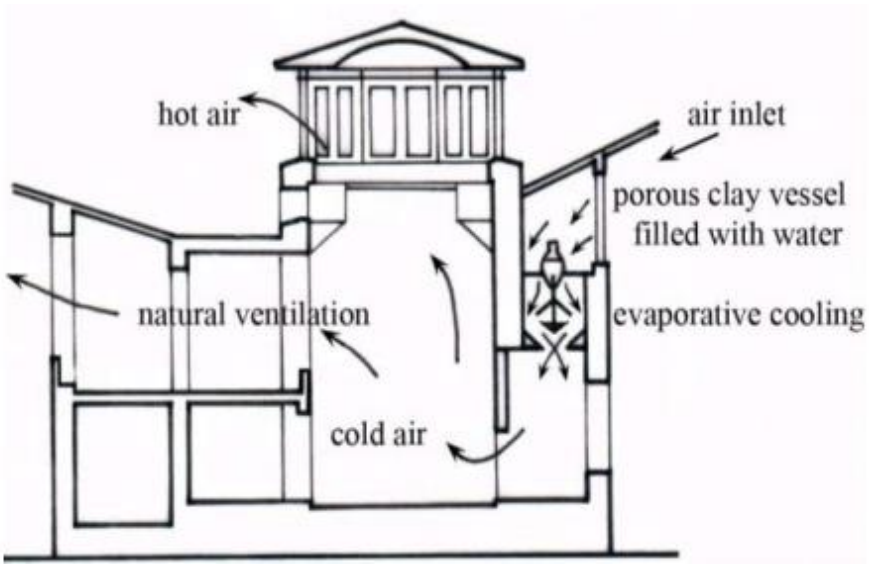


Fig 05: technique of air cooling captured from the condenser using water sprays.
Source: Haj.H.M 2009

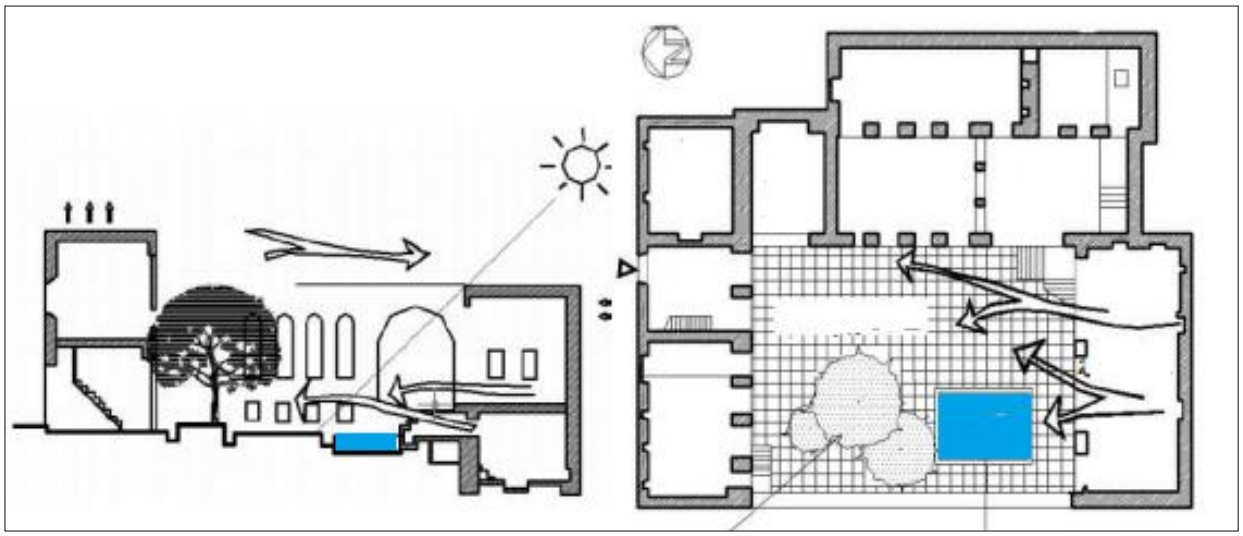


Fig 06: traditional house in Diyarbakir in turkey with a courtyard with water basin for cooling by evaporation in summer.
Source: Maddhoui. M.2019

II.3.Types of evaporative cooling systems:

Two principal methods of evaporative cooling are 1) Direct cooling: In direct cooling water evaporates directly into the airstream, thus reducing the air's dry-bulb temperature while

humidifying the air. 2) Indirect cooling: In indirect cooling, one stream of air called primary air is cooled sensibly (without addition of moisture) with a heat exchanger, while the secondary air carries away the heat energy from the primary air. Direct and indirect processes can also be combined (indirect/direct). The effectiveness of either of these methods is directly dependent on the low wet bulb temperature in the supply airstream[10].

II.3.1. Direct Evaporative Cooling (open circuit):

Direct evaporative cooling introduces water directly into the supply airstream (usually with a spray or some sort of wetted media). As the water absorbs heat from the air, it evaporates and cools the air. In direct evaporative cooling the dry bulb temperature is lowered but the wet bulb temperature remains unchanged. The efficiency of direct cooling depends on the pad media. A good quality rigid cellulose pad can provide up to 90% efficiency while the loose aspen wood fiber pad shall result in 50 to 60% contact efficiencies.

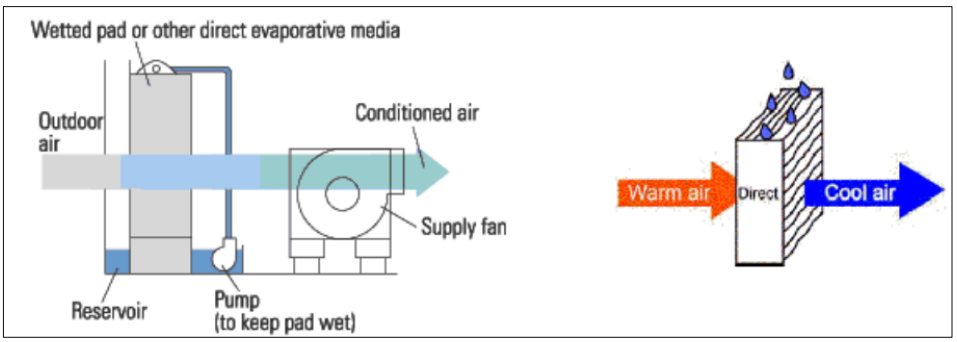


Fig 07: Direct Evaporative Cooling.
Source: A. Bhatia, B.E.2020. Principles of Evaporative Cooling System

II.3.2. Indirect Evaporative Cooling (closed circuit):

Indirect evaporative cooling lowers the temperature of air via some type of heat exchanger arrangement, in which a secondary airstream is cooled by water and which in turn cools the primary airstream. The cooled air never comes in direct contact with water or environment. In indirect evaporative cooling system both the dry bulb and wet bulb temperatures are reduced.

[10] A. Bhatia, B.E.2020. Principles of Evaporative Cooling System

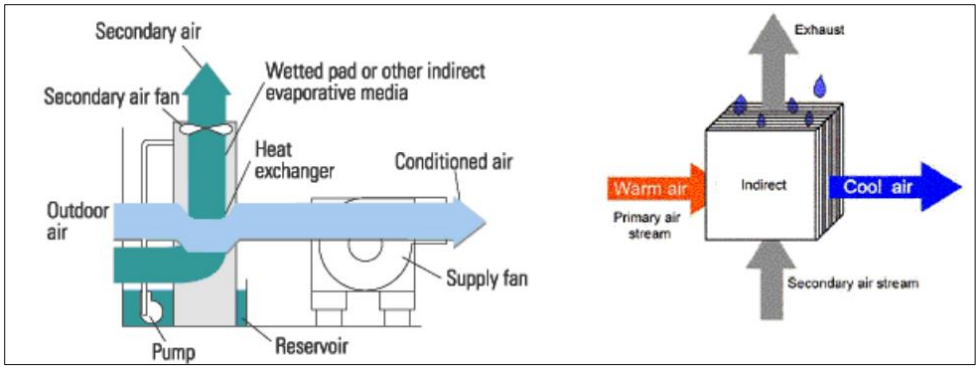


Fig 08: Indirect Evaporative Cooling.
Source: A. Bhatia, B.E.2020. Principles of Evaporative Cooling System

II.4. Advantages of evaporative cooling:

The benefits of evaporative cooling are many. The two-stage evaporative technology, especially, provides the most sustainable and environmentally friendly cooling and ventilation available to production facilities, distribution centers, and office buildings.[11]

1. Optimal indoor air quality.
2. Optimal air humidity.
3. Energy-efficient climate control.
4. A comfortable work environment.
5. Environmentally friendly.

II.5. Evaporative cooling and air conditioning:

Evaporative cooling provides a highly effective and environmentally responsible indoor climate solution for the industry. Yet many people are still suspicious of its cooling efficiency and instead stick to what they know: conventional air conditioning. This is unfortunate, as conventional air conditioning leaves a massive carbon footprint - especially in comparison with two-stage evaporative cooling.

II.6. Water as a sustainable solution:

Evaporative cooling uses nature's most potent refrigerant as its cooling agent - water! With an exceptionally high latent heat of vaporization (2501 kJ/kg at 0 °C), evaporating 1 m^3/h water generates as much as 695 kW of cooling power. The evaporated water will finally end up in the air

[11] https://www.oxy-com.com/advantages-evaporative-cooling

and at a later stage come down as rain. Traditional air conditioning technology would demand at least 250 kW to deliver the same cooling power.

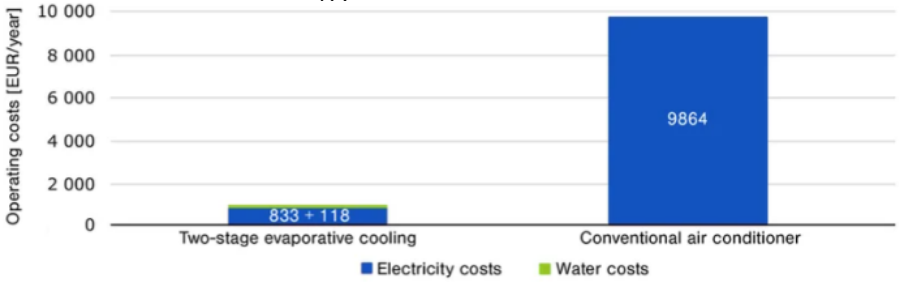


Fig 09: Electricity cost between evaporative cooling and air conditioner.
Source: https://www.oxy-com.com/advantages-evaporative-cooling

III. The Architectural Envelope:

Introduction:

Recently, in the light of climatic changes all over the world and technical developments, the building envelope, which is part of a physical system that includes internal and external environments and serves as a physical barrier between them, has become one of the most important studies of building science. These studies have led it to a change in building techniques, materials, designs and concepts of some building envelopes that have emerged all over the world. The building envelope materials are no longer just a cladding that have a secondary role in influencing the cultural appearance and character of the building, but turned into one of the important tools in functionality. This change has reflected in the evolution of the envelope capability to transform its main role from just a barrier to providing a comfortable indoor environment for occupants of the building.

III.1. Definition of the Architectural Envelope:

• To cover completely with paper, fabric, or any material... (Larousse, 1989)

• The envelope of a building plays a role as an interface with the exterior. It is a transitional space between different environments, a connecting zone, but above all, it is a protection, a "material" that allows for protection. If we adhere to this definition, the building envelope can be considered from various perspectives:

For the architect: it is a contact surface between the building and the city.

For the engineer: it is the point of connection between passive components and active systems.

For the thermal engineer: it is a transition zone between an interior atmosphere and an external environment.

For the project manager: it is the object on which he will coordinate the interventions of various trades, from the designer to the workers.

For the legislator: it is one of the characteristic elements of the building for which he will seek to align the available performing technologies as closely as possible with generalizable regulatory requirements.

For the occupant, finally: the walls that surround him are elements of thermal and visual comfort and constitute a factor of aesthetics for his building[12].

Overall, the building envelope is thus a junction between multiple factors, involving numerous stakeholders in the construction process. Their common goal is to optimize all the functions it has to perform[13].

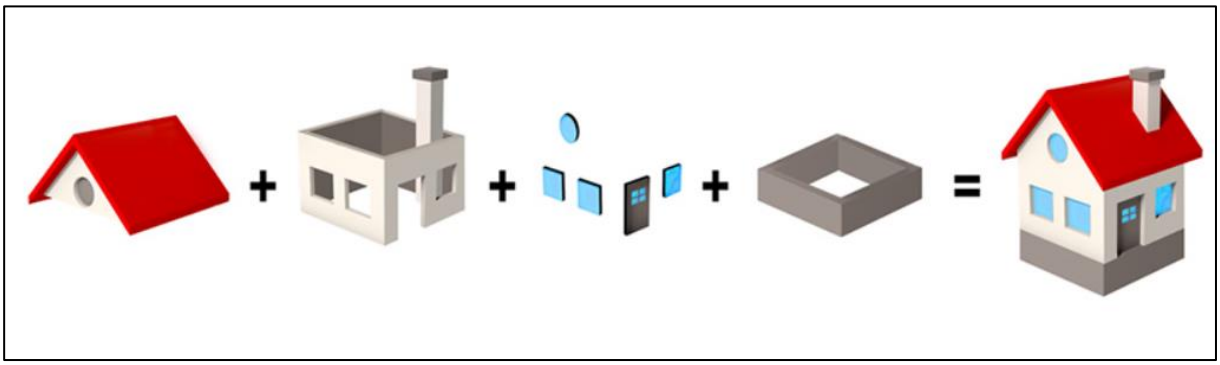


Fig 09: Simple Building Envelope.
Source: https://www.iko.com

III.2. Types of Architectural Envelope:

According to CERTU (Centre for the Study of Networks, Transportation, Urban Planning, and Public Construction), two types of architectural envelopes are distinguished based on their role and materiality:

III.2.1. Load-Bearing Envelope

It is considered a load-bearing envelope when it supports the floor and the framework, primarily made of reinforced concrete with significant thickness.

[12]Thèse master ,(2020), l'enveloppe architecturale entre l'esthétique et le confort thermique .
[13]STEPHANIE, G. et al. (2010).

Fig 10: house in Akitsu.
Source: https://blog.allplan.com/fr

III.2.2. Non-Load-Bearing Envelope

By definition, it is the opposite of the load-bearing envelope because it does not contribute to the stability of the building.

There are several types of non-load-bearing architectural envelopes:

III.2.2.1. Lightweight Envelope

Constructed on the framework of a building with lightweight materials such as metal sheets, glass, wood or Fiber panels, etc.

III.2.2.2. Double Skin

Double-skin facades (DSF) can be considered an evolution of the fenestration for highly glazed high-rise tertiary buildings. In DSF the façade is separated in two glazed layers (the 'skins'), enclosing an air cavity, generally used for hosting and protecting the shading system and for airflow control[14].

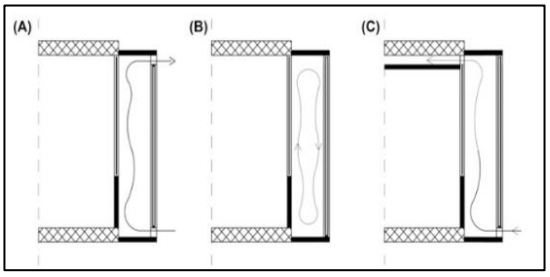


Fig 11: Different type of double-skin façade according to the type of airflow.
Source: Effect of Double-Skin Façade on Thermal Energy Losses in Buildings

III.2.3. Green Envelope

[14]Rouhollah N, Rogaye M. (2018).Effect of Double-Skin Façade on Thermal Energy Losses in Buildings.

Green facades, although often used for aesthetic and architectural purposes, also contribute to improving the energy performance of buildings and mitigating the urban microclimate. Green roofs and facades provide the building envelope with the thermal and radiative properties of natural vegetated surfaces. In summary, green envelope can be defined operationally as building skin that responds to the surrounding context with minimal impact whilst keeping the occupants in satisfactory human comfort at a cost of efficient energy consumption[15].

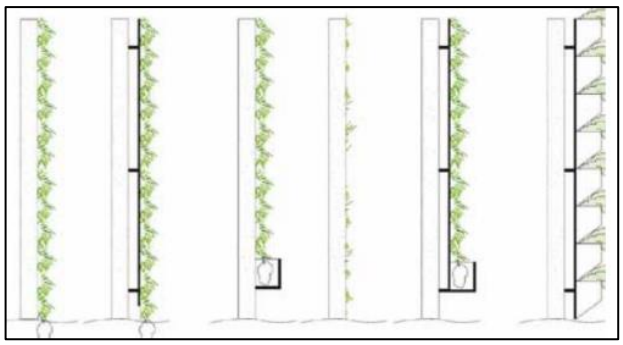


Fig 12: green façade system.
Source: https://www.greenkeeper.eu

III.2.4. Origami

Origami, the traditional Japanese art of folding paper into shapes without stretching, sticking, or cutting, continues to shape our world in increasingly diverse fields[16]. Architecture is an area where its applications are expanding more and more. One important aspect is, obviously, the visual appeal of origami folding models.

III.2.5. Perforated Envelope

Perforated building envelope presents a global contemporary architectural trend which is connected – in some circumstances – to the traditional perforated models, such as 'Mashrabiyya', 'Takhtabush', 'Qmariyyah', etc[17]. Perforated walls have used panels and screens for centuries as a means to control the level of light inside a building or to ensure the privacy of its occupants:

[15]Azlan A, Sabarinah S,and Mohd A.(2019). Green envelope as an architectural strategy for energy efficiency in a library building.
[16]Larousse en ligne.
[17]Maria L, Bader A, Rabee M. (2015)Advanced Building Skins.

Fig 13: kinetic façade.
Source: arch2o.com

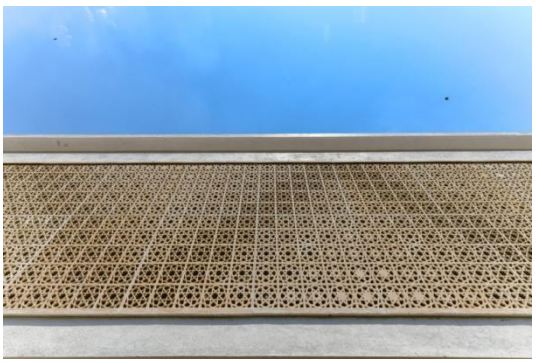


Fig 14: Perforated façade.
Source: archidayli.com

III.3. The Functions and Performance of the Envelope:

The building envelope's various functions may be divided into three categories:

III.3.1. Support: structural and dynamic stresses to resist and transmit

III.3.2. Seize control: the control function is at the heart of good performance, and it concentrates on rain control, air control, heat control, and vapor control, in that order

III.3.2.1 ***Water and water vapor control*****:** Rain control is critical, and there are a variety of ways for doing so, including ideal barriers, drained screens, and mass / storage systems.

III.3.2.2 ***Air control*****:** Controlling air flow is crucial for maintaining interior air quality, reducing energy consumption, preventing condensation (and so extending the life of the building), and providing comfort. The passage of air through the enclosure (the assemblage of materials that performs this function is referred to as the air barrier system) or through components of the building envelope (interstitial) itself, as well as into and out of the interior area, is controlled (which can affect building insulation performance greatly). As a result, air management encompasses the prevention of wind washing (cold air flowing through insulation) and convective loops, which are air movements within a wall or ceiling that can account for 10% to 20% of total heat loss.

III.3.2.3 ***thermal envelope*****:** The thermal envelope, also known as the heat flow control layer, is a component of the building envelope that may be located elsewhere, such as in the ceiling. An insulated attic floor is the major thermal control layer between the inside of the home and the outside, although the entire roof is part of the building envelope (from the surface of the roofing material to the interior paint finish on the ceiling)[18].

[18]Bin,L.(2021). Building Envelope Design and its Functions.

III.3.2.3Aesthetic: The design of the building facade goes beyond its functionality. It encompasses the aesthetic considerations that contribute to the overall architectural expression that plays a significant role in defining the character and identity of the building[19].

IV. Adaptive façades

IV.1. Definitions of adaptive façades

Adaptive façades, in particular, consist of multifunctional, highly adaptive systems, in which the physical separator between the interior and exterior space is able to change its functions, features, or behavior over time in response to transient performance requirements and boundary conditions, with the aim of improving the overall building performances (Loonen et al. 2015). Furthermore, these types of façades allow energy to be saved by adapting to prevailing weather conditions, and support comfort levels by immediately responding to occupants' needs and preferences (Loonen, Trčka, Cóstola, & Hensen, 2013). Consequently, adaptability can be understood as the ability of a system to deliver intended functionality, considering multiple criteria under variable conditions, through the design variables changing their physical values over time (Ferguson et al., 2007).[20]

IV.2. Types of adaptive facades:

IV.2.1. ACTIVE FAÇADES

Active façades (Figs. 1a), b) and c)) can be definite technological systems which have integrated elements through which envelopes self-adjust to changes initiated by the internal or external building environments, achieving comfort conditions while minimising energy consumptions. These active features should be both automatic and manual and should not need to include sophisticated electronics (Ochoa &Capeluto, 2008).

[19]Cristiano,F.(2023).Building Facade: Aesthetics and Functions.

[20] Rosa Romano1*, Laura Aelenei2*, Daniel Aelenei3*, Enrico Sergio Mazzucchelli4 .2018. What is an Adaptive Façade? Analysis of Recent Terms and Definitions from an International Perspective

a) b) c)

Fig 15: Some pictures of active façades: a) ARTICULATED CLOUD, Pittsburgh (USA), 2004; b) Nordic Embassies in Berlin, Berlin (DE), 1999; c) MEDIA-TIC, Barcelona (SP), 2007

IV.2.2. ADVANCED FAÇADES

An advanced façade is the outer, weather-protecting layer of a building that can contribute to heating, cooling, ventilation, and lighting requirements and can promote interior comfort through efficient, energy saving measures. The main difference between advanced envelope concepts and other energy efficient envelope concepts is the application of responsive building elements and their integration with building services systems and energy systems in combination with advanced control (Ad et al., 2011).

IV.2.3. BIOMIMETIC OR BIO-INSPIRED FAÇADES

The skins of plants and humans tend to be seen as the most straightforward emulation model and inspiration source for multifunctional and truly sustainable enclosure systems. Functional bioinspiration can either be direct or indirect. The first approach directly copies the observed functional principle into a building envelope technology that performs the same role. This is an example of phototropism (i.e. changing in response to light) and heliotropism (i.e. changing in response to the sun), applied, for example, in the climate adaptive building shells concepts that enable the active collection or rejection of solar energy (Vermillion, 2002)

a) b) c)

Fig. 16: Some pictures of bio-inspired façades: a) Hygroscope, Centre Pompidou, Paris (FR), 2012; b) BIPV Adaptive Flakes, Milan (IT), 2017; c) BIQ – The Algaehouse – The Clever Treefrog, Hamburg (DE), 2013

Source: journal of facade design & engineering

IV.2.4KINETIC FAÇADES

In 1970, Zuk and Clark defined kinetic architecture as an architectural form that can be inherently displaceable, deformable, expandable, or capable of movement (De Marco Werner, 2013). To elaborate, a kinetic façade is a technological system in which there is a certain kind of motion (Loonen, 2010) and that is able to guarantee variable locations or mobility and/or variable geometry to all or one of its parts. (Fox & Yeh, 1999). The term 'kinetic' also indicates an organism's response to a particular kind of stimulus in biology (Wang et al., 2012) and an ability to modulate energy in its primary forms: visible light and heat. A kinetic façade (Figs. 3a), b) and c)) can respond to the flow energy, both natural and man-made, that primarily affects building performance and the comfort of the people in them (Fortmeyer & Linn, 2014). These types of envelope, in general, need to be efficiently tuned to boundary conditions such as climatic conditions, different locations, varying functional requirements, or emergency situations. In order to guarantee the kinematic, an actuation force is needed that generates the movement.

a) b) c)

Fig. 17: Some pictures of kinetic façades: a) Campus Kolding, Kolding (Denmark), 2014; b) Kiefer Technic Showroom, Bad Gleichen Berg (A), 2007; c) ThyssenKrupp Quarter, Essen (DE), 2010

Source: journal of facade design & engineering

IV.2.5. INTELLIGENT FAÇADES

Intelligent buildings are those which combine both active and passive intelligence - active features and passive design strategies - to provide maximum occupant comfort using minimum energy (Kroner, 1997). In this context, the definition of 'intelligent' façade introduces the idea of dynamic movement and the 'component' façade in which all building services components are integrated (Knaack & Klein, 2008). Furthermore, the term 'intelligent', when applied to a façade, must indicate the responsive ability of the façade to

change according to environmental conditions (Compagno, 2002). The intelligent skin is therefore a composition of elements, which acts as a barrier to the outside environment, yet can respond to climatic changes through the automatic reconfiguration of its systems (Masri, 2015) to produce a pleasant indoor environment (ClementsCroome, 2004). The primary functions that must be performed by intelligent systems were considered: perception, reasoning, and action. This corresponds in robotics to sensors, control processors, and actuators (Hayes-Roth, 1995). For these reasons, an intelligent façade should be able to change itself through 'instinctive autonomic adjustment' (Wigginton & Harris, 2002), optimizing the building's systems relative to climate, energy balance, and human comfort, typically based on predictive models. This is often accomplished through building automation and physically adaptive elements such as louvres, sunshades, operable vents, or smart material assemblies (Velikov&Thün, 2013).

IV.2.6. INTERACTIVE FAÇADES

The term 'interactive' is used less frequently with regard to building envelopes than in reference to computer-enabled artworks, installations, and other such environments that encourage active public participation. However, an interactive façade (Figs. 4a), b) and c)) requires human input to initiate a response, and it may also be equipped with sensors and an automated building management system

and programmed to optimise energy conservation while simultaneously ensuring the comfort of its inhabitants (Velikov& Thün, 2013).

a) b) c)

Fig18: Some pictures of interactive façades: a) GreenPix – Zero Energy Media Wall, Beijing (cn), 2018; b) SolPix, New York (US), 2010; c) Cyclebowl, Hannover Expo (DE), 2000

Source: journal of facade design & engineering

IV.2.7MOVABLE FAÇADES

Movable façades can be defined as technological systems that are able to rapidly adapt to the environmental conditions and location, as well as being defined by the opening elements themselves. Furthermore, where individual parts of flexible enclosures are equipped with photovoltaic elements that track and follow the position of the sun, these type of envelope systems can produce renewable energy, thereby reducing the energy consumption of new or existing buildings (Schumacher, Schaeffer, & Voght, 2010).

IV.2.8RESPONSIVE FAÇADES

Functional responsiveness in contemporary architecture can be defined as a system's ability to adapt itself to deliver intended functionality under varying conditions through the design variables that change their physical values (Ferguson et al., 2007). A responsive façade takes an active role, initiating changes, to a greater or lesser degree, as a result and function of complex or simple computations (Negroponte, 1975). Meagher (2015) defines responsive components as all those elements of the building that adapt to the needs of people as well as to changes in the environment. These components may be high tech systems that employ sensor networks and actuators to monitor the environment and automate control of operable building elements. He also uses this term to refer to the moveable, operable, often manually controlled elements of buildings which allow the adjustment of the building envelope and interior in order to adapt the building's performance to meet everyday needs. Furthermore, these technological systems can be actively used for transfer and storage of heat, light, water, and air. They assist in maintaining an appropriate balance between optimum interior conditions and energy performance by reacting in a controlled and holistic manner to outdoor and indoor environment changes and to occupants' requirements. Responsive building elements can be essential technologies for the exploitation of environmental and renewable energy resources, and in the development of integrated building concepts (Heiselberg et al., 2012).

a) b) c)

Fig 19: Some pictures of responsive façades: a) Arab World Institute, Paris (FR), 1987; b) Yale Sculpture Building, New Haven Connecticut (USA), 2007; c) Al Bahar Towers, Abu Dhabi (AE), 2012

Source: journal of facade design & engineering

IV.3. CHARACTERISATION PARAMETERS OF ADAPTIVE FAÇADES (AFS)

As is demonstrated in the previous definitions, adaptive façade systems are notable for the presence of one or more of the following technological features: – High-performance innovative materials and systems for absorbing and storing solar energy (e.g. smart, biomimetic, or bio-inspired façades, etc.); – Devices for managing natural ventilation in combination with mechanical ventilation systems (e.g. adaptable, advanced, responsive façades, etc.); – Mobile screens for controlling solar radiation (e.g., smart, adaptable, responsive, and switchable façades, etc.); – Technological solutions designed to increase and/or control comfort inside the building (e.g. adaptable, active, kinetic, intelligent, interactive, and switchable façades, etc.); – Building automation systems for the management of plants and elements of the building skin (e.g. intelligent, responsive façades, etc.).

