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Institute of Architecture and Urbanism
Department of Architecture

Master Thesis

Workshop: Architecture, Environment, and Technologies

Workshop theme: **optimization of visual comfort with natural lighting and energy efficiency in a business hotel**

E.S.P

The design of the BUSINESS HOTEL IN THE BUSINESS DISTRICT of BAB EZZOUAR

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الحمد لله الذي وفقنا ويسّر لنا هذا العمل، ونسأله أن يتقبله بقبولٍ حسن، ويجعله خالصاً لوجهه الكريم"

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Abstract

In today's ever-changing world, where architectural innovation continues to advance to meet new challenges, business travel has become a key driver of economic growth. As nations become increasingly interconnected, the ability to communicate seamlessly and travel efficiently has become indispensable. This is business tourism, a specialized segment that not only facilitates trade but also enhances global networking opportunities. In our thesis, we wish to address this topic of tourism in Algeria and how to make it sustainable in the long term. Within this framework, we have selected a business hotel project in Bab Ezzouar To ensure not only comfortable working spaces but also luxurious areas for accommodation and leisure, aiming to fully satisfy our clients and enhance their overall experience in our hotel, this hotel situated in the business district, as it aligns with this same goal: establishing a hub for business. The design approach is structured around three main phases: (i) A comprehensive urban analysis (typo morphological, sensorial), identifying the site's strengths, constraints, and opportunities through a detailed SWOT reading, ensuring the project integrates harmoniously into its context. (ii) A study of real-world business hotels, to understand their programs, operational logic, and spatial organization. (iii)The introduction of environmental concept, aiming to reduce energy consumption through bioclimatic architectural choices and digital simulations, with the goal of balancing thermal and visual comfort.

The result is an eco-friendly business hotel, developed through thoughtful reflection at the crossroads of sustainable design, a deep understanding of business tourism requirements, and a thorough reading of the site. This project is not only an architectural response but also an invitation to rethink business spaces as intelligent, sensitive, and forward-thinking environments.

Keywords: business travel, Sustainability, business district, Ecofriendly business hotel, energy conception, visual comfort, thermal comfort.

Résumé

Dans un monde en constante évolution, où l'innovation architecturale ne cesse de progresser pour relever de nouveaux défis, les voyages d'affaires sont devenus un moteur essentiel de la croissance économique. À mesure que les nations deviennent de plus en plus interconnectées, la capacité à communiquer efficacement et à voyager de manière fluide est devenue indispensable. Le tourisme d'affaires est un segment spécialisé qui non seulement facilite les échanges commerciaux, mais aussi améliore les opportunités de mise en réseau à l'échelle mondiale. Dans notre thèse, nous souhaitons aborder le tourisme d'affaires en Algérie et les moyens de le rendre durable sur le long terme. Dans ce contexte, nous avons sélectionné un projet d'hôtel d'affaires à Bab Ezzouar. Afin de garantir à nos clients des espaces de travail confortables, mais aussi des espaces luxueux pour l'hébergement et les loisirs, dans le but de satisfaire pleinement leurs attentes et d'améliorer leur expérience globale dans notre hôtel, cet hôtel situé dans le quartier des affaires s'aligne sur ce même objectif : créer un pôle d'affaires. L'approche conceptuelle s'articule autour de trois phases principales : (i) une analyse urbaine complète (typo morphologique, sensorielle), permettant d'identifier les atouts, les contraintes et les opportunités du site, et d'assurer l'intégration harmonieuse du projet dans son contexte grâce à une lecture détaillée de l'analyse SWOT. (ii) Une étude des hôtels d'affaires réels permettra de comprendre leurs programmes, leur logique opérationnelle et leur organisation spatiale. (iii) L'introduction d'un concept environnemental, visant à réduire la consommation d'énergie grâce à des choix architecturaux bioclimatiques et des simulations numériques, pour un équilibre entre confort thermique et visuel.

Le résultat est un hôtel d'affaires respectueux de l'environnement, conçu à partir d'une réflexion approfondie alliant design durable, connaissance précise des besoins du tourisme d'affaires et analyse minutieuse du site. Ce projet ne se contente pas d'offrir une réponse architecturale, il invite également à repenser les espaces d'affaires comme des environnements intelligents, sensibles et tournés vers l'avenir.

Mots-clés : voyages d'affaires, durabilité, quartier d'affaires, hôtel d'affaires écologique, conception énergétique, confort visuel, confort thermique.

ملخص

في ظل عالم يشهد تغيّرات متسارعة وابتكارات معمارية متواصلة لمواكبة التحديات الجديدة، أصبح السفر من أجل الأعمال أحد المحركات الأساسية للنمو الاقتصادي. ومع تزايد الترابط بين الدول، باتت القدرة على التواصل السلس والتنقّل الفعّال ضرورة لا غنى عنها. ويُعدّ "سياحة الأعمال" قطاعًا متخصصًا لا يكتفي بتسهيل التبادل التجاري، بل يُعزّز أيضًا فرص التواصل والشبكات على المستوى العالمي.

في هذا السياق، يتناول هذا البحث موضوع **سياحة الأعمال في الجزائر**، مع التركيز على سُبل جعلها **مستدامة على المدى الطويل**. وقد تم اختيار مشروع **فندق أعمال في منطقة باب الزوار** ليكون موضوعًا تطبيقيًا لهذا التوجه. يهدف المشروع إلى توفير فضاءات عمل مريحة ومجهزة، إلى جانب مناطق راقية للإقامة والترفيه، بما يضمن تلبية تطلعات النزلاء وتعزيز تجربتهم الشاملة داخل الفندق. ويقع هذا الفندق في قلب الحيّ التجاري، مما يعزز ارتباطه الوثيق بأهداف المشروع المتمثلة في خلق نقطة ارتكاز لمجتمع الأعمال.

يرتكز المنهج التصميمي المتبع على ثلاث مراحل رئيسية:

تحليل حضري شامل (مورفولوجي، حسي) (SWOT)، يتضمن دراسة دقيقة لنقاط القوة والضعف والفرص والتهديدات لضمان إدماج المشروع بانسجام ضمن محيطه العمراني.

دراسة تطبيقية لفنادق الأعمال الواقعية، لفهم برامجها ووظائفها وتنظيم فضاءاتها التشغيلية.

إدراج مفهوم بيئي مستدام، يهدف إلى تقليل استهلاك الطاقة من خلال اعتماد حلول معمارية بيوكليماتية مدروسة، مدعومة بمحاكاة رقمية، لتحقيق توازن بين الراحة الحرارية والبصرية.

وتُوّجت هذه المقاربة بإنتاج **فندق أعمال صديق للبيئة**، نابع من تفكير معمق عند تقاطع التصميم المستدام، وفهم متكامل لمتطلبات سياحة الأعمال، وقراءة دقيقة للواقع العمراني للموقع.
إنه ليس مجرد مشروع معماري، بل **دعوة لإعادة التفكير** في كيفية بناء فضاءات تلبي حاجيات الاقتصاد المعاصر، دون التفريط في البعد الإنساني والبيئي.

الكلمات المفتاحية: السفر التجاري، الاستدامة، الحي التجاري، فندق أعمال | صديق للبيئة، مفهوم الطاقة، الراحة البصرية، الراحة الحرارية.

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The educational approach of the “Architecture and Environment” workshop

The “Architecture and Environment” workshop aims to raise students' awareness of a contextual and integrated approach, harmoniously combining the urban and architectural scales while respecting the principles of sustainability. This approach aims to respond to the major challenges of the 21st century, particularly climate change, which is the most urgent ecological issue facing humanity. In addition, under the effect of overwhelming globalization, architectural identity has been weakened. It is within this framework and context that the workshop seeks to find answers to the question of how to strike a balance between urban, architectural, identity, and environmental requirements.

To achieve this objective, a cross-sectional urban analysis was carried out, combining typomorphological, sensory, and SWOT analyses. The typomorphological analysis focuses on interpreting the urban form through two temporalities: diachronic, through which a territorial interpretation and the formation and transformation of the city are studied, and synchronic, which allows us to identify the types and dysfunctions existing in the intervention sector through the logic of the fabric. Through this approach, students will be called upon to find the climatic responses that each part of the fabric carries within it. Sensory analysis then enriches the spatial reading through the perception and experience of users in the urban space, which would allow us to identify the urban image or the imaginability of the city in question. Finally, SWOT strategic analysis is considered a synthetic approach that allows students to revisit the urban analysis and identify the strengths, weaknesses, risks, and opportunities of their study area and propose solutions aimed at an urban strategy that the students would also have identified. We felt that this approach was essential for understanding urban dynamics, identifying existing dysfunctions, and proposing solutions to improve the daily lives of residents.

In response to the issues identified, students will be required to propose a coherent and appropriate urban program that fits within the previously defined urban strategy. This approach aims to resolve dysfunctions and strengthen the area's assets by promoting sustainable urban development. It is within this specific contextual framework that students will have to choose and develop their final projects in direct relation to the specific issues of their area of study.

Based on the contextual specificities of their projects and a review of scientific and technical literature, students will be able to identify the most significant consumption sector of their projects. This step will enable them to target passive strategies to improve the environmental performance of their projects, focusing their attention on a single environmental aspect, such as hygrothermal and visual comfort and indoor and outdoor thermal comfort, by assessing the impact of the exterior design. In addition, students will have to integrate passive strategies such **as orientation, insulation, composition,**

vegetation, natural ventilation, etc. to improve the comfort and energy efficiency of their projects.

At the same time, thematic research and analysis were conducted to design a space that is functionally and environmentally coherent. The thematic analysis covered a variety of aspects, including environmental, formal, functional, and structural aspects, as well as other parameters such as biodiversity, materials, and landscape integration.

Finally, the students focused on the architectural design itself, seeking to reconcile architectural requirements and environmental performance. To this end, several specialized tools, methods, and software programs were made available to the students to help them refine their proposals and assess the environmental impact of their projects. This educational approach aims, we hope, to train architects capable of designing architectural projects that are respectful of their environment, “sometimes” innovative, and adapted to current climate challenges.

Workshop teacher: Dr. Boukarta Soufiane

CHAPTER 01 :

GENERAL INTRODUCTION

Chapter 1 : General introduction

1.1. General Introduction:

The Industrial Revolution fundamentally transformed human civilization, ushering in an era of unprecedented technological advancement and economic growth while simultaneously establishing fossil fuels as the dominant energy source that continues to power modern development. This energy reliance, accounted with unchecked industrialization and exponential population growth, has created a perfect storm of environmental crises from climate change and resource depletion to social consequences (Smil, 2017)

Climate change, driven by the rapid increase in greenhouse gas (GHG) concentrations, poses a severe threat to the planet. Since the Industrial Revolution due to human activities such as burning fossil fuels deforestation, and industrial emissions have significantly elevated atmospheric levels (GHG) levels have surged marking a 50% increase then in the pre-industrial which caused the Earth's average temperature has risen by roughly 1.2°C since the late 19th century and accelerated ice melt (with Arctic sea ice declining by 13% per decade), and caused global sea levels to rise by 3.7 mm per year over the last decade. (Arndt, Baringer, & Johnson, 2010)

globally, the new shape of the modern civilized world led to urban migration due to shift in living condition between rural area and urban cities with the overgrowing population, this development model is compounded by significant social challenges, including urban overcrowding, housing inequities (Pobiner & A, 2013)

In a global context where these environmental challenges are in question and increasingly pressing action, Sustainability was introduced in 1987, emphasizes meeting present needs without compromising future generations' ability to meet their own needs , The term 'sustainable architecture' emerged a little earlier in the 1970s and gained significant popularity during the 1990s, which is attributed to the construction of the headquarters of the United Nations in New York, USA (World Commission on Environment and Development ,1987)

The Sustainable Development Goals (SDGs) play a crucial role in architectural education, as buildings contribute 39% of global energy-related carbon emissions and 40% of extracted materials are used in construction. This research investigates the current status of SDG integration in architecture education, its challenges, and potential future advancements (Mennatullah & Mahreen, 2024)

Algeria as country falls in with rest facing the same challenges, with increase in housing crisis, housing became more of a shelter neglecting many aspects of comfort and wellbeing that end up effecting on productivity of individual and social alike and prioritizing quantity over quality, Consequently Algeria the latter took part in the recent Conference on Climate Change held in Paris (COP 21), committing to significant measures aimed at mitigating global warming. Algeria has established a comprehensive strategy focused on decreasing reliance on fossil fuels and advancing the use of renewable energy sources (Bulakh, 2022).

Architecture serves as a concrete manifestation of culture and society, embodying the needs and values of a community during a particular period in its history. Furthermore, this field plays a crucial role in influencing our environment, particularly regarding the utilization of material resources and energy consumption, as (Ching, 2014) mention in the book "Designing with nature means understanding the interplay between energy consumption and the environment, leading to buildings that are both functional and sustainable." (Green Building Illustrated, P78, 2014)

Ultimately, the adoption of sustainable materials and eco-friendly construction practices in Algeria reflects a collective awareness of environmental issues. By incorporating these elements into architectural design, it is possible not only to reduce buildings' environmental impact but also to foster development that supports the local economy and enhances residents' well-being. Showing that sustainability is not only a global goal but also a local imperative for harmonious and viable development (Bulakh, 2022).

1.2. General Problematic

Today's metropolises are seen as large-scale example for national development. Countries'. The potential attractiveness of metropolises is in terms of both economic success and cultural influence. A metropolis is a city, large in size and population, with a diverse concentration of infrastructure and facilities that enable international activities to flourish. Many capital cities count as metropolis due to historical importance (Nasrollahzadeh, 2022). The tourism sector includes the planning and development of hotels, resorts, cultural sites, and recreational areas that draw visitors and enrich their experiences. Nevertheless, as the focus on environmental safekeeping intensifies, the integration of sustainable architecture has become crucial in the advancement of tourism. This strategy aims to reduce ecological footprints, safeguard local heritage, and promote enduring advantages for communities. According to the UNWTO, generates more than 5% of greenhouse gas emissions (UNWTO, 2017). In metropolis, the business sector serves as the economic backbone of any major city, with the central business district (CBD) functioning as its pulsating heart. These concentrated zones of commerce and finance represent much more than just clusters of office towers they embody the city's economic ambitions, global connectivity, and urban identity. And modern workspaces are embracing sustainable architecture to reduce environmental impact while boosting employee well-being and productivity (M.Derriso & D.McCurry, 2012).

Bab Ezzouar business district in Algeria occupies a strategic position in the country's economic development, particularly in the business sector. The latter, which attracts national and international professionals for conferences, business meetings, and partnerships, represents an essential lever for Algeria's economic growth. However, buildings dedicated to the professional sector present major energy challenges, often marked by the harsh integration with urban surrounding dehumanization of the district and heavily infested with automobiles that kill the ease of pedestrian experience moreover it's a necessity to meet not only national requirement but also international and express

the economic development with architecture. Therefore it is important to put in place a business and tourism development strategy that respects the environment and is adapted to the specific characteristics of the Bab ezzouar, we have two questions to ask ourselves. The nature of the urban development and the other concerns the environmental aspect of the architectural project. At this stage of development, a question arises:

What kind of development strategy could enhance the city of Bab ezzouar architecture to strengthen business and tourism in Algeria, and integrate principles of sustainability?

To answer the question posed above, we considered Bab ezzouar business district as a site for reflection. Thus, we pose the following **hypothesis:**

Based on SWOT analysis matrix crossing concluded elements from typo-morphological and sensorial analysis , we will be able to identify malfunctions and develop a strategy that support humanization and guide us to integrate our project in order enhance the coherency of the district.

1.3. Specific Problematic:

Bab ezzouar as a metropolis, with its major commercial vocation on a national scale, is supported by its existing infrastructure, particularly in the business sector. a space that accompanies the process of metropolisation that the city of Bab ezzouar is undergoing, while at the same time emphasizing business and tourism as a way of promoting local culture by enhancing what already exists. It is therefore important to put in place a tourism development strategy that respects the environment and is adapted to the specific characteristics to both aspects urban planning and architectural project. A question arises then:

How to design ecofriendly business hotel in the existing business district of Bab ezzouar.

To respond to our problematic presented above, we suggest the following **hypothesis:**

Integrating passive design strategies in the conception of the hotel would reduce its impact on the environment.

The importance given to the project in the intervention area necessitates the creation of a business hotel that aims to merge work, hospitality, leisure, and commercial services into a single mixed-use program. This aims to serve as a central hub for managing commercial activities, an unprecedented destination for tourists, visitors, and residents, an "all-in-one" destination for working, living, Moreover, the ongoing project is expected to meet sustainability standards. Thanks to our initial readings, we have identified natural lighting being one of important pillar of psychological comfort however its side effect plays role in thermal heat gain. In this work, our focus is on natural lighting. To do this, we pose the following question:

How to balance the optimization of visual comfort with the thermal gain.

To respond to our problematic presented above, we suggest the following hypothesis:

The architectural form, combined with an intelligent envelope design, can serve as an effective strategy to balance visual comfort and thermal gain

1.4. Objective:

The objective of this thesis is to design a project that meets the growing needs of business tourism in Bab Ezzouar, while incorporating sustainability principles and ensuring comfort. The aim is to create an environment that is both welcoming and functional for professionals, adhering to ecological and energy efficiency standards. This work involves the development of a comprehensive state of the art to address key questions and understand the concepts relevant to the project.

This includes defining the key terms of the subject and conducting analyses of case studies, which will inform the quantitative and qualitative programming necessary for the architectural design. The project seeks to integrate modern architectural solutions with sustainability objectives to contribute to the economic and environmental resilience of Bab Ezzouar.

1.5. Methodology of the thesis

In order to be able to provide answers to our problems, we have structured our work as follows:

Theoretical part: made up of two stages:

- A contextual study on the scale of the city of Bab ezzouar and on the scale of the business district with the aim of better control of the site
- And a thematic study which consists of exploring the documentation available on the knowledge relating to the theme of business hotels.

The practical part: composed of two stages:

- Conceptual aspect and it is the Project philosophy: which includes the design process (ideation, conceptualization and materialization which is based on the contextual and thematic study.
- Constructive approach: consists of identifying the constructive system and the materials used in the design of the project

1.6. Structure of the thesis:

1.6.1. Chapter 01: Introductory

This chapter includes a presentation of the research theme and places it in the global perspective and in Algeria. Next, we identified the general and specific issues that led to hypotheses, as well as the objectives of the work and the structure of the thesis.

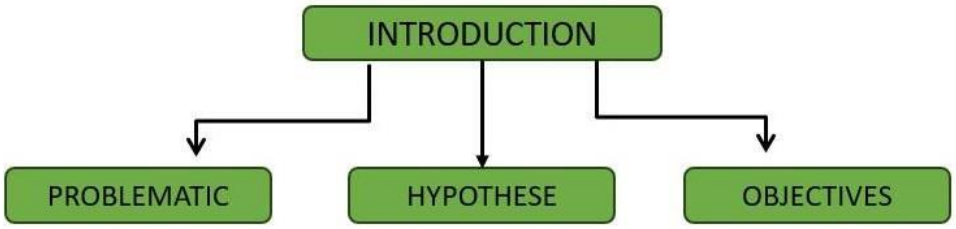


Figure 2: first chapter components. Source: Authors

1.6.2. Chapter 02: State of the Art

All of the bibliographic research on our topic—tourism, business tourism, intelligent envelop building and balancing between visual and thermal comfort , and their connections to architecture—as well as examples are collected in this second chapter. In order to broaden our understanding and emphasize the ideas and resources that will help us with architectural design.

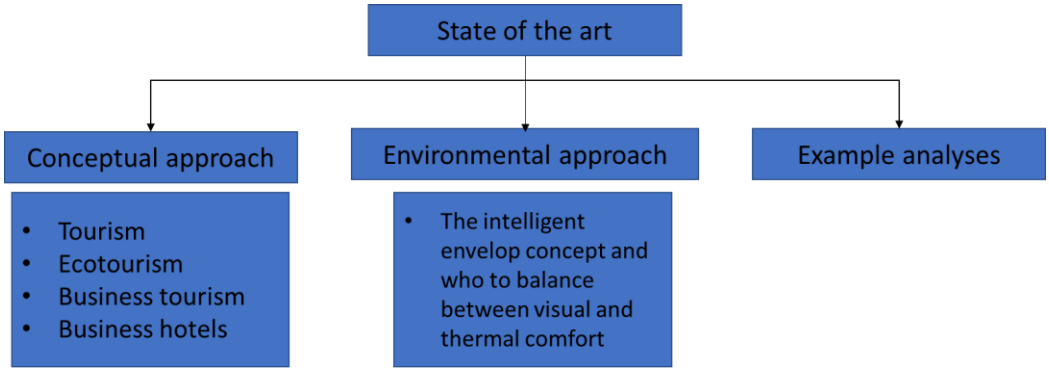


Figure 3: Second chapter components. Source: Authors

1.6.3. Chapter 03: Case Study

The case study is covered in the third chapter, which starts with a climate and urban analysis of the town of BAB EZZOUAR. This is followed by the analysis of the study area, which includes a climate analysis. We suggested a development plan as part of an urban intervention. Lastly, using the knowledge from the previous chapter, we analyzed the intervention site where we started the architectural project's conceptual phase.

And finally the simulation phase, in which we used the "Design Builder" program to apply a number of scenarios and techniques in order to assess and optimize the project's energy performance.

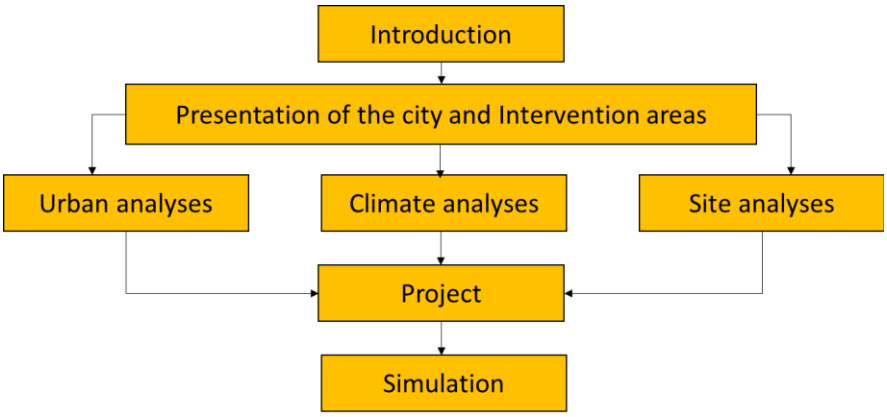


Figure 4: third chapter components. Source: Authors

CHAPTER 02 :

STATE OF THE ART

2.1. INTRODUCTION:

The main objective of this research is to deepen our understanding and analysis of the knowledge required to answer our working hypothesis. To this end, we have devised a three-stage process that will enable us to better frame our thinking. The first stage consists in laying the theoretical foundations by clarifying fundamental concepts (tourism, business tourism and business hotels...), the second part focuses on the environmental dimension, studying more specifically how to optimize visual comfort thanks to natural light, while ensuring energy efficiency adapted to business hotels. Finally, the last part will draw on the analysis of real-life examples to enrich our reflections.

2.2. PART I:

2.2.1. Tourism:

2.2.1.1. Definition:

Tourism is a socio-cultural and economic process that involves the movement of people away from their usual place of residence, usually for recreational purposes. It includes a variety of activities that may or may not involve commercial transactions, and has an impact on the economy, the environment and local communities (unwto, 2000).

2.2.1.2. Tourism's socio-economic impact on the nation

Tourism plays an essential role in socio-economic development, helping to create jobs, develop infrastructure and improve public services. It stimulates various fields such as agriculture, industry, construction and transport, thereby contributing to economic diversification and local development, particularly in rural areas (ILO, 2019). Since 2010, tourism leaders at the G20 have highlighted the importance of tourism as a "driver of job creation, economic development and progress". The tourism sector can have a number of positive impacts on the national economy, such as: (i) Encouraging the creation and expansion of new businesses. (ii) Encouraging the development of new infrastructure and innovative transportation services. (iii) Improving workers' skills (the tourism industry encourages local/rural residents to acquire foreign language skills and customer service training). (ILO, 2019).

2.2.1.3. The State of Algeria's Tourism Industry

Many of the leading nations in the tourism industry lack the diversity of potential and resources that Algeria possesses. These qualities could establish Algeria as a preeminent destination on a regional and international scale, provided they are properly considered and utilized. However, a number of obstacles prevent the growth of Algeria's tourism industry (A.Djanane, 2024).

2.2.1.4. Tourism in Algeria: Between potential and challenges to overcome:

Algeria is positioned as a promising travel destination due to its substantial natural, historical, cultural, and economic resources. Notwithstanding these benefits, the industry still faces many organizational and structural obstacles that prevent it from reaching its full potential. (Nadia, 2017). On one hand, Algeria has many natural resources, such as a 1,200-kilometer Mediterranean coastline, a variety of Saharan landscapes, and a large

number of protected areas and thermal springs. Furthermore, there is a lot of potential. For cultural tourism due to its rich historical and cultural legacy, which is represented in UNESCO-listed sites, traditional crafts, and cuisine. Moreover, the nation's connectivity (ports, airports, and highways), modern infrastructure, and advantageous geographic location offer a strong basis for the expansion of tourism, especially Saharan tourism, which is already well-known worldwide (ibid).

Figure 5: Algeria naturel and cultural resources .SOURCE: cresus.dz

On the other hand, there are a number of enduring issues that hinder the sector's ability to compete: First, the lack of proper infrastructure for lodging, dining, and entertainment has a detrimental effect on the experience of tourists; Second, the lack of professionalism among tourism stakeholders (travel agencies, hotels, restaurants) and the limited use of digital technologies (e-payment, online booking) further limit the sector's efficiency; and Finally, the lack of innovation in tourism offerings, high travel costs, and the absence of a strong tourism culture among locals all further hinder Algeria's efforts to become a top travel destination (Ibid).

2.2.1.5. Algerian tourism policy

Tourism in Algeria has long been neglected in public policy, despite its stated ambitions in terms of job creation and foreign currency generation. However, since the 2000s, the country has strengthened its tourism strategy with the adoption, in 2008, of the tourism Development Master Plan 2030, serving as a framework for the sector's development. (A.Djanane, 2024). This policy aims to enhance the country's heritage while preserving the environment, diversify the economy to reduce dependence on hydrocarbons, boost GDP and employment, and energize related sectors such as agriculture and crafts. It is also based on the development of tourism clusters of excellence using a participatory and sustainable approach, guaranteeing the feasibility and coherence of projects (Nadia, 2017).

2.2.1.6. Tourist Centres of Excellence: Algeria's New Growth Engines"

In Algeria, tourist centres of excellence are geographical areas specifically selected to stimulate and coordinate the development of tourism. These centres bring together various tourist villages with accommodation, entertainment and tourist activities, helping

to build Algeria's international reputation. The main aim of these hubs is to structure the area and focus tourism initiatives on key zones, rather than spreading tourism uniformly throughout the country. This should lead to optimized resource management and enhanced destination appeal (Dahmoun, 2017).

Figure 6: Tourist Centers of Excellence in Algeria. Source: DAHMOUN.2017

2.2.2. Ecotourism: The Future of Conscious Travel

2.2.2.1. . Definition:

Ecotourism is both a concept based on sustainability principles and a market segment. Since the 1990s, it has been studied by experts and NGOs as a tool for sustainable development (Wood, 2002). A form of sustainable tourism, it favours the discovery of nature and urban ecosystems while encouraging encounters and respect for local lifestyles. (KHODJA Nour El Hana 1, 2021). It's a responsible trip to preserved areas, limiting environmental impact and contributing to the conservation, education and development of host communities (Tardif, 2003).

2.2.2.2. **Principle:**

According to (Wood, 2002) Ecotourism is based on a number of principles that can be summarized as follows:

- ✓ Reduce the negative environmental and cultural impacts that can damage a site.
- ✓ Inform the visitor about the value of conservation.
- ✓ Emphasize the value of conducting business responsibly, which collaborates with local government representatives and citizens to address local needs and provide conservation advantages.
- ✓ Contribute directly to natural and protected area management and conservation.
- ✓ Insist on the necessity of regional tourism zoning and visitor management plans for either natural areas or regions that are being developed into eco-destinations.

- ✓ Stress the use of long-term monitoring programs and environmental and social baseline studies to evaluate and reduce impacts.

2.2.2.3. Impact:

Ecotourism, which is growing rapidly around the world, is characterized by impacts that are spread over three dimensions: economic, social and environmental.(Tardif, 2003) :

- **Socio-cultural impact**
  The enrichment of culture through the preservation and rediscovery of lost traditions, the strengthening of identity and cultural pride, and the appropriation of heritage, along with limited yet occasionally meaningful interactions between communities and tourists.
- **Economic impact**
  Creation of jobs, diversification of the economy, financing for protected areas, and local development through better services and infrastructure, though often limited to secondary roles in isolated areas.
- **Environment impact**
  To ensure the sustainability of sites, tourism can fund the conservation of natural areas, bolster ecological monitoring using indicators like carrying capacity, evaluating disturbance, and maintaining ecological interest.

2.2.2.4. SYNTHESIS:

Tourism in Algeria has real potential, but is still hampered by a number of difficulties. To revitalize the sector, the government has launched a series of strategies to promote its development. As part of this effort, ecotourism is emerging as a more responsible alternative based on sustainable development practices.

2.2.3. BUSINESS TOURISM

This section focuses on business tourism. It aims to better understand this type of tourism and its impact on the development of countries and their infrastructures.

2.2.3.1. **What is business tourism**?

Business tourism during the 19th century, Europe and North America felt the need to design huge venues to bring people together, especially those belonging to academia. Increasingly, hotels offered rooms specifically dedicated to scientific meetings. According to Dupuy (2005, p. 38), "*the congress thus came into being because of the need felt by individuals from diverse professions and social backgrounds to come together in order to confront their perspectives and advance their professional work or ideals*". Towards the beginning of the 20th century, a new trend in meetings emerged: companies sought to

optimize the training of their employees, particularly those working in the sales sector. Today, “business tourism is an essential element of corporate strategy” (Oliveira, 2013).

The term business tourism remains the most appropriate to designate this specific branch of the travel industry, which aims to frame, stimulate, develop, create business opportunities and facilitate communication. He define business tourism as all travel related to the travellers’ work or professional interests. These trips may be essential to the performance of the job, contribute to its improvement, or be a reward for employees. (Oliveira, 2013). Business tourism, or MICE, is a fast-growing specialized segment that promotes interaction between sectors through organized events and complementary services (Ortiz & Cárdenas: 2022). Encompassing professional travel to meetings, conferences, and exhibitions, it is defined by consistent demand, a substantial local economic impact, and tailored services that enhance the competitiveness of regions. (Yana, 2022). The Business tourism can take many forms. It can be a stimulating excursion, a congress, a convention, a symposium, etc. In general, business tourism can be divided into four major categories, grouped together under the acronym MICE: Meeting, Incentives, Conventions, and Exhibitions. (SÈZE, 2002). See figure below:

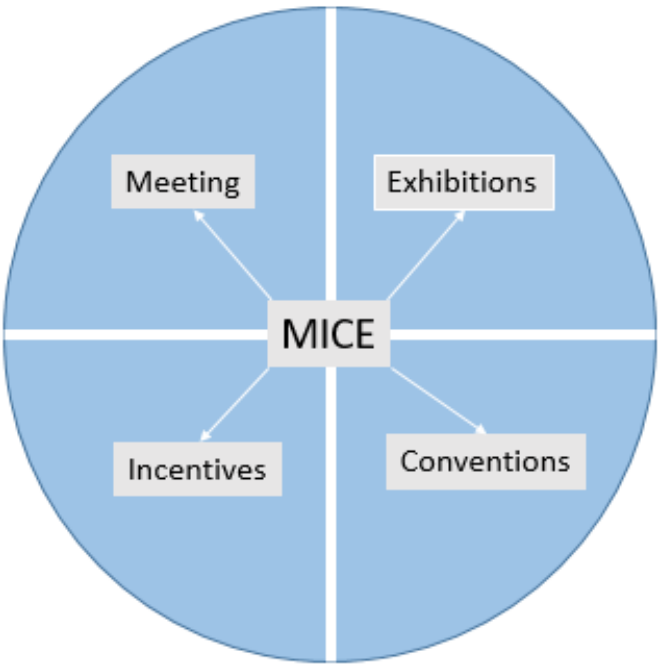


Figure 7:BUSINESS TOURISM FORM. SOURCE: OLEVIEARA, 2013

These categories remain general and can be refined according to the specific characteristics of the meetings, as illustrated in the table below. (Oliveira, 2013)

Table 1:Types of meetings. SOURCE: Oleviera, 2013.

	Characteristics/objectives	Duration
Incentive travel	The incentive trip is designed to reward an employee who has achieved the objective(s) previously set by the company.	Depending on the company's budget.
Seminar	Generally organized by a company, the aim is to provide training and exchange on a specific theme.	From 2 to 7 days, with a possible tourist dimension.
Congress	Event organized by various organizations to exchange knowledge and experience on a specific theme.	Lasting around six days, including a social program with social events, shows and official meetings.
Conference	Interactive meeting to discuss and solve problems.	The duration varies according to the sector: up to 3 days for a national association, 5 days for an international one and 1 to 2 days for the public sector.

2.2.3.2. . Business tourism impact

According to (Oliveira, 2013), the economic impact of business tourism can be summed up as follows: (i) Business travel directly affects the economy, primarily through hotel and airfare expenses, which can account for as much as 40% of the overall budget. (ii) Space rental, employee hiring, and logistics are some of the indirect effects of business tourism that produce induced activity that is 1.5–2 times higher than direct sales. (iii) The spending of workers who are compensated by the industry and the consumption of businesses that profit either directly or indirectly from this revenue are the causes of the induced effects of business tourism.

2.2.3.3. . Business tourism: a strategic asset for the country's development

Business tourism includes both individual and organized trips for professional purposes lasting at least 24 hours. It plays a vital role in enhancing a country's global presence by attracting talent and professionals from diverse backgrounds, ultimately strengthening its economic and cultural standing on the international stage (SÈZE, 2002). This type of travel provides (ILO, 2019): (i) it boosts the local economy by bringing in money for a range of industries, such as event planning, transport and the hospitality sector. (ii) Employment creation in a variety of sectors. (iii) Transfer of knowledge and technology is made

possible by international conferences and meetings that promote the sharing of creative ideas and expertise. (vi)A need for modern facilities, better connectivity, enhanced public services, and overall improvements in urban development and infrastructure. (vii) Increased foreign investment, as business travellers often look for opportunities to expand their markets, form alliances and engage in trade.

2.2.3.4. . **Business districts: invisible drivers of sustainable business tourism**

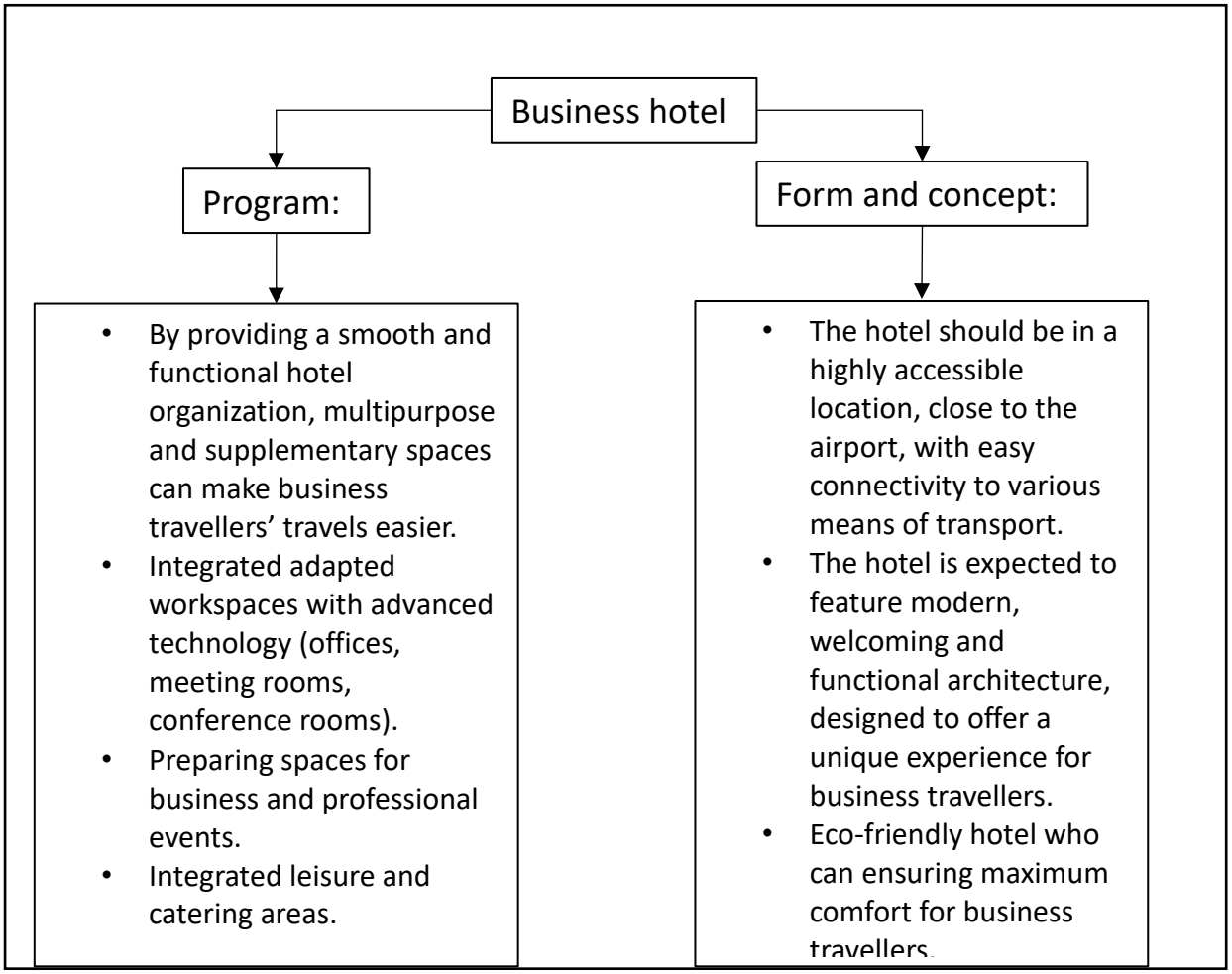
Business districts have become strategic locations for companies, thanks to their accessibility, quality of service and ability to host international activities, boosting the attractiveness of business tourism (JLL, 2020). Today, business districts represent an important lever for the development of business tourism. Thanks to their optimized accessibility (proximity to train stations, public transport, parking), their modernized urban setting, and the diversity of services they offer (accommodation, catering, green spaces), they provide companies with a functional and attractive environment. This organization not only enhances the quality of life for users, but also reinforces the image of openness and economic dynamism on a national and international scale (JLL, 2020).

2.2.4. Business hotels, a pillar of business tourism

Hotels play a key role in business tourism, which is an essential driver of a country's economic development. This type of tourism relies on the quality and organization of infrastructures, guaranteeing services tailored to professionals and business events. The first hotels appeared around 1790. Under British law, a hotel is an establishment that offers food and accommodation to travellers, provided they can pay and meet the conditions required to be welcomed (tourismenote).Today's hotels offer more than just accommodation. They are modern infrastructures that also integrate spaces dedicated to professionals and the organization of business events (Sucheran, 2019). Business hotels play a major role in enhancing a country's image by positioning it as an attractive destination for professionals. Thanks to the way they operate and the complementary nature of their spaces (conference rooms, co-working areas, adapted services), they make it easier for foreign businessmen to travel (ibid). What's more, these establishments make a significant contribution to the development of the local economy, creating jobs and having a positive impact on other sectors such as catering and transport. (ILO, 2019).