V. Business Centre:

V.1. Definition:

We can define a business Centre as a place composed of spaces of small, medium, or large sizes, fully equipped. These spaces are intended to accommodate businesses, entrepreneurs, and other types of users for a specified duration, whether short or long term.From individual or shared offices to meeting or conference rooms, the various areas of a business centre are typically located in a building reserved for this purpose or spread across one or several floors of a building dedicated to tertiary activities. They have the advantage of being fully equipped, whether in terms of real estate (offices, chairs, sofas, lamps, etc.) or the technical facilities necessary for the daily operations of a business (internet connection, telephony, printers, etc.)[21].

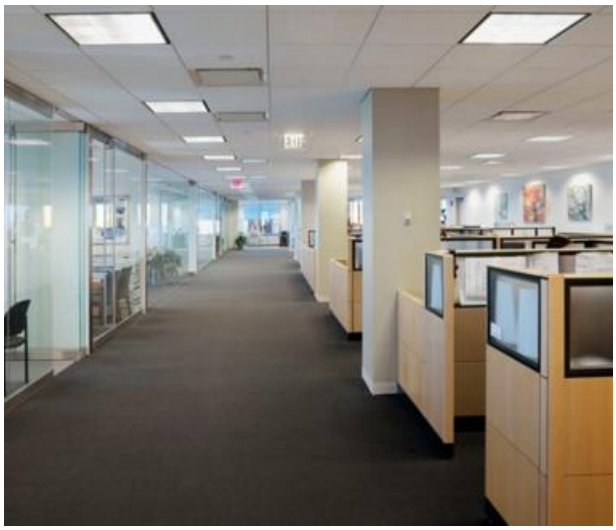


Fig 20: business center
source: https://wfmmedia.com

V.2. Target population:

The business Centre targets a specific clientele:

1. Small businesses and startups that do not consider a long-term commitment.
2. Companies in need of an office for a short stay.
3. Intermittent users - when their premises are not yet available.
4. Many personnel forced to relocate due to a lack of space in their current office.

[21]MGS BUSINESS.com

5. Users working on a specific project (survey, film production, etc.)[22]

V.3. The role of business centers:

- ❖ provide an environment that is particularly conducive to economic activity, enabling companies to achieve their objectives.
- ❖ They offer companies, on demand and immediately, fully equipped and furnished offices for rent at the start of an activity, thus minimizing the cost of investment in real estate and furniture.
- ❖ A place for exchange, communication, and camaraderie.
- ❖ The variety of services in place to ensure the comfort and security of businesses and their clients provides them with the opportunity to conduct business on-site, thereby minimizing potential travel.
- ❖ A prestigious and enhancing image for the client.
- ❖ Creates a focal point of attraction for work.[23]

V.4. The Evolution of Office Design:

Over the last century, the evolution of office design has been driven and progressed by the dramatic transformations in the way we work and what we expect from our office environment. The introduction of new tech and tools, changing staff needs and work models, and the shift from an industrial to a knowledge-based economy have altered the paradigm of how and where we work.

1. Office Design in the 1800s

From the Romans to the East India Trading Company, offices were used long before the 1800s for administrative tasks, but the 19th Century saw them popularized as a place for conducting business. This was mainly due to the comprehensive roll-out of the railway across the UK, which brought an array of freight, logistics, importing and exporting tasks and required much larger workforces to support it.

In this century, workplaces were shaped like their businesses – branching hierarchies with merchants and clerks housed on the building's lower floors, while the owners often lived above the office.

[22] www.arenas-partners.fr/fr/guide/qu-est-ce-qu-un-centre-d-affaires
[23] Master thésis. (2021) L'AMELIORATION DE LA QUALITE DE L'AIR DANS LES ESPACES DE TRAVAIL.

Fig 21: office
source: https://www.oktra.co.uk

Early 1900s Office Design

In the early 20th Century, technology revolutionized the form and function of the workplace. The invention of electric lighting opened up spaces – providing an entire floor plate where staff could work without gas lights (read more on the importance of office lighting here). Masonry-bearing walls often constrained building heights and new materials and techniques had to be developed before multistory buildings could be safely built. The typewriter, telegraph and telephone accelerated communication and allowed organizations to manage their company offices from afar.

American engineer FREDERICK TAYLOR is recognized as one of the first people to design an "office space". He was one of the leaders of the 'Efficiency Movement' that was highly influential in developing the mass production processes we know today. These spaces were similar to factories. Linear rows of desks were set for typists and admin personnel – resembling paperwork assembly lines with managers with separate rooms.

Fig 22: office
source: https://www.oktra.co.uk

2. 1950s Office Space

After the war, business theorists began to steer away from the Taylorism concept of "employees as units" and look towards flatter hierarchical structures that encouraged communication and interaction. This was popularized in Germany by the '**Bürolandschaft**' (or "office landscape") movement, which produced the first of what we now commonly call open-plan offices.

These workplace designers used organic geometries and fluid circulation plans to facilitate movement throughout the office. Informal spaces such as break rooms and lounges were first introduced to provide employees with an "escape" from the desk. Designers used cabinets and curved partitions to counter the noise and distractions of loud typewriters and telephone conversations. This decade also saw a great improvement to indoor air quality with innovative air conditioning systems and gas-firedboilers replacing coal. This encouraged the development of increased floor sizes and lower ceilings, but spaces tended to still be designed at lower occupancies – due in no small part to noise issues[24].

Fig 23: Bürolandschaft office
source: https://k2space.co.uk

3. The 1960s workplace

The late 50s saw the dawn of a humanized modernism with a blending of modern architectural principles with warm colors and soft textures. In this search, the cubicle was invented, the "Action Office" by George Nelson and Robert Propst. The 'cube' system was a three-sided moveable partition developed to allow personal privacy, convenience and less distraction, which was thought to be lost in many of the larger open-plan office environments.

The take up of this new system was slow due to its expense, but this all changed with Action Office II in 1968. The office industry particularly loved this template for the cubicle

[24]https://k2space.co.uk.(2022)[2]

system, which was cheaper and easier to install. So, people began to replicate it, and other companies devised with their own action offices.

4. Offices in the 1970s

Cubicle offices continued to be the dominant layout during this period, but the decade also saw the rise of the individual and a new focus on wellbeing and ergonomics. This shift led to office spaces designed to give individual workers the freedom to be creative, collaborate, and work autonomously. In addition, computers started to enter offices. These vast, noisy machines filled entire rooms and were mainly used for data storage and complex calculations.

Fig 24: Cubicle office
source: https://www.oktra.co.uk

5. 1980s office design

The 1980s saw substantial technological developments take hold with new communication and information processing devices requiring space in the office – namely, the personal computer. At the same time, with business-orientated political policies taking hold across the globe, this decade represented a time when the corporation was king. Accordingly, commercial office design took on a futuristic aesthetic, dominated by clean lines and materials that emphasized a hard-edged, industrial look, such as metal and glass. During this time, London's skyscrapers boom began, most noticeable with the CANARY WHARF development.

6. 1990s offices

At its outset, 90s offices looked and felt quite similar to those from the previous decade. Private, enclosed workstations were still standard, and personal computers were bulky with heavy-duty power and data cabling. However, as laptops began to become more affordable, open office plans and hot-desking became an increasingly popular design plan as companies sought to promote flexibility and collaboration in the flourishing Information Age and knowledge-based economy.

Fig 25: 1990s office
source: https://www.oktra.co.uk

7. Office design from the 2000s

The rise of dot-coms and start-ups from young, entrepreneurial minds reformed many of the practices and behavioral notions of the workplace. Work-life balances started to blend with the designs of the workplace, with more 'playful' aspects entering the office. With the boom, the "office as playground" became a familiar concept, characterized by innovative systems, an open plan office and a university campus or neighborhood "spirit." The rapid growth of mobile tech also enabled employees to work away from the desk and popularized coworking spaces. The first such center in the UK, "Impact Hub", opened at London's Angel Station in 2005.

Fig 26: relaxing space
source: https://www.oktra.co.uk

8. Office space in the 2010s

The 2010s workplace combined a mix of influences from the latter half of the 20th century – taking aspects from many different work styles to create "agile work" environments that make people, how they work, and the outcomes they produce the prominent focus, rather than the work itself. One of these concepts, 'Activity Based Working', became a prominent workstyle to address this new methodology and remains popular today. Furthermore,

biophilia and the introduction of nature into the corporate space became increasingly popular, as did an objective examination into wellbeing.

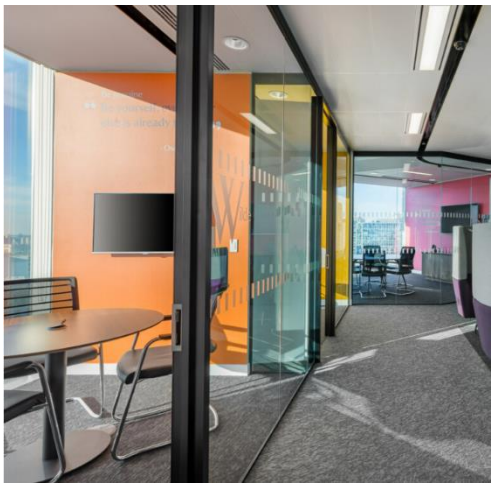


Fig 27: Variety of workspace environments
source: https://www.oktra.co.uk

9. Current office design in the 2020s:

Our post-COVID world has accelerated changes that were already happening within the office landscape, remote working, virtual collaboration and self-organizing team structures being three major examples. Where to next? A 2021 study by GARTNER suggests that by 2023, less than one-third of digital workers will select the corporate office as their preferred place to work. And by 2030, 48% of employees will work remotely (compared to 30% before the COVID-19 pandemic). Furthermore, **Cone Communications**' Millennial Employee Study found that 64% of Millennials won't take a job if their employee doesn't have a robust corporate social responsibility policy, and 83% would be more loyal to a company that contributes to social and environmental issues. As a result, we see companies incorporating sustainable design into their offices – from furniture procurement to subscribing to BREEAM and SKA based ecological, social, and economic assessments.[25]

Fig 28: Highly adaptable and modular spaces
source: https://www.oktra.co.uk

[25] **https://www.oktra.co.uk.(2022)**

V.5. the spatial requirements of a business center offices

Typology: Two types of offices are distinguished based on their dimensions and layout: individual offices and open-plan offices. All other types are variations and present a different organization compared to these two.

V.5.1bTypes of Spaces:

a. Individual Offices: Single and double offices are arranged on either side of a corridor, often benefiting from artificial lighting. Shared equipment occupies a valuable space in the rooms in front of the windows because the clearance paths do not allow for furniture. Economic occupancy by two or more people can hinder concentration. Occupancy by a single person limits internal communication (Fig. 1 a).

b. Open-plan Offices: A form of office developed in the 1960s and 1970s. Artificial lighting and air conditioning installations have allowed for very large office spaces, symbols of communication and openness, accommodating a hundred or more people. However, the economic volumetrics of the building require significant technical distribution equipment. This form of office is not well-liked by users (Fig. b).

c. Collective Offices: The experience gained from very large office spaces has led to the design of collective offices with around4 to 15 workstations, always used by the same employees or departments. This form of office is preferred, especially for creative, formatting, coordination, and development activities (Fig. c).

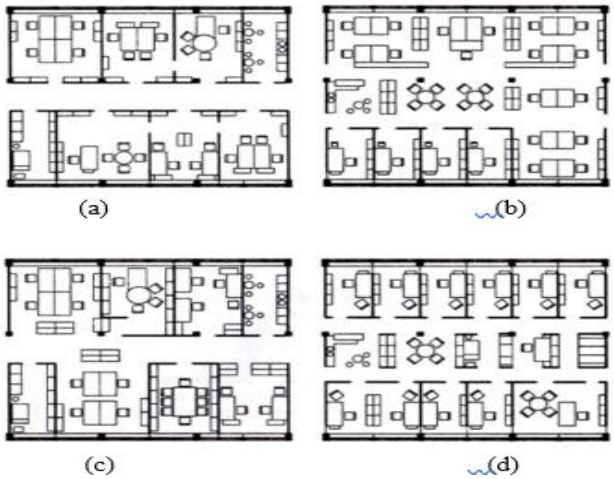


Fig 29: types of spaces of office
source: Nefeurt. (2010)

d. Ancillary Spaces:

Ancillary and additional spaces Depending on the organizational structure and representation needs, the demand for workspace varies between 23 and 45 square meters per workstation. The 2.6 square meters of underground parking space not included in the gross area are taken into account here (**O. Gottschalk, 1994).** This trend has been on the rise since the 1970s.

e. Entrance Hall:

Linking the public area to workstations. Essential functions include protection against wind, access control, information, visitor registration, and waiting space. Essential for the company's image (corporate identity). The first impression is crucial.

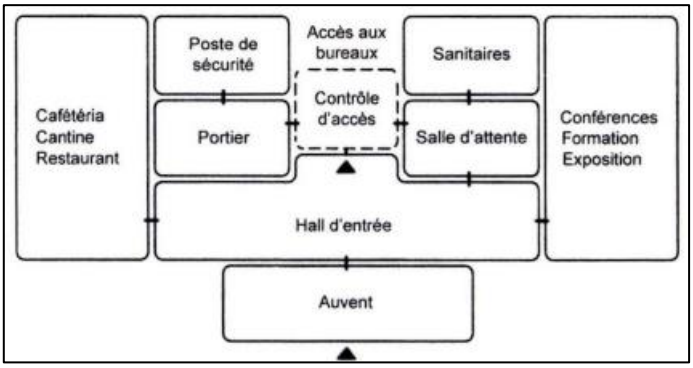


Fig 30: Spatial Layout of the Entrance and Access Control to Common Areas
source: Nefeurt. (2010)

f. Conferences, Training:

Conference areas should be directly connected to the entrance space. Storage rooms are planned to store movable partitions used to divide large halls, tables, seats, and audiovisual equipment, as well as an office for receptions (these annex spaces occupy about a third of the conference room area). Acoustic insulation must be ensured. Approximately 2.5 square meters per seat in the conference space (excluding annex spaces). Required space: 0.3-1.0 square meters per workstation.

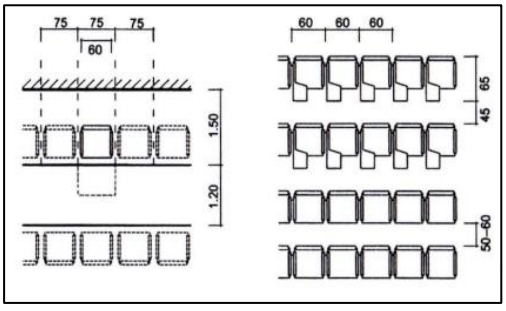


Fig 31: Space Required in Conference and Training Rooms
source: Nefeurt. (2010)

j. Archives:

Despite the use of new office techniques, paper consumption as the primary medium for information storage has increased. Until 1980, paper consumption doubled every four years. Computer-assisted information storage as an information medium can be more widely used within office communication systems. Non-coded information (letters, texts, magazines) will always have its place in the form of paper volumes.

Objective: Clear organization and classification of documents requiring minimal movement and ensuring efficient use of space. Archives congestion (fig. 1). The passage widens as the depth of the filing cabinets increases.

L x W (filing cabinets) = filing area + 1/2 L x W + 0.5 = passage area

Total congestion = filing area + passage area.

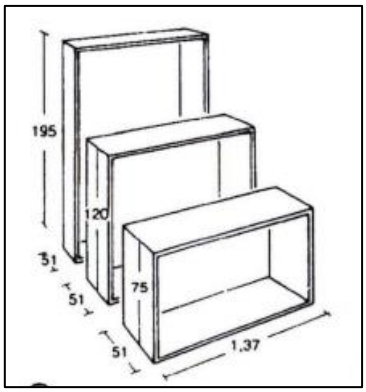


Fig 32: File cabinet system
source: Nefeurt. (2010)

h. Digital Data Processing:

It is crucial to plan the network design in advance. This helps determine whether computer rooms require permanent workstations and whether they should be centralized or decentralized in the building. Due to their high technical level, these rooms must have a technical floor of 70 cm and be air-conditioned. Access must be particularly controlled. Backup systems should ideally be installed in fire-protected areas separated from the computer room.

i . Recreation Spaces:

The company restaurant or cafeteria often functions as independent units. Their proximity to the reception, upstream of visitor control, allows them to be used by visitors.

Tea kitchens should be located in direct proximity to workstations, connected to communication areas. A large kitchenette of about 10 square meters is considered for 50 to 100 people.

g. Restrooms:

Restrooms should be sized according to workplace regulations (see p. 317); spatial separation should be provided between the sink area and the restrooms themselves. A restroom group for approximately 50 to 80 people is always satisfactory. Required space: 0.6-0.8 square meters per workstation.

k. Maintenance Rooms:

for building maintenance should be provided on each floor, as well as a room for cleaning products, ideally with a water point and a drain. Central garbage room, possibly a garbage collection room per floor with separate garbage collection container and document shredder. Also, provide a relaxation room, storage space, and a workshop for the caretaker in the center.[26]

VI. Conclusion:

In this chapter, we have covered various concepts related to thermal comfort, its characteristics, and the conditions for achieving it. We also explored evaporative cooling technology, considering our hot and dry climate, and identified the architectural envelope as an adaptive and sustainable element for solar protection. Additionally, we discussed some other protection techniques and materials. Furthermore, we delved into the principles and design standards for business centers, understanding their types, historical evolution, etc. Ultimately, we concluded that applying thermal protection with minimal energy consumption has become a necessity we cannot overlook, especially given the high energy consumption of these large facilities, which negatively impacts the environment. Therefore, implementing adaptive envelope technology in the best possible way represents the optimal solution to these problems.

[26]Nefeurt. (2010)

— CHAPTER 02: —

ANALYTICAL CHAPTER

Introduction:

This chapter delves into the analytical part of the study, where it presents an analysis of examples of selected business centers based on a well-organized and studied functional arrangement for their spaces. The aim is to understand the nature of each project and identify the positive aspects of each example to utilize them in the design process while avoiding any negative points. Additionally, the chapter includes an analysis of the project site to determine its characteristics, strengths, and weaknesses, and how to address them in the design phase. Ultimately, the chapter concludes by presenting the proposed program for the project.

The Existing examples:

Springboard Business Centre

UFO business centre

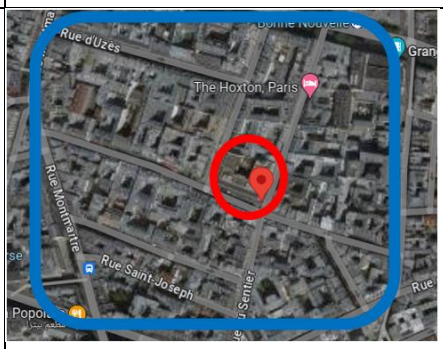
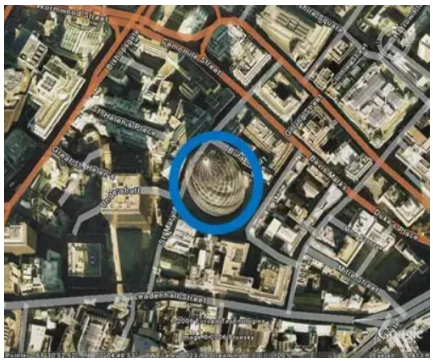
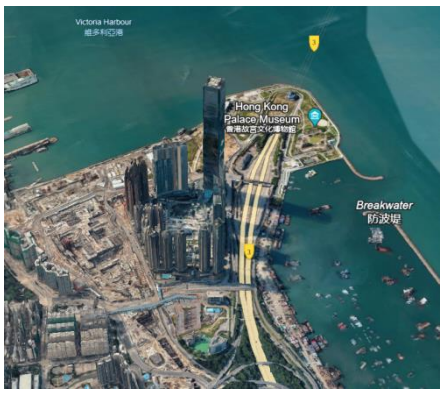
Swiss Re building

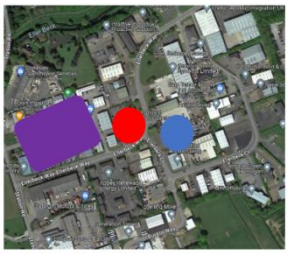
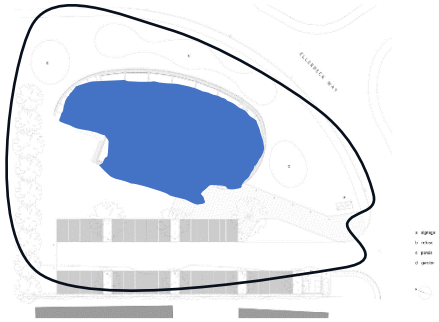
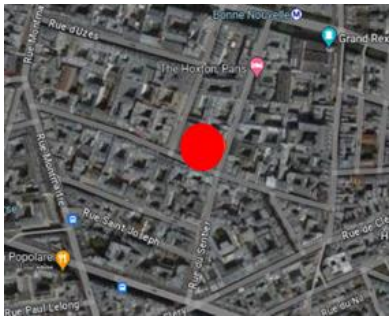
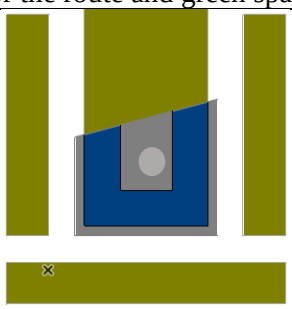
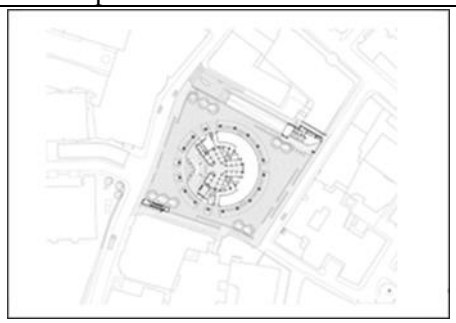
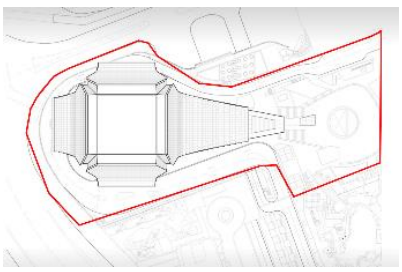
International Centre / KPF

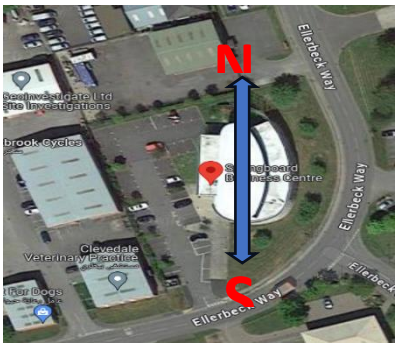
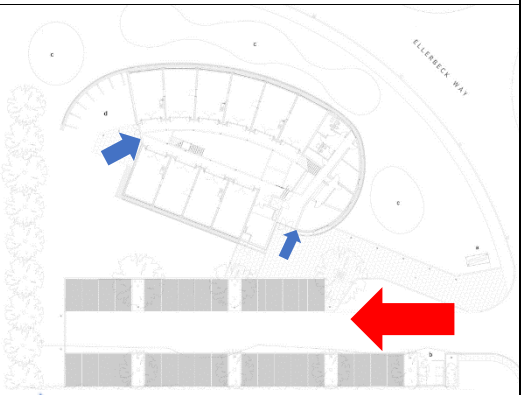
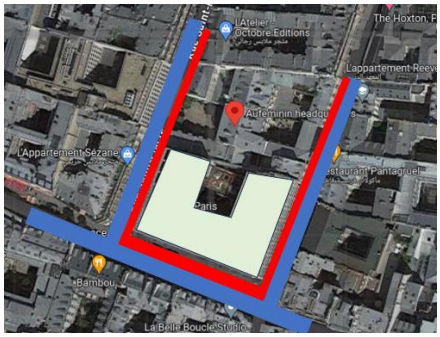
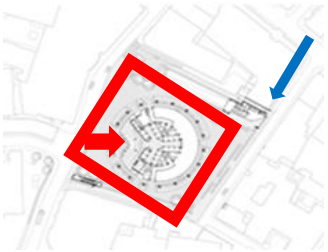
Example from architectural review:

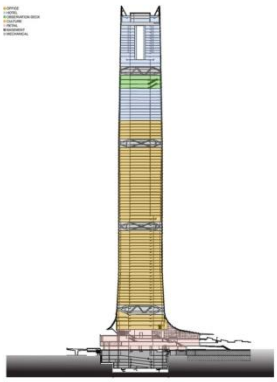
NUMIDIA “ANNABA” business center.

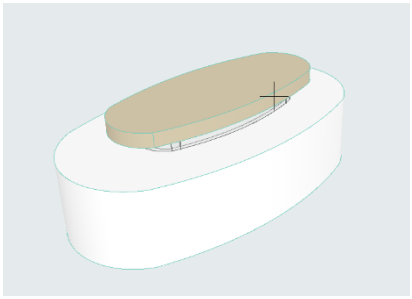
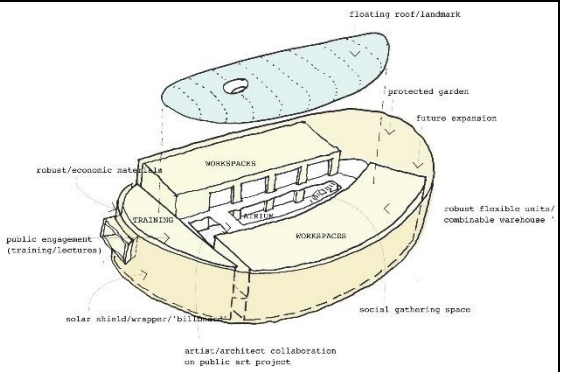
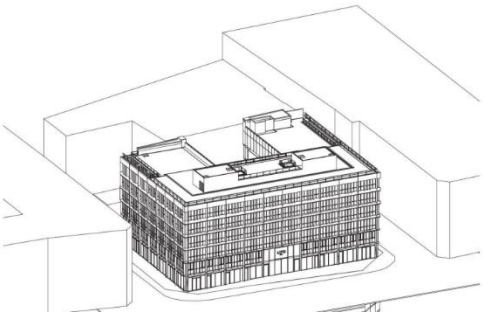
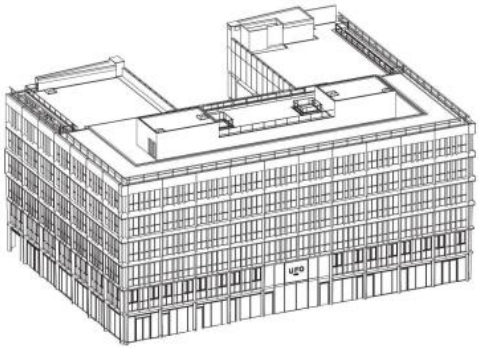
The Project	Technical information	location
 **Springboard Business Centre**	Type: business centre. Execution date: on11 April 1985 Architects: McDowell Benedetti	located in an industrial park in Stokesley,North Yorkshire
 **UFO business centre**	**PROJECT MANAGER:** Raiffeisen Immobilien **PROJECT MANAGEMENT:** Design and construction: Axel Schoenert architects **SURFACE**: 8000 m² **CERTIFICATIONS:** HQE excellent, BBC, BREEAM excellent, WELL Gold, Wired Score Platinum	Located in 22-24 rue des Jeuneurs, 75002 Paris.
 **Swiss Re building**	Architects: Foster +Partners client: Swiss Re Area: 64,469 m² Height: 180 m | 590 ft Project Year: 1997 – 2004	Location: St. Mary Axe, Bury Street, Bury Court and Browns Buildings, London,
 **International Commerce Centre / KPF**	Kind:business centre Date of completion: 2002-2010 Architect: KPF (Kohn Pedersen Fox) Associates	HONG KONG,

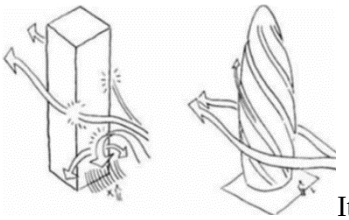
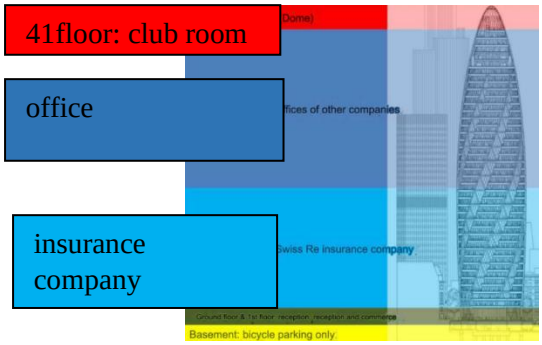
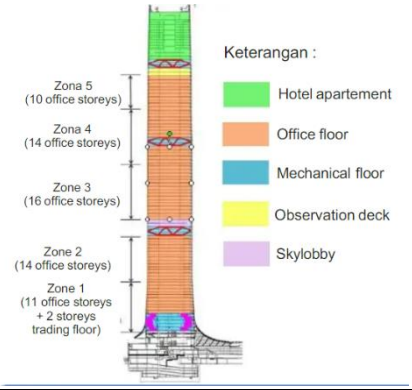
The Project	
Springboard Business Centre	 The project is located in the midst of the industrialpark and has a good positioning on the site
UFO business Centre	 The project located in a compact site and well-integrated into the environment
Swiss Re building	 • located in the business district of the City of London in England. • The building look like as if it is planted on the Street .
International Centre / KPF	 in West Kowloon, Hong Kong. It is a part of the Union Square project on top of Kowloon Station. It was the 4th tallest building in the world (third in Asia) when its construction was completed in 2010.