For a business hotel to become a **destination for business travellers** and contribute to the development of business tourism in Algeria, it is essential to understand the needs of business travellers and how we can enhance their experience. Therefore, I propose several recommendations that will attract business travellers and position our hotel as a key business destination in the following figure:

Figure 8: Some recommendations for hotel conception. Source : made by author based on OLIVIERA.2013



2.2.4.1. . Towards more sustainable business hotels: the rise of eco-friendly hotels

One of today's major challenges is to adopt a responsible approach to nature, promoting climate- and resource-friendly energy, and reducing water and energy consumption without compromising comfort. The building sector plays a crucial role, consuming up to 40% of the world's primary energy. This is why buildings today must be designed according to the principles of energy efficiency and respect for the climate. These sustainable buildings, known as Green Buildings, combine quality of life, energy efficiency and aesthetic appeal. Their design is based on an integrated approach, lifecycle analysis tools, and collaboration between all project stakeholders (Michael Bauer, 2007). For the materials of eco-friendly construction can play a crucial role in sustainable building by lowering environmental impact, conserving natural resources, and improving energy efficiency. They support healthier indoor spaces, reduce waste, and align with global sustainability goals to promote responsible, resilient construction practices. (Madiraju, 2024). The key necessities of eco-friendly construction materials are presented in Figure below:

Figure 9:key naterials for ecofriendly construction. SOURCE: (Madiraju, 2024)

Hotels have long been places to sleep, eat and drink. Over time, they have grown to offer more, such as restaurants, meeting rooms, conference facilities, spas, vacation spots and all kinds of fun. But providing all these services takes a lot of resources. In fact, hotels are considered big polluters. They use too many things that don't last, and they burn a lot of energy, which accounts for 21% of all CO2 pollution. Because of this heavy use of the earth's resources, hotels are now trying to become more environmentally friendly. (Sucheran, 2019). It is therefore essential to follow green actions in hotels, as hoteliers are now responsible for taking care of nature, as their future depends on it. Therefore, hotels must pay attention to ecological concerns and rules at every stage of their work. Hoteliers have realized the importance of preserving nature and conserving resources and have adopted green practices in their daily work. This has helped hotels gain an edge over others, improve their image, lower the price of their work, attract public attention and satisfy customers' desire for a green product (ibid). Concern for the environment has changed what people want and how they act. Hotels can help the planet in many ways, such as managing water and energy better, recycling, using less stuff, working with suppliers who respect the environment, and offering green services. It has become a worldwide trend to push hotels to be friendlier. A green hotel is a place that takes care of nature and uses green plans to help protect our world while making the hotel more efficient. (Petr Scholz1, 2022). Many studies show just how important these things are :(i) 90% of people who stay in hotels in the U.S. prefer to stay in those that are going green. (ii) 16% of Kempton Hotels and Restaurants customers choose their hotel because of its green practices. (iii) 53% of travellers from the UK and Australia also choose green hotels. A study in Bulgaria surveyed hotels in Sofia and Varna and found that hotels there are making green efforts. They save energy (85.42%), sort their waste (57.29%) and save water (50%). Almost half of the hotels (47.92%) have reduced their use of chemicals and over a third (35.42%) have worked to encourage their staff to do the same (ibid).

In conclusion, business hotels cater primarily to a professional clientele that is often concerned about environmental issues. In this context, adopting sustainable practices not only meets the expectations of these travelers, but also enhances the image of the hotel and strengthens its competitiveness.

2.2.4.2. . Nature and comfort: The art of humanizing hospitality:

Integrating nature and creating welcoming spaces are essential to humanizing hotels and enhancing the guest experience (excelsa, 2024). Hotels can be humanized through: (i) Integrating nature into hotel design, by using natural materials, installing plant walls, or creating interior gardens. (ii)Avoiding high, closed walls to create a more open, welcoming atmosphere. (iii)The development of outdoor and indoor green spaces, offering places to relax while reinforcing the link with nature. (vi)The optimization of natural light, which reinforces this link with the environment and reduces the use of artificial lighting (ibid).

2.2.4.3. **. SYNTHESIS**:

Business tourism, which includes business travel, plays an essential role in a country's international image. It can be enhanced by appropriate urban developments, such as business districts and modern infrastructures like hotels designed for the needs of professionals. By aligning the design of spaces with global trends and international expectations, a country can not only improve its image as a business destination, but also boost business tourism in a sustainable way.

2.3. PART 02: Balancing visual comfort with thermal comfort using smart envelope.

2.3.1. Introduction

The importance of natural light in buildings. Today, we spend 90% of our time in enclosed spaces (BENDEKKICHE, 2017) , limiting our contact with the outdoors. Visual comfort is a vital aspect of architectural design that directly influences mental and physical wellbeing , knowing to achieve visual comfort we need to understand the priorities of naturel light and key elements effecting visual comfort and architecturally speaking the receiving end is the envelope of building if not measured there will be side effects resulting on thermal discomfort which when understand the correlation between visual comfort and thermal comfort the factors of the intersected phenomena and comprehend the receiving envelope properties and the metrics of judgment of performance we can provide solution of particular aspect or large scale concept like intelligent envelopes.

2.3.2. Definition of visual comfort:

According (Alain Liébard, 2004) visual comfort is a subjective experience influenced by factors such as age, visual acuity, and the characteristics of the object observed (size, appearance, color). Light plays a key role in this perception, thanks to its quantity, distribution and quality, which influence aspects such as illuminance, luminance, contrast, glare and light spectrum(ibid) .To improve visual comfort according to according to the authors , several parameters can be adjusted : (i) the level of illuminance required for the visual task, (ii) the uniform distribution of light in space, (iii) the balance of luminances in the room, (iv) the elimination of annoying shadows, (v) the enhancement of the shapes and volumes of objects, (vi) access to an outside view, (vii) the faithful reproduction of colors, (viii) the management of light tint and (ix) the absence of glare. (Alain Liébard, 2004).

2.3.3. Definition of thermal comfort:

According to (Alain Liébard, 2004), thermal comfort is defined as a state of satisfaction with the thermal environment. It results from a dynamic balance between the body's thermal exchanges and its environment (Alain Liébard, 2004). Thermal comfort is influenced by two types of factors: personal factors (metabolic rate and clothing level) and environmental factors (air temperature, mean radiant temperature, air speed and

humidity) (DOĞRAMACI, 2020) .In our research, we will focus on the temperature factor, which is directly impacted by poor daylight management. Excessive exposure to solar radiation can lead to overheating in summer, while a lack of solar gain in winter can cause heat loss, compromising occupant comfort.

2.3.4. BUILDING ENVELOP as mediator between Lighting and thermal comfort?

The building envelope is the physical barrier between the interior and exterior environments of a structure. It includes walls, roofs, windows, doors, and foundations, and plays a critical role in energy efficiency, indoor comfort, and structural integrity. (Morris & Cleveland, 2009)

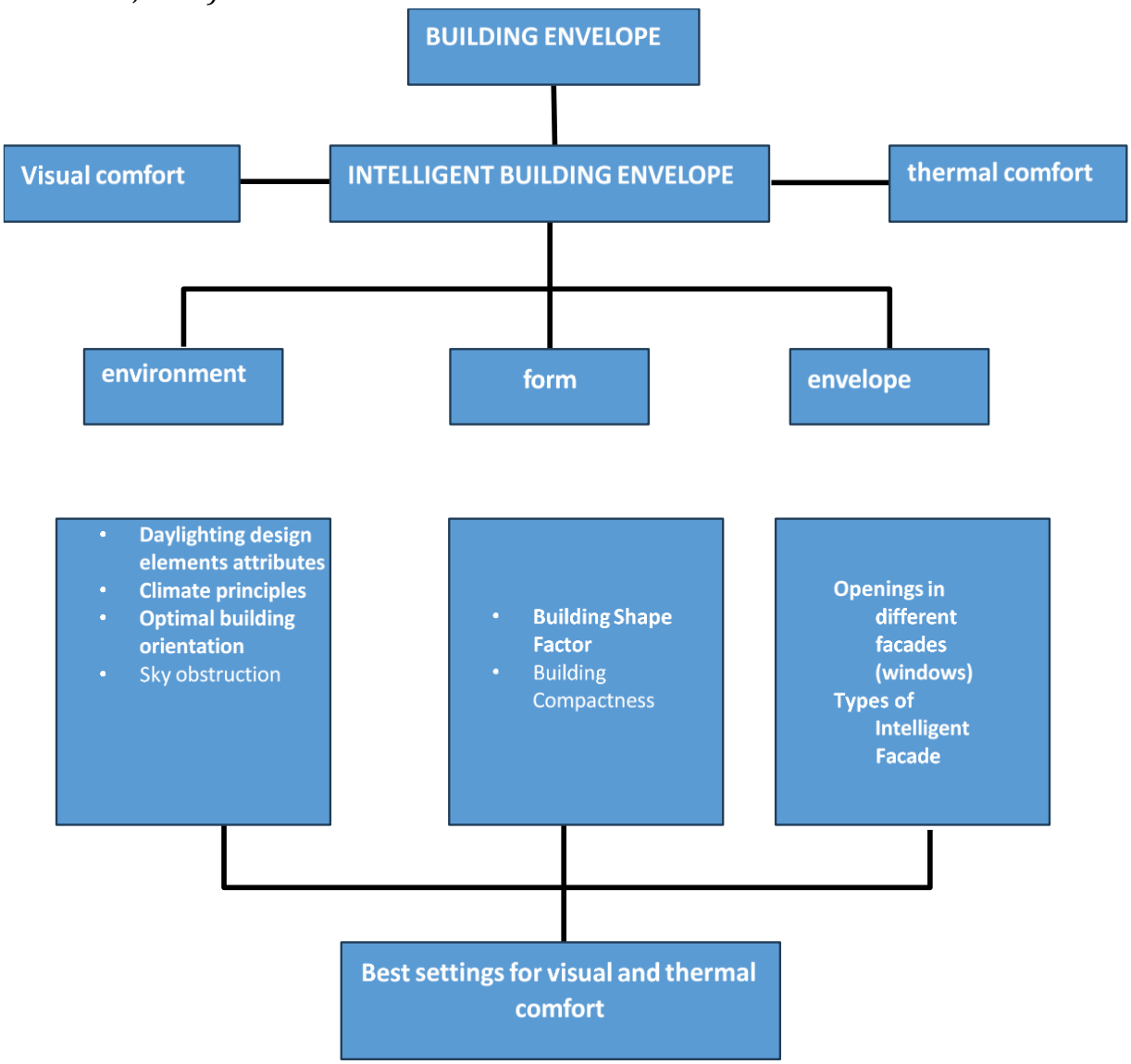


Figure 10: a conceptual frame work. Source : authors

2.3.5. INTELLIGENT BUILDING ENVELOPE

Wigginton and Harris (2002) define the intelligent building skin or envelope as an active and responsive mediator between the outside environment and the interior of a building which ensures an optimal interior comfort with minimal energy consumption. A recent definition describes the intelligent envelope as the result of its individual design process, which implements its adaptability with regard to internal and external Conditions. (Ochoa & capeluto, 2017). Function of Intelligent Building Envelope:

- Energy Efficiency
- Thermal Regulation
- Daylight Optimization
- Indoor Air Quality (IAQ) Management
- Acoustic Comfort
- Moisture and Humidity Control
- Structural Durability
- User Comfort and Well-Being

However we will focus on the aspects of thermal regulations and daylight optimization to ensure thermal and visual comfort for habitant well-being.

2.3.5.1. Environment

a) Daylighting design elements attributes

The penetration of daylight into a building depends on many parameters such as prevailing site climatic conditions, site latitude, environmental masks and many design elements to make effective use of daylighting elements in architecture, it is necessary to know which elements are most relevant and what their impact is. (Ochoa & capeluto, 2017)

b) Climate principles

Considering climate design principles are useful to keep in mind user comfort strategies can be derived from examination of the biophysical effects of the environment inside a building (Givoni, 1998). They show how changes in the climate affect temperature levels, thermal comfort and solar radiation absorption. With these factors in mind, climate strategies can be grouped in the following groups:

1. Heat management, collection and storage
2. Ventilation for comfort and air quality
3. Daylight (and sunlight) admission and control.

In order to understand better these strategies, a graphical contrast is made between hot and cold climate requirements (see Figure 8 below,)

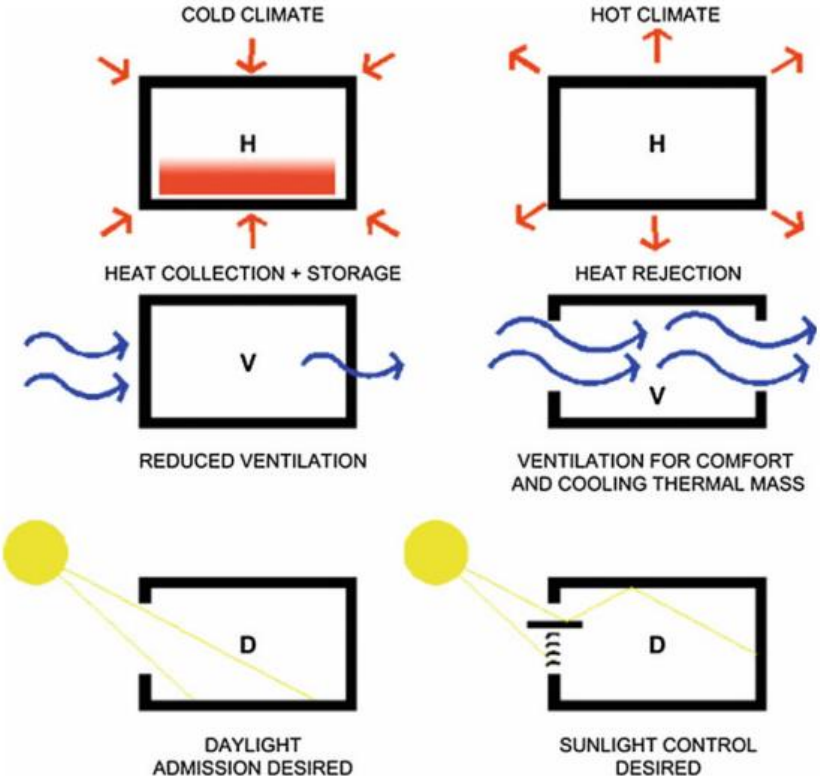


Figure 11 Contrast between the main climatic strategies for cold and hot climate Source : Intelligent Envelopes for High-Performance Buildings p64 (Ochoa & capeluto, 2017)

c) Shade effect of surrounding naturel and artificial structure

Shadows cast by naturel and artificial significantly influence architectural design, affecting natural light, energy efficiency, thermal comfort, and even the psychological well-being of occupants by integrating solar studies, responsive architecture, and thoughtful urban policies (Va´zquez-Molını & A, 2018).

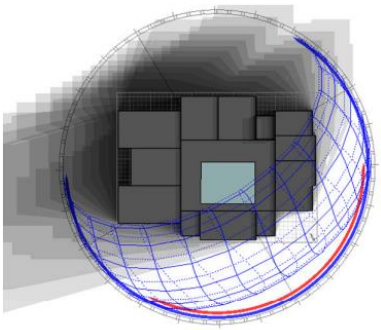


Figure 12 building shade source (Va´zquez-Molını & A, 2018)

d) Sky obstruction

An external obstruction influences daylighting performance based on the amount sky Obstructed or not and the color of the external surface finish. The amount of sky visible on the work plane is a governing factor for general illumination. (Ching, 2014)

e) Optimal building orientation

Another significant aspect influencing building performance is its orientation. This strategy aims to manage heat gains by obstructing and filtering solar radiation from penetrating the structure (Catalina, Virgone, & Iordache, 2011) . A reduction in radiation correlates with a decrease in the energy required for cooling the interior environment. To effectively regulate the influx of solar radiation, it is crucial to comprehend its effects on heat gains and losses within a building

Optimal building orientation is essential for maximizing natural daylight while ensuring visual comfort and energy efficiency. A well-considered approach that combines strategic facade placement, window design, and shading techniques can significantly enhance occupant experience and reduce reliance on artificial lighting and cooling systems(Ismail & Roslan, 2018) , table below showcase our climate

Table 2 Optimal building orientation, source: (Ismail & Roslan, 2018

Orientation Type	**Advantages**	**Disadvantages**
South-Facing	Maximizes winter solar gain; good daylight access	Requires careful shading in summer
East-West	Consistent daylight; minimizes glare	May lead to increased heat gain without shading
North-Facing	Provides diffuse light; minimal heat gain	Less direct sunlight; may require artificial lighting
North east/ South west	Balanced daylighting throughout the day	Can lead to intense solar heat gain at midday
North west/ South east	Good morning/evening light; reduces midday heat	May not optimize daylighting during peak hours

f) Synthesis

The environment outside factors are the starting points on which we dictate architecture climate concepts and the influence of the surrounding built and naturel environment, with each location the environmental variables change and the cope with it and achieve the best visual and thermal comfort we must follow certain procedures

- Defining the climate stage of the addressed location

- Climate analysis and synthesis of all diagrams in play from software (meteonorm and climate consultant) with trusted climatic data sources (meteonorm- climate. building)
- Suggested design strategies from Szokolay bioclimate Diagram and Mahoney table
- Site analysis depict (sun-path diagram) solar and shading study wind direction which are attribute of daylight design element

2.3.5.2. Form

a) Building Shape Factor

The amount of solar radiation that a building receives is influenced not only by its geometric configuration but also by the overall area of its façades and roof. Additionally, the external surfaces of the building significantly impact the management of heat loss and gain (Raji, Tenpieri, & den, 2017). The shape of a building is primarily characterized by two key factors: building compactness and relative compactness. The formulas for calculating compactness (C) and relative compactness (RC) are presented in Equations (1) , below:

$$C = V/A_{ext} \qquad (1)$$

b) Building Compactness (critic)

The compactness of a building is characterized by the ratio of its surface area that is exposed to solar radiation (Aext) to its overall volume (V). A greater surface area exposed to the external environment results in a less compact form, which facilitates the transfer of heat into or out of the building through its surface. (Danielski, Fröling, & Joelsson, 2012) Figure illustrates the comparison between compactness and energy consumption of buildings that possess identical volumes.

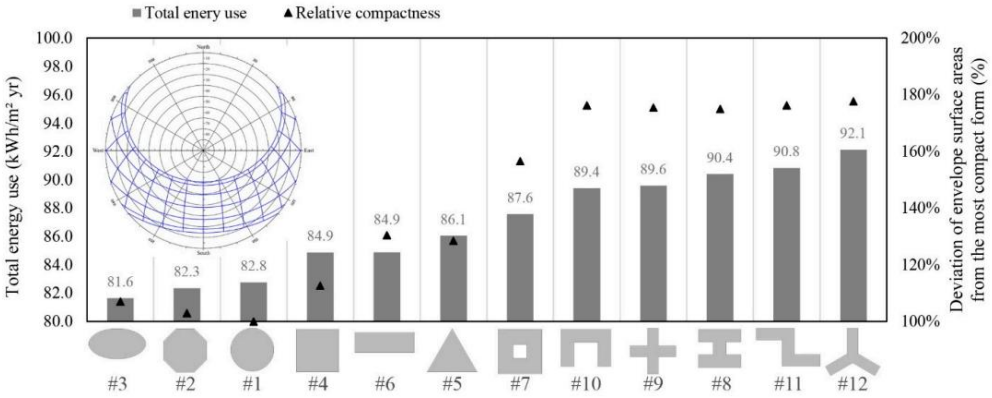


Figure 13 building total energy use of 12 plan shapes (WWR=50%) in association with their compactness in Amsterdam (Martin & Babak, 2017)

c) Synthesis

Building compactness significantly influences heat gain and energy consumption, primarily due to its impact on the surface-to-volume ratio (SVR), Lower SVR (More

Compact Buildings) Reduced exposure to external conditions. Less solar heat. Better thermal retention due to minimized heat loss. However more compact building limit naturel light source due to reduced perimeter space , meaning the correlation between building compactness is , oppositional when it comes to thermal and visual comfort and to answer the paradox for optimal visual comfort we chose to go by moderate compactness and deal with thermal comfort with envelope enhancement (material choice and insulation).

d) Self-Shading Architecture: Sustainable Design for Thermal and Visual Comfort

Self-shading in facades can serve as a strategy to reduce heat gain and improve the energy efficiency of building envelopes. It leverages the form of the building envelope or its components to provide partial protection against solar radiation By manipulating geometry, orientation, and form volume to create shade **indoors** environment our **outdoor** parcourse (Lionar, Kroll, Soebarto, Sharifi, & Aburas, 2024), see figures below.

- form manipulation (façade) for improved indoor comfort qualities (Figure 15)

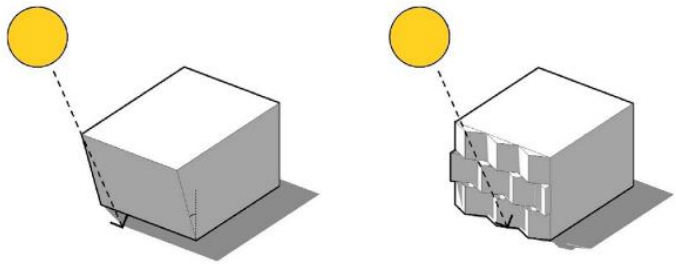


Figure 14 . Self-shading through manipulation of building form (left) and façade components (right). source ; A review of research on self-shading façades in warm climates (Lionar, Kroll, Soebarto, Sharifi, & Aburas, 2024)

- Form mass provide shading for outdoor comfort qualities(see Figure below)

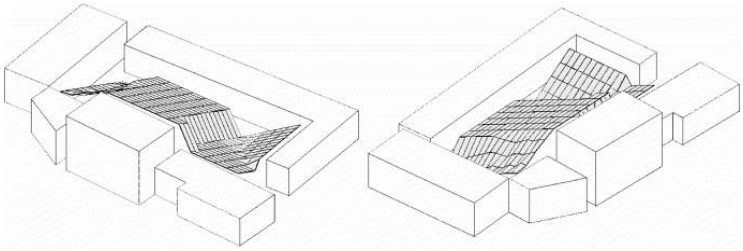


Figure 16. Self-shading outdoor spaces using building mass source ; A review of research on self-shading façades in warm climates (Lionar, Kroll, Soebarto, Sharifi, & Aburas, 20

e) Synthesis

Self-shading is building designs that use their own form, geometry, and structural elements to block excessive solar radiation, reducing cooling loads while maintaining daylight and aesthetic appeal. Using form mass is passive method used over centuries in

urban architecture in hot climates like in *bnim'zab* cites to shade the streets and lower Solar radiation and for façade manipulation it require us to do a precise Solar study and to specify the function and occupation time of the space behind the façade to correctly manipulate the facade for that period of use.

2.3.5.3. Envelope

a) Intelligent Facade

Intelligent Facade is a design that is implemented of a building's exterior envelope (façade) that dynamically adapts to environmental conditions, inhabitant comfort and wellbeing requirements through the integration of advanced technologies, responsive materials, and automated systems. However there is also static smart technologies for performance optimization without mechanical components. (Osama & Kamal, 2023)

b) Types of Intelligent Facade

- ***Double skin façade***

"Double skin facade refers to a building facade covering one or several stories with multiple glazed skins, the skins can be air tight or naturally/mechanically ventilated. The outer skin is usually a hardened single glazing and can be fully glazed. Inner skin can be insulating double glazing and is not completely glazed in most applications. An air-tightened double skin facade can provide increased thermal insulation for the building so as to reduce the heat loss in winter season. On the other hand, moving cavity air inside a ventilated double skin facade can absorb heat energy from the sunlight glazing and reduce the heat gain as well as the cooling demand of a building. (Osama & Kamal, 2023) (Figure 18).

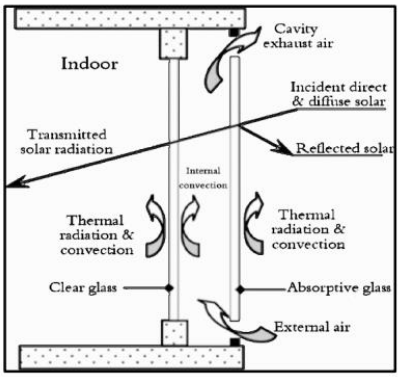


Figure 17 the heat transfer and air movement (Osama & Kamal, 2023)

- **Kinetic façade**

Kinetic facades, as part of the intelligent facades, are capable of adjusting their shape, form, orientation or openings to automatically respond to the environmental parameters.

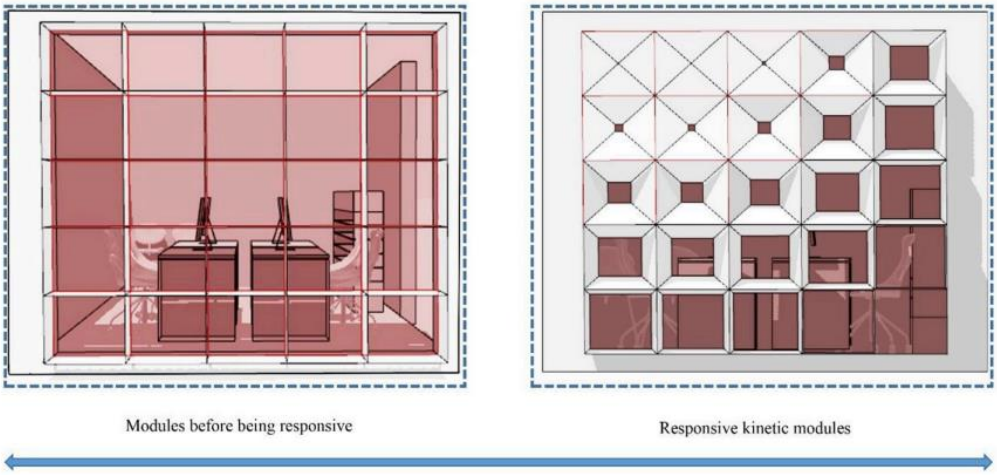


Figure 19: Kinetic façade tyoe , Source :(Wang, Gwilliam, & Jones, 2009)

The adaptive kinetic façade investigated through architectural conceptual design, mechanism, evaluation, materialization and maintenance process based on several design frameworks. The architectural design phase is a fundamental stage of kinetic terms that specifies direction and procedure of next levels by proposing concept, module and morphology (Wang, Gwilliam, & Jones, 2009). Design concept provides idea for changing from static into dynamic. See figures, below.

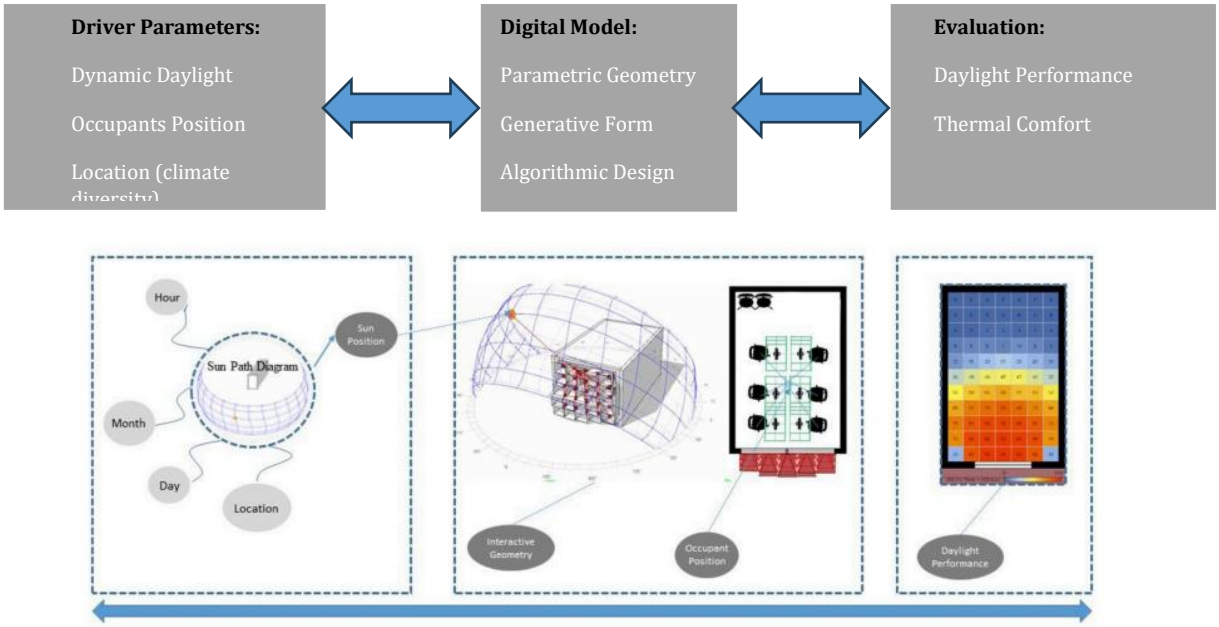
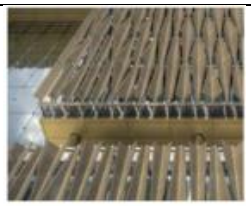
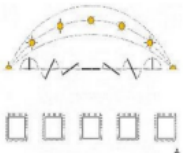
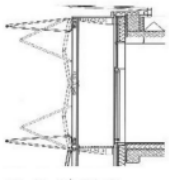
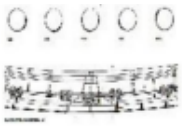
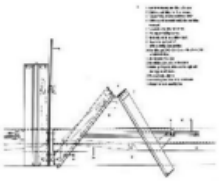


Figure 20: Design concept provides idea for changing from static into dynamic. Source: (Wang, Gwilliam, & Jones, 2009)

Table 3: Analyzing kinetic façade regarding interactivity and indoor comfort condition by movement types and characteristic element. Source: author based on Wang, Gwilliam, & Jones, 2009

Project Name	**Climate**	**Characteristic Element**	**Detail**	**MoveMent Type**	**Scale**	**Function**
Thyssen Krupp Cube, Q1(2010)	Cfb			Flap Pivot	LEF	IDD RG, DP
Kiefer Technic Showroom(2007)	Cfb			Fold	LEF	IDD, IFS DP, CSH
EWE Arena(2005)	Cfb			Slide	PF	GEF DP
House at the Milsteto r(2008)	Dfb			Fold Slide	LEF	IDD DP
St. Ingbert Town Hall(2009)	Cfb			Fold , Slide	LEF	IDD DP, CSH

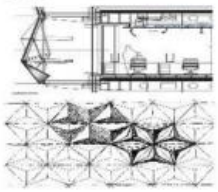
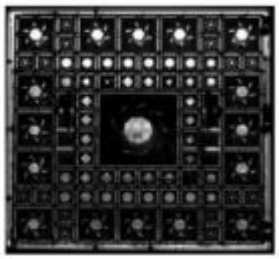
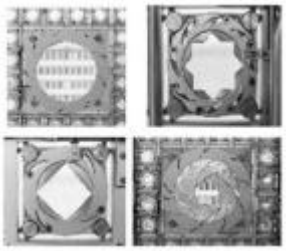
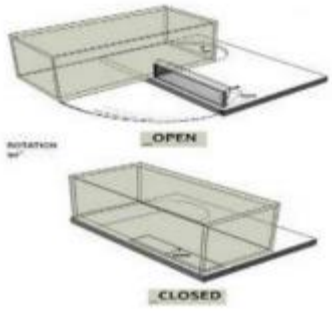
Al Bahar Towers (2012)	BWh			Fold Expand & Contract	LEF	IDD DP, RG, CSH

Table 4: (continued) follow the same width.

Project Name	**Climate**	**Characteristic Element**	**Detail**	**Movement Type**	**Scale of**	**Function**
Institut du Monde Arabe (1987)	Cfb			Rotate	LEF	IDD DP
SDU Campus (2014)	Cfb			Flap	LEF	IDD, IFS DP, CSH
Sharifi-Ha House (2013)	Csa			Rotate	PF	ISC, IFS DP, CSH

With : Climate zone : Dfb: Humid continental, Cfb: Temperate, BWh: Warm desert, Cfb: Marine West Coast, Csa: mild, semi-humid / **Movement type:** F: Flap, Fo: Fold, R: Rotate, P: Pivot, S: Slide, EC: Expand & Contract/ **Scale of the facae:** PF: Parts or volumes in the façade, LEF: Larger element in façade and **Functions,** IDD: Interactive to dynamic daylight, IHM: Interactive to human movement, IW: Interactive to wind, GEF: Generating energy in façade, ISC: Interactive to seasons change, IFS: Interactive functional

scenarios; Indoor environment quality, RG: Reducing Glare, DP: Daylight Performance, CSH: Control Solar Heating.

c) Synthesis

intelligent facade provide solution from all fronts , addressing every climatic aspect and answering with high-tech technology however the dynamic facades pose many challenges include the cost of development and production of custom moving parts the more complex the higher the cost is and also the required maintenance. Thus for common use architects stick to simple shading dynamic and static intelligent facade that take advantage of smart and right material choices and construction technics that take into account the physical phenomena that effect comfort

d) Window glass variables

Window glass plays a major role in both lighting and thermal comfort in buildings. Several factors in the design and materials of window glass influence how light and heat behave indoors. (Karam & Mazran, 2013)

- Thermal factors of Heat Behaviour in Glazing Materials: A General Conceptualization

The thermal heat behaviour of glazing materials is governed by how they manage the transfer of heat energy through **conduction**, **convection**, and **radiation, see figure below**. (Karam & Mazran, 2013). The table below summarizes the thermal factors of glazing.

Table 5 Thermal factors source: (Karam & Mazran, 2013)

Category all thermal property ?	**Factor**	**Description**	**Effect**
thermal Property	Solar Heat Gain Coefficient (SHGC)	Amount of solar heat transmitted through glass	Low SHGC = less heat gain (good for warm climates)
thermal Property	Thermal Transmittance Ug-Value	Rate of heat transfer through glass	Low U-value = better insulation
thermal Property	Thermal Conductivity (material properties)	Intrinsic property of the material to conduct heat	Glass has moderate conductivity coatings and spacers reduce overall conduction
Thermal insulation	Emissivity Low-E Coatings	Microscopically thin metallic layer	Reflects heat, retains warmth or coolness
Thermal insulation	Glazing Layers (Single/Double/Triple)	Number of glass panes	More layers = better thermal insulation
Thermal insulation	Gas Fills (Argon/Krypton)	Inert gases between glass panes	Reduces convective heat transfer

- Visual factors of light Behaviour in Glazing Materials:

The amount and quality of light passing through glass are primarily influenced by Visible Light Transmittance (VLT), glass tinting, coatings, and the number of glass layers. Higher VLT means more natural daylight enters the space. Tinting and reflective or Low-E coatings can reduce glare and heat but also slightly lower light transmission. Additionally, multi-pane glazing (like double or triple glazing) and surface treatments such as frosting or patterns can diffuse or reduce light. Choosing the right glass involves balancing daylight, glare control, and energy efficiency (Karam & Mazran, 2013), see figure below.

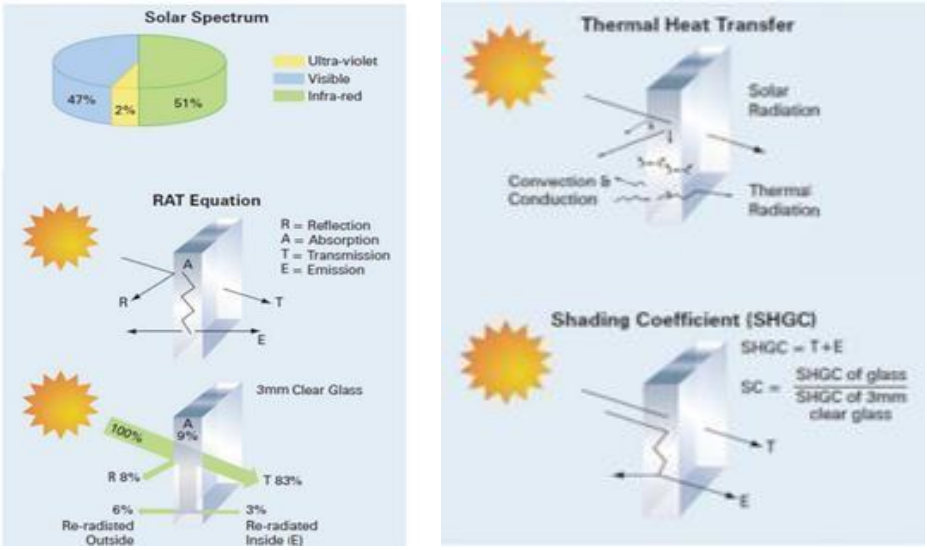


Figure 21: glazing properties& thermal heat transfer. Source : (Karam & Mazran, 2013)

Table 6: : visual factors, source: : (Karam & Mazran, 2013)

Category	**Factor**	**Description**	**Effect**
Lighting	Visible Light Transmittance (VLT)	Percentage of visible light that passes through glass	Higher VLT = more daylight indoors
Lighting	Glass Tinting	Color tint reduces glare and brightness	Lowers VLT, reduces eye strain, enhances comfort
Lighting	Visible Reflectance	Reflects part of visible spectrum	Reduces glare, can enhance privacy
Lighting	Glass Clarity / Color	Clear vs. colored or patterned glass	Affects quality and amount of light
Lighting	Glass Thickness / Pane Count	Thicker or more panes slightly reduce light	Slight impact on light; more noticeable with coatings

- Smart glass

Represents a sophisticated glazing technology that alters its light transmission characteristics upon receiving an electrical signal. When engaged, it transitions from transparent to tinted, thereby regulating the influx of light and heat into an environment, eliminating the necessity for traditional blinds or shades. (Ismail & Roslan, 2018), see table below.

Table 7: Types of Smart Glass (Ismail & Roslan, 2018)

Type	**Activation Method**	**Behaviour**
Electrochromic	Electrical voltage	Changes from clear to tinted
Thermochromics	Temperature	Tints when heated
Photochromic	Sunlight (UV exposure)	Darkens when exposed to UV
SPD (Suspended Particle)	Electrical current	Switches from dark to transparent
PDLC (Polymer Dispersed Liquid Crystal)	Electrical current	Switches from transparent to frosted

- Balance ratio of heat gain and lighting (LSG):

LSG (Light-to-Solar Gain Ratio) is the ratio of Visible Light Transmittance (VLT) to the Solar Heat Gain Coefficient (SHGC) : **LSG = VLT/SHGC** (Karam & Mazran, 2013)**.**

- Synthesis

Although we mention the factors that affect lighting and thermal gain and the metric of the judgment in glazing we can't choose a specific settings for our climate and functions due to other influences such as window to wall ratio and facade orientation.

Table 8 most available materials in the market (hechong, 1998),

Type	**Layers**	**Color**	**Tvis**	**SHGC**	**LSG**	**Ug ($W/m^2 \cdot K$)**	**R-value ($m^2 \cdot K/W$)**
Acrylic/fiberglass	Single-glazed	Clear	0.92	0.77	1.19	5.7	0.18
		Med White	0.42	0.33	1.27	5.7	0.18
		Bronze	0.27	0.46	0.59	5.7	0.18

	Double-glazed	Clear	0.86	0.77	1.10	2.8	0.36
		Med White	0.39	0.30	1.28	2.8	0.36
		Bronze	0.25	0.37	0.87	2.8	0.36
Fiberglass	Insulated translucent	Crystal	0.30	0.30	1.01	0.24	4.17
		White	0.20	0.23	0.85	0.24	4.17
		Bronze	0.10	0.16	0.64	0.24	4.17
Poly-carbonate	Single-glazed	Clear	0.85	0.89	0.96	5.0	0.20
		Bronze	0.50	0.69	0.73	5.0	0.20
		Med White	0.37	0.50	0.73	5.0	0.20
	Double-glazed	Clear	0.73	0.75	0.97	2.5	0.40
		Bronze	0.43	0.58	0.73	2.5	0.40
		Med White	0.32	0.43	0.74	2.5	0.40
Glass	Single-glazed	Clear	0.89	0.82	1.09	5.8	0.17
		Bronze	0.55	0.64	0.87	5.8	0.17
		Green	0.74	0.59	1.25	5.8	0.17
	Double-glazed	Clear	0.78	0.70	1.11	2.7	0.37
		Bronze	0.48	0.51	0.94	2.7	0.37
		Green	0.66	0.47	1.40	2.7	0.37
	Double-glazed low-e	Clear	0.72	0.57	1.25	1.6	0.63
		Bronze	0.45	0.39	1.15	1.6	0.63

e) Openings in different facades (windows)

Windows function as a boundary between interior and exterior environments, facilitating the transfer of light, heat, and sound, while also providing a method for natural ventilation. They play a significant role in determining energy usage and visual comfort within structures. Decisions regarding their orientation and size are integral to the initial stages of the design process (Gabriele & sameh, 2012). A window is defined by: (i) Window areas (WWR): for building envelope designs, a window area is commonly represented by the window-to-wall ratio, which is defined as the ratio of the total area of windows to the total gross external wall area (including windows). (Gabriele & sameh, 2012); (ii) Glass type controls the amount of daylight penetrating into an interior in terms of light transmittance. In daylight calculation, light transmittance is directly proportional to the daylight factor. In this study, the buildings use single glazing (Gabriele & sameh, 2012); (iii) Window orientation, South-facing windows have a high luminous levels and variable illumination. East- and West-facing windows provide average luminous levels, but their illumination levels during the day are very different. East-facing windows have a high level in the morning, while West-facing windows provide a high level in the afternoon. (Gabriele &

sameh, 2012); (iv) Windows wall ratio and orientation of the study (Gabriele & sameh, 2012), the simulations were run for the different orientations and the following glazing ratios: 30%, 50%, 70% and 90%. The orientations considered are: south, north, east, west, 30º from N to E, 30 º from S to W, 60 º from N to E, 60 º from S to W, 30 º from N to W, 30º from S to E, 60 º from N to W, 60 º from S to E

. Table shows the results translation into performance evaluation in terms of thermal, visual comfort and energy efficiency to be high, medium or low performance.