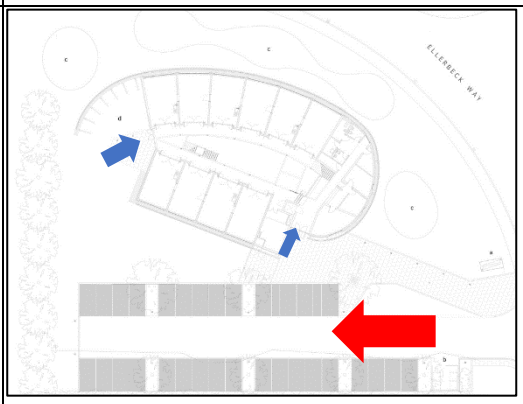
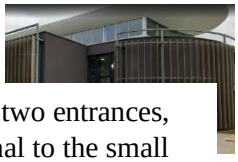
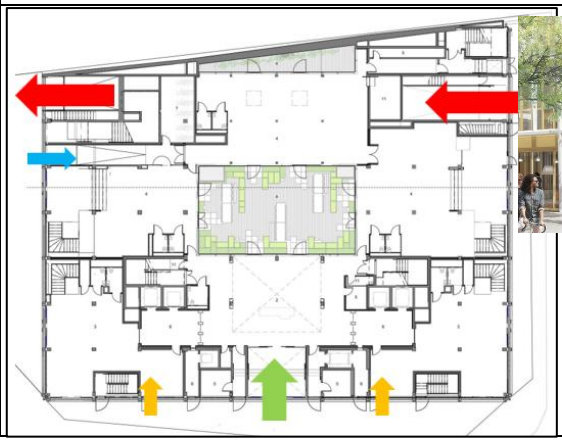
The project	The project in its immediate environment	The project parcel
Springboard Business Centre	 The project Stokesley business park Terry Dicken business park The building is surrounded by industrial equipment	 The built part the unbuilt part The project occupies 40% of site and the rest for the route and green space
UFO business Centre		 The built part The unbuilt part The project occupies 30% of site and the rest for patio.
Swiss Re building	 •Lloyd's Building •St'Helen's •Tower 42 •Bevis Marks Synagogue •Bishopsgate •Mitre Square The building is surrounded by administrative buildings.	 The built part The unbuilt The project occupies 37% of site and the rest public space.
International Centre / KPF	 lined with an impressive array of skyscrapers along its shores. The latest supertall addition by architects KPF reaches an altitude of 484 meters above the Victoria Harbor in Kowloon.	 The boundaries of the site and the tower

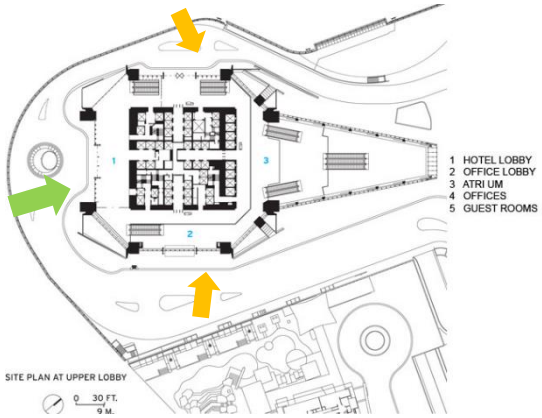
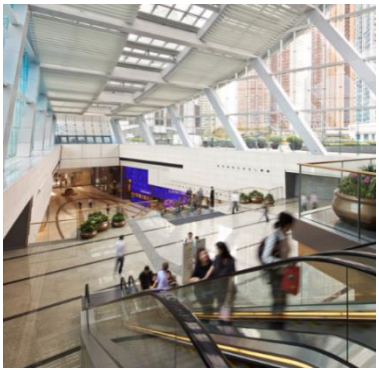
The project	Project integration	Accessibility
Springboard Business Centre	 The architect took into consideration the North South axis to maximize daylight through a central atrium	 Pedestrian access Mechanical access The project is well served by mechanical and pedestrian access
UFO business Centre	 The project is integrated into its environment. It represented the architectural style of the city as well as the architectural envelope that reflects the nature of the city and the dominant colors, while respecting the height of the urban fabric.	 Pedestrian access Mechanical access The project The project has high accessibility as it is located between three main mechanical axes
Swiss Re building	 its cigar shape responds especially to the small plot of land Allows you to clear all the remaining space is arranged to create a public square which will be landscaped	 Pedestrian access Mechanical access The building has high accessibility pedestrian but have No provision for private car parking.

International Centre / KPF	 A fluid and continuous relationship between the interior of the building and the environmental place	

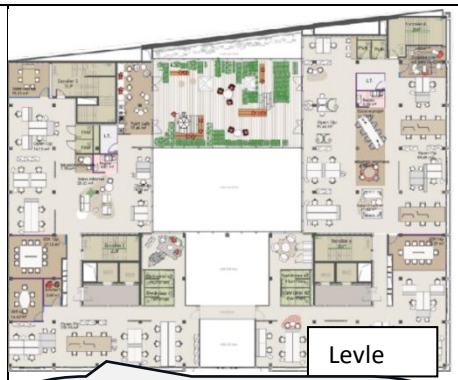
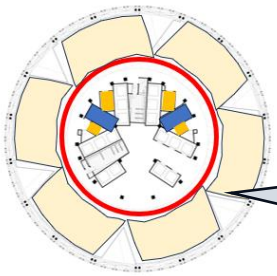
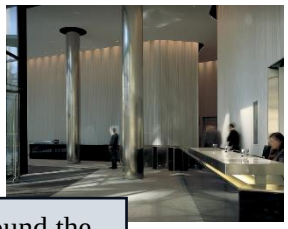
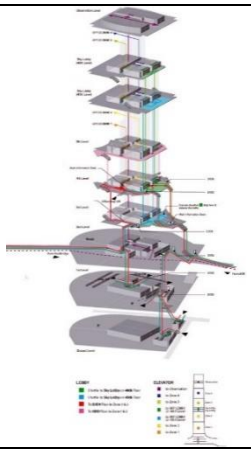
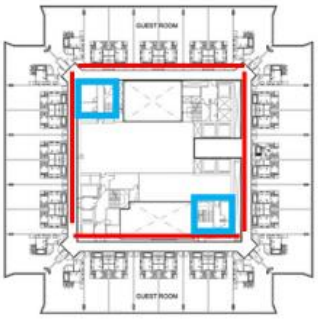
The project	**Volumetry**	The composition
Springboard Business Centre	 The project consists of an oval shape at the base and a floating roof at the top in order to give natural lighting and locate the center	 The architect relied on arranging the spaces around a central corridor bordered by a strict layout of two rows of offices on two floors.
UFO business Centre	 The general shape of the project is a sculpted parallelepiped	 The volumes are grouped and rationalized around a central patio, which provides natural light to the office floors, all of which benefit from dual exposure

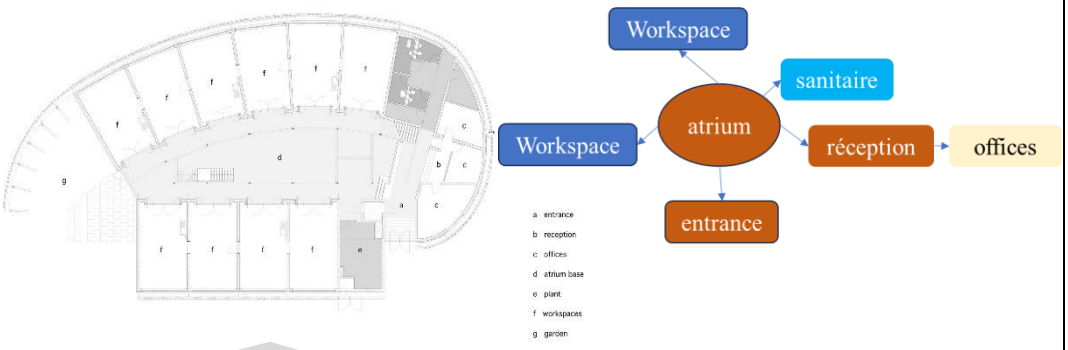
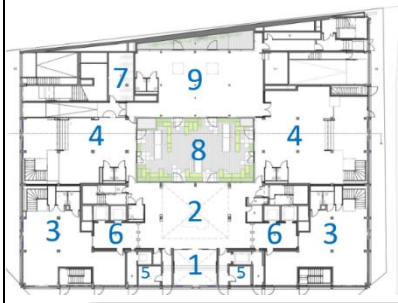
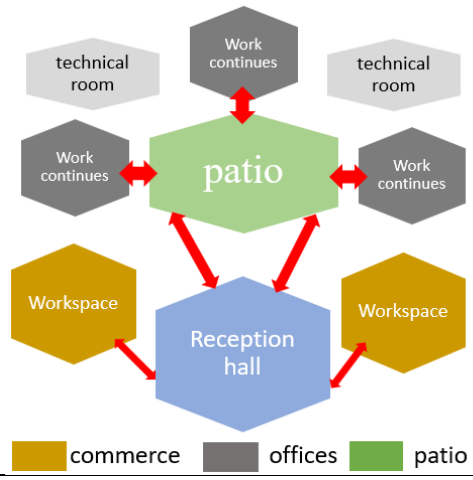
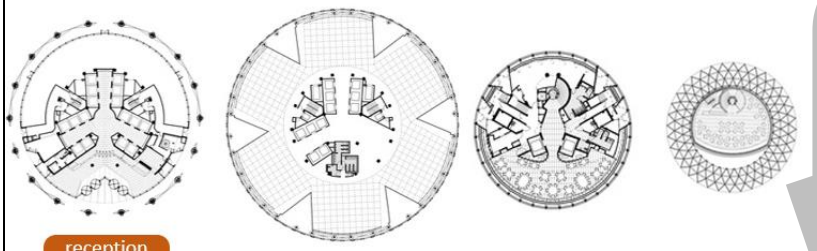
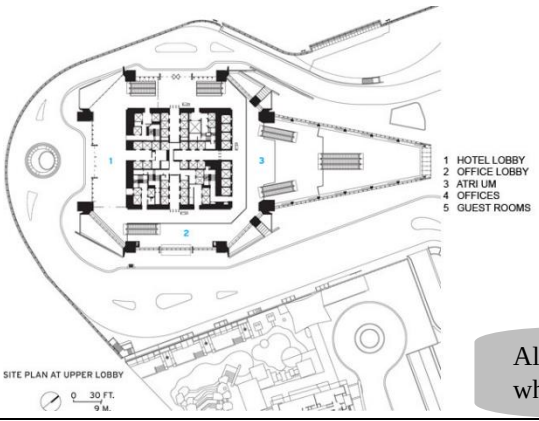
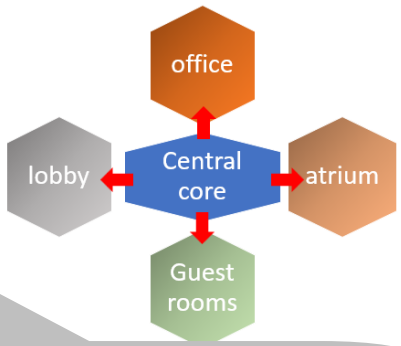
Swiss Re building	 Its aerodynamic shape makes it possible to reduce the effect of wind around the building and to use it in the building's ventilation system.	
International Centre / KPF	 Analyzed wind performance and tenant preferences. -Circular floor plate good for wind, but not preferred by financial tenants. -Square floor plate preferred by tenants but performs poorly in the wind. -Chose a square floor plate with notched corners for improved wind response.	

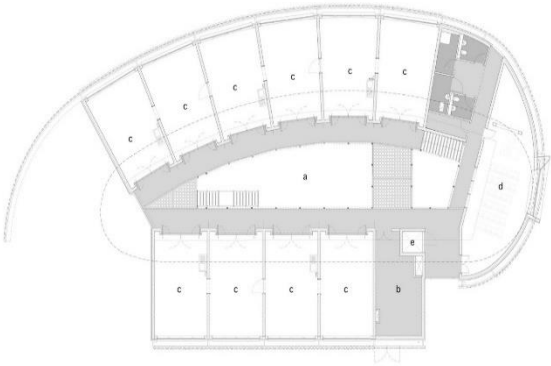
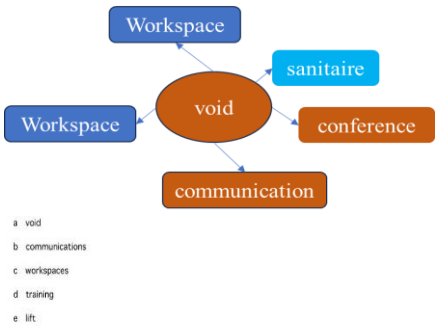
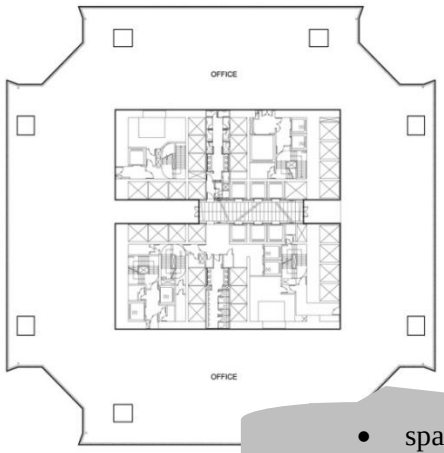
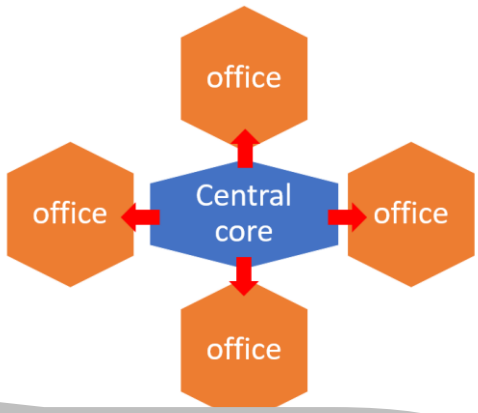
The project	The project in its immediate environment
Springboard Business Centre	 mechanical access Pedestrian access   The project has only two entrances, and this is proportional to the small size of the project
UFO business Centre	  mechanical access Pedestrian access (principal) Pedestrian access (secondary) bicycle access The architect decided to distribute the entrances according to use

Swiss Re building	  Pedestrian access (principal) Pedestrian access (secondary) bicycle access The building has entrances for pedestrians only in order to provide space for movement
International Centre / KPF	 Pedestrian access (principal) Pedestrian access (secondary) 

The project	circulation
Springboard Business Centre	  curved circulation Linear circulation Elevator The architect use both of curved and linear circulation because the form of the central atrium

UFO business Centre	 Levle We notice the movement within the space is unrestricted, with vertical circulation via stairs.  evle 02 the movement within the space is linear, with the presence of vertical
Swiss Re building	  The circulation is horizontal around the core area at the center and its vertical inside the core area (stairs, lifts)
International Centre / KPF	 Utilizes a system of cascading escalators to divide office population between local and shuttle elevators. Linear circulation Elevator 

The project	Spatial and functional organization
Springboard Business Centre	 The DRC divides the sectors according to their functions
UFO business Centre	 1 SAS principal 2 Reception hall 3 Workspace 4 Work continues 5 Technical room 6 ESC/ASC stage 7 Bike room 8 patio 1 9 patio 2 • This level is for serves and visitors • spatial organization around a central patio 
Swiss Re building	 *All spaces are connected to a central core which contains services, stairs and toilets *Spatial organization of the offices is free
International Centre / KPF	  All spaces are connected to a central core which contains services, stairs and toilets

The project	Spatial and functional organization
Springboard Business Centre	 
UFO business Centre	  1 Meeting room 2 Office 3 Unions/CE 4 Passage 5 Empty on ground floor 6 ESC/ASC stage 7 Accessible terrace 8 Empty space on patio 1 ground floor 9 Empty on patio 2 ground floor • This level is for working and meeting • spatial organization around an empty space
UFO business Centre	  TYP OFFICE_L009 • spatial organization around central core which include the elevators and toilets

NUMIDIA “ANNABA” business center

This project is a proposal made by the (B.E.W.A) on behalf of the EPLF, to give a new dynamic to the city center.

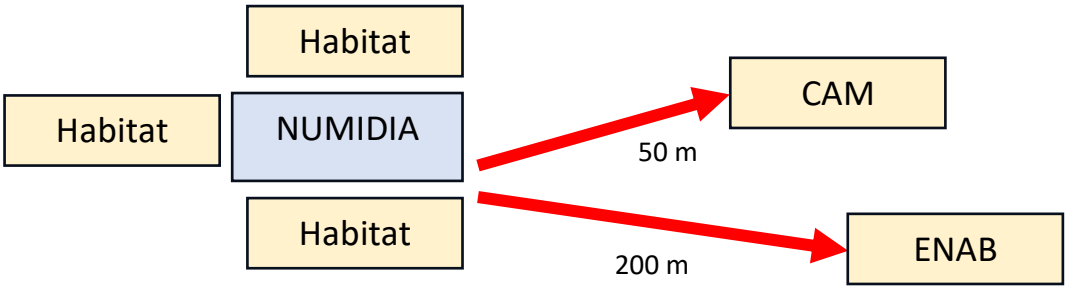
Location:

- The project is located southwest of the city centre at a distance of 200 m.
- Served by the highway which connects SafSaf to the city centre, this gives great importance to the project.

<u>Situation in relation to the immediate environment:</u>

-It is located in an area surrounded all around by mechanical roads and limited by industrial housing of R+2.

-It is close to two (02) business centers which are CAM and ENAB.



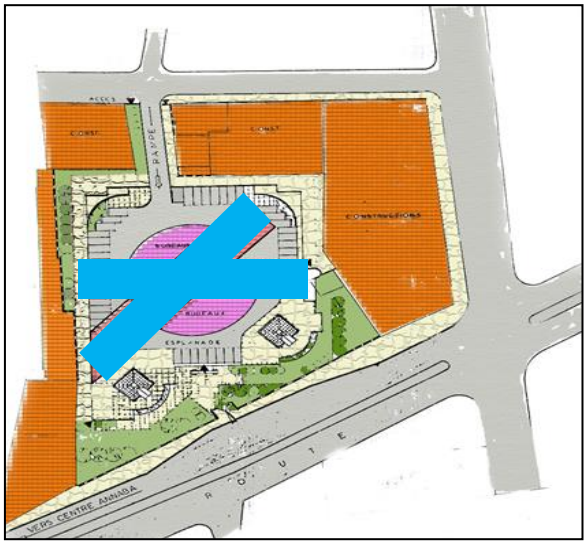
The project parcel:

Buildings

Parking

Business

Hosting



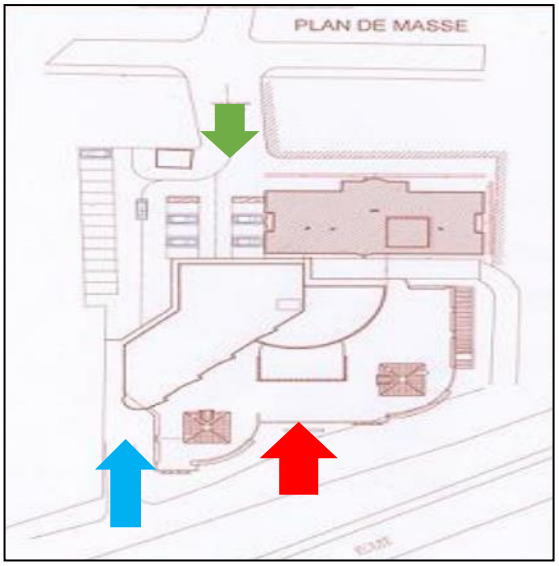
Accessibility:

Pedestrian access

Mechanical access

Personal access

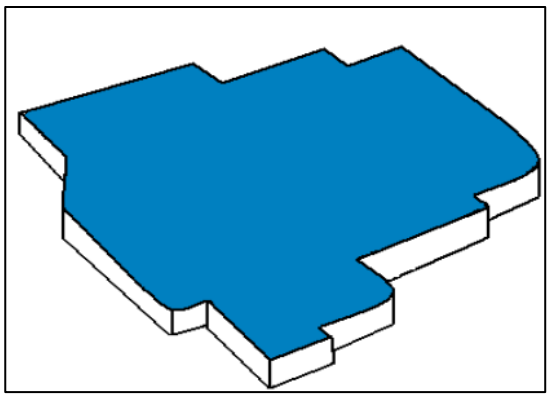
The project is well served by mechanical and pedestrian access



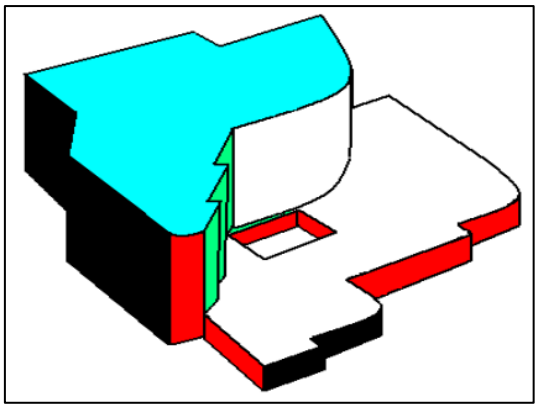
Volumetry:

The project is a compact and monolithic volume, consisting of 03 components:

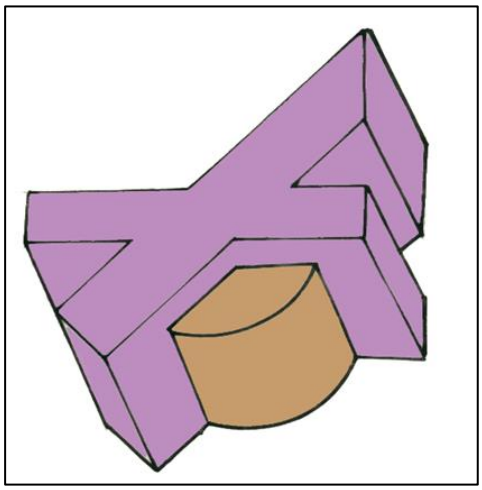
Volume 01: For this volume, we observe the combination of various geometric shapes following a repeated rhythm (curves), hollowed at the center to make the patio, providing both lighting and ventilation."



Volume 02: The architect followed the curved rhythm associated with setbacks.



Volume 03: The intersection of two rectangles and a circle, it houses liberal professions and accommodation.



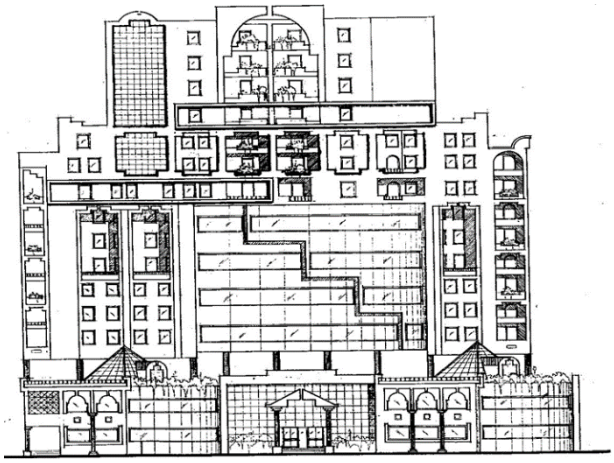
The project components can be read through the external appearance

Façade:

The significance of the facade is linked to the urban context of the city, expressing contemporary architecture while incorporating architectural elements correlated with the old town and colonial fabric.

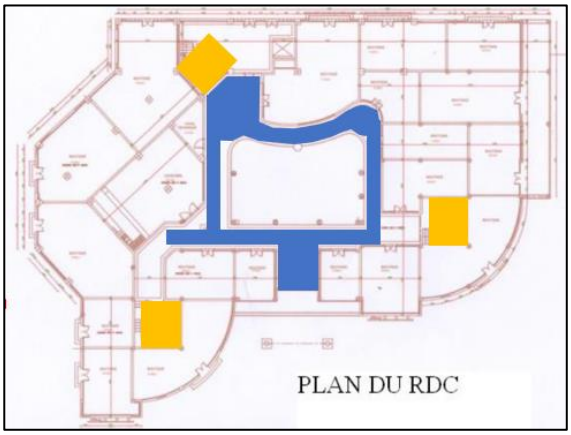
- The use of arches.
- The concept of void and solid expressed in alternation, with dominance in favor of the void to allow natural lighting.

- Play of volume.
- The use of volumes to emphasize the main entrance.



Circulation:

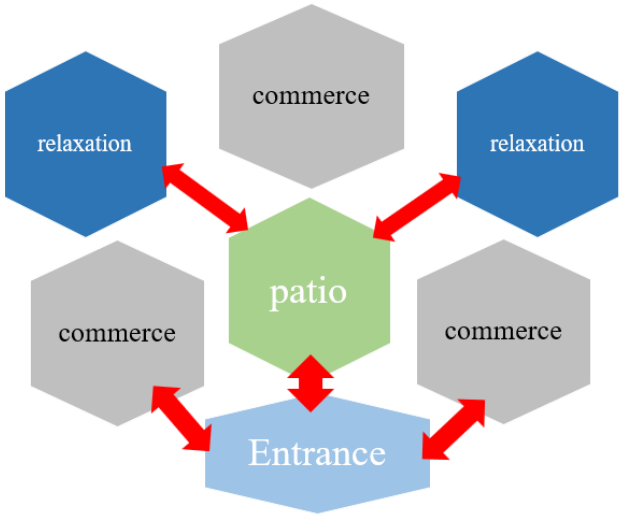
the movement within the space is linear around a central patio, with the presence of vertical circulation

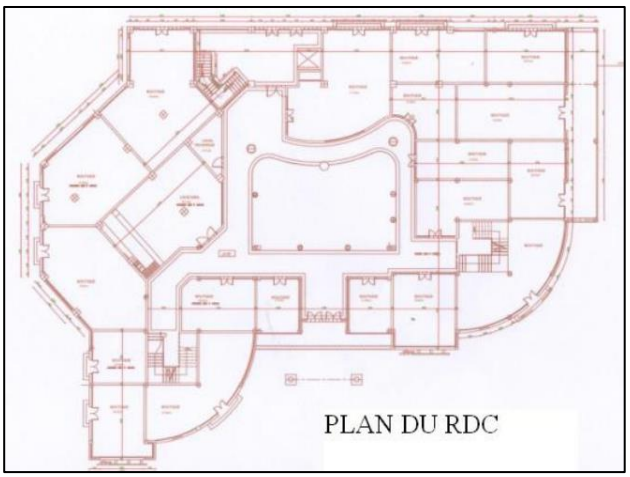


the movement within the space is linear, with the presence of vertical circulation

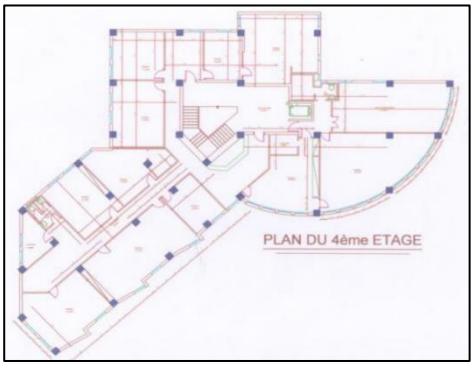
Spatial and functional organization:

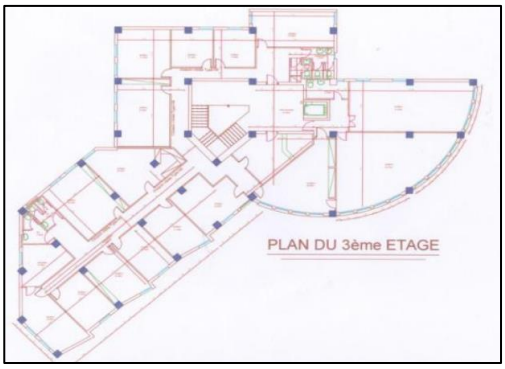
Functional Organization 'level 0+level 01'

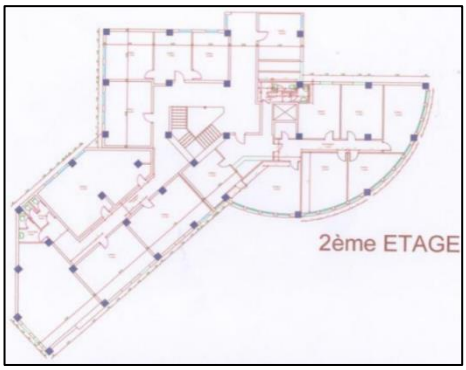




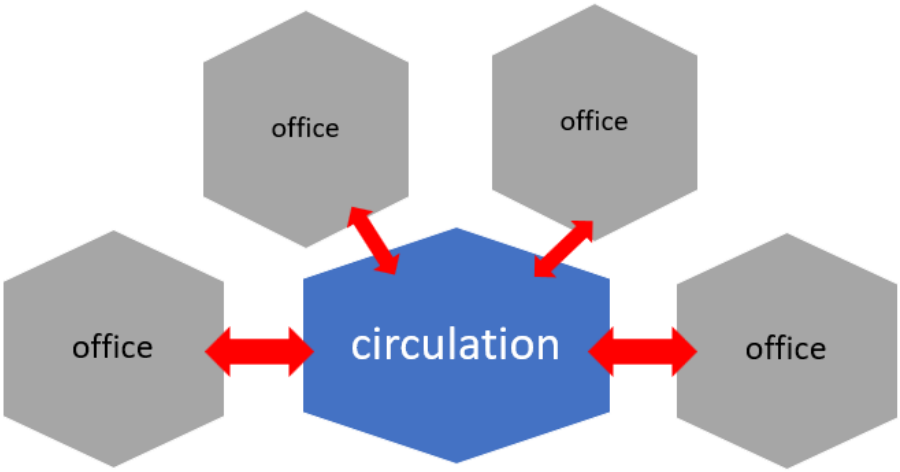
Functional Organization 'level02+level 03+level 04'



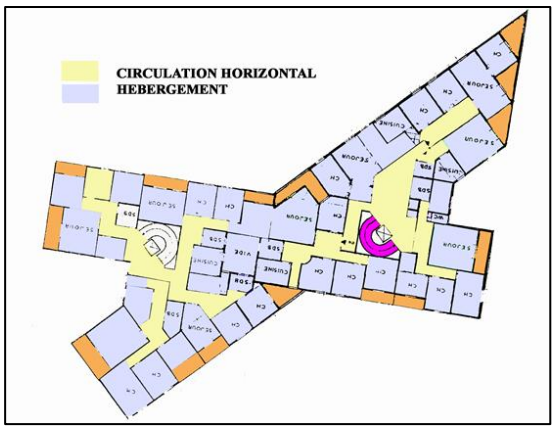


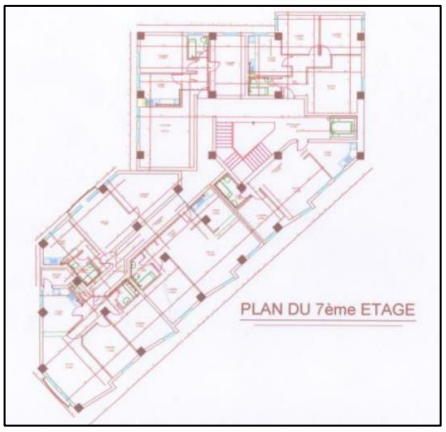


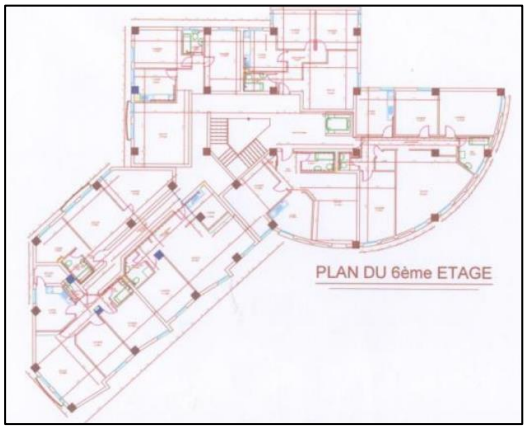
This Levels for business



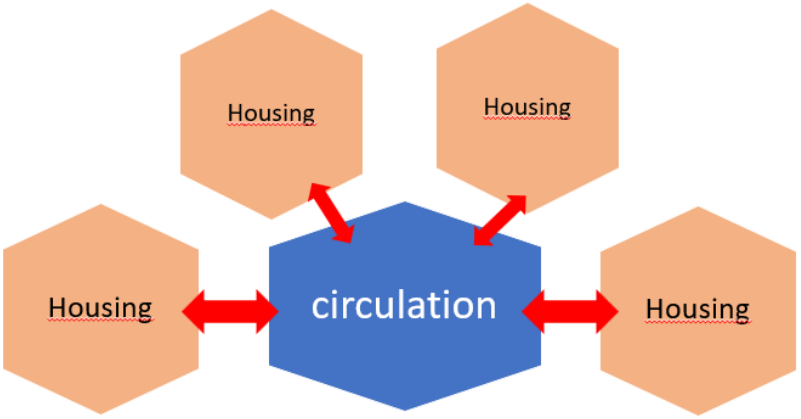
Functional Organization 'level06+level 07+level 08







This Levels for housings



conclusion:

- The arrangement of spaces follows a hierarchy, ranging from the loudest to the quietest and from the largest to the smallest.
- the coexistence of offices and housing may pose a disadvantage to individuals' privacy.
- Distribution of entrances according to the type of space use.

II. Analyze examples about adaptive envelope

II.1 Institute of the Arab World

Basic Information:

- Client: Foundation of the Institute of the Arab World
- Program: Cultural Center
- Location: Paris, France
- Completion Date: 1987
- Area: 26,900 m²
- Site Area: 7,250 m²
- Architect: Jean Nouvel, Architecture-Studio, Gilbert Lezenes, Pierre Soria
- Contractors: Nord France (General Contractor), Baudin Chateauneuf (Construction Manager)
- Structural Engineering: SETEC Bâtiment
- Adaptive Envelope Area: 2,000 m²
- Coordinates: 48°50′ N, 2°21′ E
- Average Temperature: Max June 26°C, Min January 8°C
- Climate: Oceanic

Fig 33: Institute of the Arab World
Source: quechuytrinh. (2020). master theses lonvlope adaptative

Energy Performance

The Arab World Institute is one of the earliest examples of adopting adaptive architecture in the world. In the 1990s, when information technology and materials technology were not sufficiently developed, only mechanical technology played a significant role in realizing this ambitious project. A south facade of 2000m² consists of 240 moucharabiehs corresponding to thousands of pieces made of aircraft-grade aluminum alloy, steel, and bronze. However, highly mechanical solutions tend to break easily, and the different parts are not easy to

replace when this happens. This is why the openings required more maintenance than the Arab World Institute was able to provide, and within a few years, the system had stopped working. In other words, the design of the articulated transmission has so many details that it leads to a lot of energy consumed due to friction. So, the amount of energy needed to operate the system is significant. From an energy perspective, Jean Nouvel's adaptive envelope design for the Arab World Institute did not achieve any savings, but it historically acts as a proud pioneer that understood the potential of an adaptive envelope to contribute to a building's performance

The entire envelope has 240 moucharabieh panels. "Each square panel measuring 198 centimeters on each side consists of thousands of pieces made of duralumin (an alloy used in aircraft construction), steel, and bronze. These pieces slide relative to each other and form, in the center, a large moucharabieh, forty small ones surrounding it, sixteen medium ones on the periphery, and sixteen others completing the composition - totaling seventy-three movable devices like camera lenses

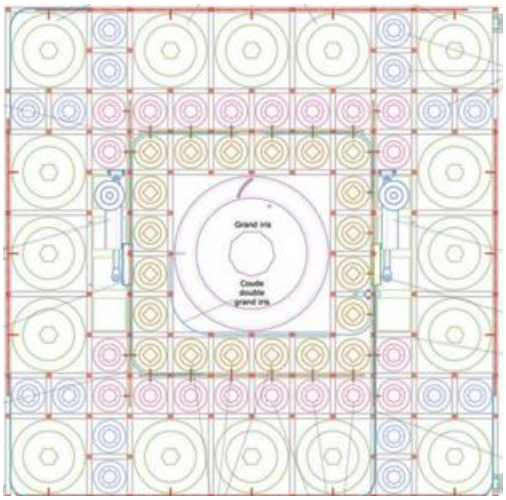


Fig 34: moucharabieh
Source: quechuytrinh. (2020). master theses lonvlope adaptative

Function

The southern facade has a total of 240 moucharabieh panels comprised of numerous metal diaphragms in various sizes. These diaphragms are controlled by electronically operated servo motors that respond to changes in sunlight intensity. They function similarly to a camera shutter, opening and closing to regulate the amount of light entering the interior. A central computer receives data on solar intensity and outside temperature from an external sensor located on the roof. Users can predefine a setpoint for temperature and solar intensity;

all servo motors are then controlled by the central computer to open or close the diaphragms accordingly.

Solar intensity serves as the primary condition for controlling the diaphragms. If sunlight levels exceed the predefined setpoint (for example, on a very sunny summer day), the central computer commands the diaphragms to close to regulate the interior light intensity and minimize solar heat gain. However, when the outside temperature falls below 5°C, the computer disregards solar intensity and commands all diaphragms to open to maximize solar heat gain. The servo motors operate based on digital signals from the computer, meaning the diaphragms can only be fully open or fully closed. The mechanism is timed to perform a maximum of 18 movements per day.

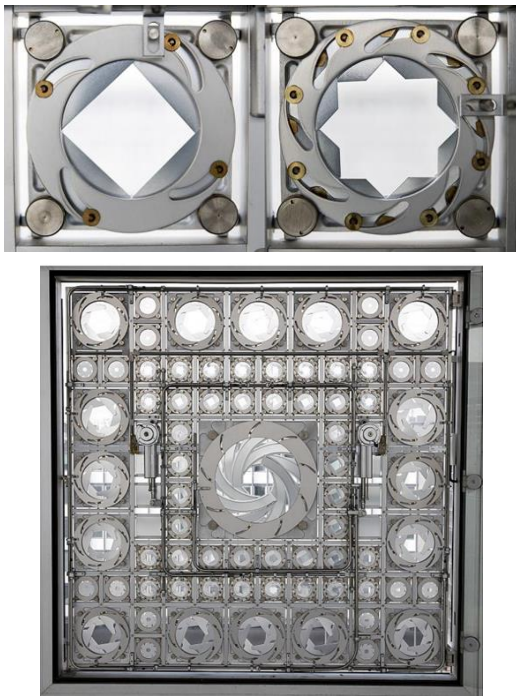


Fig 35: moucharabieh
Source: quechuytrinh. (2020). master theses lonvlope adaptative

Conclusion

Although the adaptive envelope of the southern facade of the Arab World Institute did not effectively function from an energy perspective, what I consider the legacy of this project is that it was one of the first to understand the potential of an adaptive envelope to contribute to a building's performance. Furthermore, it not only made it a matter of performance but also turned it into a more poetic component of architecture. If Jean Nouvel were to design the Arab World Institute today, it would be a very different building. It might not seem different,

but it would be vastly different from a technological standpoint. It would function well and be easier to maintain.

II.2.Media-TIC / Enric Ruiz Geli

OFFICE BUILDINGS

BARCELONA, SPAIN

Architects: Enric Ruiz Geli

Fig 36: Media-TIC building
Source: archidayli.com

The Medio-TIC Office Building uses distributed sensors to control solar shading through the ETFE (ethylene tetrafluoroethylene) cladding. The ETFE cladding surface has two different configurations to match the building's orientation to the sun. The southwest facade filters solar radiation through a screen of vertical padded panels filled with nitrogen, resembling a cloud-like sunshade and the southeast facade consists of a shading system made of a polymer ETFE cladding with coated thin slats, whose pneumatic mechanisms are automatically triggered by light sensors when exposed to sunlight.

Fig 37: Media-TIC building
Source: quechuytrinh. (2020). master theses lonvlope adaptative

The cladding consists of three layers of material on the facade exposed to significant sunlight. These layers are automatically inflated using sensors to create two empty chambers. The first layer of ETFE is transparent, while the second and third layers have an inverse pattern design that, when inflated or deflated, makes the facade either transparent or opaque. This prevents the entry of light and heat during maximum sunlight. This is known as the "ETFE Diaphragm" configuration. The system can adjust the airflow through the facade, with appropriate objectives in terms of energy efficiency.

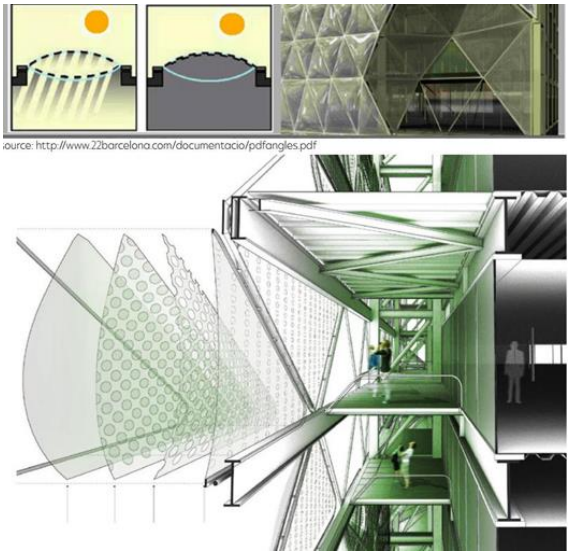


Fig 38: Media-TIC envelope
Source: quechuytrinh. (2020). master theses lonvlope adaptative

Overall, the Media-TIC Office Building achieves 20% energy savings by using 2500m² of ETFE cladding.

III.Analytical synthesis of examples:

	Synthesis
Situation	The projects are mainly located in the heart of cities, in the compact urban site
The project in its distant environment	The projects located in a compact's sites and well-integrated into the environment
The project in its immediate environment	Most of project are located in compact site or in business district, surrounding by commercial facilities
The project parcel	Most projects utilize 50 to 70 percent of the parcel
Project integration	Taking into account the north-south axis in order to increase natural lighting as well as control solar rays.
Accessibility	The projects are well equipped with access
Volumetry	All of projects are monobloc, With differences in shape depending on conception
The composition	Most projects have architectural forms with space central (atrium) for lighting and natural ventilation
La circulation	Diversity of paths: free, circular, curved, and linear type to connect project spaces.
The entrees	Diversity of entrances (main entrance, secondary entrances, entrance mechanical and pedestrian)
Spatial and functional organization	The main component spaces of business centers are: offices, conference, meeting room and exhibition.

IV.Proposed program:

Section	**Spaces**	the number	The area	The total area
reception	Reception area	01	16	16
	Waiting area	01	140	140
	Administration and services	04	16	64
Total=220				
Business	Partitioned offices	140 posts	1p 5m	700
	Co working	300 per	1p 4m	1200

	Semi-open offices	300 per	1p 5m	1500
	Meeting rooms	13	26	338
	Conference room	01	200	200
	Exhibition space	02	200	400
	Room Visio-Conference	5	16	80
	Creative rooms	6	16	96
Total=4255				
services	banking annex	01	120	120
	communication agency	01	120	120
	tourist and travel agency	01	120	120
Total=360				
commerce	shops	12	20	240
Consumption	Restaurant	01	100	100
	Cafeteria	05	28	140
Total=480				
Leisure and relaxation	Prayer (men/women)	04	12	48
	gym	01	300	300
Total=348				
Management	Director's office	01	60	60
	Secretary’s Office	01	15	15
	Meeting room	01	60	60
	Accounting office	01	15	15
	Reception office	01	15	15
	Archives	01	15	15
	Cloakrooms	01	15	15
	Control points	01	15	15
	Camera control spaces	01	15	15
Total=210				
sector Technical	Storage	04	50	50
	Technical area	01	20	20

	toilets	40	2.25	90
	Security room	05	16	80
Total=240				
Parking = 70 Cars				
Total	6113			
Circulation	20%T: 1223			
total built-up area	7.336			

V. Contextual Study and Site Analysis:

V.1.1. Context Analysis

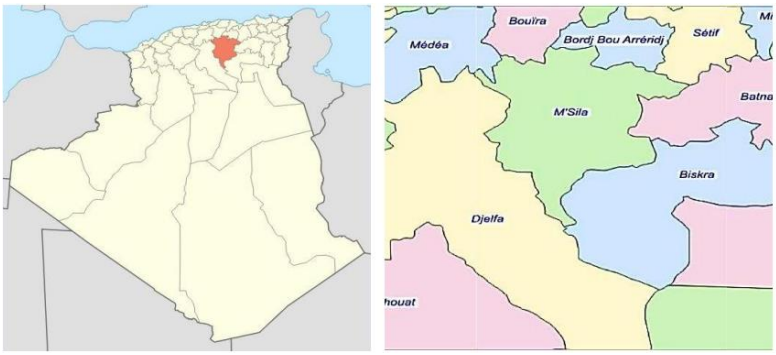
V.1.2.Geographic Location:

M'sila is located in the central part of Algeria, 250 km from the capital, Algiers. It is part of the Central High Plateaus region and covers an area of 18,175 km².

Geographic Boundaries:

The province of M'sila is bordered by:

- To the northeast, by the provinces of Bordj Bou-Arreridj and Sétif;
- To the northwest, by the provinces of Médéa and Bouira;
- To the east, by the province of Batna;
- To the west, by the province of Djelfa;
- To the southeast, by the province of Biskra.



Location map of the province of M'sila and the boundaries

V.1.3.Climate of msila :

M'sila has a temperate Mediterranean climate with hot and dry summer (Csa) according to the Köppen-Geiger classification. Over the year, the average temperature in M'sila is 20.5°C and precipitation is on average 148.1mm.

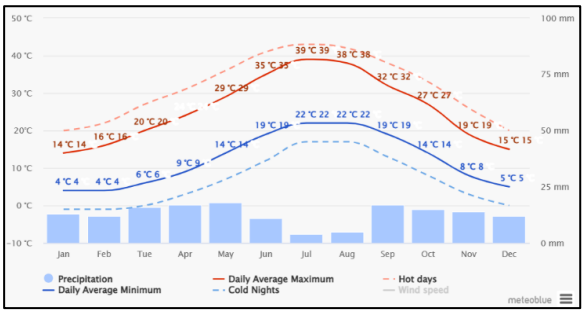


Fig 39: climate of msila

Source: meteoblue.com (2023)

- The temperature varies throughout the year. It increases in summer and decreases in winter. It is noted that in the month of December it reaches the lowest. It has a level in winter, but outside the season it reaches a higher level in Jul.
- msila receives very reduced amounts of precipitation

Cloudy skies, sunshine and rainy days:

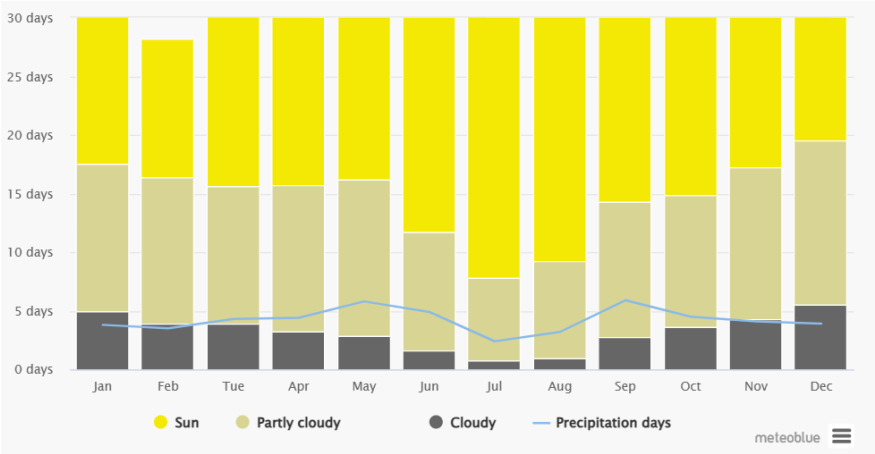


Fig 40: Cloudy skies, sunshine and rainy days

Source: meteoblue.com (2023)

M'sila is characterized by sunny weather for most months of the year, which explains the low rainfall.

The Wind :

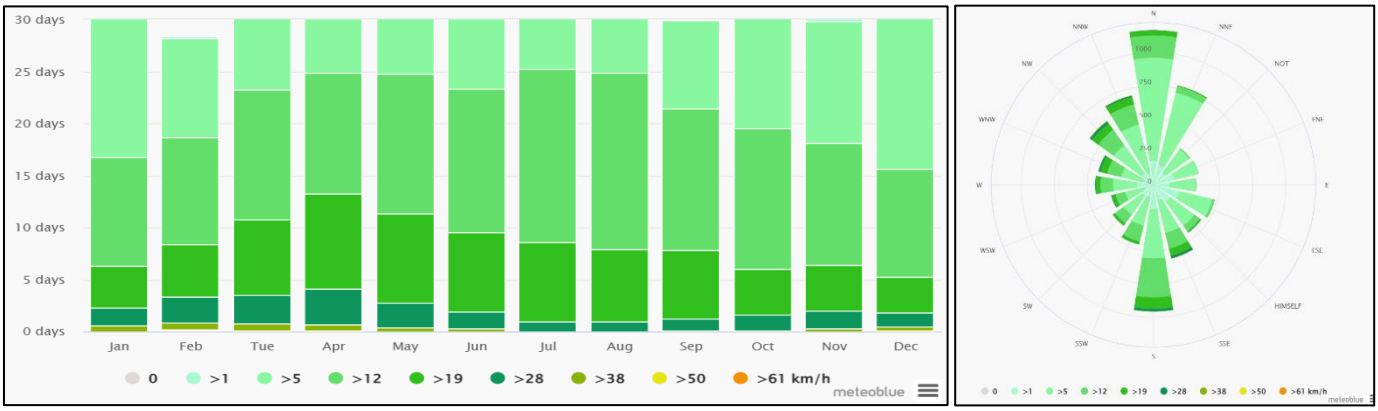


Fig 41: wind speed

Source: meteoblue.com (2023)

According to climate data, the prevailing wind comes from the north in the winter and from the south in the summer, with an average speed of 12 km/h.

V.1.4.Bioclimatic analysis of the city of M'sila:

The bioclimatic analysis and reading of the city of M'sila are primarily based on the analysis of climatic data using Mahoney tables and Givoni diagram.

This enables us to derive recommendations that assist us in the design process:

- Site layout: Compact plans with interior courtyards
- Spacing between buildings: Compact layout
- Air circulation: Unrestricted air circulation
- Openings: Moderate, 25 to 40% of the wall
- surface Placement of openings: Openings in the North and South walls, including openings in interior walls
- Protection of openings: Shielding from direct sunlight

V.1.5. Synthesis of recommendations:

The climate of the M'sila wilaya experiences very hot and dry summers. Therefore, during the summer period (from May to September), M'sila climate requires:

- Nighttime ventilation for buildings, which should be compact to reduce sun exposure.
- Utilization of insulation and vegetation as shading and cooling tools.

V.1.6 Location of the site in the city

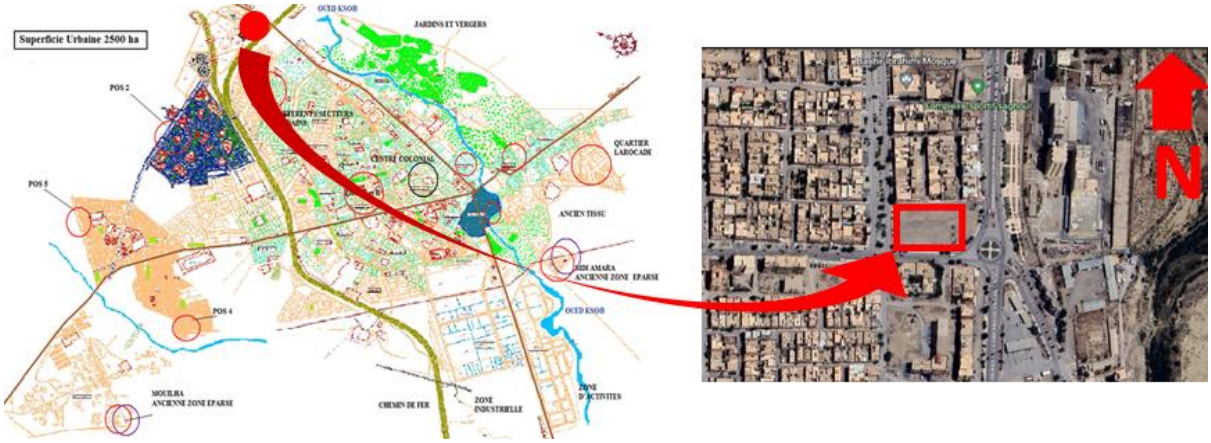


Fig.42 : site location
Source : Plan directeurd'aménagement et d'urbanisme PDAU, 2010 treated by the author

Fig 43: view of the terrain
Source: author

The site is located in the city of M'sila, City 270, with an area of 5000m².

V.1.7 Immediate environment

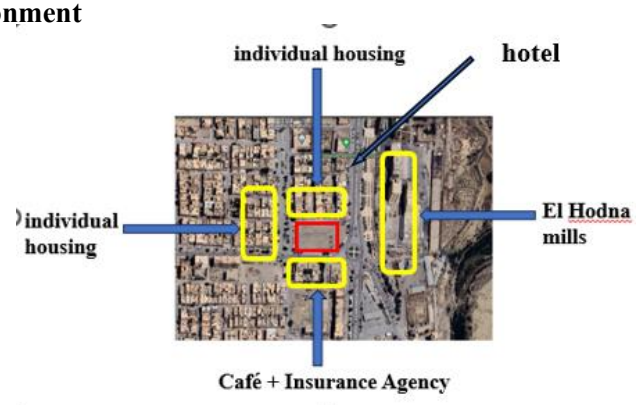


Fig.44: site location

Source : google earth treated by the author

There is diversity in the environment surrounding the site

V.1.8. Accessibility

The site is located near the three mechanical routes, the main route (700), which facilitates accessibility to the project

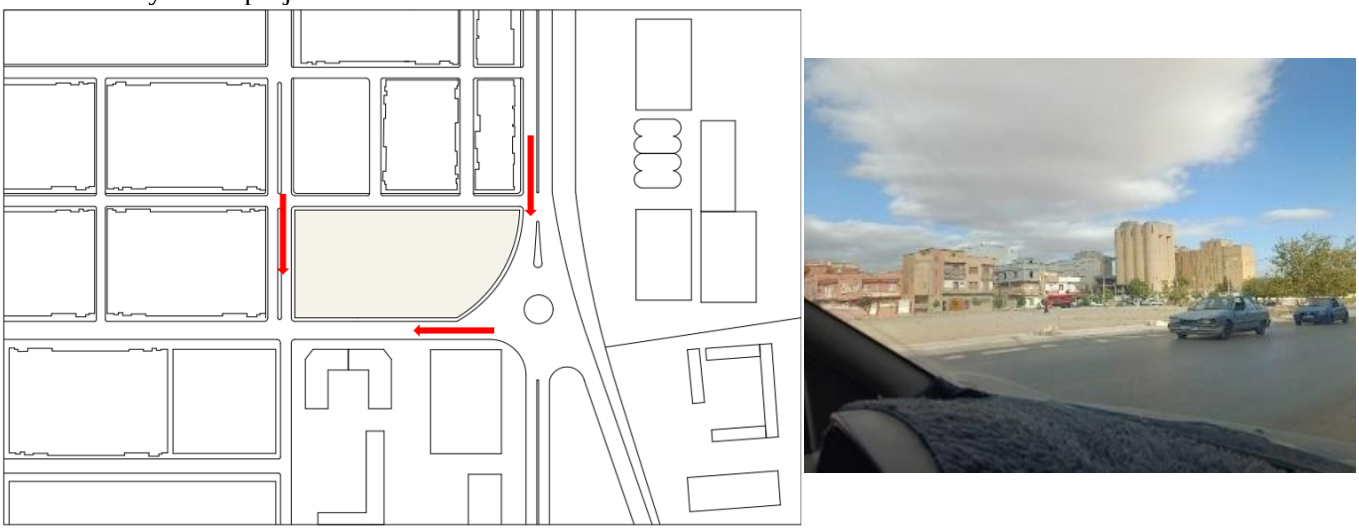


Fig.45: Accessibility
Source: author

V.2. Parcel study

V.2.1 Morphology:

The shape of the site: a regular geometric shape, almost rectangular.