Table 9 Performance of glazing percent and orientation, (+) High performance, (0) Medium , source : (Gabriele & sameh, 2012)

Orientation and Opaque transparent ratio	**Energy efficiency**	**Thermal comfort**	**Visual comfort – daylight**	**View in-out**
South 30% glazing	**+**	+	-	0
South 50% glazing	**0**	0	+	+
South 70% glazing	**-**	0	+	+
South 90% glazing	**-**	-	+	+
North 30% glazing	**+**	-	-	0
North 50% glazing	**+**	+	+	+
North 70% glazing	**+**	+	+	+
North 90% glazing	**0**	0	+	+
East 30% glazing	**+**	+	0	0
East 50% glazing	**0**	0	-	+
East 70% glazing	**-**	0	0	0
East 90% glazing	**-**	0	0	0
West 30% glazing	**+**	+	0	0
West 50% glazing	**0**	0	-	+
West 70% glazing	**-**	0	0	0
West 90% glazing	**-**	0	0	0

- Synthesis

The visual comfort and thermal comfort change not on type of glazing alone but also window to wall ratio and façade orientation and also change between summer and winter if not shaded properly. The greater the ratio the better naturel light is in north and the highest thermal discomfort due cold north façade in winter. For the south higher wwr ratio in summer might pose a question in heat gained although it's easy to provide shade in summer , while there is advantageous passive heating in winter. East and West are similar in results but only in west there is thermal discomfort as challenge and this the orientation where we can use moderate wwr for good daylight and solar glare control using façade manipulation and intelligent shading devices mentioned above. However we can't achieve thermal comfort on glazing properties alone as the walls play major roll in that so without simulation of chosen material it is pointless to decide now

f) Glazing Selection for Windows

Choosing the right glazing for windows is essential for optimizing energy efficiency, comfort, and safety in a building. Here are the primary types of glazing options available, along with their characteristics and applications. (Gabriele & sameh, 2012)

Table 10: Performance of glazing selection, (+) High performance, (0) Medium performance, and (-), source : (Gabriele & sameh, 2012)

Glazing type	**U value (W/m^2K)**	**g value**	**Energy efficiency**	**Thermal comfort**	**Visual comfort – daylight**	**View in-out**
Single glazing	5.8	0.855	-	-	+	+
Double argon filled	1.3	0.624	0	0	+	+
Double glazing	1.4	0.589	0	0	+	+
Double tinted, gray	1.3	0.397	+	0	0	0
Double tinted, silver	1.3	0.298	+	+	0	-
Double tinted, gold	1.3	0.212	+	+	-	-
Reflective glazing	2.1	0.27	+	0	0	-

For optimal thermal and visual comfort, double or triple glazing with Low-E coatings is highly recommended. These options provide excellent insulation against temperature fluctuations while allowing ample natural light and reducing glare. Homeowners should

consider their specific climate conditions and personal preferences when selecting glazing types to achieve the best results in comfort (Ochoa & Capeluto, 2009).

g) Materials

The significance of construction materials in achieving thermal comfort is rooted in their capacity to control indoor temperatures, thereby creating a pleasant living or working atmosphere. Additionally, various factors influence the selection of these materials. (Qudama & Marta, 2021)

- Material choice criteria:

According to our state of the art, choosing a material could be done based on several criterion: (a) Aesthetic Qualities: Color, texture, scale, (b) Environmental Impact: Life-cycle assessment and sustainability considerations; (c) Economic Factors: Cost of acquisition and source local/imported; and (d) Physical properties(metrics), see table below.

Table 11 physical thermal properties, source: (Qudama & Marta, 2021).

Property	Definition	Ideal for Thermal Comfort
Thermal Conductivity (k)	How well a material conducts heat (W/m·K)	Low (slows heat transfer)
R-value	Resistance to heat flow (m^2·K/W)	High (better insulation)
Specific Heat Capacity	Heat needed to raise 1kg by 1°C (J/kg·K)	High (stores more heat)
Thermal Diffusivity (α)	heat propagates through a material	High α → Heat spreads rapidly Low α → Heat moves slowly
Thermal Mass	Ability to absorb/store heat	High (stabilizes temperatures)
Emissivity (ε)	Efficiency at radiating heat (0–1 scale)	Low (reduces heat loss)
Solar Reflectivity	Ability to reflect sunlight (0–1 scale)	High (keeps surfaces cool)
Density(ρ)	Mass per unit volume (kg/m^3)	Moderate-High (for thermal mass)

Thermal Conductivity (k), Density (ρ) , Specific Heat Capacity (c_p) are important variable in which used in formula of **Thermal diffusivity (α)** and **thermal inertia (I)** they are concepts in heat transfer and building physics (Qudama & Marta, 2021)

Thermal diffusivity (α)

Low (0.1–0.5) moderate (0.5–1.5) high (1.5-10)

$$\alpha = \frac{k}{\rho \cdot c_p} \quad (2)$$

Thermal inertia (I)

Low (5-15) moderate (15-25) high (35)

And they are usually the deciding factors

$$I = \sqrt{k \cdot \rho \cdot c_p} \quad (3)$$

the table below presents some of materials with high rate of thermal intertia. It means that these materials could create a thermal phase shifting interesting to get in climate zones with higher thermal amplitude.

Table 12 Thermal inertia of materials. Source: (Qudama & Marta, 2021).

Material	Conductivity (k) [W/m·K]	Specific Heat (c_p) [J/kg·K]	Density (ρ) [kg/m³]	Diffusivity (α) [$\times 10^{-6}$ m²/s]	Effusivity (e) [$Ws^{0.5}/(m^2K)$]	Inertia (I) [$Ws^{0.5}/(m^2K)$]
Concrete	**1.4–2.5**	**880–1000**	**2300–2500**	**0.5–1.3**	**~2200–2500**	**~30–35**
Brick	**0.6–1.0**	**800–1000**	**1600–2000**	**0.4–0.6**	**~1200–1600**	**~20–25**
Wood (Pine)	**0.12–0.16**	**1300–1700**	**500–600**	**0.13–0.17**	**~250–350**	**~3–5**
Steel	**45–50**	**420–500**	**7800–8000**	**13–17**	**~12,000–14,000**	**~14 (low storage)**
Glass	**0.8–1.0**	**750–840**	**2500–2700**	**0.34–0.45**	**~1500–1700**	**~15–20**
EPS Foam	**0.03–0.04**	**1200–1500**	**15–30**	**0.03–0.05**	**~20–30**	**~0.5–1**
Fiberglass	**0.04–0.05**	**700–850**	**10–50**	**0.05–0.07**	**~15–30**	**~0.5–1**
Gypsum Board	**0.17–0.25**	**840–1090**	**600–800**	**0.2–0.3**	**~300–400**	**~5–8**

- Thermal insulation

Thermal insulation is the process of reducing the transfer of heat between objects or environments with different temperatures. The physics of thermal insulation is based on the principle that heat flows from a warmer object to a cooler one, and insulation materials are designed to slow this flow. And its mechanics based on Radiation, Convection, Conduction (Qudama & Marta, 2021).

h) Phase Change Materials (PCMs)

Phase Change Materials (PCMs) are substances that absorb, store, and release large amounts of thermal energy as they change between solid and liquid states (melting and freezing). When used in walls, they help regulate indoor temperatures by reducing heat transfer, improving energy efficiency, and maintaining thermal comfort. (Qudama & Marta, 2021)

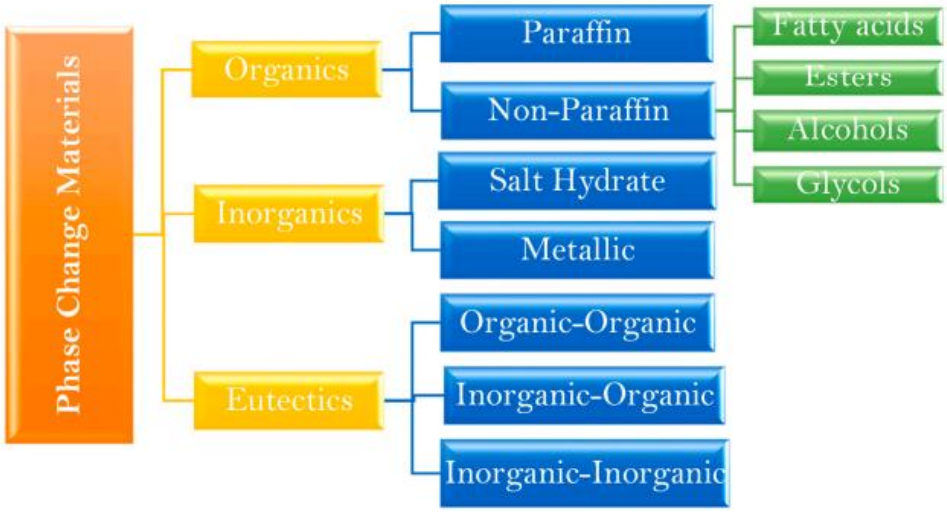


Figure 22: classification of PCMs. Source: (Qudama & Marta, 2021)

Table 13 : pcm types and properties. Source: (Qudama & Marta, 2021).

Type	Melting Range (°C)	Specific Heat (kJ/kg·K)	Thermal Conductivity (W/m·K)	Density (kg/m^3)
Paraffin Wax	18–31°C	2.0–2.5 (s), 2.1–2.8 (l)	0.15–0.25	750–900
Fatty Acids	20–45°C	1.6–2.3 (s), 2.1–2.5 (l)	0.15–0.17	850–1,000
Salt Hydrates	15–90°C	1.4–2.5 (s), 2.0–3.0 (l)	0.5–1.2	1,400–1,800
Bio-PCMs	20–40°C	1.8–2.4 (s), 2.0–2.6 (l)	0.15–0.20	900–1,100
Eutectics	10–60°C (custom)	1.5–2.5 (s), 2.0–3.0 (l)	0.4–0.6	1,200–1,500

- Phase Change Materials (PCMs) placement

Phase Change Materials (PCMs) can be integrated into walls in several ways, including embedding them in gypsum wallboards or plaster for interior surfaces, mixing microencapsulated PCM into concrete or mortar for thermal mass, placing PCM (in panels or pouches) within wall cavities, incorporating them into insulation layers, or installing them behind exterior cladding. The optimal placement depends on climate and building design—interior PCM layers are ideal for absorbing excess heat exterior integration helps regulate temperature swings. Proper encapsulation ensures no leakage, and enhancing thermal conductivity (Qudama & Marta, 2021)

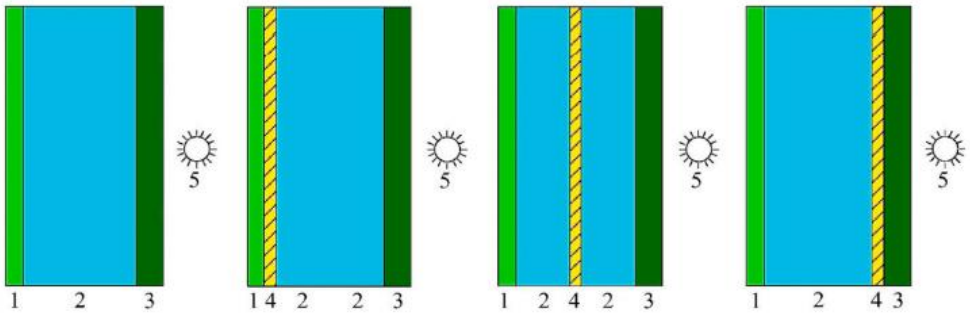


Figure 23: pcm location within wall usage, (Qudama & Marta, 2021)

- Synthesis

To be able to choose a best material for our case and climate we need to do a simulation that include glazing properties that promise visual comfort and balance negative thermal discomfort with best choice through simulation using software like design builder

i) Daylighting

Daylighting uses natural daylight to illuminate interior spaces. It includes direct sunlight, diffuse sky light and reflections from surrounding surfaces. (benhakrat, 2006)

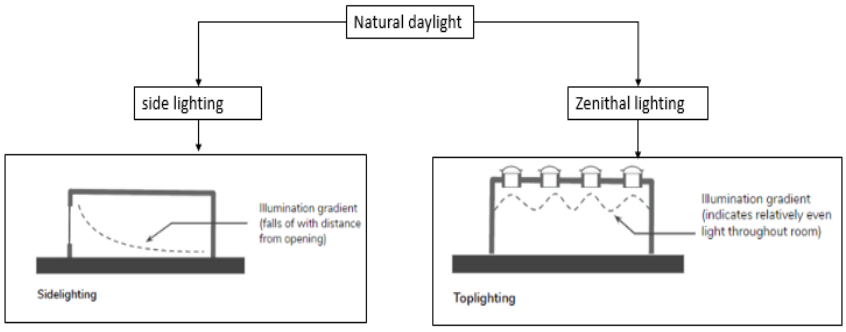


Figure 24: daylighting type. SOURCE: author .based on benhakrat.2006

According to Banhakrat (2006), the choice between side lighting (facade windows) or zenithal lighting (roof windows) depends on the height and configuration of the room: (i) for spaces with low ceilings (between 2.50 and 3 meters), side lighting is the most suitable. (ii) For rooms over 4.50 meters high, overhead lighting becomes essential, except in the case of shallow rooms, where additional side lighting at the top of the facades can be considered. (iii)For rooms with intermediate heights (between 3 and 4.50 meters), the choice depends on other factors such as depth, width and building configuration. (benhakrat, 2006). According to the Side lighting, we can identify, Unilateral Lighting from a single façade, creating contrasts but often not uniformity. Bilateral Lighting from two façades, providing greater uniformity and reducing shadows. And Multilateral: Light from more than one side, improving ventilation and reducing glare, but may lead to heat loss. We recommend a solar shading system and a type of glazing to reduce heat loss. (benhakrat, 2006)

- Passive Design Strategies for Enhanced Daylighting and Solar Control

These are passive techniques and devices integrated at window level that improve natural light penetration while limiting the negative effects of sidelight. We have :

✓ *Daylight guidance or distribution systems*

Reflectors are construction elements that reflect natural light into spaces and also shade glass surfaces. The aim of these systems is to direct daylight deeper into interior spaces, while reducing direct glare. as shown in the following diagram

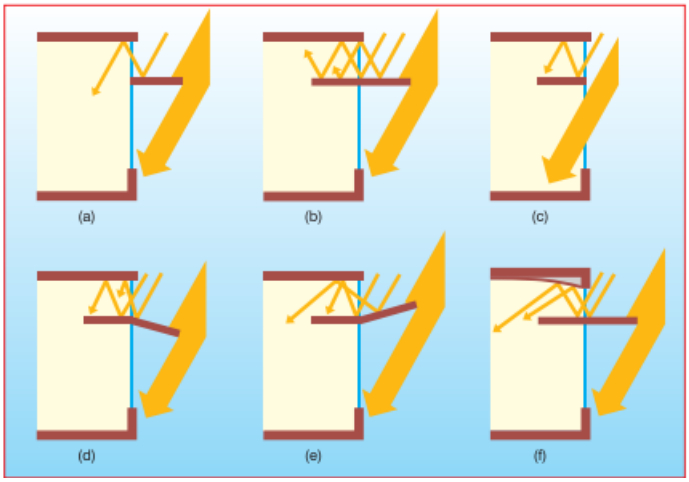


Figure 25: types reflectors. Source : benhakrat.2006

✓ *Solar shading devices:*

Are passive techniques that reduce the problems associated with direct exposure to the sun by creating shaded areas. There are different types and layouts, adapted to the

orientation and needs of the building, as shown in the following diagram. There are different types of solar protection depending on the orientation of the façade. For south-facing facades, horizontal shading is generally preferred to block the sun's rays in summer, while letting in light in winter. On the other hand, for east and west-facing facades, vertical shading is more effective in blocking the harsh morning and afternoon sun. The following figure show some solar devices type:

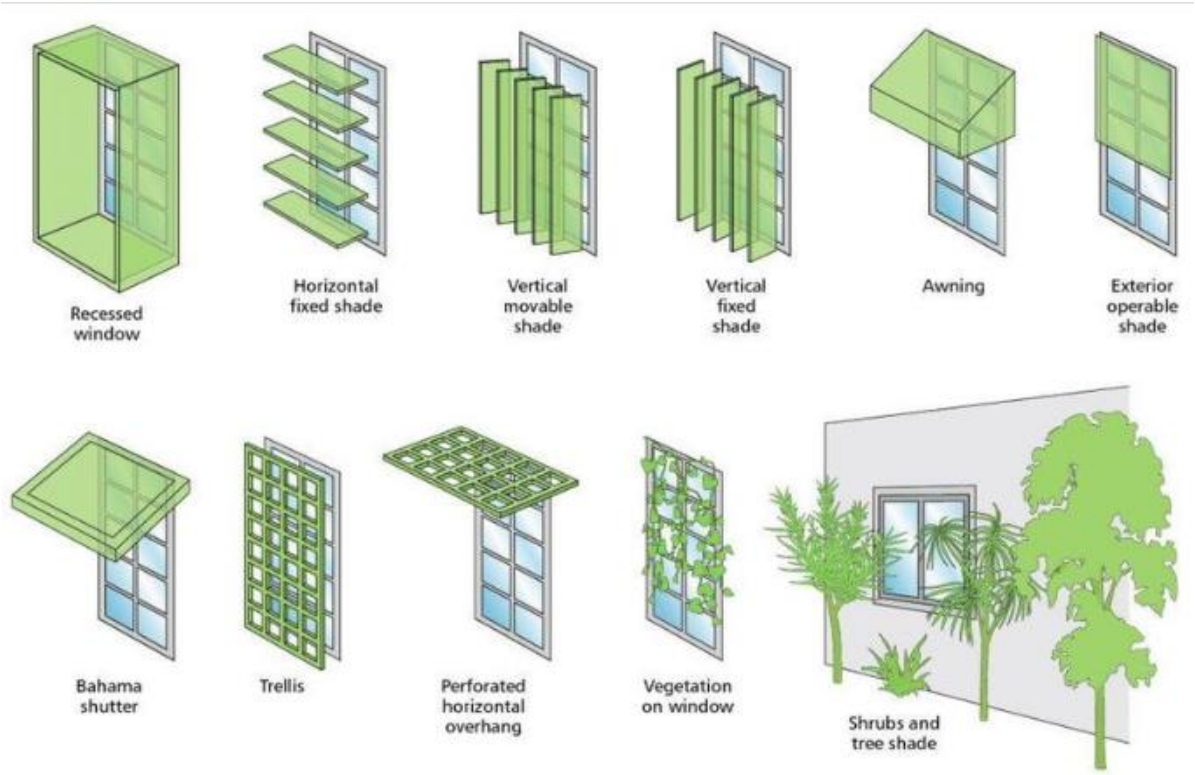


Figure 26 Types of external shading devices. Source : Qudama Al-Yasiri.2019

✓ *Smart shading devices*

Are advanced systems designed to optimize natural light, reduce energy consumption, and enhance occupant comfort by automatically adjusting to environmental conditions. These devices use Management System (MS) composed of sensors, algorithms, and automation to respond to sunlight, temperature, and user preferences. Here's an overview of key types, benefits, and technologies: (Guedi, 2017), see figure below.

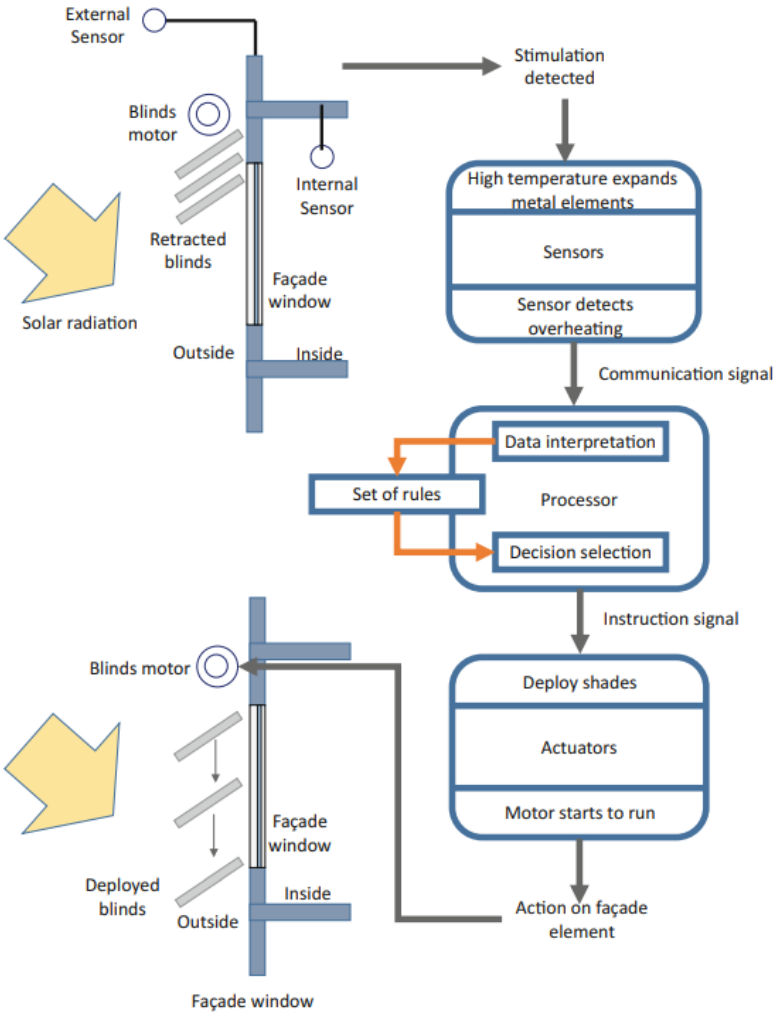


Figure 27: relationship of impute and responses in shaders (Guedi, 2017) p17

2.3.5.4. Visual comfort indicators: VDF and uniformity of illumination:

Daylight factors: The daylight factor (VDF) is a key indicator for evaluating the quality of natural lighting in a space. It expresses the ratio between the indoor and outdoor illuminance in standard conditions (overcast sky) as a percentage**.** According to standard EN 17037, a space is considered to be adequately lit if the FLJ exceeds 1.8% over at least 50% of the reference surface area. A minimum level of 2% is recommended for hotel rooms, and a level above 5% for optimal lighting comfort (Šprah, 2020). See figure below:

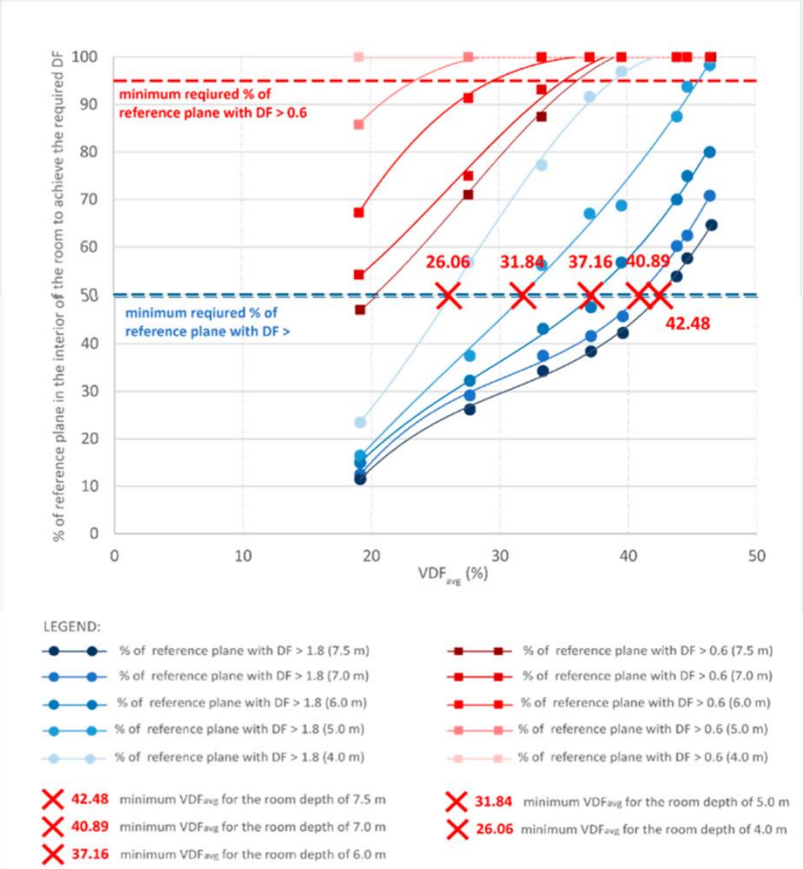


Figure 28: daylights factor. Source: (Šprah, 2020)

Uniformity of illumination: Lighting uniformity (U) is a measure of how light is distributed over a given surface. In a room, lighting should be distributed evenly to ensure that no areas are excessively dark or bright. According to EN 12464-1, "The illuminance uniformity in the immediate surrounding area shall be $U_0 \geq 0.40$." The following figure shows the levels of uniformity required for different activities (lighting, n.d.).

Type of task / activity area	$\bar{E}_m$ (lx)		U_o
	required	modified	
Filing, copying, etc.	300	500	0,40
Writing, typing, reading, data processing	500	1000	0,60
Technical drawing	750	1500	0,70
CAD work stations	500	1000	0,60
Conference and meeting rooms	500	1000	0,60
Conference table	500	1000	0,60
Reception desk	300	750	0,60
Archiving	200	300	0,40

Figure 29: Uniformity of illumination. Source : performanceinlighting

2.3.5.5. Conclusion of the state of art:

To achieve optimal balance between visual and thermal comfort we touched every aspect that plays role in achieving the balance maximizing natural light usage and dealing with thermal gain and loss going from larger scale to smallest details as follows:

a) Environment

the environment effect on the building is the starting point due to it being changeable variable that change with location thus the opportunities and weakness effect the response of the architect to provide solutions for comfort starting with form in order to understand the interplay of the environment we must do a climate analysis, an urban analysis and a site analysis

b) Form

the form is first physical Insight act for the architect the form must answer the weakness of the preparation phase in previous analysis and select best suited form to enhance visual comfort and reduce thermal gain problem taking advantage of best orientation to face its facades, provide passive solution through facade texture manipulation and form design and put in mind the compactness of the form which we must regulate later with envelope settings.

c) Envelope

the envelope is the interface between the outside environment and the created interior environment of the building (form) it hold the natural lighting points of access (the window) which the visual comfort source and at envelope level it happens unavoidable phenomena of thermal gain through both glazing in opening and solid walls and in order to reach optimal balance between visual and thermal comfort we must test and adjust variables in the envelopes based on our form in our particular environment using simulation programme so we can evaluate the results and make definitive choice and to improve the results there also the role of intelligent envelope, passive and dynamic envelope variables, glazing (window to wall ratio-glass – glass properties , window frame) and wall (material properties – insulation – changing phase material).

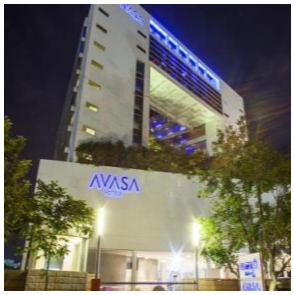
2.4. PART III: Analysis of examples

The third part of the thesis presents an analysis of examples to better understand the knowledge and steps involved in designing a successful and functional business hotel. Through the study of real cases, this analysis enriches our thinking by offering innovative ideas and practical design know-how. The project is studied in terms of functionality through three essential dimensions: the environment, the form, and the envelope. First, the environment includes the location, climate, accessibility, and master plan, helping us explore how the hotel integrates into its urban context. Then comes the form, starting with the project's initial ideas and concept, followed by the program and spatial organization, which help us understand circulation principles and functionality. Finally, the envelope is examined through the façade design, materials, and colours, focusing on how to ensure good perspective and visual quality for observers. This part also considers durability techniques used in the envelope and external views of the hotel, which can inspire new ideas. For this study, three significant projects were analysed—two international references and one national project—offering a comparative and inspiring vision for the design of a modern business hotel.

2.4.1. Project presentation:

We begin with a brief introduction to the projects, where each project is presented with its name, an illustration, the criteria that guided its selection, and essential technical data such as surface area and number of stories.

Table 14 :projects presentation. Source: author.

Project	**AVASA BUSSINES HOTEL**(Madhapur , INDIA) 	**SHERATONE BUSINESS HOTEL** (Annaba , Algiers) 	**HAYATT REGENCY HOTEL PUNE** **(**Maharashtra INDIA) 
Selection criteria	• Situated in a business district. • A highly eco-friendly project integrating sustainable strategies. • Designed on a compact site with efficient space utilization. • Spatial organization (functionality)	• Functionality and Complementarity of Spaces • Urban Landmark • Located in Algiers • Modern touch.	• Situated in a business district. • Verity of spaces in hospitality sector • Implementation of public stores • Hierarchy and clear separation between function • Verity in hotel rooms and suits
Architect and year of construction	Nandu Associates on 2012	Fabris & Partners on 2019	
Project area	8 169.0 m^2	5 000 m^2	15 224 m^2
Number of stories	11 stories	20 stories	13 stories

2.4.1.1. Avasa business hotel analyses. *Source: archdaily, modify by author*

Location:

Avasa located in Hyderabad's Hitech City at Survey No. 64 in the Huda Techno Enclave in Madhapur.

- **Accessibility:** The project accessible from one side only (the side of the main road), by a mechanical access with tow pedestrian access in the same side.
- **Masse plan:** The hotel is located in a dense urban environment, surrounded by administrative and commercial buildings. The project includes:

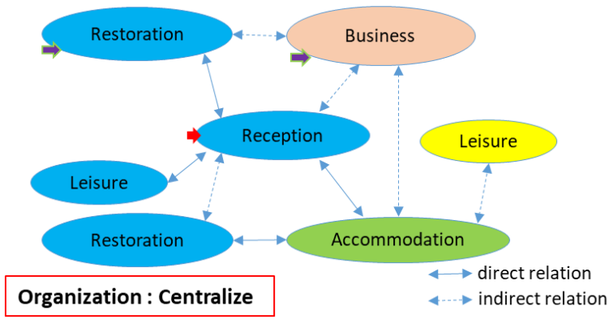
- A mechanical circulation enveloping the built structure for safety reasons.
- 10% of the plot dedicated to green spaces, integrating vegetation adapted to the urban environment.
- A perimeter wall and a plant wall to ensure privacy while enhancing the aesthetic and ecological aspects

- **Concept and volumetry:** Avasa is a project designed for both business and relaxation, with an A-shape that optimizes space. It widens towards the main avenue and narrows at the rear. Eco-responsible, it incorporates tiered planted terraces to compensate for the lack of green space and promote natural light to enhance well-being.\

- **Program and distribution:**

Function	Space	Floor
Business	Meeting rooms , conferences rooms, business center, offices, ballroom	Ground floor, 1st floor
Accommodation	Standard rooms, double rooms, suites rooms	From the second floor to the 12th
Relaxing and leisure	Pool, gym, spa	Second floor and 5, 11 floors
Restauration	03 Restaurants, cafeteria,02 lounge , sky lounge ,bar	Ground floor , second, 5,,10,11 floors

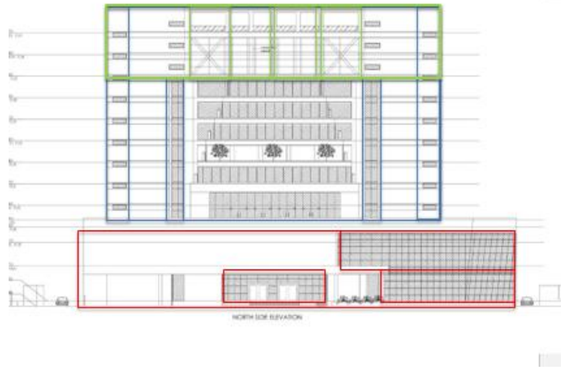
Spatial organization :



- **Façade**

a. Concept: The façade of this hotel is composed of three distinct sections: **the base, the shaft, and the crown**. Each section is treated architecturally in a way that aligns with its specific function, reflecting a design approach where **form follows function**.

1. The base : **Horizontal Emphasis , transparency** for a visual effect of elegance and modernity
2. The shaft : **Verticality , The rhythm , less transparency than the base** for more intimacy and stability
3. The crown : like the base treatment **horizontality with transparency** to mark the end of the building and the



- **Durability:**

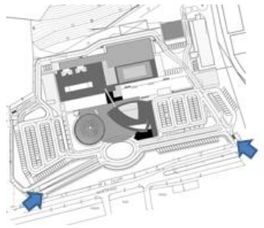
Passive	Active
Facade orientation (south-facing glazed facades)	Solar photovoltaic (PV) panels
Sun protection (use of caps, sunshades or external blinds.)	Solar thermal system
Tiered terraces (optimize ventilation and natural light).	Central air conditioning system

- **Outdoor spaces :**

2.4.1.2. Sheraton Annaba business hotel. *Source: archdaily.modidy by author*

- **Location:** the Sheraton Annaba Hotel is situated in the center of Annaba,

- **Accessibility:** The project is only accessible from the main road. It includes a U-shaped mechanical access for vehicles, as well as a pedestrian access.



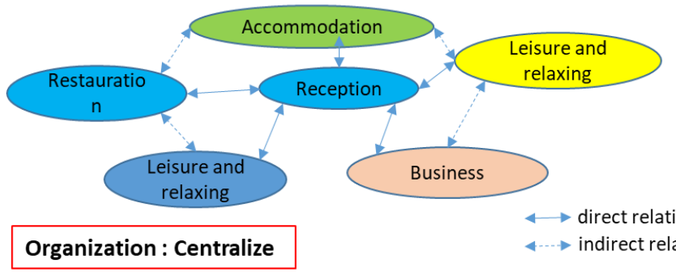
- **Mass plan:** The hotel is strategically positioned, centralized within a functional environment. Its accesses and exits are optimized to facilitate traffic flow. A mechanical road surrounds the project, guaranteeing rapid intervention by emergency services in the event of an emergency.

- **Concept and volumetry:** The Sheraton Annaba Hotel stands out for its verticality and modern design, creating an iconic presence in the city. Its dynamic architecture, with bold lines and a striking silhouette, asserts its emergence as an essential urban landmark.

Program and distribution:

main functions	Spaces
Accommodation	187 standard room, 15 executive suites, 1 presidential suite
Business Facilities	2 BIG Meeting Rooms, 5conferences, business center, ballroom
Leisure and Relaxation	Swimming Pool, gym, Spa.
Reception	Reception, main Lobby
Restoration	02 principal Restaurants, cafeteria, lounge

Main functions :



Organization : Centralize

- **Façade:**

a. Concept:

1. Transparency of the Façade
2. Horizontality of the Treatment Façade
3. Rhythm
4. Dynamism and Movement

b. Materials: An innovative double-skin glass façade. The combination of concrete and steel, used for their structural role, ensures strength and stability, while glass provides transparency and modernity. Steel accents on the facade reinforce its elegance and contemporary character.

Structure:

The tower has a self-stabilizing, reinforced concrete post-and-beam structure. The adjoining bubble has a metal frame.

Durability techniques :

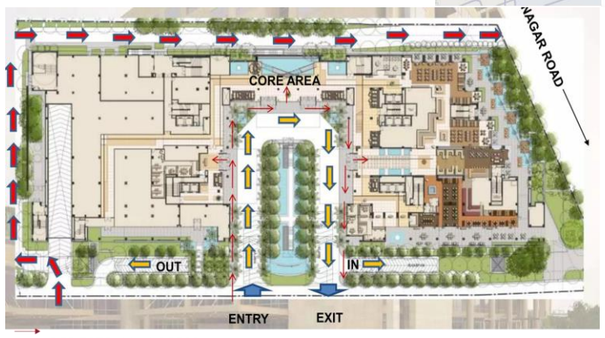
Passive techniques	Active techniques
Searching for best orientation of the tower by deleting north orientation using form	Solar photovoltaic (PV) panels
	Solar thermal system
Using double skin façade.	Central air conditioning system

Outdoor spaces:

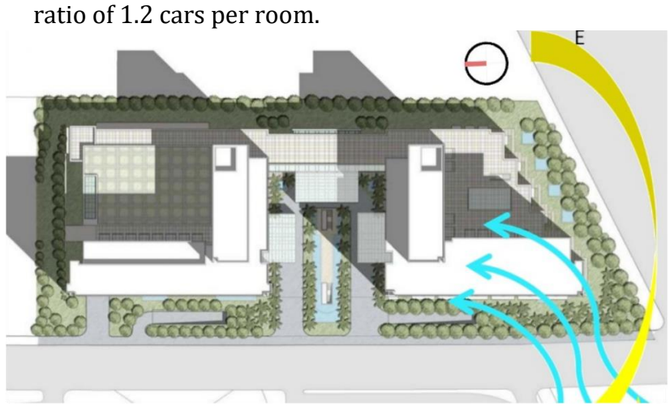
2.4.1.3. Hyatt Regency Pune and Residences. Source: archdaily.modidy by author

- **Location:** India, Weikfield IT Park, Nagar Road, Pune, Maharashtra.

- **Accessibility:**

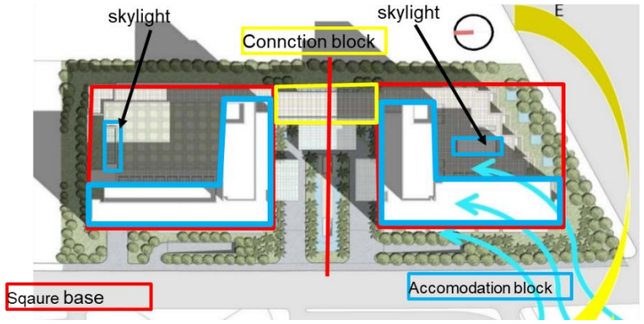


- **Mass plan :** The project covers a total area of 15,224 m^2, with a total built area (SHON) of 55,574 m^2. The footprint represents 46% of the plot, or 7,126.73 m^2, while 10% of the area is dedicated to green spaces (1,522.4 m^2). The basement, spread over two levels, covers 18,533.2 m^2. The planned parking area includes 353 spaces, representing a ratio of 1.2 cars per room.

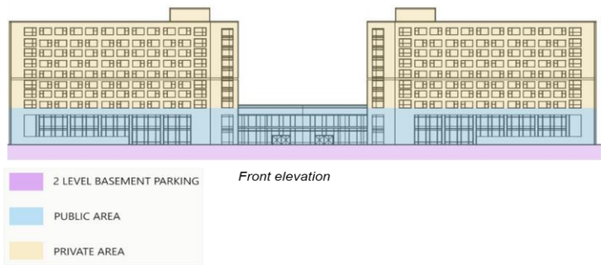


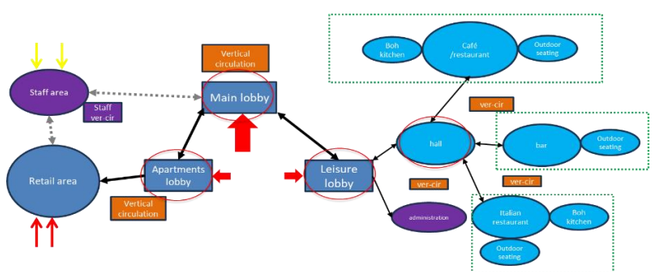
- **Project idea & concept:**

The project adopts a simple and functional form, consisting of two square blocks connected by a central core, with L-shaped Blocks above for housing and the hotel. The layout is based on axiality and symmetry for a clear understanding of the access points.



- **Distribution of main function :**





System distribution radial ensure hierarchy and the main and secondary lobbies are the start points.

- **Façade**

  - ✓ The first 2 floors have higher percentage of opening that include the entrances at 63% vacant 37% filled
  - ✓ Repetitive floor ratio 24%, filled 76% empty Per floor and total 44% empty 56% filled
  - ✓ Different treatment from then repetitive floors opening size and shape

- **Outdoor spaces:**

2.4.2. SYNTHESES:

Table 15: example analysed synthesis. source : author

Project	**Sheraton Hotel**	**AVASA Hotel**	**Hyatt regency pune and residence**
Main function	Leisure, relaxation, and accommodation and business	Leisure, relaxation, and accommodation and business	Leisure, relaxation, and accommodation and business
Key Program Features	✓ Rooms are organized around the tower (centralize organization). ✓ Offered panoramic views form his height	✓ Multifunctional program ✓ atrium distribution of rooms ✓ A stepped terrace with an open patio integrated into the façade creates a visually striking and well-balanced architectural composition.	✓ Multifunctional program. ✓ Apartments block ✓ Linear distribution of rooms
Programmatic Goals	A landmark project combining business spaces and tourism, enhanced by its height and visibility.	Design a sustainable project integrating bioclimatic techniques to enrich the business district and attract visitors and professionals.	Provide restoration services for business district And accommodation medium and short term

A comparative study of international and national projects reveals fundamental program objectives to guide the design of a business hotel, such as:

- ❖ Accommodation and business space (workspaces) must offer maximum comfort.
- ❖ Integrate common spaces to encourage exchanges and networking.
- ❖ Offer a mixed-use program to reduce the need for users to travel.
- ❖ Complement the project with accompanying functions (ancillary services useful to business travellers).
- ❖ If the height of the project is significant, take advantage of it to offer panoramic views that enhance the user experience.