.

Fig 46: Morphology of the site
Source: google erth treated by author

V.2. 2. Sunlight exposure

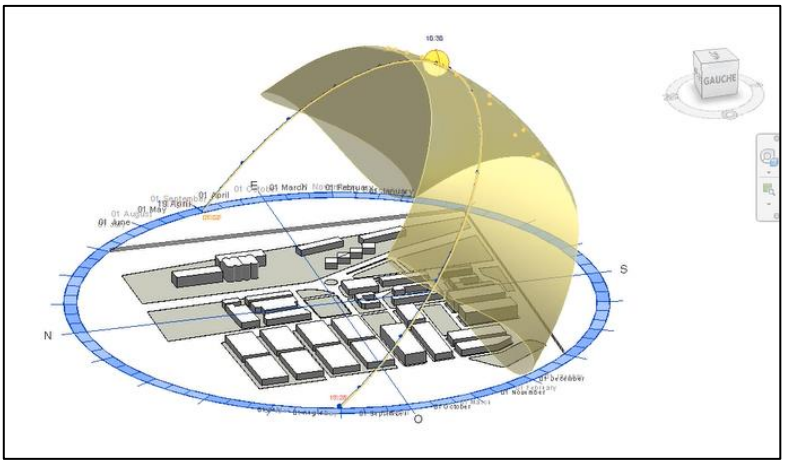


Fig 47: Sun path

Source: author

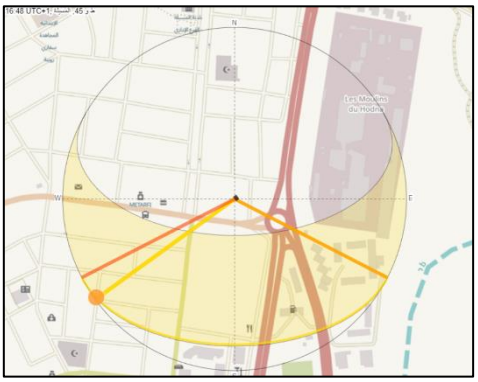


Fig 48: Sun path

Source: author

The site is naturally lit, and well exposed to sunlight, allowing good use of natural lighting of spaces according to needs and must be protecter from direct.

V.3. Synthesis:

The location is strategic, as it is located on the city's axis, which gives the project a landmark

The land is accessible from two directions, the main axis of accessibility gives importance to the land,

Terrain morphology: Soil has a flat morphology without any constraints

The site is naturally lit, and well exposed to sunlight, allowing good use of natural lighting of spaces according to needs.

The land is exposed to hot (S) and cold (N) winds, we can improve the quality of outdoor spaces and reduce exposure to winds.

Conclusion:

In this chapter, we analyzed examples related to the business center project, including written examples and real-life cases. Through this analysis, we reached conclusions regarding the key characteristics that distinguish business centers, both on an urban level in terms of general location, connectivity, flow, etc., and in terms of functional distribution of spaces, movement, facade design, etc. Additionally, we conducted an analysis of the project site, identifying its strengths and weaknesses. Ultimately, we developed a proposed program that responds to the functional requirements of the project as a business center and serves the urban area in which it is located.

— CHAPTER III: —

CONCEPTUAL STUDY

Introduction:

This chapter is based on information obtained by studying various concepts, including thermal comfort, architectural envelope, as well as the principles and design standards specific to business centers. It also incorporates conclusions drawn from the analysis of architectural studies of examples and site analysis of the project. Where we will clarify the basic ideas that play a pivotal role in forming the creative and intellectual basis for the design project.

Finally, we will present the different design stages, the application of simulation, the results obtained, and the conclusions considered in the design and graphic documentation of the project.

1. CONCEPTUAL PATH:

1.1 Passage elements:

Goals	intentions
Goals and intentions for theme	
Implementation of design requirements for adaptive envelope	- Smart systems appropriate to the project function. -adaptive envelope Depending on the active system
Applying the characteristics of adaptive envelope in the project	-Through the building's response to the external environment. - Achieving the lowest energy consumption.
Show and highlight the local identity in the project	- use of traditional local elements
Goals and intentions for project	
Project Landmark	-The high of the Project (Tower) -distinctive facades - rich volumetry
optimal project orientation	-North / South.

flexibility of movement	-separation of the mechanical and pedestrian movement -use movable partitions -Clarity of movement elements!
Transparency	opening of the project to the outside
ensured spatio-functional continuity	Use distribution and assembly spaces.

1.2 The idea:

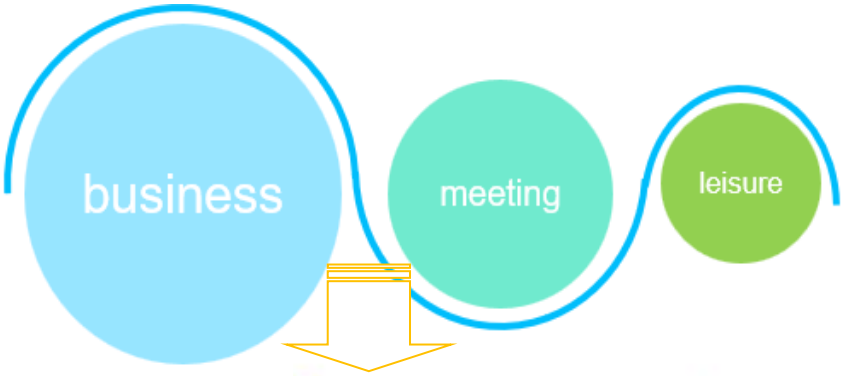
The design concept of the project revolves around blending local traditions with modern innovation in architectural design, drawing inspiration from M'Sila city. One of its notable landmarks is the Bani Hammad Citadel, situated in the village of Maadid. The goal is to reflect the region's history and identity in a contemporary and innovative style.

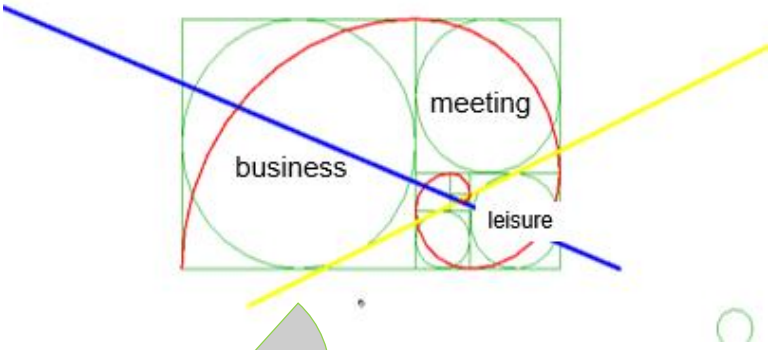
> **First:** I linked two axes: the **historical**, which represents the history of the city, and the second axis, which represents the direction of the city's **modernexpansion.**

1.3. Idea development:

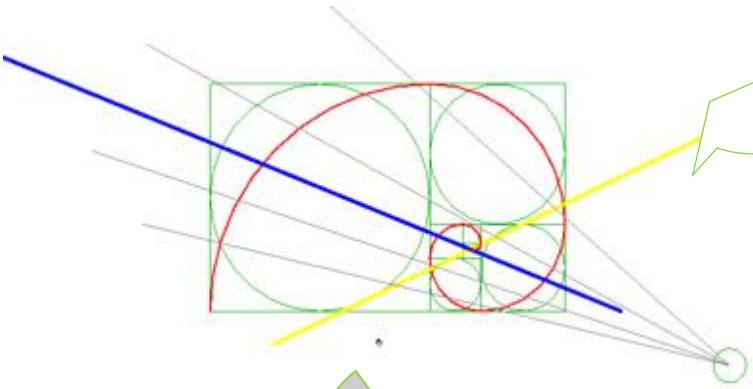
Fig 49: conceptual idea
Source: author

Secondly: we already knew that the basic functions of the project are:

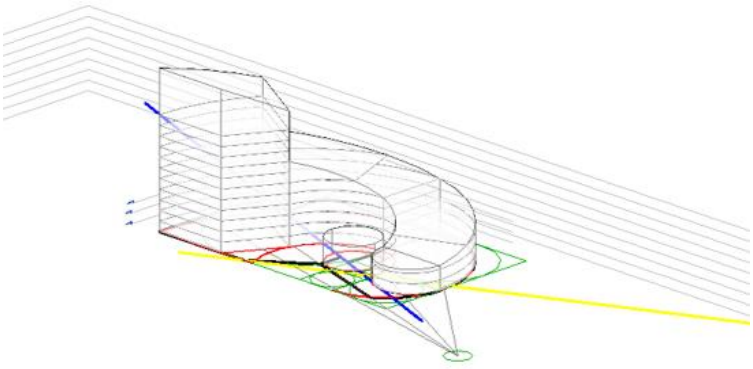




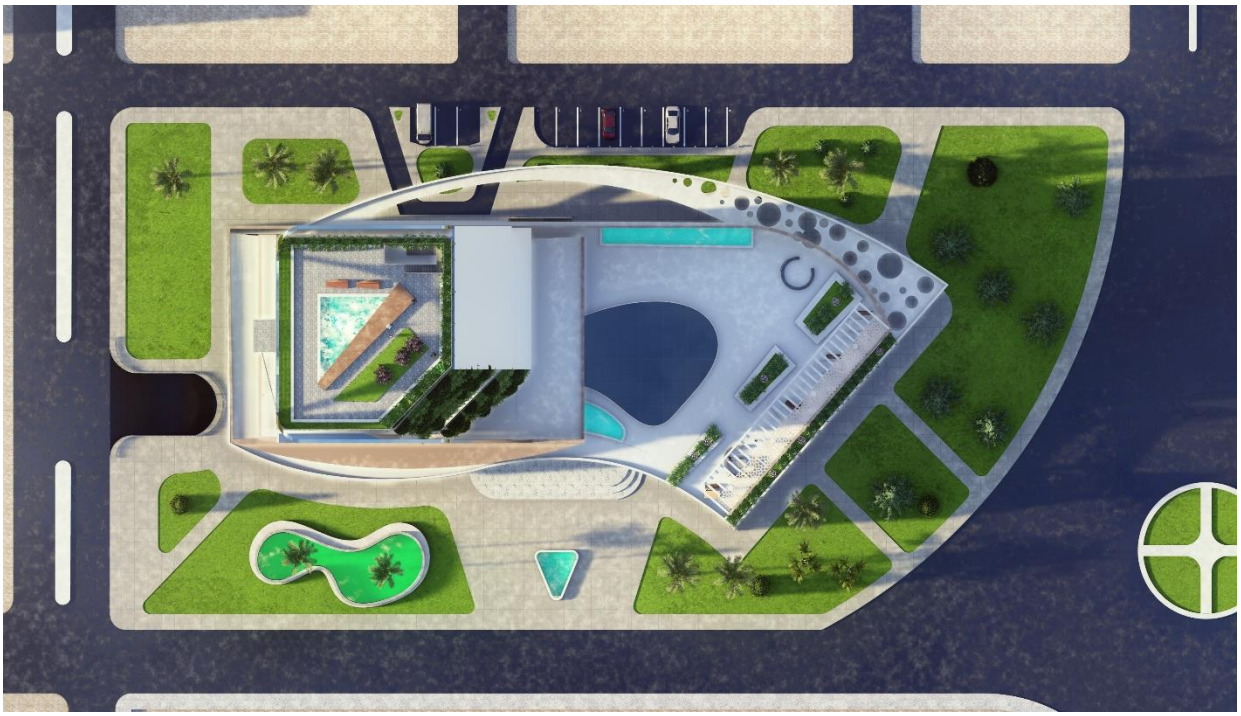
Thirdly: After that I organize this function using the golden spiral



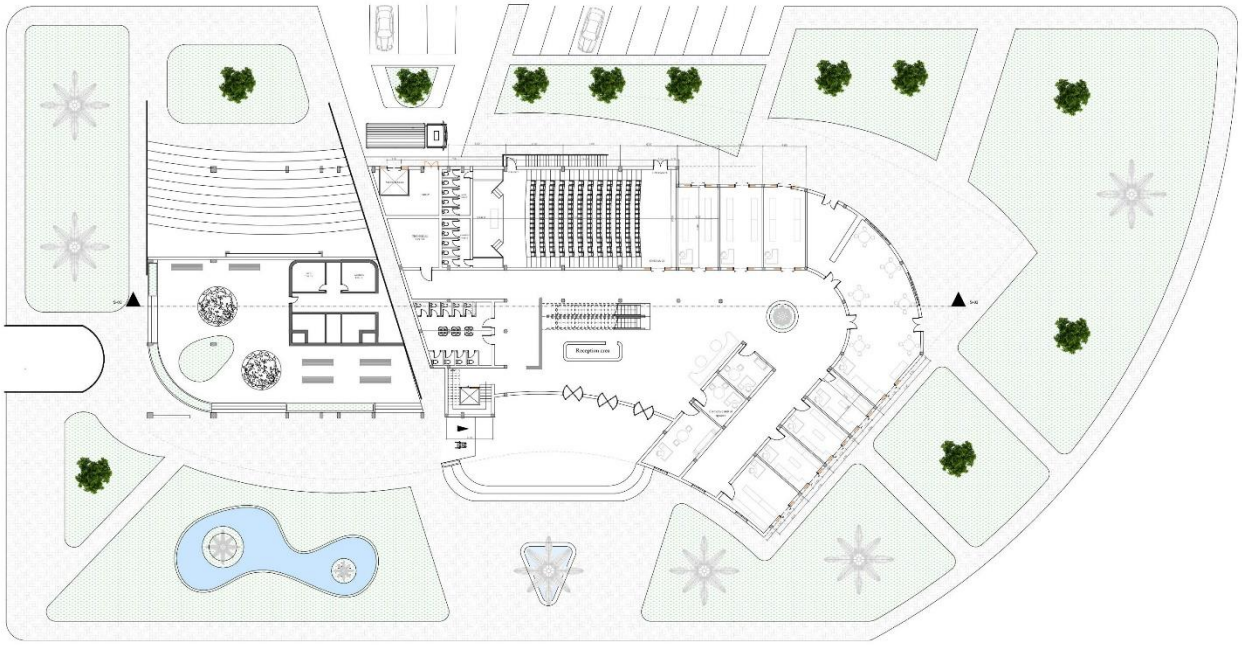
Fourthly: Preserving a visual escape for the behind of the parcel



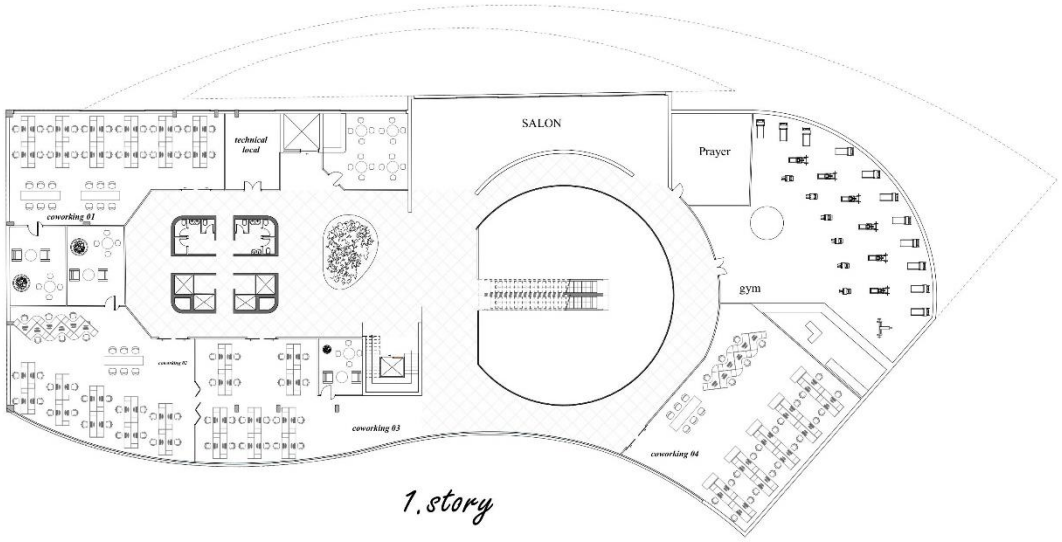
2. Graphic documents:



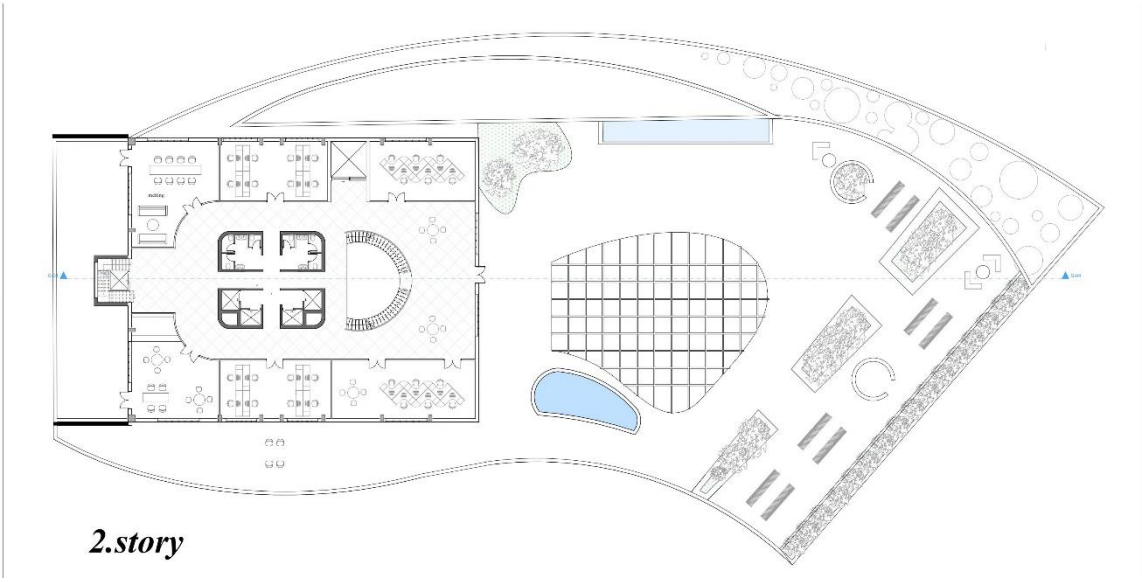
site plan



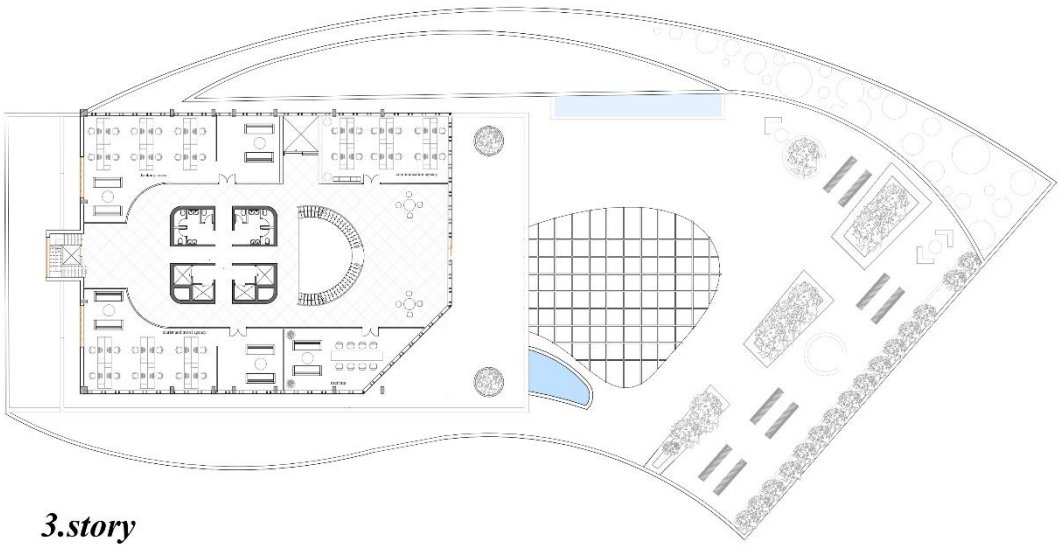
GROUND FLOOR



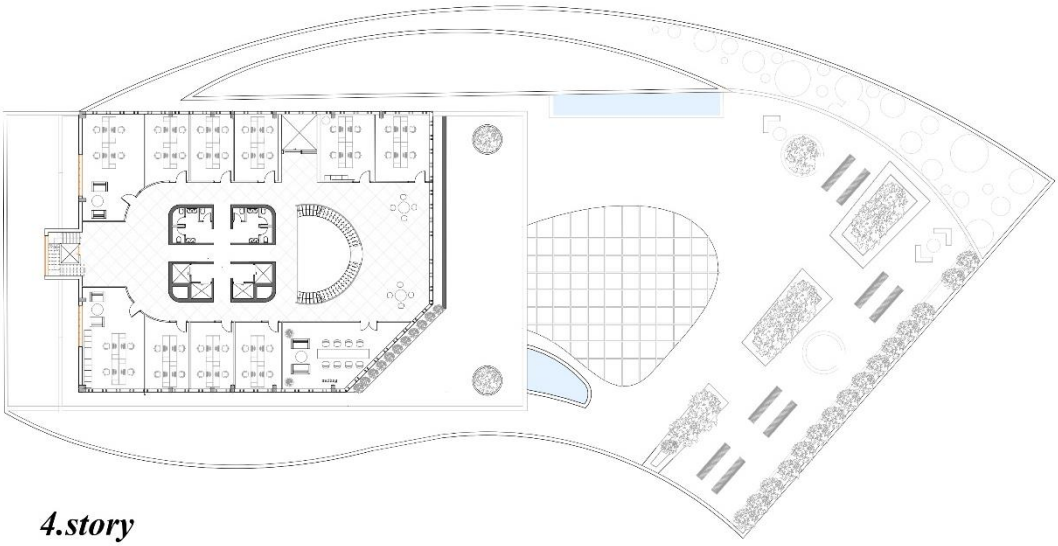
1.story



2.story



3.story



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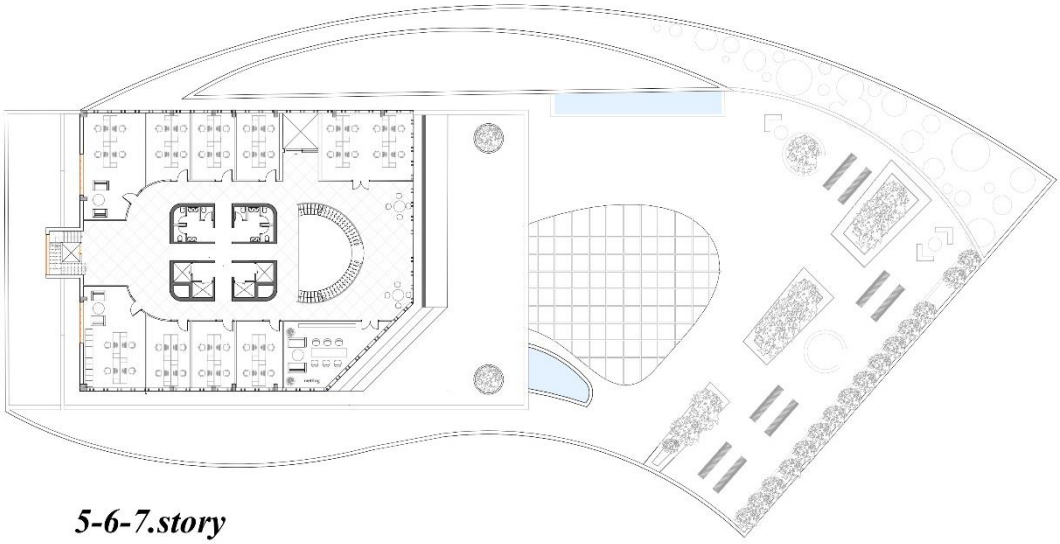
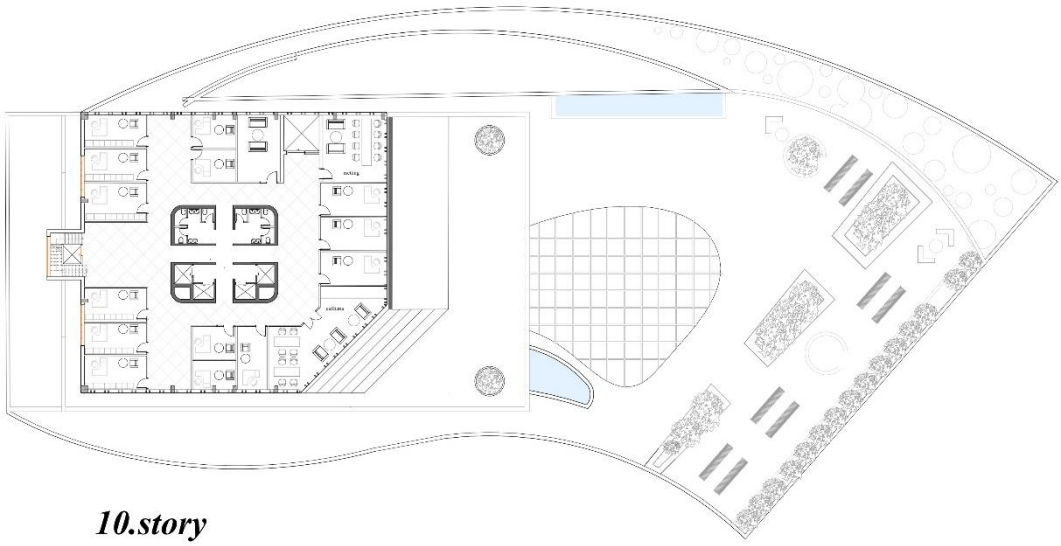


5-6-7.story



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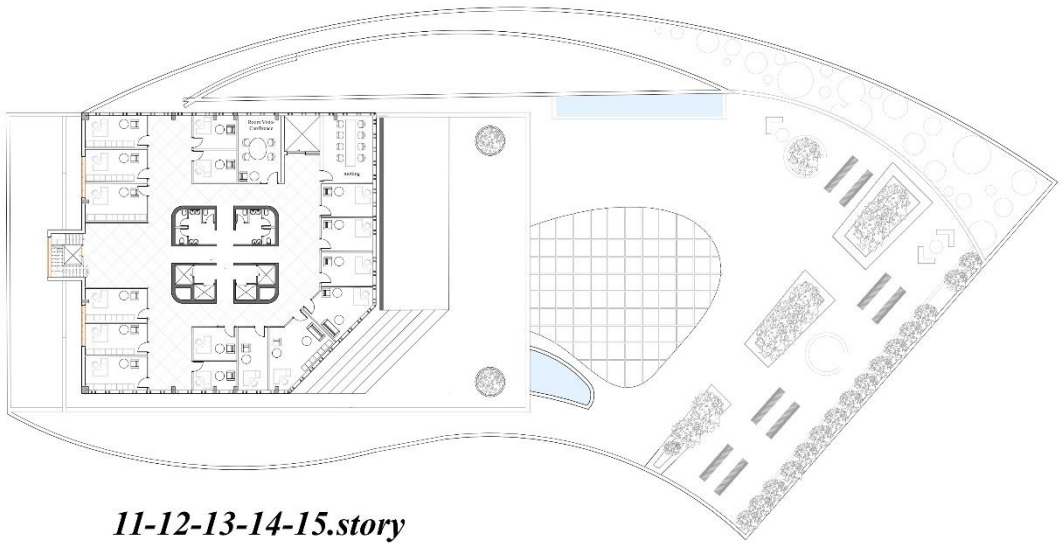