This analysis has clearly defined the various stages of the project's design, from urban integration to final technical and aesthetic details. In both 2D plans and 3D volumetric, the accommodation function dominates spatially, occupying approximately 60% of the total area with specialized distribution for each category (linear, centralized, and organized around an atrium). The business function accounts for 25% of the hotel (conference rooms, meeting halls, ballrooms). The remaining 15% accommodates common functions such as dining, relaxation, and leisure facilities.

CHAPTER 03 :

CASE OF STUDY

2.5. Introduction:

After discussing tourism and business tourism, as well as ways to develop them in Algeria, in the last chapter, we chose to focus on the Bab Ezzouar business district, which reflects Algeria's international image. We will present its history and evolution alongside an urban and climatic analysis to identify the key elements that guided the design of our business hotel to become successful and future benchmark destination.

2.6. Presentation of the choice of study:

We begin this chapter with a presentation based on the macro to micro method, i.e. from the country, Algeria, to our site located in the Bab Ezzouar business district.

2.6.1. Algeria: Africa's Giant:

Algeria is one of the North African countries and the largest on the continent in terms of land area. It plays an important role on the African stage and is emerging as a key gateway to North Africa.

2.6.2. Algiers: Heart of a Nation

Algiers, the country's capital, is strategically positioned on the Mediterranean coast. It is the political, economic and cultural heart of Algeria, with a population of around 4 million. The city's prestigious universities, state-of-the-art medical facilities and growing business sector make it a major hub in North Africa. Despite certain challenges, Algiers continues to evolve, blending its historical roots with contemporary ambitions to assert itself as a leading metropolis in the region (Review, 2025).

Figure 30: ALGIERS. SOURCE: Wikipedia

2.6.3. Bab Ezzouar: A Strategic Urban Powerhouse:

Bab Ezzouar is a strategically important community that has been established as a major urban and economic hub to the east of Alger. Its development is closely linked to its proximity to the international airport Houari Boumédiène, the Grand Mosque of Algiers, and a number of transportation infrastructures, such as the tramway, national routes (RN5 and RN24), and the railway, which guarantee optimal connectivity. With more than 300,000 residents, Bab Ezzouar is one of the most populous communes in the country, covering 822,8 hectares. By housing numerous corporate headquarters, academic institutions like the University (USTHB), commercial hubs, and hotel complexes, it plays a crucial role in the country's economy. Finally, Bab Ezzouar has three main assets: economic strength, a residential vocation and a scientific hub. (malki, 2012)

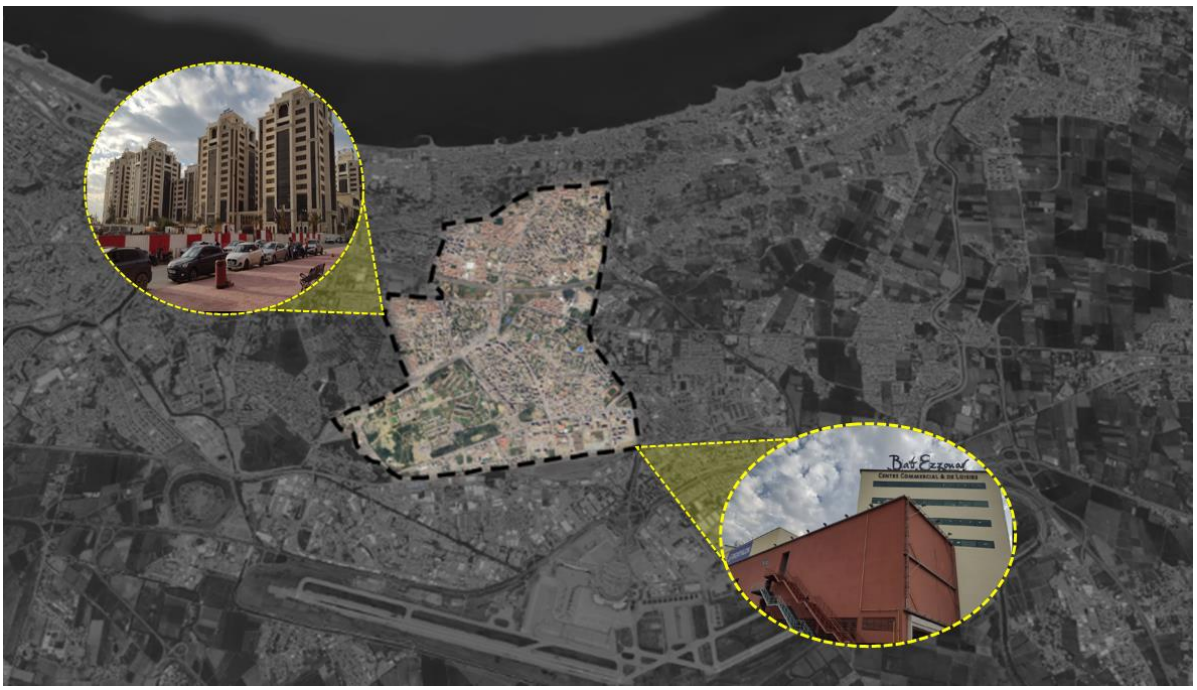


Figure 31: BAB EZZOUAR .SOURCE: www.skyscrapercities.com, google earth pro. Modify by author

3.2.2.1. Motivations for Choosing

Bab Ezzouar benefits from several strategic advantages. Its proximity to Algiers International Airport ensures excellent accessibility, particularly through its connection to major national roads, which facilitates both national and international travel. The area is also well served by a diversified transport network, including the train, tramway, freeway, and bus lines. In addition, the presence of a thriving business district adds significant value to the site, reinforced by modern and dynamic development projects.

3.2.3.2. Geographical limits of Bab Ezzouar

✓ **Administrative boundaries:**
Bab Ezzouar is bordered by Bordj El Kiffan to the north, Oued Smar to the south, Mohammadia to the west, and Dar El Beïda to the east.

✓ **Physical boundaries:**
The area is bounded by the railroad to the south, and by national roads to the east, west, and north.

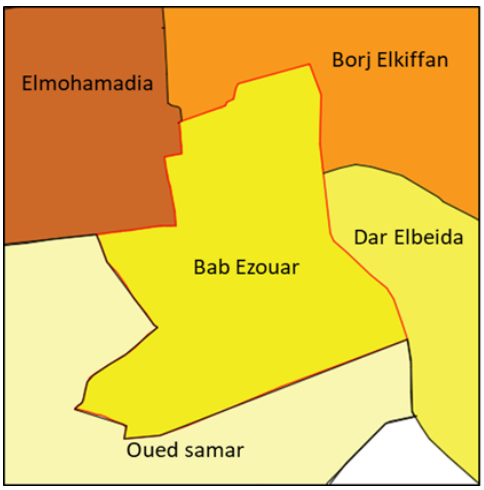


Figure 32: Administrative boundaries. SOURCE: PDAU. Modify by author

3.2.3.3. **Axis structuring the town of Bab Ezzouar:** The town of Bab Ezzouar is structured around several major roads: RN 24, RN05, the northern ring road and the railroad line. This organization reinforces its accessibility and makes Bab Ezzouar a well-connected area, both locally and regionally.

3.2.3.4. **Accessibility:** Bab Ezzouar is easily accessible thanks to the main roads mentioned above, as well as a wide range of means of transport such as trains, streetcars, buses and main roads.

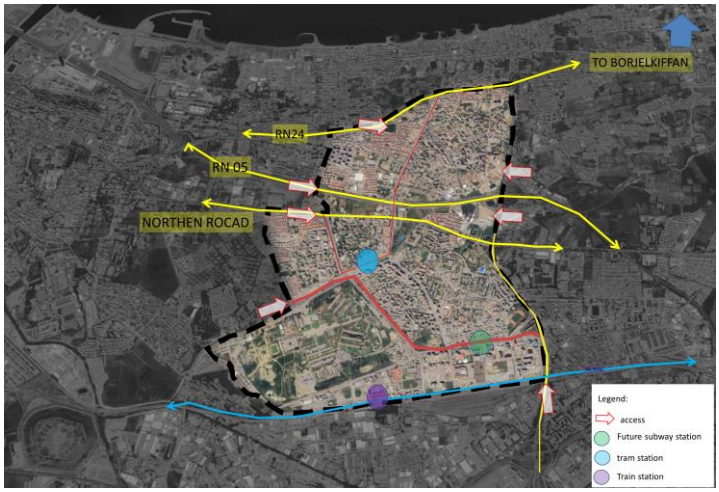


Figure 33: structural axes and accessibility. SOUREC: PDAU. Modify made by author

3.3. Climate analysis

In this study, we will examine the climate of city of bab ezzouar with a presentation of the climatic data in order to obtain an overview of the climatic stage of our case study, with **Meteonorm** and **Climate Consultant V6** using data from **climate.onebuilding.org**. Secondly we will use **sozoklay diagram** to moderate comfort necessities to facilitate the choice of recommendations to follow that adapted to the climatic condition of the site

Precipitation: Yearly average 622 mm and about 75-85 raining days.

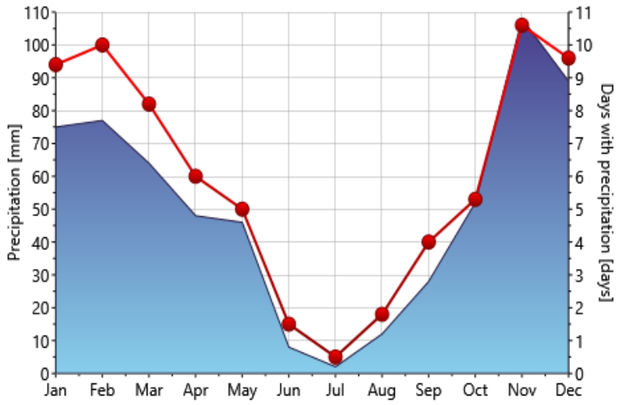


Figure 34: Precipitation. Source: Meteonorme 8

Humidity: Humidity monthly average peek in JAN at 80% And low in JULY at 66%, with yearly average being 74%.

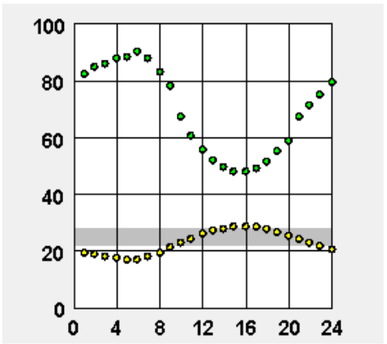


Figure 35: humidity. Source: Meteonorme 8

Winds: The cold winds in winter blow from south and west. Andthe hot winds in summer come from direction of the north and east side.

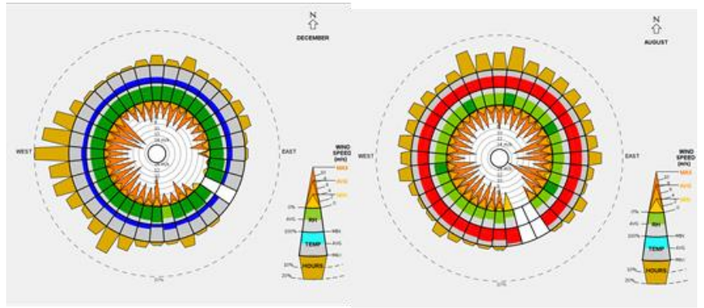


Figure 36: wind rose. Source: Meteonorme 8

Temperature: Cold winter (dec-feb) below comfort zone averages in 10.5° . Hot summer (jun-sep) above comfort zone averages 25° with highest daily temp averages at 30°. Comfort in transition months May and September.

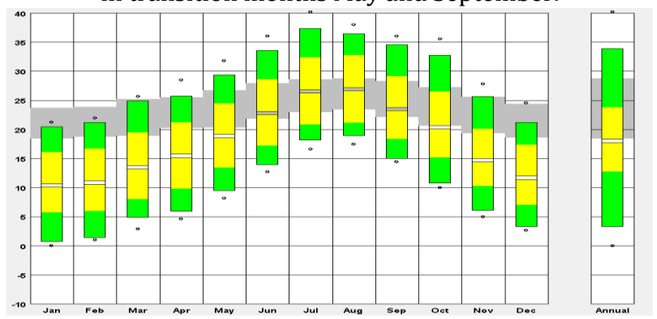


Figure 37: temperature. Source: Meteonorme 8

Synthesis (Identification of the climate zone):

- ✓ **P: Yearly precipitation = 622 mm.**
- ✓ **T: Yearly average temperature = 17.96 °.**
- ✓ **Martonne aridity index: P/T+10= 44**
- ✓ **MAI = 44**
- ✓ **30 < MAI< 55**

Climate zone:The Mediterranean humid climate is characterized by **hot, dry summers** and **mild, wet winters**, with an average **annual precipitation of 622 mm** and a **yearly average temperature of 17.96°C**.

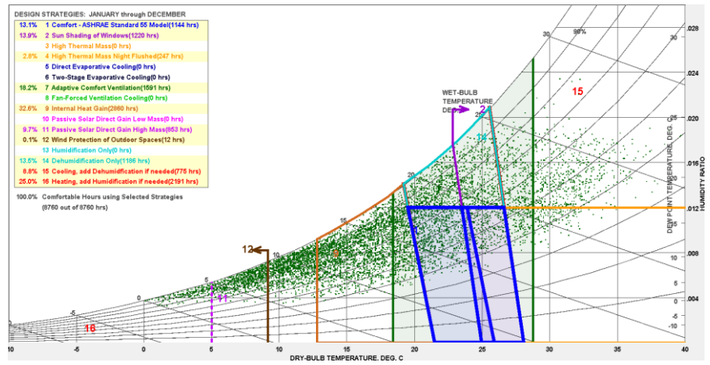


Figure 38: Szokolay diagram. Source: Climate Consultant 6

Recommendations:

1. Effective natural ventilation should be aligned with the dominant wind patterns.
2. Implement shading strategies, such as light-colored flat roofs, to mitigate excessive heat.
3. Utilize light-hued construction materials and cool roofing systems.
4. Incorporate screened areas for occupancy and patios to facilitate passive cooling.
5. Install double-glazed, high-performance Low-E windows on the west, north, and east facades, while opting for clear glazing on the south side.
6. Employ evaporative cooling techniques to humidify hot, dry air before it enters the building from enclosed outdoor areas

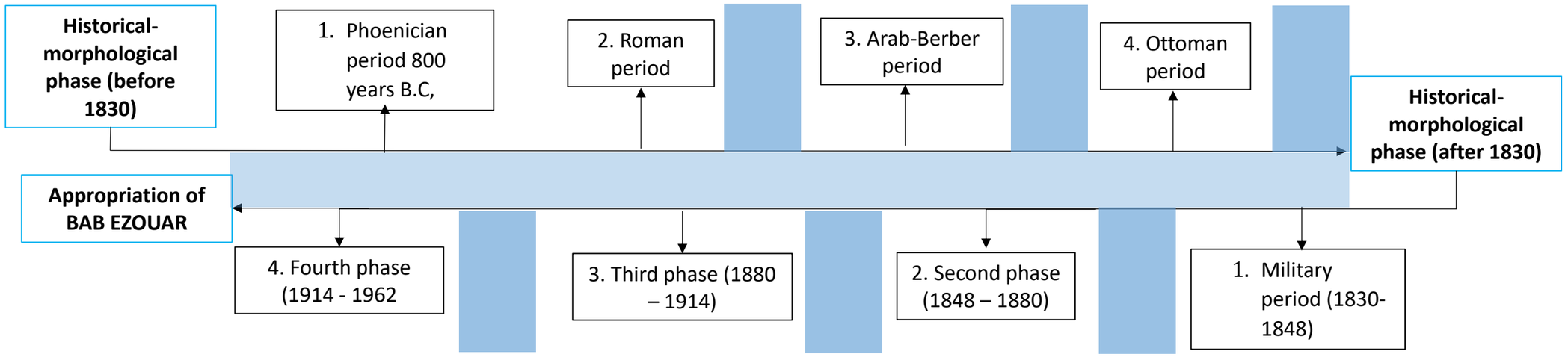
Table 16: Table of Mahoney. Source: Author

Mahoney Table	Recommendation
Mass plan	Building oriented along a longitudinal east-west axis
Spacing between buildings	Compact lay-out plan
Air movement	Double orientation, allowing a continuous air circulation.
Dimensions of openings	Average, 25 to 40% of the wall surface.
Position of openings	Openings in the north and south walls, at man-height on the exposed windward side including openings in interior walls
Protection of openings	Provide protection from the rain.
Floors and walls	Solid walls, time difference of more than 8 hours.
Roof	Solid roof, time difference of more than 8 hours. Thermal gain

3.4. Historical over view:

Bab Ezzouar is the result of the various developments that took place in Algiers during the colonial period. To understand its evolution, it's essential to retrace the main stages in the transformation of the city of Algiers, right up to the emergence of the Bab Ezzouar district

Figure 39: historical over view of Algiers. SOURCE: made by author



The history of Algiers is rich and vast, shaped by the passage of various civilizations over time. Each civilization has left its unique mark on the city. This long and diverse historical journey can be summarized as follows:

3.4.1. Historical-morphological phase (before 1830):

As shown in the figure, before 1830, Algiers went through four major historical phases, each marked by its own cultural and urban characteristics, which have left a visible imprint on the city's morphology. None of these urban developments extended beyond the limits of what is now considered the historical core of Algiers.

- ✓ The **Phoenician period** marked the first stage, during which settlements were established along the Algerian coastline mainly for commercial purposes.
- ✓ Next came the **Roman period**, which left a strong urban legacy still noticeable today. The Romans were known for their structured planning, characterized by the presence of two main axes — the *cardo* and *decumanus* — and a centralized organization within a dense urban fabric.
- ✓ Following that, the **Arab-Berber period** introduced a more organic and compact urban layout, with narrow, winding streets. This phase saw the city extend further inland, reaching the surrounding hills.
- ✓ Finally, the **Ottoman period** brought significant transformations, including the reinforcement of the city's defensive structures and the widening of certain urban spaces, contributing to a more complex and fortified urban system.

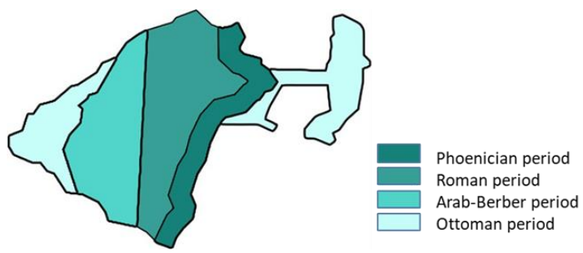


Figure 40: Algiers before 1830. Source: G.camps.1986.

3.4.2. Historical-morphological phase (after 1830):

After 1830, French colonization began at Sidi Fredj, marking the start of four major phases of urban expansion in Algiers. These stages are characterized by successive extensions outside the ancient city and the gradual introduction of European concepts.

- ✓ **The first phase (1830-1848)** was that of military occupation, marked by the extension of the Casbah towards Bab El Oued and the construction of a new defensive enclosure.
- ✓ **The second phase (1848-1880)** saw a more structured expansion, reaching as far as the port of Admiralty, with profound changes to the old fabric. It was during this period that the European quarter developed, to the detriment of the native town.
- ✓ **The third phase (1880-1914**) was marked by southward extensions, the development of residential districts, and the integration of new public spaces, reflecting a desire to rationalize the city.
- ✓ **The fourth phase (1914-1962)** is that of modern urban planning. It incorporated the concepts of zoning, hygiene and the use of irregular plots organized by a tree-like road system. This phase also saw the emergence of far-flung extensions, such as the appropriation of the Bab Ezzouar site, marking the desire to expand far beyond the historic core.