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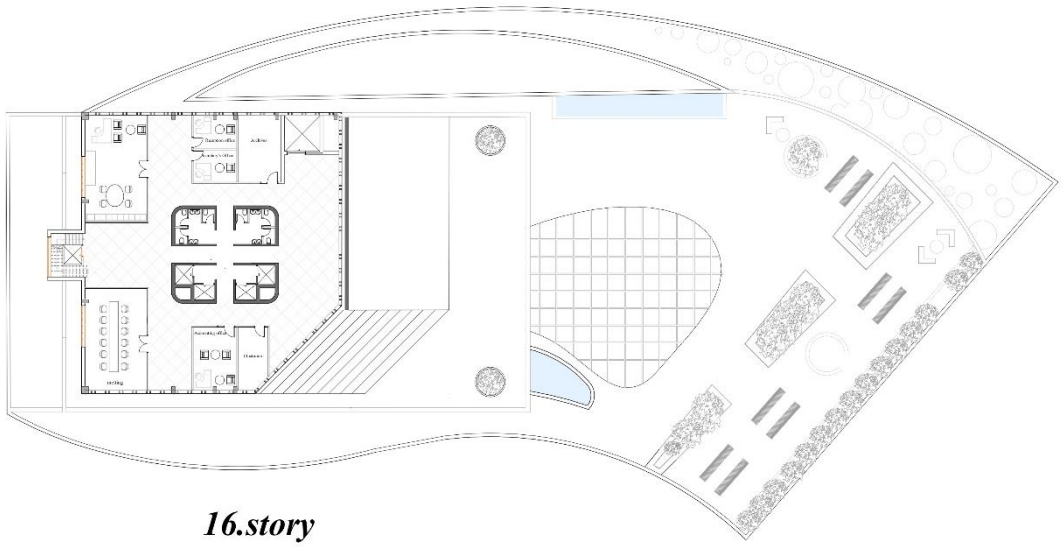

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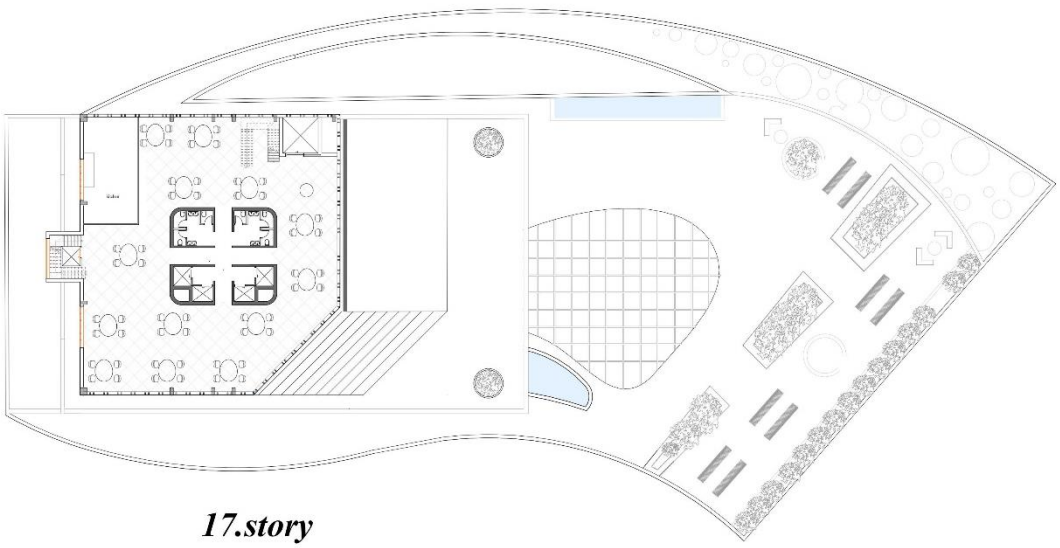

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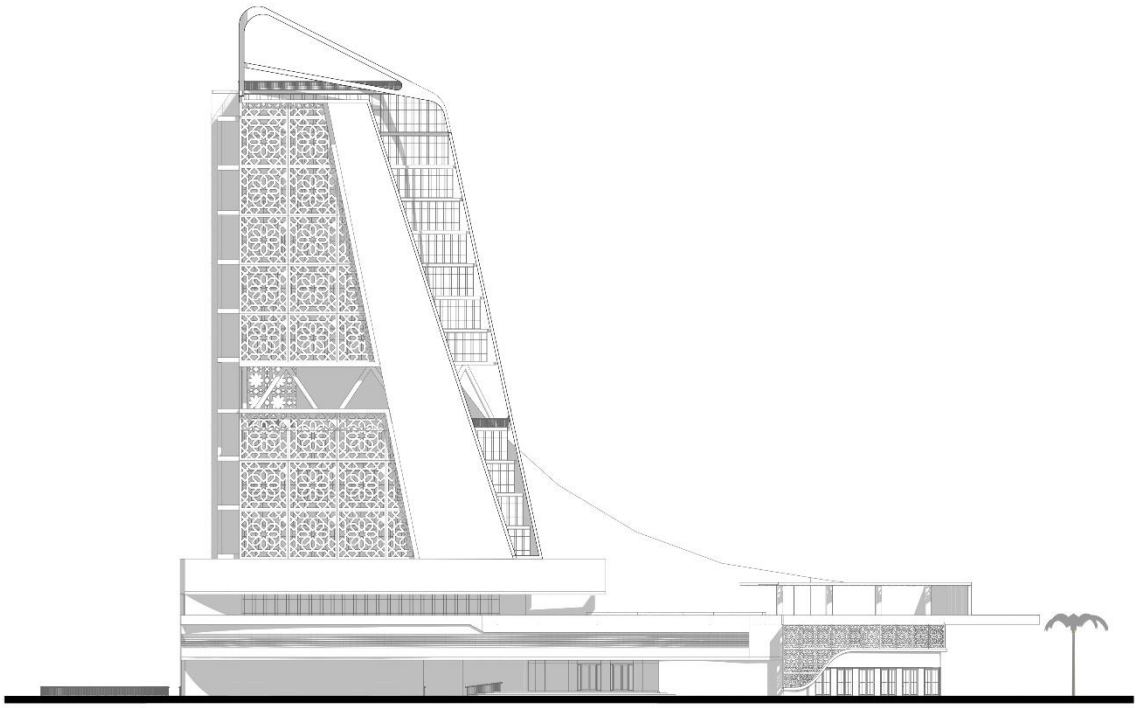
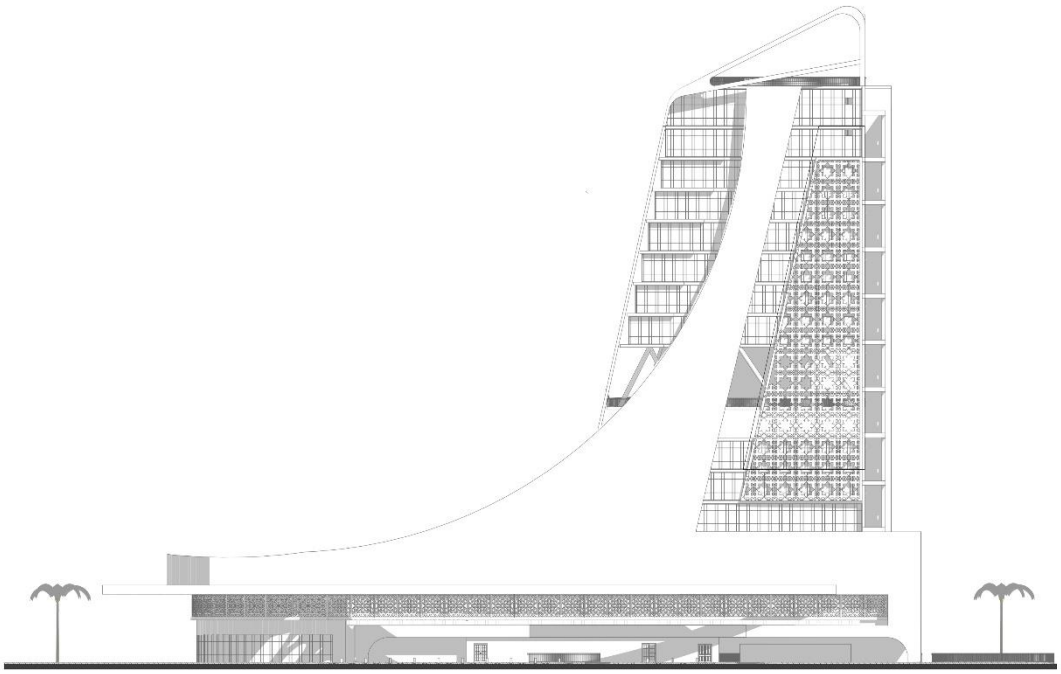


SOUTH FACADE



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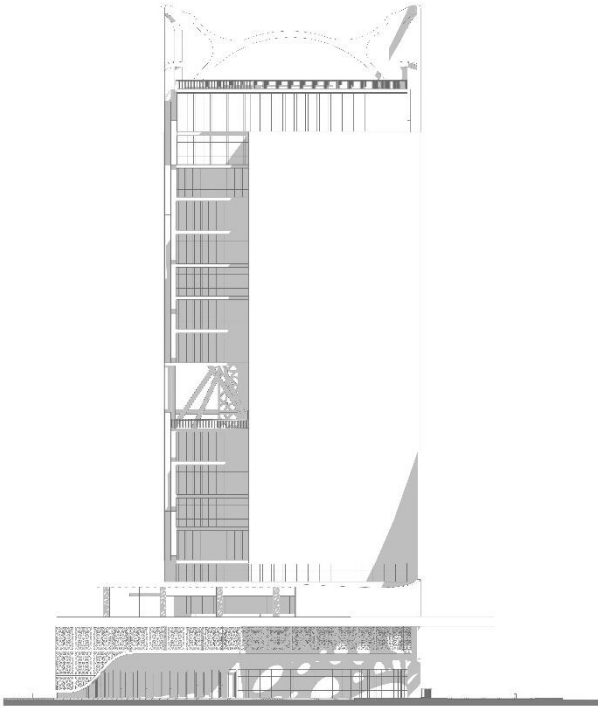
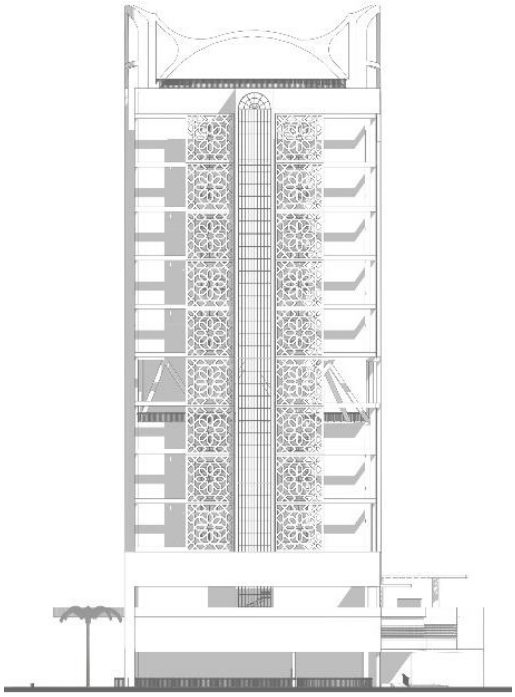
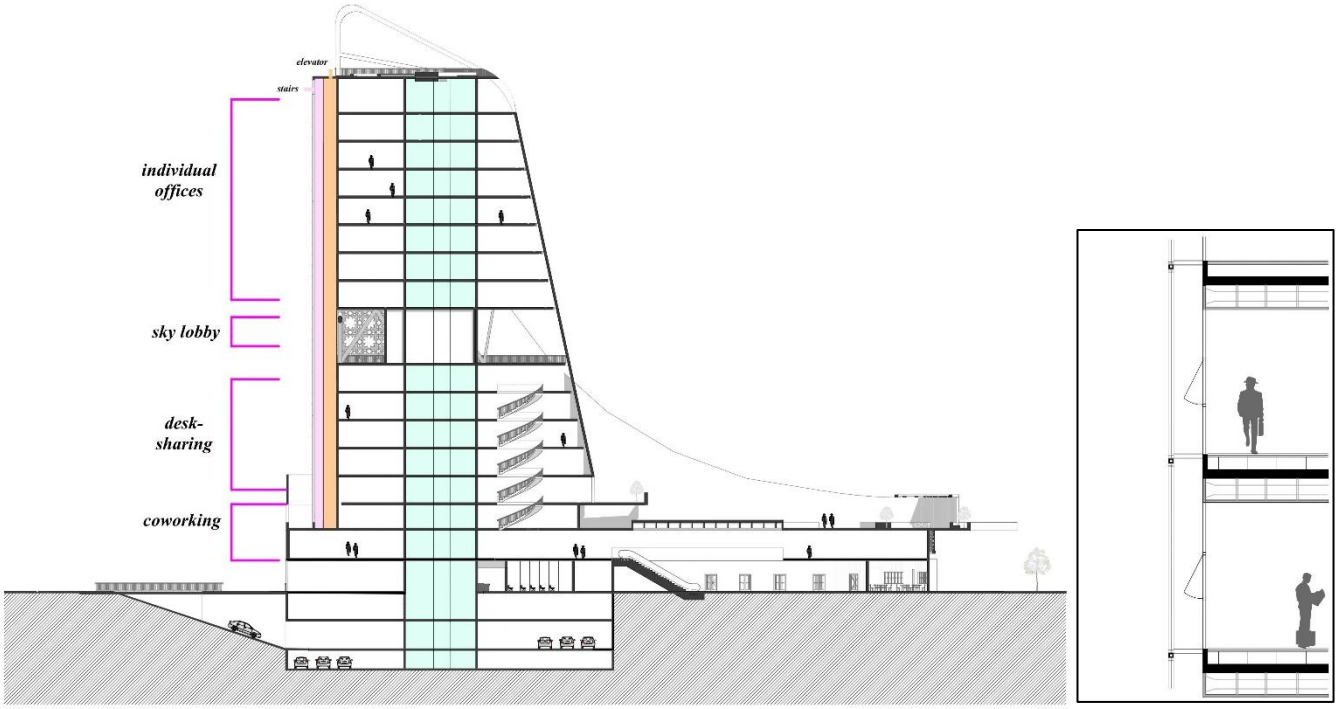


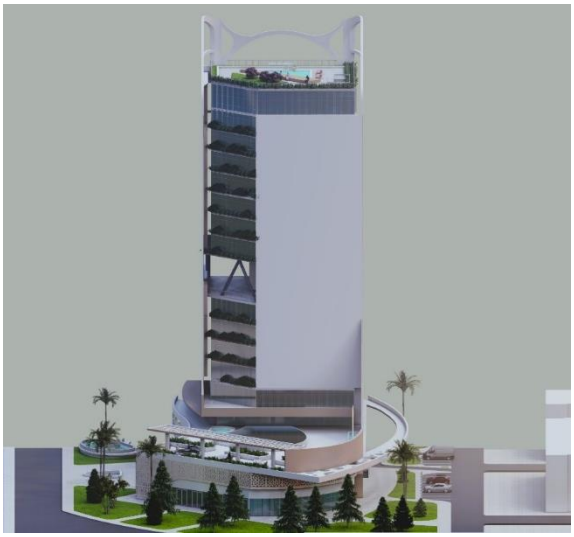
EAST FACADE

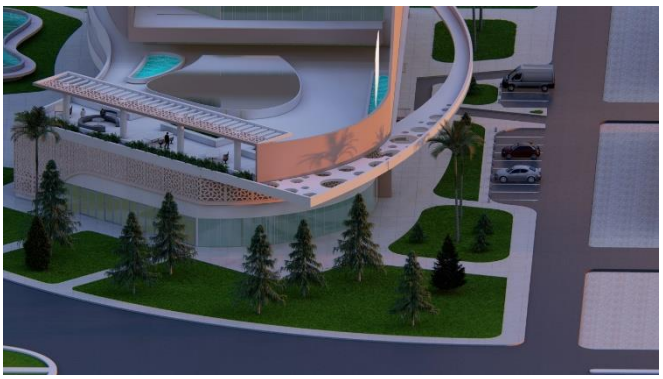


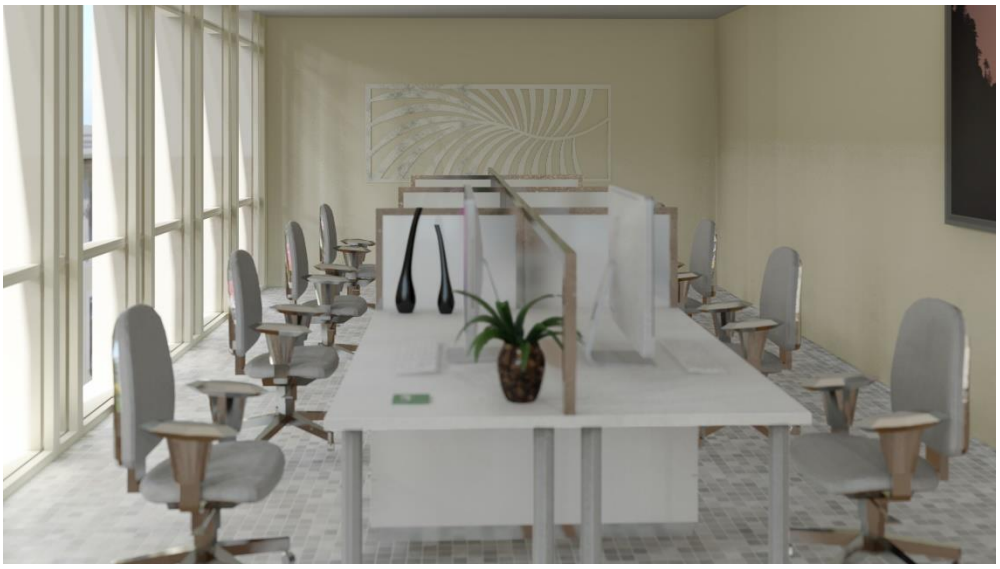
WEST FACADE

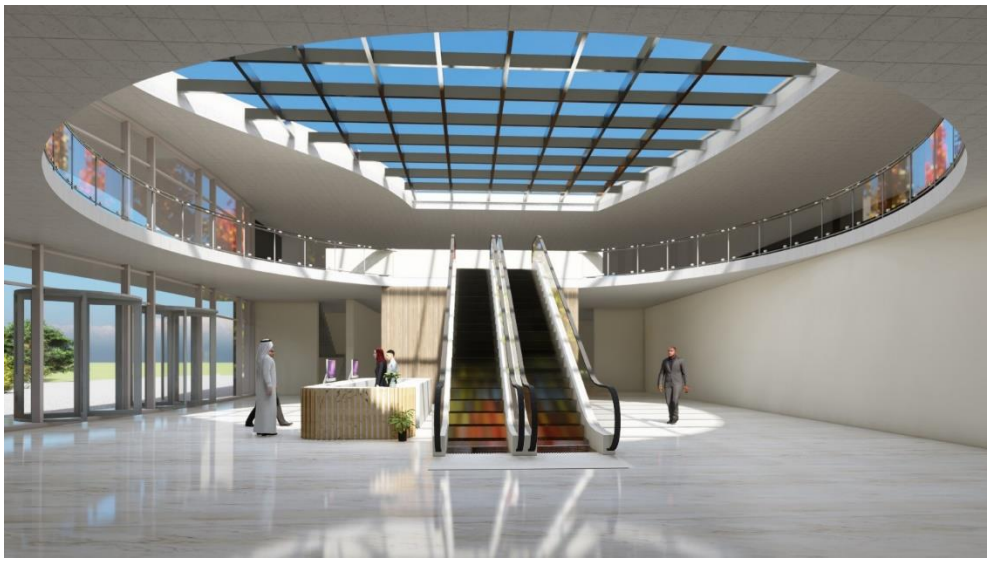


Section A-A





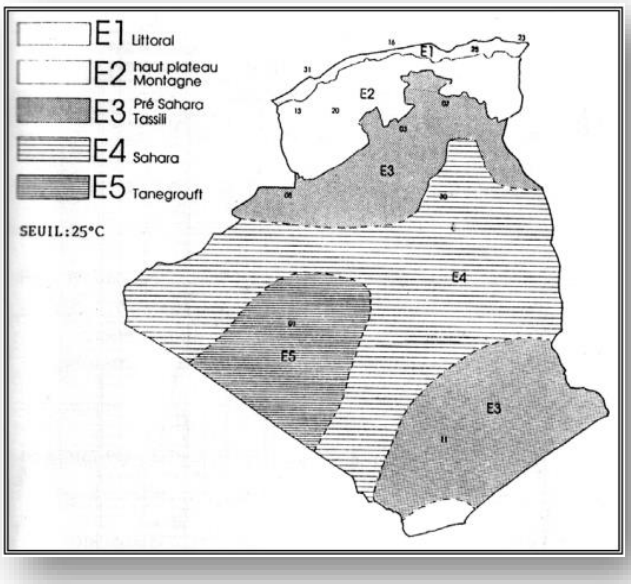




5. Digital Application:

A. Thermal Comfort margins of M'sila:

In this study, we relied on the thermal comfort limits of Algerian cities designated by the Ministry and within which the winter and summer thermal comfort limits of the city of M'sila are included in order to be taken as a reference for programming. (Fig ……)



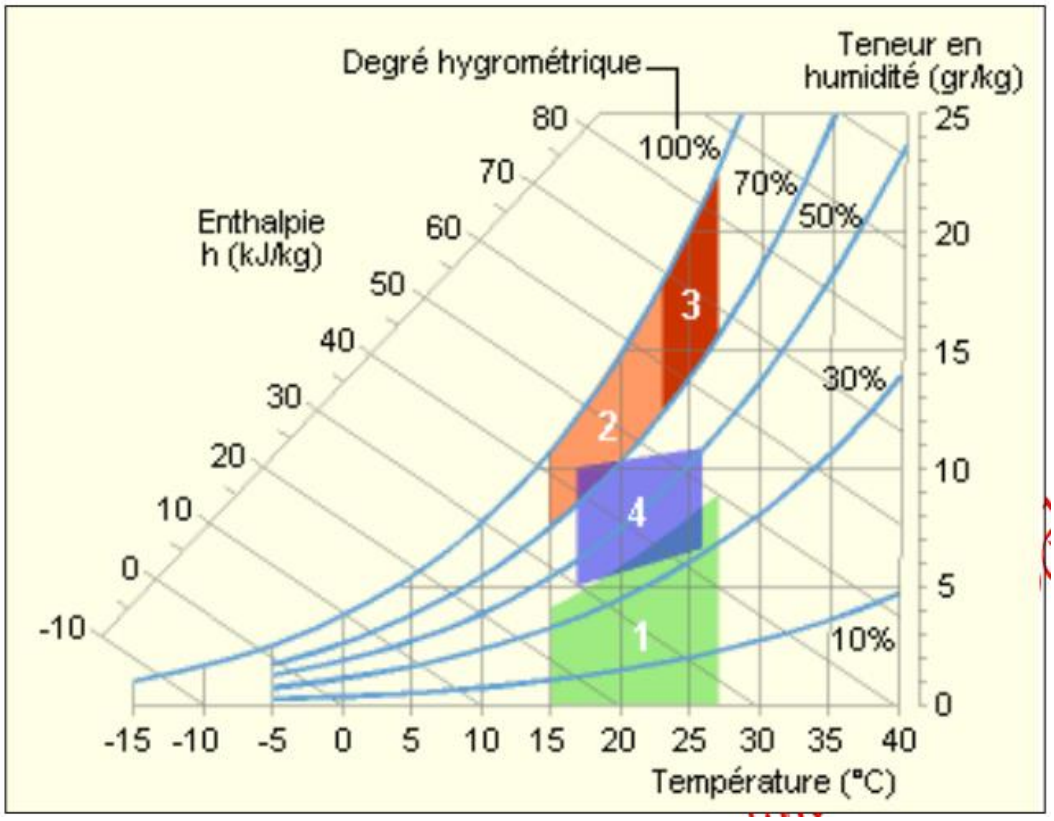
Summer climate zones in Algeria
Groupe BEIS

From the above, the thermal comfort zone of the city of M'sila were determined by the Ministry of Housing according to the following table

ZONE CLIMATIQUE HIVER		LIMITES DU CONFORT		ZONE CLIMATIQUE ETE
		TEMPERATURE (C°)	HUMIDITE RELATIVE (%)	
H1 LITTORAL	**H1a**	21-25	22-70	**E1** LITTORAL
	H1b	20-24	20-70	
H2 HAUTS-PLATEAUX	**H2a**	21-26	21-69	**E2** HAUTS-PLATEAUX
	H2b	20-25	23-75	
H3 SAHRA	**H3a**	***22-27***	***19-65***	**E3**
	H3b	23-27	19-60	**E4**
	H3c	23-28	20-62	**E5** SAHRA

Summer climate zones in Algeria
Source: Groupe BEIS

The city of M'sila is classified within the winter thermal zone H3a, and the summer thermal zone E3, and we note that both regions are characterized by the same data of thermal comfort limits, represented in temperature from 22 °C to 27 ° C and relative humidity from 19 to 65%.



The comfort temperature-humidity range.

Source: Dakhia. A 2022

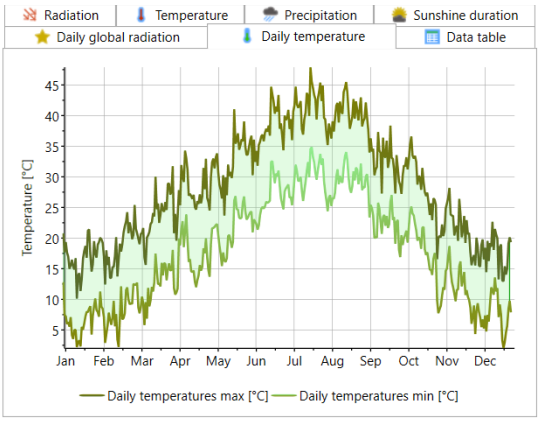
According to this we see that the comfort zone is between 19 °C to 26 ° C and between 40% and 70% of humidity.

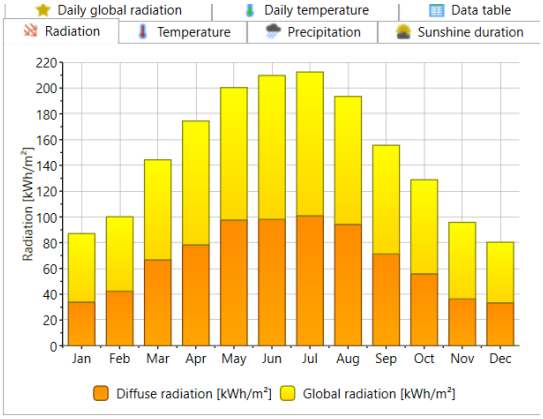
B. Algorithm of the System Sensor:

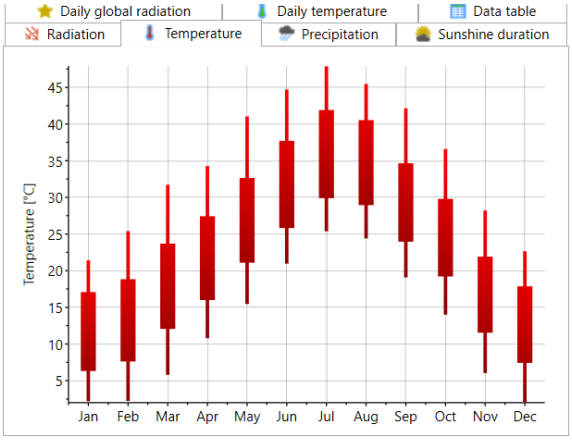
```
Variables:
Air_Temperature, Relative_Humidity : of type Integer;
Sensor_Button : of type character;
Adapted_Envelope, Sensor : of type Boolean;

__ Start
|
|  Adapted_Envelope <---- false;
|
|  __ While (1) do            //infinite loop
|  |
|  |  __ if (Sensor_Button == "is pressed") do
|  |  |
|  |  |   Sensor <---- true;
|  |  |
|  |  |__ else do
|  |  |
|  |  |   Sensor <---- false;
|  |  |
|  |  |__ endif;
|  |
|  |  __ if (Sensor == true) do
|  |  |
|  |  |  __ if (Relative_Humidity<19 && Air_Temperature>27) do
|  |  |  |
|  |  |  |     Adapted_Envelope <---- true;
|  |  |  |
|  |  |  |__else do
|  |  |  |
|  |  |  |    Adapted_Envelope <---- false;
|  |  |  |
|  |  |  |__ endif;
|  |  |
|  |  |__ endif;
|  |
|  |__ endwhile;
|
|__ end;
```

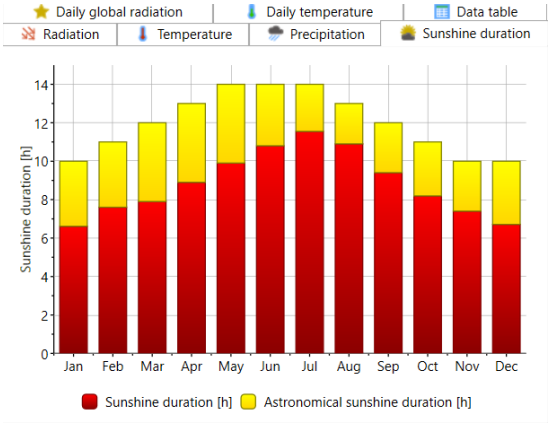
C. Programming results:

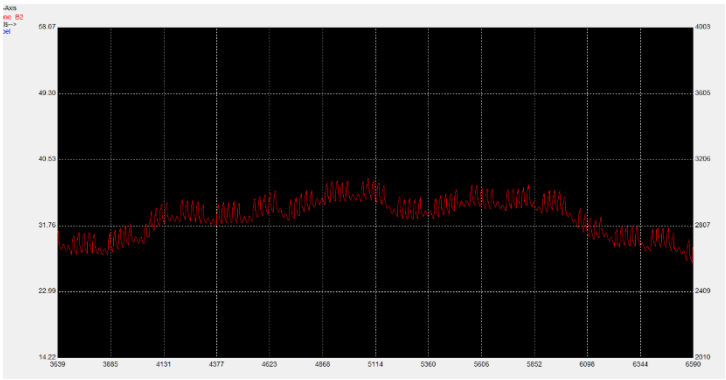
1. Using the METEONORM program, I entered the climatic data for the state of M'sila , then simulated a preliminary model using the TRNSYS software.

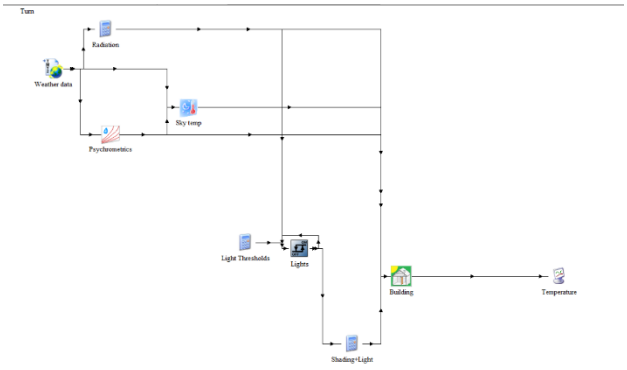




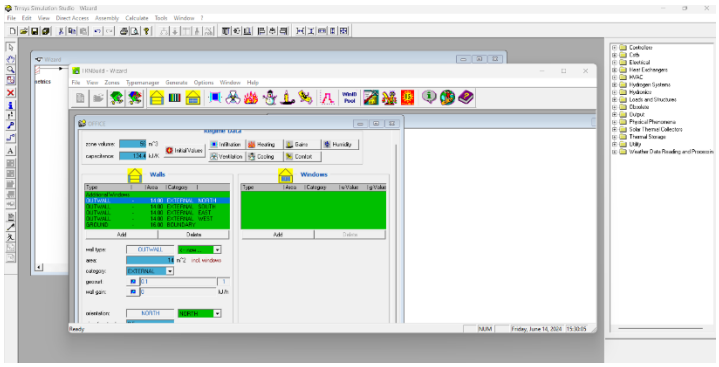


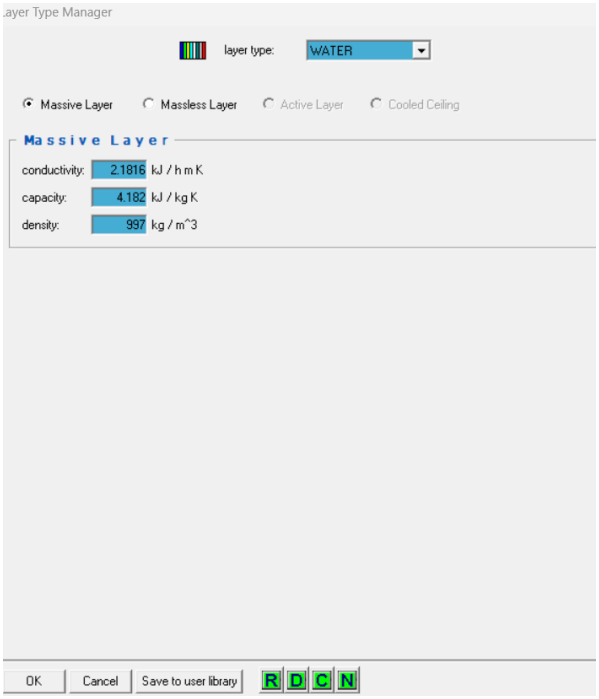


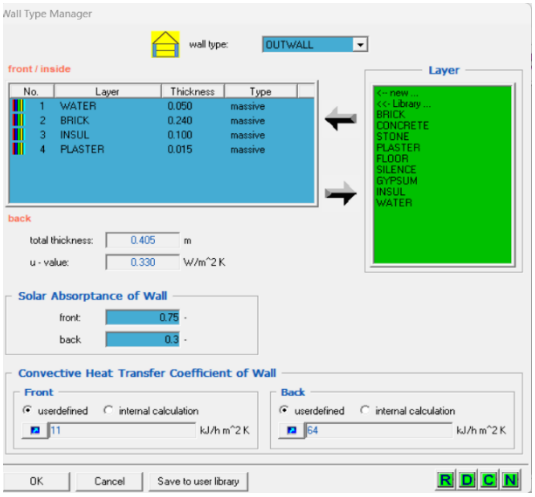




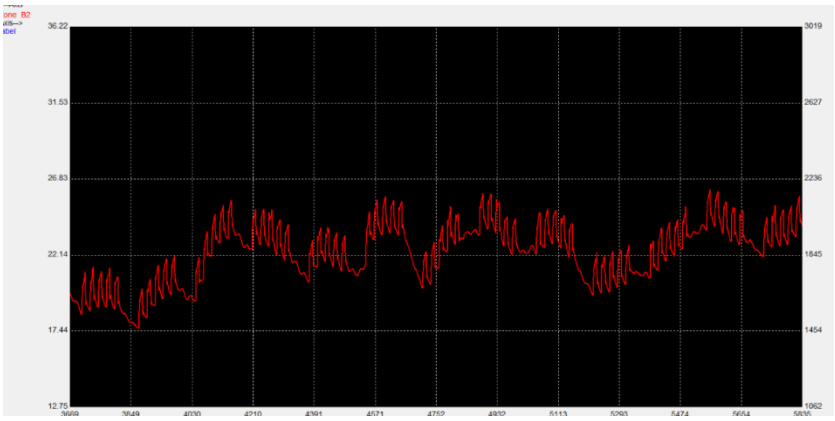
2. Afterwards, I added water properties and incorporated them into the external envelope of the building.







3. The results obtained after adding the water:



We notice that the temperature drops by 8 degrees.

General Conclusion:

This research revolves around the concept of thermal comfort and the role of architectural envelope in achieving environmental sustainability, specifically at the level of business centers in hot and dry climates. The research consists of three chapters, where the theoretical chapter addressed the concept of thermal comfort, its design requirements, and the role of architectural envelope in achieving it, in addition to the foundations and design standards specific to business centers. In the analytical chapter, examples related to business centers and project groundwork were analyzed, and a proposed program was prepared. Finally, in the applied chapter, the design of a business center with a smart and sustainable architectural envelope was reached.

Through this study, a set of results and observations were obtained, where it was found that one of the most important factors affecting thermal comfort is the building envelope, which must respond to environmental conditions to provide a suitable environment. It was also found that applying smart adaptive envelope technology to business centers in hot and dry climates is the optimal solution to reduce the problem of excessive energy consumption resulting from cooling, by providing an effective solar protection system. It was also shown that evaporative cooling technology presents an opportunity to achieve thermal comfort without the need for significant artificial cooling, and it has been proven effective through simulation software (Trnsys16).

In conclusion, the idea of evaporative cooling through the architectural envelope is a solution to two problems; it addresses both the heat and humidity issues together to create better energy consumption while providing comfort for users.

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الجمهورية الجزائرية الديمقراطية الشعبية
وزارة التعليم العالي والبحث العلمي جامعة محمد خيضر – بسكرة –
جامعة محمد خيضر – بسكرة

عنوان المشروع

اقتراح وتصميم نموذج لغلاف معماري ذكي ومتكيّف مع الظروف المناخية الحارة والجافة

الاسم التجاري	صورة العلامة التجارية
MistCool- Tech	M.C.T

السنة الجامعية 2023-2024

بطاقة معلومات :

فريق الإشراف وفريق العمل

1- فريق الإشراف

فريق الإشراف	
الأستاذة المشرفة ماضوي مريم	هندسة معمارية

2- فريق العمل

فريق المشروع	التخصص	الكلية
حمريط فؤاد	هندسة معمارية	كلية العلوم و التكنولوجيا

فهرس المحتويات

المحور الأول: تقديم المشروع

مقدمة: يعتبر المناخ من العوامل الرئيسية المؤثرة على راحة الإنسان الجسدية و النفسية في المجالات العمرانية والمعمارية سواء كانت خارجية أو داخلية، خاصة إذا كان هذا المناخ يسود بيئة شبه صحراوية تتميّز بشدة الحرارة و الجفاف. لقد أثبتت أغلب الدراسات أن التصميم المعماري الذي لا يأخذ بعين الاعتبار معالجة التأثيرات السلبية للعوامل المناخية كالحرارة و الإشعاع، الضغط الجوي و الرياح، الرطوبة ينجم عنه إنتاج عمارة مستهلكة بشكل كبير للطاقة الكهربائية التي تعتبر من الطاقات غير المتجددة من جهة و غالية التكلفة في الإنتاج و الاستهلاك من جهة أخرى.

مجال نشاطنا يتمثل في اقتراح و تصميم نموذج لغلاف معماري ذكي و متكيّف مع الظروف المناخية الحارة و الجافة

1. **فكرة المشروع (الحل المقترح):**

المشروع يهدف إلى إنشاء و تطوير نموذج لغلاف معماري متكيّف و ذكي (Smart envelope) من أجل حماية المجالات الداخلية للمباني من انتقال الحرارة المرتفعة من الخارج إلى الداخل صيفا، حيث أنه يعمل بطريقة مستدامة و متكيّفة مع المناخ الحار و الجاف و يهدف إلى التقليل من استهلاك المباني للطاقة الكهربائية المكلفة. هذا النموذج مستلهم من العمارة التقليدية التي تعتبر مرجعا جيدا لاستخلاص الدروس من الماضي خاصة وأنها أثبتت فعالية تكيفها مع معطيات المناخ القاسية.

فكرة المشروع مستمدة من نظام تبريد تقليدي حيث كان يستعمل الماء قديما كوسيلة فعالة لخفض درجة الحرارة، وتلطيف الجو، حيث كانت الأسطح ترش يدويا للتخلص من الحرارة المخزنة داخلها بواسطة التبخر. أما الساحات و الفناءات الداخلية كانت تزود بأحواض أو نافورات مائية، إذ يقوم الهواء الذي يمر فوقها بخفض الحرارة بواسطة ظاهرة الحمل الحراري (Convection) أين يعوض الهواء البار النافذ إلى داخل المبنى الهواء الساخن الذي يُطرد إلى الخارج من خلال فتحات علوية. إضافة إلى استعمال في بعض المناطق شديدة الحرارة تقنية الجرة المملوءة بالماء التي كانت توضع في الشبابيك و المشربيات لتشكل حاجزا أمام الهواء الساخن و تمنعه من الدخول إلا بعد خفض درجة حرارته بعد ملامسته للماء.

من هنا نشأت فكرتنا لاستعمال استراتيجية التبريد بالتبخير(Evaporation cooling) للبنايات من خلال تصميم غلاف معماري ذكي متكيّف مع المعطيات المناخية يعمل بطريقة ذكية حيث أنه يكون مزود بمستشعرات (Sensors) لدرجة الحرارة و نسبة الرطوبة تعمل بخوارزمية مدروسة، فبمجرد تسجيل درجة حرارة مرتفعة و تكون خارج نطاق الراحة الحرارية للمنطقة و كذا نسبة رطوبة منخفضة يبدأ النظام في العمل مباشرة حيث يقوم الغلاف المعماري في بدأ عملية إطلاق رذاذ الماء المضغوط (قطرات ماء دقيقة جدا) باتجاه البناية وعند ملامسة هذا البخار للهواء الخارجي يحدث تلطيف و تبريد للسطح الخارجي المبنى و بفعل التبادل الحراري الذي يحدث في الغلاف الخارجي للمبنى يتم خفض درجة حرارته عند انتقالها إلى الداخل.

2. **القيّم المقترحة**

- تعتبر فكرة المشروع بتقنيتها الذكية حديثة ولم يسبق تطبيقها من قبل في مجال البناء محليا، حيث يمكنها تلبية حاجيات قطاع البناء من حيث خفض تكلفة استغلال الطاقة غير متجددة والتوجه نحو تحقيق الاستدامة في هذا القطاع.
- بالنسبة لأداء المنتج فهو مضمون لان التبريد بالتبخير اثبت فعاليته قديما عندما كان يشتغل بطريقة تقليدية بدائية مما يجعله اليوم أكثر فعالية بعد إدخال التكنولوجيا العالية و تشغيله بنظام الذكاء الاصطناعي.
- المشروع يتميّز بقابلية التكيّف حسب المعطيات المناخية لكل منطقة و ذلك بإعادة ضبط خوارزمية المستشعر الحراري حسب حدود الراحة الحرارية المطلوبة للمكان.
- تصميم المشروع يتميّز بالمرونة التامة لأنه سوف ينسجم مع شكل البناء و الواجهات قيد الانجاز أي يمكن تطبيقها حسب التصميم المعماري كما يمكن كذلك أن يكون حلا معالجا مقترحا لبنايات سبق انجازها و يوجد بها خللا في تحقيق راحة حرارية داخلية لمستعملي المجال.

  كما أن مرونة المشروع تكمن كذلك في إمكانية استعماله بشكل أفقي للمجالات الخارجية مثل تغطية الساحات العامة المعرضة لأشعة الشمس لفترات طويلة مما يجعلها شبه مهجورة صيفا و التي تكون على شكل بارقولا مظللة و ملطفة للجو (Pergola).
- بالنسبة لسعر المنتج سوف يكون في حدود المعقول لأنة لا يتطلب مواد مستوردة باهضة الثمن بل أغلبها مواد محلية يمكن اقتناءها بكل سهولة مما يجعله اقل تكلفة و هذا سوف ينعكس ايجابا على العملاء من ناحية مساعدتهم في خفض تكاليفهم.
- مخاطر استعمال المنتج تكون شبه منعدمة لان الغلاف الخارجي للمبنى يعتبر احد أجزاء حماية البناء و لهذا فان إدخال تكنولوجيا ذكية لتدعيم هذه الحماية سوف يكون آمنا إلى حد كبير و لا ينجم عنه أي خطر.
- بعد خروج المنتج و طرحه في السوق سوف يكون متاحا لجميع الزبائن من قطاع البناء أو المرقيين العقاريين و شركات البناء أو أخصائيين في التهيئة الخارجية و ذلك عبر وسائل التواصل و المواقع الالكترونية أو مقرات و مكاتب العمل لان طلب المنتج سوف يكون مدروسا حسب الحالة سواء كانت مساحة و شكلا.
- المنتج سهل الاستعمال لأنه يعتمد على نظام تشغيل متطور و غير معقد ونظام تشغيله يكون ببرمجة تلقائية مستشعرة للحرارة و الرطوبة.
- حققت بعض التجارب العالمية لمنتج مشابه نوعا ما لفكرة مشروعنا نجاحا باهرا، خاصة في اسبانيا و المملكة العربية السعودية.

3. فريق العمل

الطلبة	التخصص	الدورات التكوينية
حمريط فؤاد	هندسة معمارية	- تربص ميداني في ديوان الترقية والتسيير العقاري بالمسيلة. - دورة تكوينية في مكتب دراسات. - اتقان برامج الرسم المعماري والمحاكاة 3d.

4. أهداف المشروع

بالنسبة للأهداف السوقية للمشروع فإننا نسعى على المدى البعيد لنكون المنتج رقم واحد في السوق الجزائرية خلال السنتين الأوليتين لان فكرة المشروع مبتكرة ولم يسبق تطبيقها من قبل في البنايات السكنية أو الإدارية أو تهيئة المجالات الخارجية في المناطق الحارة والمدن الصحراوية في الجزائر وذلك انطلاقا من حصة سوقية مستهدفة على المدى القريب والمتوسط تصل إلى 80 بالمئة.

5. جدول زمني لتحقيق المشروع

	الأشهر	1	2	3	4	5	6	7	8	9	10	11	12
الأعمال	1 الدراسة الأولية: اختيار مقر الوحدة الإنتاجية و تجهيز الوثائق اللازمة	✓	✓	✓									
	2 طلب التجهيزات				✓	✓							
	3 بناء مقر الإنتاج					✓	✓	✓	✓				
	4 تركيب المعدات								✓	✓			
	5 اقتناء المواد الأولية										✓	✓	
	6 بداية الإنتاج												✓

المحور الثاني: الجوانب الابتكارية

1. **طبيعة الابتكارات:** تعتبر فكرة المشروع من الابتكارات التكنولوجية الحديثة
2. **جوانب الابتكارات:** تتمثل الجوانب الابتكارية في مشروعنا فيما يلي:

- المنتج في شكله الحديث غير شائع الاستعمال في قطاع البناء والتهيئة العمرانية في الجزائر رغم فعالية التبريد التبخيري للمباني.
- مواد التصنيع عبارة عن مواد صديقة للبيئة مما يمكننا من تحقيق أهداف التنمية المستدامة.
- تقديم منتج يعمل بالذكاء الاصطناعي وبالتالي المساهمة في مواكبة القطاع الصناعي للعصرنة والتطور التكنولوجي.
- تطوير وابتكار تصاميم جذابة تتماشى مع متطلبات أصحاب المشاريع لإضفاء لمسة جمالية ووظيفية في نفس الوقت.
- المنتجات قابلة للتطور والتنوع لتشمل عناصر معمارية وعمرانية أخرى تعمل بنفس هذا النظام.
- سهولة التركيب والتشغيل وضمان لجودة المنتج.

المحور الثالث: التحليل الاستراتيجي للسوق

1. **تحليل PESTEL**

لسياسي	الاقتصادي	الاجتماعي	التكنولوجي	البيئي	القانوني
- سياسات الدعم الحكومي للمشاريع البيئية والمستدامة	-الطلب الاستهلاكي على الأثاث والمنتجات الخارجية	-الاتجاه نحو استخدام المساحات الخارجية لأغراض الترفيه والاسترخاء	-التطورات التكنولوجية في تقنيات التبريد ونظم الرش بالماء	-تأثيرات استخدام التبريد برذاذ الماء على استهلاك المياه والبيئة المحلية	-التراخيص والتصاريح المطلوبة لبناء وتشغيل المنشآت الخارجية
-السياسات البيئية والتشريعات المحلية في مجال البناء والتشييد	-التذبذبات في أسعار المواد الخام مثل الألمنيوم والأخشاب	-زيادة الوعي بين المستهلكين بشأن المنتجات البيئية والمستدامة	-الابتكارات في تصميم وبناء المنشآت الخارجية	-اتجاهات التشريعات البيئية والمتطلبات للحفاظ على البيئة	-الالتزامات القانونية المتعلقة بالصحة والسلامة في الأماكن العامة

2. تحليل SWOT:

قوة (Strengths):	ضعف (Weaknesses):
تقنية مبتكرة ومستدامة لتبريد المساحات الخارجية. منتجات تتميز بالجودة والمتانة. فرصة للاستفادة من الاتجاه العالمي نحو الاستدامة والمنتجات البيئية. إمكانية التخصيص وفقًا لاحتياجات العملاء.	تكاليف بداية عالية للتأسيس والتشغيل. التحديات في إدارة استخدام المياه والتأثيرات البيئية. القدرة المحدودة على التواصل مع العملاء النهائيين بشكل مباشر.
فرص (Opportunities):	**تهديد (Threats):**
زيادة الطلب على المنتجات الخارجية المبتكرة والمستدامة. التوسع في الأسواق الجديدة، سواء محليًا أو عالميًا. شراكات محتملة مع المطورين العقاريين وأصحاب المنازل.	التنافس الشديد من المنافسين التقليديين والمبتكرين. التغيرات في السياسات البيئية والتشريعات. التذبذبات في أسعار المواد الخام والتكاليف الإنتاجية.

3. تحليل PORTER

4. التسعير:

سوف نعتمد على سياسة التسعير بالتكلفة بالإضافة الأخذ بعين الاعتبار اسعار المنافسين، بحيث: سعر المنتج = تكلفة الوحدوية للمنتج + هامش الربح

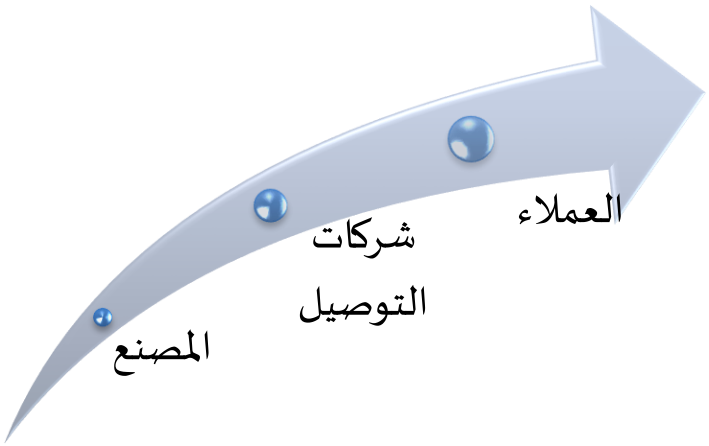
المنتجات / الخدمات	السعر المقترح
Pergola	7000دج للمتر المربع الواحد
مظلات وسقف معدني بالرش بالماء:	100.0 دج للمتر المربع الواحد

5. الترويج

وسيلة الترويج	التفاصيل	التكلفة
موقع ويب خاص (موقع الكتروني)	إنشاء موقع ويب محترف خاص بالمؤسسة يعرض المنتوجات ويوفر معلومات مفصلة حولها، لتسهيل عملية البيع والتواصل مع العملاء.	2000 دج
الدعاية والاعلان على مو اقع التواصل الاجتماعي	إنشاء صفحات على فيسبوك، إنستغرام، و... نشر منشورات دورية تروج للمنتج وتبرز مميزاته.	مجاني
الفعاليات والمعارض	المشاركة في المعارض والاحداث المحلية ذات الصلة، لعر ض المنتجات والتواصل المباشر مع العملاء المحتملين	5000دج (متغيرة)
المطبوعات الترويجية	تصميم وطباعة مطبوعات تعريفية عن المنتج وتوزيعها في المعارض والفعاليات الصناعية.	5000دج
اللافتات الاعلانية	انجاز المطبوعات الترويجية مثل النشرات وتوزيعها في الأماكن المناسبة.	4000*5=20.000 دج
المجموع		**32000 دج**

6. التوزيع:

ستكون طريقة التوزيع كما يلي :



7. طريقة الدفع :

تكون على شكلين:

- الدفع المباشر (عند الاستلام)

-الدفع عن طريق CCP

8. عرض القطاع السوقي:

السوق المحتمل: هو كل سوق قطاع البناء والتهيئة الحضرية عبر كامل التراب الوطني.

السوق المستهدف: الشريحة المستهدفة تمثل مجموعة الأفراد أو المؤسسات الناشطة في مجال البناء والتهيئة العمرانية مثل المستثمرين العقاريين ومكاتب الدراسات أو حتى أصحاب المساكن الفردية الذين يبحثون عن معالجة ذكية لواجهات بناياتهم خاصة في المدن الصحراوية

مبرر اختيار السوق المستهدف: أهم مبررات الاختيار نجد:

- نقص حاد لتقنيات حديثة ومتطورة لحماية المباني من الحرارة المرتفعة.
- قطاع البناء في المدن الجنوبية للبلاد يعتبر من أكثر القطاعات استهلاكا للطاقة غير متجددة جراء استعمال المكيّفات الهوائية بكثرة.

9. قياس شدة المنافسة:

المنافسون المباشرون:

الاسم	الموقع	الخبرة	نقاط القوة	نقاط الضعف
ALL STORES	28, Cité El Moustakbel-AinAllah, Dely Ibrahim, Alger	14 سنة	-شركة رائدة ذات خبرة جيدة. -شركة متعددة الاختصاصات تنشط في مجال التهيئة الداخلية و الخارجية	-الشركة تستعمل كاسرات الشمس كأسلوب حماية المبنى من أشعة الشمس لكن لا تعتمد أساليب أخرى للتبريد والتهوية الطبيعيتين خاصة في المناطق الحارة والجافة.
ALSEV SPA	29, Route de Meftah – l'Arbaâ – 09300 W. Blida Larbaa, W 0930	8 سنة	-شركة رائدة ذات خبرة جيدة. -شركة متعددة الاختصاصات تنشط في مجال التهيئة الداخلية و انشاء غلاف المباني	-الشركة تستعمل الغلاف المعماري المثقوب كأسلوب حماية المبنى من أشعة الشمس لكن لا تعتمد أساليب أخرى للتبريد و التهوية الطبيعيتين خاصة في المناطق الحارة و الجافة.

المنافسون غير مباشرون:

الاسم	الموقع	الخبرة	نقاط القوة	نقاط الضعف
DESINOVA	N° 01, rue Guillaume Apollinaire, batiment Le Liszt. Miramar, 31000 Oran		تقوم شركة DESINOVA بإجراء الدراسات والإنتاج الجاهز والديكور ومعالجة الواجهات	الشركة تركز على الناحية الجمالية فقط

10. الاستراتيجية التسويقية

- نعتمد في تسويق منتجاتنا على **استراتيجية التميّز** مقارنة مع ما تنتجه المؤسسات المنافسة من حيث تكون منتجاتنا ضرورية و لا غنا عنها للحياة الفردية و للمجتمع و ذلك في كل مجالات البناء في المناطق الحارة لأنها تعالج مشكلة واقعية معاشة تأرق كاهل المستعمل للفضاءات الداخلية و الخارجية من حيث ارتفاع تكلفة فاتورة الكهرباء.
- عرض نماذج تصميمية مختلفة ثلاثية الأبعاد على الزبائن بالحاسوب وتمكينهم من حرية الاختيار او التعديل ان لزم الأمر ذلك.
- متابعة الأشغال و من التصميم إلى التنفيذ مع إضافة خدمة الصيانة المجانية خلال السنة الأولى من التشغيل

المحور الرابع: خطة الإنتاج والتنظيم

1. مخطط الإنتاجي :

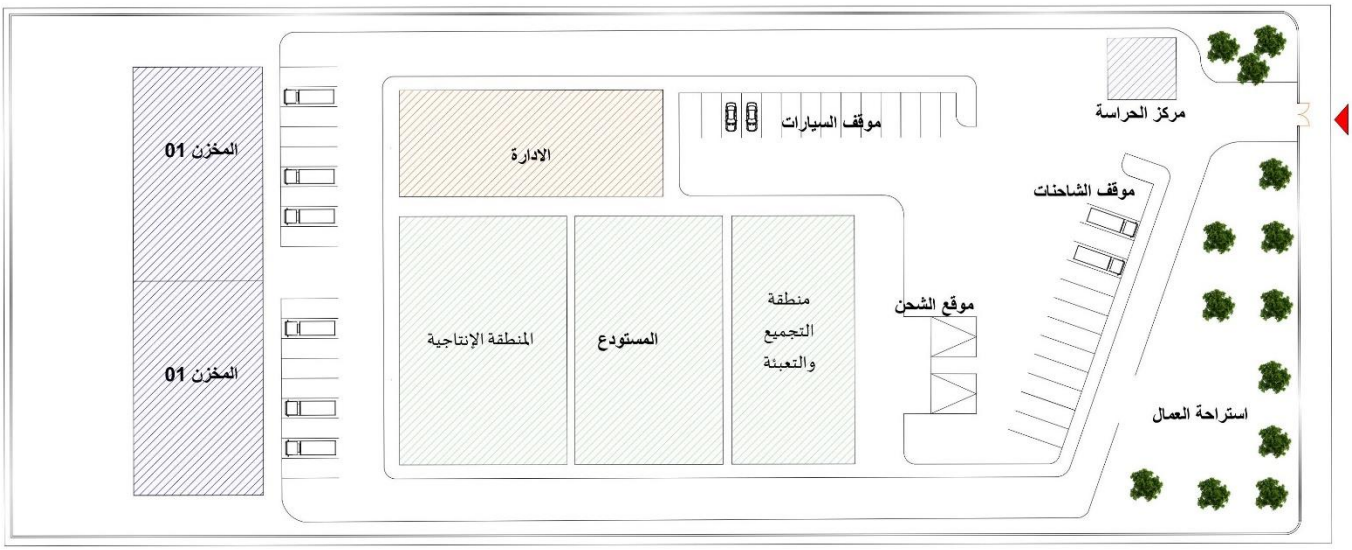
1.1- الموقع : يقع المشروع في المنطقة الصناعية في الولاية المسيلة

2. أسباب اختيار الموقع:

- قربها من مراكز الخدمات :وجود بنية تحتية متطورة وشبكة مواصلات جيدة.
- الوصول إلى الموارد :سهولة الوصول إلى المواد الأولية ومزودي الخدمات.
- العمالة :توافر العمالة المدربة والفنية في المنطقة.
- الامتيازات الحكومية :قد تتوفر بعض الامتيازات والدعم الحكومي للمشاريع الصناعية في هذه المنطقة.

3. الجانب العمراني للمشروع:

المنطقة	المساحة (متر مربع)	الاستعمال
المنطقة الإنتاجية	500	تحتوي على المعدات والآلات ، تخطيط pergola اللازمة لإنتاج لمراحل التصنيع
منطقة التجميع والتعبئة	200	تجميع المنتجات الجاهزة وتعبئتها للشحن
منطقة التخزين والمستودعات	300	تخزين المواد الخام والمنتجات النهائية والمعدات
منطقة الإدارة والمكاتب	100	المكاتب الإدارية، غرف الاجتماعات، غرف الموظفين
منطقة المرافق والخدمات	100	المرافق الصحية، وغرف الفحص، ومناطق الاستراحة للموظفين
المجموع	1200	



4. المعدات و الآلات :

اسم الآلة	سعر الآلة	العدد المطلوب	السعر الإجمالي (دج)
آلة قطع الألمنيوم	800,000	2	1,600,000
آلة ثني الألمنيوم	1,000,000	2	2,000,000
آلة حفر الألمنيوم	600,000	2	1,200,000
آلة لحام	1,200,000	2	2,400,000
آلة قطع الأخشاب	500,000	2	1,000,000
آلة طلاء	900,000	2	1,800,000
المجموع		10,000,000	

5. المعدات المكتبية:

سم العتاد	سعر الوحدة (دج)	الكمية المطلوبة	السعر الإجمالي (دج)
طابعة مكتبية	80,000	1	80,000
حاسب شخصي وشاشة	150,000	2	300,000
طاولات مكتبية	50,000	3	150,000
كراسي مكتبية	30,000	3	90,000
خزائن مكتبية	100,000	2	200,000
هاتف مكتبي	60,000	1	60,000
ماسح ضوئي	100,000	1	100,000
المجموع	980,000		

6. احتياجات المواد الأولية:

المواد	السعر	الكمية المطلوبة	السعر الإجمالي (دج)
الحساسات	1 --- 300	300	90000
لمعادن (حديد مجلفن أو ألمنيوم)	1م² 400 دج	1000	400000
الخشب	1م² 400 دج	3000	1200000
المسامير والبراغي	/	/	/
الدهانات	20 لتر ب 1200	1500 لتر	90000
المجموع	1780000		

7. احتياجات الطاقة والكهرباء:

الخدمات	الاحتياجات الثلاثي% الزيادة ب% 1	تكلفة السنة (دج)
الماء	800m3	15.600
الكهرباء	200.000 KW	5.200.00
انترنت وهاتف	غير محدود	38.400
صيانة	/	100.000
المجموع	674,000	

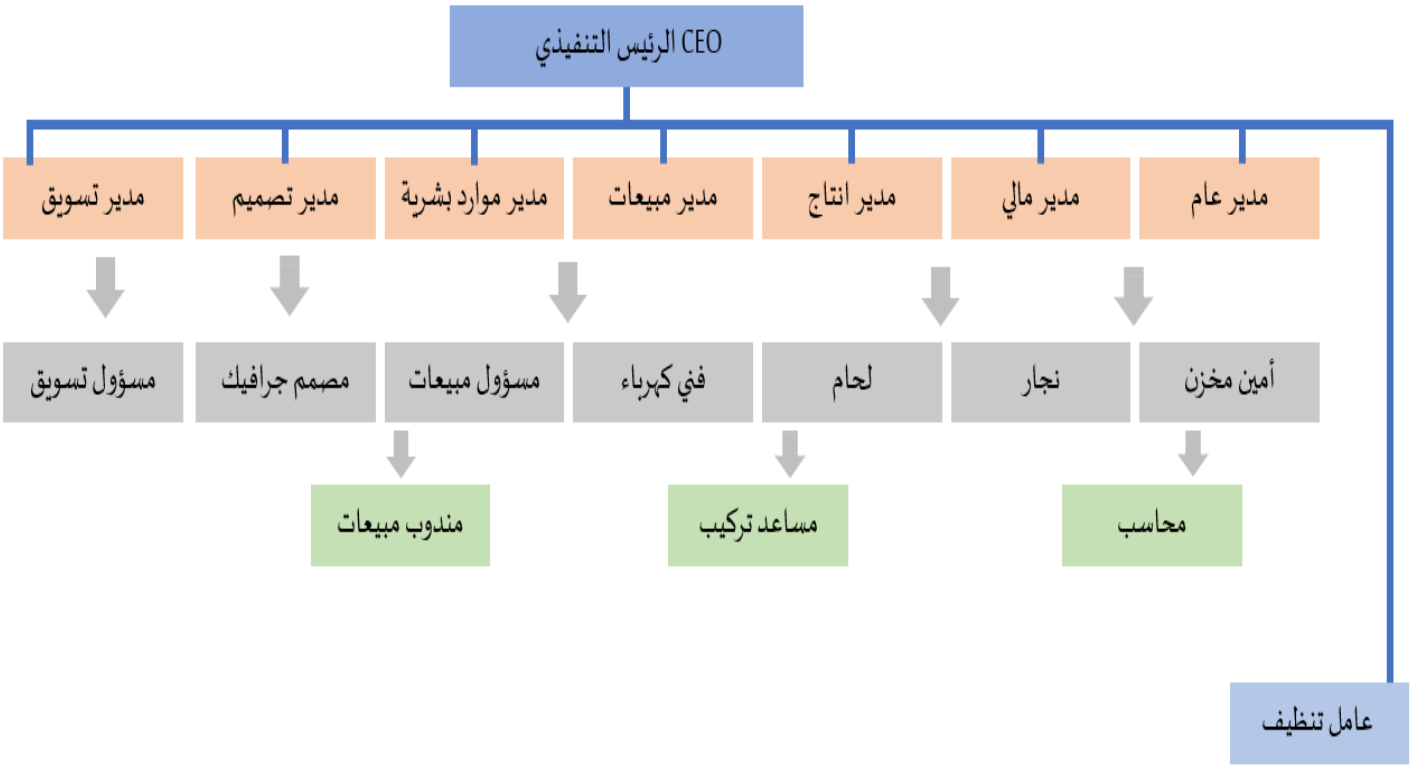
8. طقم البسة العمال

البند	الكمية المطلوبة	سعر الوحدة (دج)	السعر الإجمالي (دج)
قميص عمل	10	3000	30,000
بنطلون عمل	10	3500	35,000
حذاء عمل	10	5000	50,000
قبعة أمان أو خوذة	10	2000	20,000
قفازات عمل	20	1000	20,000
نظارات واقية	10	1500	15,000
المجموع			170,000

9. عملية الإنتاج

- **استقبال الطلب والمعطيات (المساحة، الحجم، الشكل.....):** وهي مرحلة تلقي طلبات الخدمة من العملاء سواء كانوا خواص او ممثلين لهيئات حكومية.
- **التصميم:** مرحلة اقتراح **شكل** التصميم على العملاء.
- **اقتناء المواد الأولية:** مرحلة شراء كل المواد اللازمة لصناعة النموذج.
- **التصنيع:** بداية صناعة وحدات متقايسة من الغلاف الذكي المستشعر للحرارة والرطوبة.
- **تكييف المنتج وتركيبه:** تركيب الوحدات حسب الشكل الذي طلبه العميل.

10. المخطط التنظيمي:



11. احتياجات اليد العاملة والأجور

المنصب	التخصص	العدد	الوظيفة	الأجر التقريبي (دج شهريًا)
مدير عام	إدارة عامة	1	إدارة الشركة وتخطيط العمليات	200,000
مسؤول تسويق	تسويق ومبيعات	1-2	تطوير استراتيجيات التسويق والمبيعات	100,000
مصمم جرافيك	تصميم جرافيكي	1	تصميم المواد الإعلانية والتسويقية	80,000
مسؤول مبيعات	تسويق ومبيعات	1-2	تنسيق عمليات البيع والتسويق	100,000
فني كهرباء	هندسة كهربائية	1-2	تركيب وصيانة أنظمة الكهرباء	100,000 لكل فني
لحام	لحام	1-2	عمليات لحام وتجميع المعادن	60,000 لكل لحام
نجار	نجارة	1-2	تصنيع وتركيب الأخشاب والهياكل	60,000 لكل نجار
محاسب	محاسبة ومالية	1	إدارة الحسابات والتقارير المالية	80,000
مساعد تركيب	تركيب وصيانة	1-2	مساعدة في عمليات التركيب والصيانة	60,000 لكل مساعد
عامل تنظيف	خدمات عامة	1-2	تنظيف وصيانة المنشآت والمعدات	40,000 لكل عامل
المجموع				880.000

12. التموين

ستكون سياسة الشراء كما يلي :

- **ا لآلات:** تكون مرة واحدة فقط الا إذا احتجنا الآلات جديدة فأيضا يكون الشراء مرة واحدة فقط والدفع يكون اما عند الاستلام او عن طريق CCP .
- **مواد أولية:** تكون حسب الطلب في نوعية المنتوج.
- **التجهيزات المكتبية واللوازم:** تكون مرة واحدة فقط.

13. الشركاء:

اسم الشريك	دور الشريك
الموردين: موردي الآلات والمعدات وموردي المواد الأولية	يكمن دورهم واهميتهم في انجاح المشروع بتوفير كافة المستلزمات من الات وتجهيزات ومواد ألولية
حاضنة الاعمال لجامعة بسكرة	تعمل على تمويل ومرافقة المشروع والذهاب نحو تجسيده على ارض الواقع
شركات النقل والتوصيل	دورها نقل وتوزيع المنتجات الى العملاء بفعالية.
العملاء والمستهلكين	يكمن دورهم في تطوير وتحسين المنتجات عن طريق تقديم ملاحظات واقتراحات لتطلعاتهم واحتياجاتهم المستقبلية حول المنتج والخدمة المقدمة من ناحية الجودة والأداء والتصميم.... الخ

المحور الخامس: الخطة المالية

1. التكاليف والأعباء

a. تكاليف استثمارية

الأصول	التكلفة (دج)
المبنى	/
الآلات والمعدات	**10,000,000**
الأثاث	**980,000**
رأس مال العامل	**880.000**
طقم البسة العمال	**170,000**
مجموع	**12,030.000**

b. تكاليف تشغيلية

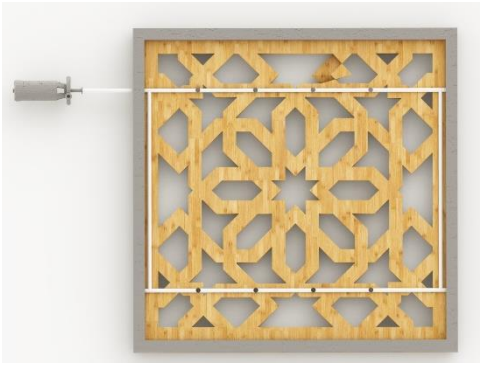
الأصول	التكلفة (دج)
المواد الاولية	**1.780.000**
الاجور	**880.000**
الماء والكهرباء	**674,000**
الهاتف والإنترنت	**38.400**
المجموع	**3,372.400**

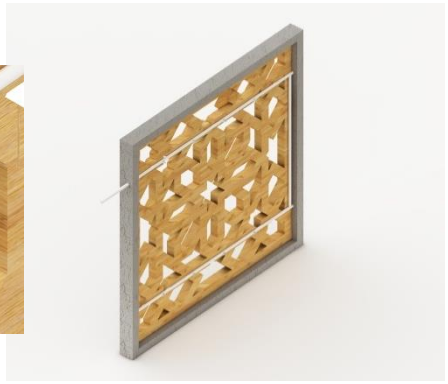
c. جدول حسابات النتائج المتوقعة

السنة	جانفي	فيفري	مارس	افريل	ماي	جوان	جويلية	اوت	سبتمبر	اكتوبر	نوفمبر	ديسمبر	المبيعات السنوية (الوحدة)
2025 70%	1000	1100	1210	1331	1464	1610	1771	1948	2143	2357	2593	2852	2852
2026 70%	1100	1210	1331	1464	1610	1771	1948	2143	2357	2593	2852	3137	3137
2027 80%	1210	1331	1464	1610	1771	1948	2143	2357	2593	2852	3137	3451	3451
2028 90%	1331	1464	1610	1771	1948	2143	2357	2593	2852	3137	3451	3796	3796
2029 100%	1464	1610	1771	1948	2143	2357	2593	2852	3137	3451	3796	4176	4176
مجموع	17412												
قيمة المبيعات (دج)	121,884,000												

المحور السادس: النموذج الأولي التجريبي

1. تصميم التركيبة 3D

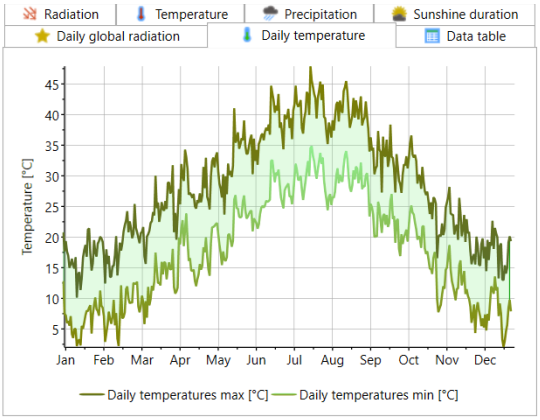


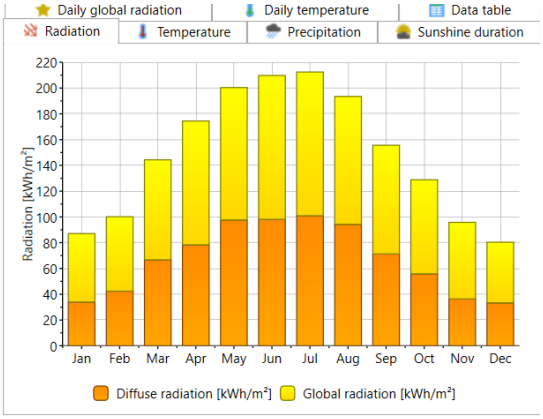


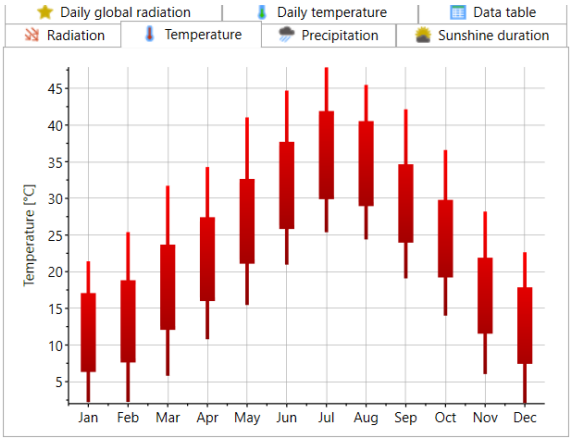
يمكن استعمال هذه الفكرة المبتكرة على واجهات المباني او في الأماكن العامة

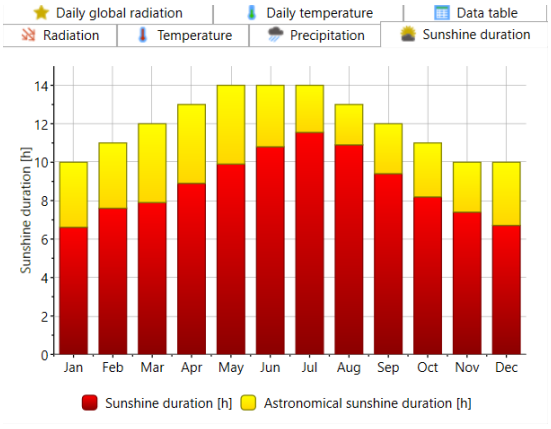
2. التجارب المنجزة على النموذج الأولي

باستعمال برنامج **meteonorm** قمت بإدخال المعطيات المناخية لولاية المسبلة ثم عمل محاكاة على نموذج اولي بواسطة برنامج TRNSYS

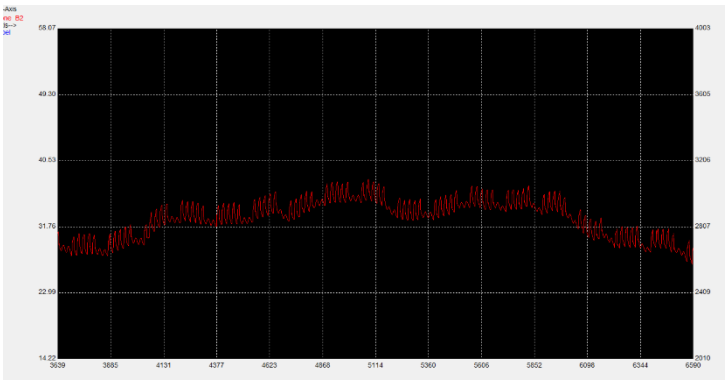


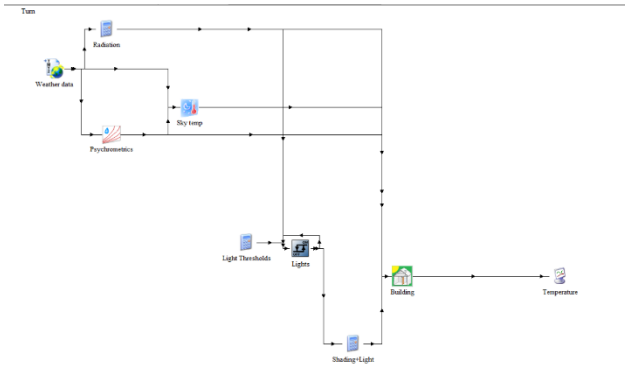




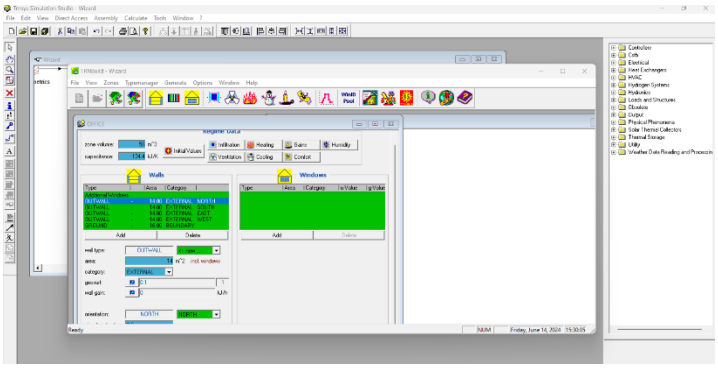


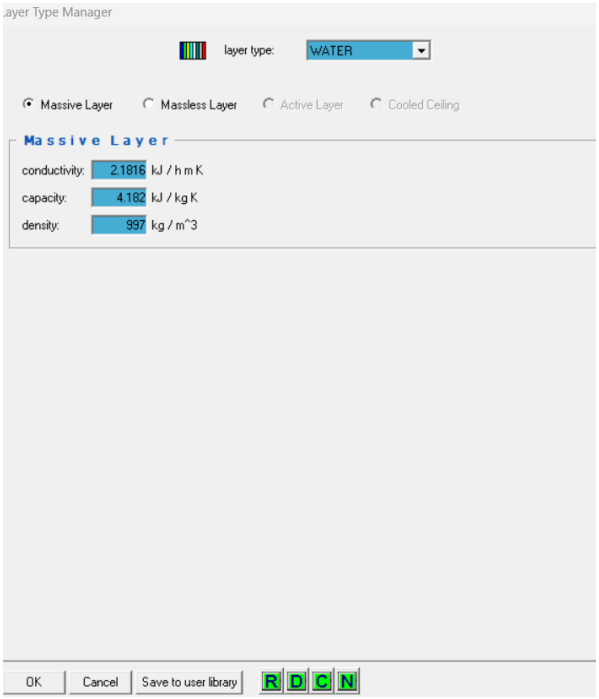
النتائج المتحصل عليها قبل إضافة الغلاف المتكيف:

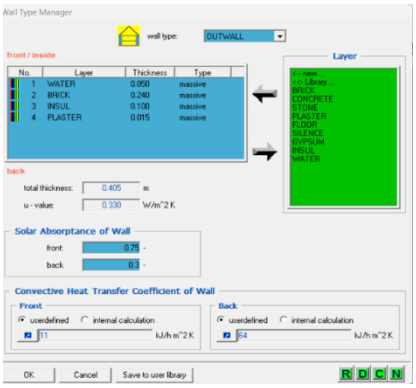




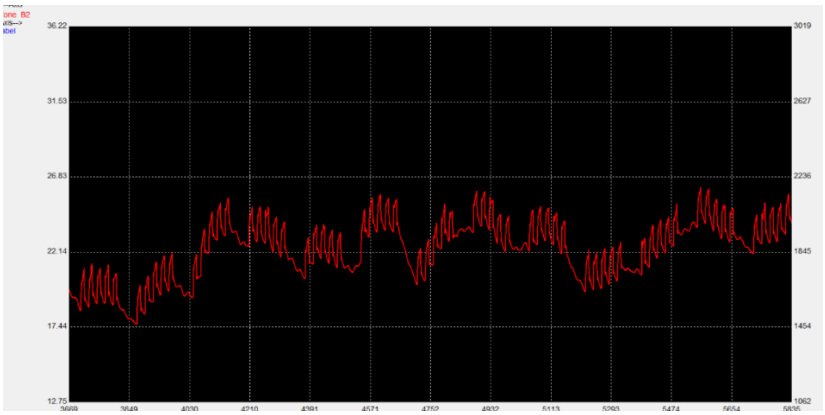
بعد ذلك قمت بإضافة خصائص الماء واضافتها للغلاف الخارجي للمبنى:







النتائج المتحصل عليها قبل بعد إضافة الغلاف المتكيف:



نلاحظ ان الغلاف المتكيف يعمل على تخفيض درجة الحرارة بقيمة 6 الى 10 درجات مئوية.

3. واخير برمجة نظام للتحكم في أوقات رش الماء:

```
Variables:
Air_Temperature, Relative_Humidity : of type Integer;
Sensor_Button : of type character;
Adapted_Envelope, Sensor : of type Boolean;

__ Start
|
|  Adapted_Envelope <---- false;
|
|  __ While (1) do            //infinite loop
|  |
|  |  __ if (Sensor_Button == "is pressed") do
|  |  |
|  |  |   Sensor <---- true;
|  |  |
|  |  |__ else do
|  |  |
|  |  |   Sensor <---- false;
|  |  |
|  |  |__ endif;
|  |
|  |  __ if (Sensor == true) do
|  |  |
|  |  |  __ if (Relative_Humidity<19 && Air_Temperature>27) do
|  |  |  |
|  |  |  |     Adapted_Envelope <---- true;
|  |  |  |
|  |  |  |__else do
|  |  |  |
|  |  |  |    Adapted_Envelope <---- false;
|  |  |  |
|  |  |  |__ endif;
|  |  |
|  |  |__ endif;
|  |
|  |__ endwhile;
|
|__ end;
```

شر ائح العملاء	العلاقات مع العملاء	القيم المقترحة	الأنشطة الرئيسية	الشركات الرئيسية
-أصحاب المنازل الذين يرغبون في تحسين مناطق الجلوس في الهواء الطلق بمنزلهم -الأشخاص الذين يعيشون في مناطق ذات مواسم حارة ويرغبون في خيارات للتبريد المريحة -الأسواق الشعبية والفعاليات العامة التي ترغب في توفير مناطق للراحة والتبريد للزوار -المتنزهات والمناطق الترفيهية - المر افق العامة الكبيرة اللذين يحتاجون لتضليل المبنى والنوافذ لتحسين الراحة الحرارية	-خدمة العملاء الممتازة -دعم فني مستمر -تعاقدات صيانة وخدمات ما بعد البيع **القنوات** المبيعات عبر الإنترنت المعارض والمؤتمرات شبكات البيع بالجملة	- توفير بيئة مريحة ومنعشة خلال الأيام الحارة. -تقليل درجات الحرارة بشكل فعال دون زيادة في استهلاك الطاقة. -نظام بسيط للتركيب والصيانة - إمكانية تخصيص pergola حسب احتياجات العميل من حيث الحجم والألوان والملحقات.	- تصميم وتطوير pergola بتقنية التبريد برذاذ الماء - تصنيع وتجميع الهيكل الألمنيوم وتركيب أنابيب الرش - اختبار وتعديل الأنظمة لضمان الأداء الأمثل - التسويق والبيع للعملاء المحتملين **الموارد الرئيسية** -مقر العمل : المصنع -المواد الأولية -الآلات والمعدات -عمال ذو كفاءة -علامة تجارية	- موردي المواد الأساسية (الألمنيوم، الخشب، أنابيب الرش) - موردي التكنولوجيا (أنظمة التبريد برذاذ الماء، مضخات المياه) - الموردين لأنظمة التحكم والتوقيت.

المصادروالارادات	هيكل التكاليف
-بيع الأصول (بيع المنتجات) -تقديم خدمات (الصيانة، التركيب والاستشارة.)	-تكاليف ثابتة: تكاليف شراء الآلات والمعدات، تكاليف تهيئة المقر، اجا ر العمال -تكاليف متغيرة : تكاليف المواد الأولية، تكاليف املاء و الكهرباء و الغاز

الجمهورية الجزائرية الديمقراطية الشعبية

وزارة التعليم العالي والبحث العلمي

جامعة محمد خيضر -بسكرة

حاضنة أعمال جامعة بسكرة

رقم29/ الحاضنة /2024

شهـــادة توطيـــن /تحضيـــن "مشروع مبتكر ضمن قرار 1275"

انا الممضي أسفله، السيد (ة): **محمد جلاب**

مسير(ة) حاضنة الأعمال: **جامعة محمد خيضر – بسكرة-**

المقر الاجتماعي / العنوان: **المجمع الإداري المقابل لكلية العلوم الاقتصادية، الطابق الثاني، جامعة بسكرة 07000**

رقم علامة الحاضنة: **2311223051**

تاريخ تسليم العلامة: **23 نوفمبر2022**

أشهد أن الطالب التالية أسمها:

الاسم و اللقب	الطور الدراسي	التخصص	الكلية
حمريط فؤاد	ماستر 02	هندسة معمارية	العلوم والتكنولوجيا

تحت إشراف الاساتذة التالية أسمائهم:

الاسم و اللقب	الرتبة	التخصص	الكلية
ماضوي مريم	استاد محاضر -أ	هندسة معمارية	العلوم والتكنولوجيا

تم احتضانه على مستوى *حاضنة أعمال* جامعة محمد خيضر - بسكرة بمشروع تحت اسم:
الغلاف المعماري التكيفي كمنظم حراري فعال في المناخ الحار والجاف
خلال السنة الجامعية 2024/2023 .

سلمت هذه الشهادة بطلب من المعني للإدلاء بها في حدود ما يسمح به القانون.

حرر في: بسكرة بتاريخ 2024/06/04

مدير الحاضنة

جامعة محمد خيضر بسكرة
حاضنة المؤسسات الناشئة
Start Up Incubator
MOHAMED KHIDER UNIVERSITY OF BISKRA

المسؤول حاضنة المؤسسات الناشئة

د/ محمد جلاب