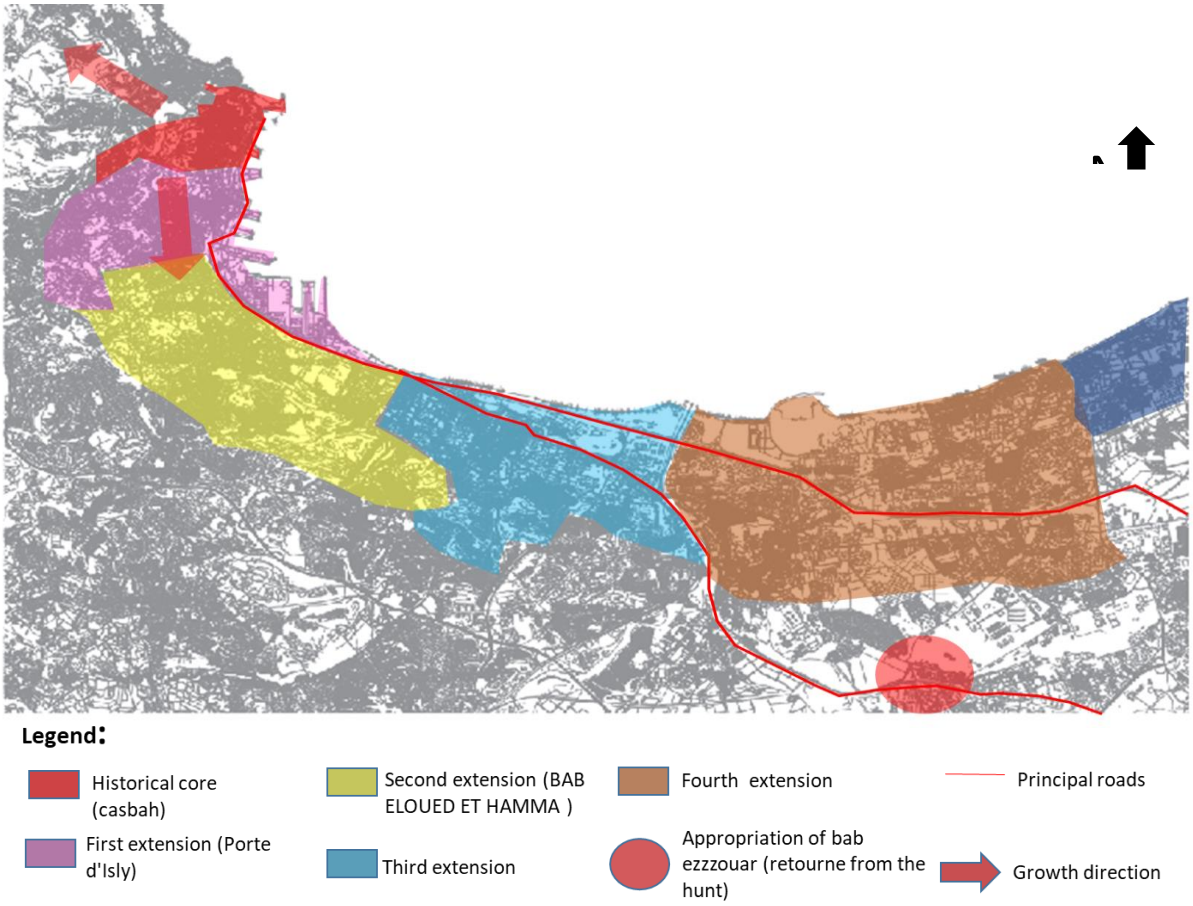


Figure 41 algeirs evolution after 1830. Source: author based on (Osmani, 2004).

3.4.3. Appropriation of Bab ezzouar and his expansions

3.4.3.1. The appearance of the central core:

In 1870, a new settlement known as "Retour de la Chasse" (Return of the Hunt) emerged, marked by its agricultural character. This development coincided with the early phase of Algiers' urban expansion during the initial period of French colonization, which was primarily a military occupation.

3.4.3.2. First Phase of Urban Expansion:

The initial core of Bab Ezzouar consists of a collection of two-story individual houses, along with two historic districts from the colonial era: Mahmoud District and Sidi Mahamed District. During this period, Bab Ezzouar remained largely unchanged, as its fertile soil favored agricultural use, leading to the preservation of vast stretches of land.

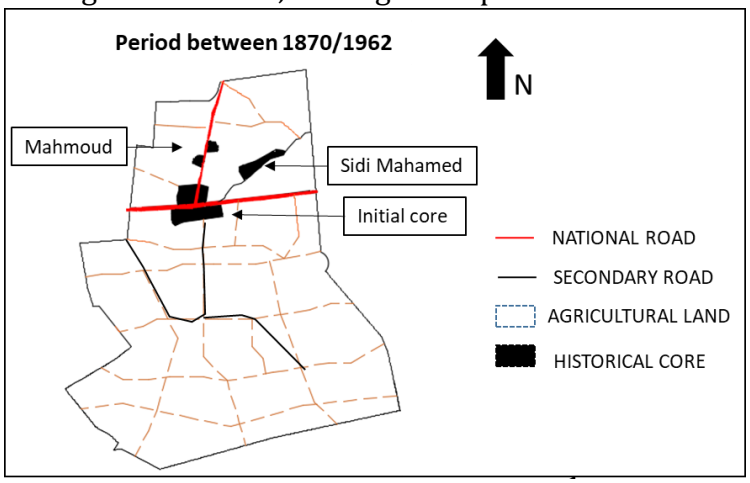


Figure 42: first phase of urban expansion of Bab ezzouar. SOURCE: POS. modify by author

3.4.3.3. Second Phase of Urban Expansion:

After independence, Bab Ezzouar witnessed the development of four major social housing projects, which emerged as a popular and practical solution to address the growing housing demand.(8 MAY, TAHAR RABIA, ELDJORF,5 JUILLET). The creation of the University of Science and Technology Houari Boumediene (USTHB).

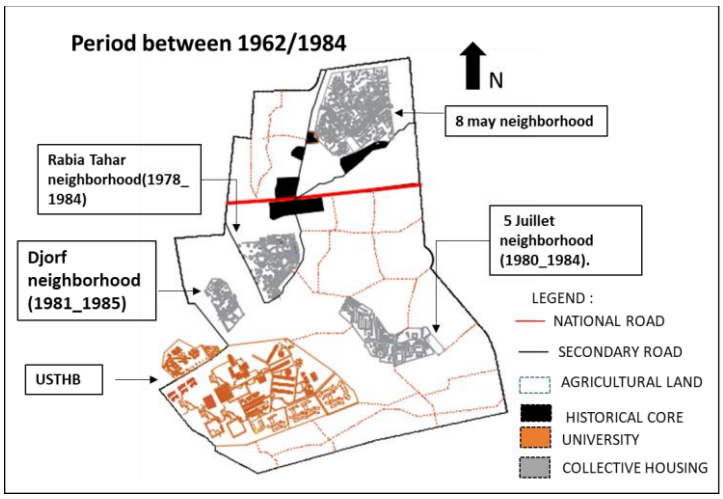


Figure 43: second phase of urban expansion of Bab ezzouar. SOURCE: POS. modify by author

3.4.3.4. Third Phase of Urban Expansion:

Bab Ezzouar saw a significant uptick in the construction of social housing between 1984 and 1995, which was indicative of a larger pattern of swift urban growth. The building of important infrastructure, such as the highway, which enhanced accessibility and connectivity, was a notable feature of this phase.

- During this time, large-scale residential complexes like Ismail Yefsah and "Douzi" emerged, adding to the expanding urban fabric of the area.

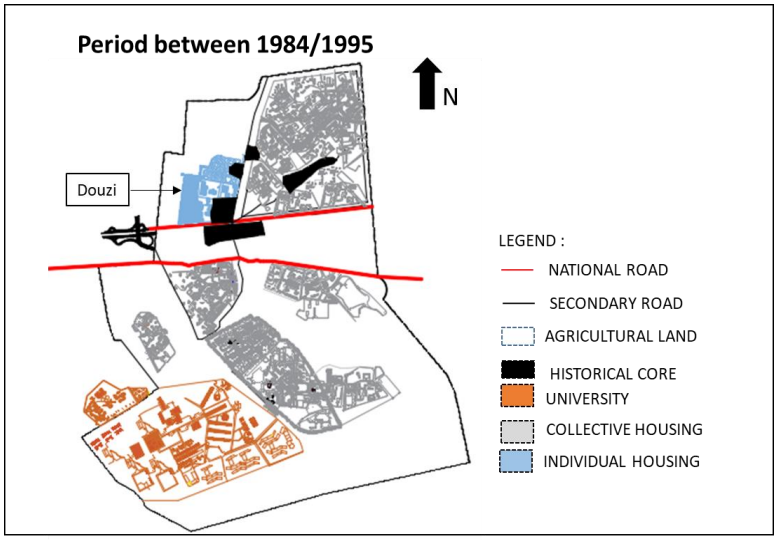


Figure 44: third phase of urban expansion of Bab ezzouar. SOURCE: POS. modify by author

3.4.3.5. Fourth Phase of Urban Expansion:

The urbanization process in Bab Ezzouar has led to a clear shift toward higher-density housing, as seen in the development of large-scale social housing blocks, some comprising up to 602 residential units. This change is reflected in recent urban allocations, which include major developments like: ADL Towers, Mercure Hotel, Plot subdivisions for new urban extensions.

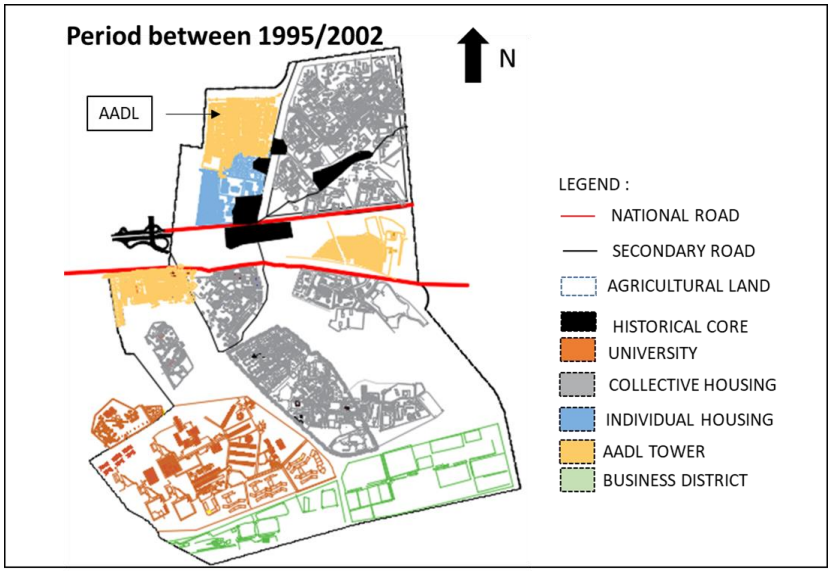


Figure 45: forth phase of urban expansion of Bab ezzouar. SOURCE: POS. modify by author

3.4.4. Summary:

The historical evolution and transformations of Algiers, up to the appropriation and development of the Bab Ezzouar district, can be summarized in the following table:

Table 17: historical over view synthesis. SOURCE: made by author. Based on, Osmani, 2004 , G. Camps, 1986

Criteria	Before 1830	Between 1830-1962	After 1962 (independence)
Historical context	Phoenician, roman, Arab-beber, ottoman	French domination.	National development period.
Main objectives	Responding to community and climate needs.	Impose colonial power.	Responding to Massive Housing Needs Affirming National Identity.
Urban type	Compact, adapted to topography and climate.	Geometry and follow the European concept.	Rapid, ill-planned extensions.
City Expansion	The historic core of Algiers.	Planned expansion around central core.	Planning large-scale projects to meet housing needs.
Cultural influences	Phoenician, roman, arab-berber, ottoman.	Hussumannian, classical, European planning concept.	Vernacular inspiration.
Urban Form	A dense urban form, with narrow streets, limited around casbah (historical core.	Geometric form with Large expansions.	Planned urban form (large-scale developments).
Typology	Residential, defensive, religious.	Residential, administrative, military.	Residential, public facilities.
Iconic Elements	Casbah, mosques, ottoman places, skifa, patio, inside opening,	Arcades, vaults, balconies.	Public facilities, transparency, residential towers.

3.5. The study areas: business district:

The Bab Ezzouar business district is a strategic economic hub, home to numerous public and private companies. And a key contributor to the national economy.
Its proximity to key infrastructures such as the railway station, the USTHB, the RN11 and RN5 trunk roads and the international airport make it an attractive hub for business and investment.

Figure 46: busniss district of bab ezzouar. SOURCE: google earth pro, modify by author

3.5.1. Distribution of function in the district:

Economic and administrative buildings occupy the most important areas of this district. Construction sites and new projects also cover a considerable area. Finally, the shopping center and park are the main leisure functions, representing the district's last functional category.

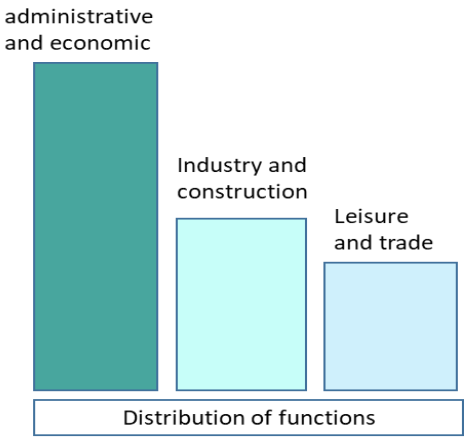


Figure 47: distrubtion of function of the business district. SOURCE: POS.modify by author

- Our evaluation criteria for this district include its great importance at national and international levels, as well as in the wilaya of Algiers. It plays a major role in the country's economic development thanks to its strategic location, its proximity to Houari Boumédiène airport and the diversity of its means of transport

3.5.2. Location:

The Bab Ezzouar business district is located in the south of the Bab Ezzouar commune. It is bounded by the 5 Juillet and Smail Yefsah districts to the north, by Oued Samar to the south and west, and by the Dar El Beïda commune to the east.

3.5.3. Accessibility:

This district is accessible from the RN5 on the east side, via the University Boulevard to the north, and through the railway station located to the south.

Figure 48: business district location and accessibility. SOURCE: google earth pro, modify by author

- After acquiring knowledge about the area or district in which we're working, we'll analyze it using a typomorpho-sensory reading to explain the following points:

Table 18: analyses grille. Source: BOUKARTA.

Road system	Built system	Plot system	Public spaces
Road hierarchy	Landmarks	Dimension	Spatialization
Nodes	Built density	Geometry	Vocation
Road safety	Building condition	Topography	
Traffic flow	Alignment		
Lane geometry	Facade		

- After identifying the points above, we'll come up with a few summaries of each system, followed by a sensory analysis that links urban morphology with human senses, in order to finalize this work by starting a SWOT analysis to define the neighborhood's strengths and weaknesses, which will help us in our project design.

3.5.4. ROAD SYSTEM

✓ **The hierarchy of lanes:**

There is a hierarchy of lanes in the business district. The main lanes, which serve as the district's boundaries, are an important consideration. These include University Road and national road n°5. Next are the secondary roads, which connect the business district to main roads. One such road divides the district into two parts horizontally. Finally, the third type of road consists of tertiary roads that lead to more distant parts of the district. Our site is strategically located at the intersection of two secondary roads that serve as the district's main entrances.

Figure 49: business district roads. Source: authors.

✓ **Nodes:**

There are different forms of nodes, including main nodes and secondary nodes. They play an important role in organizing traffic and lane flow management. Our site benefits from its position on a secondary node, which reinforces its connection to the district's traffic network.

Figure 50:the secondary node of the business district. Source: author .

The road hierarchy and traffic nodes we have described are illustrated in the figure above:

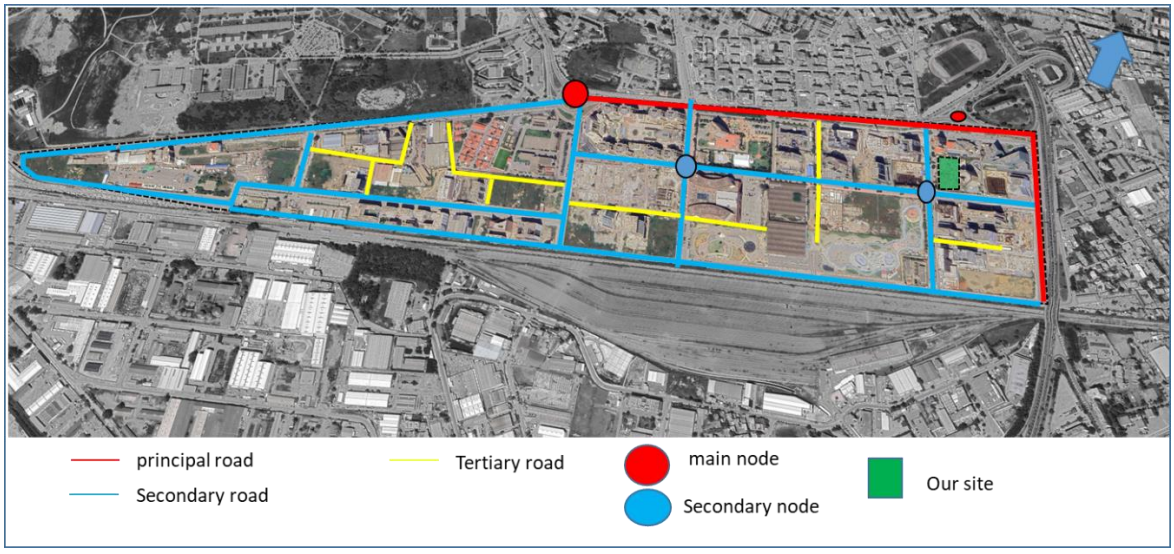


Figure 51: The road hierarchy and traffic nodes of business district. Source: google earth pro. Modify by author.

- ✓ **Road traffic:**

Significant mechanical flows are observed during rush hours, particularly at 8am and 4pm. This causes traffic jams and slows down traffic at traffic circles. The lack of parking spaces leads to parking on the edge of the road, which disrupts traffic flow and creates an anarchic situation.

- ✓ **Pedestrian flows:**

Pedestrian flows are mainly concentrated around the shopping center and Park. Pedestrian traffic is characterized by the presence of wide, landscaped sidewalks. However, the lack of secure parking spaces means that vehicles park on the sidewalks, making them unsafe and creating an anarchic situation.

- ✓ **Track geometry:**

The table below shows the types of roadway geometry in the business district:

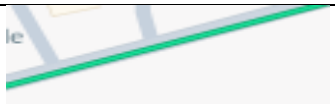
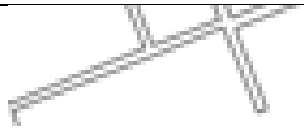
Road			
Geometry type	**Loop system**	**Linear system**	**Impasse**

Table 19: road geometric classification. Source: author.

The linear system is dominant in the business district, due to its morphology and the organized distribution of plots.

The following map shows traffic flows (vehicular and pedestrian) and lane geometry within the business district.

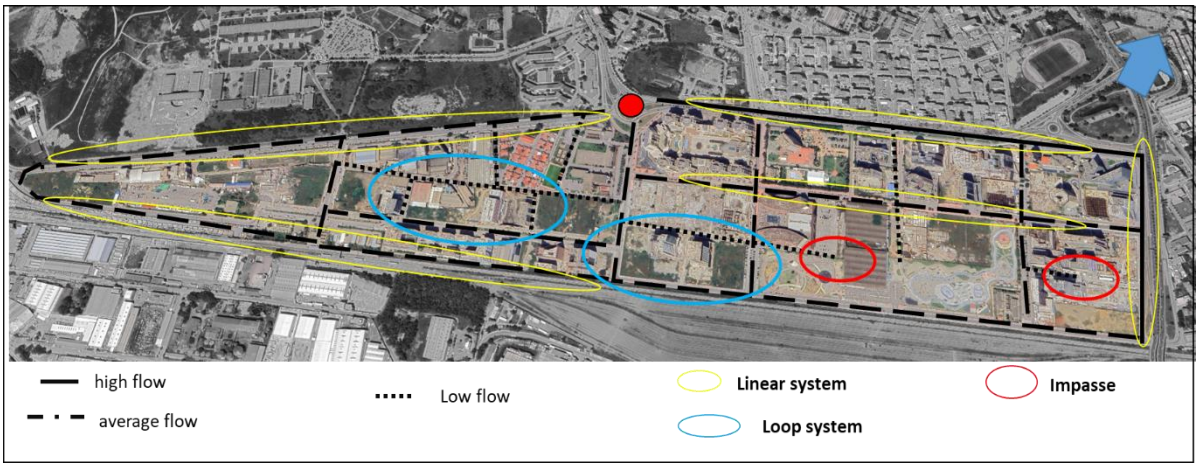


Figure 52: traffic flows and road geometric of business district. Source: google earth pro. Modify by author.

3.5.5. BUILDING SYSTEM

✓ **Landmarks:** The Bab Ezzouar business district is home to several projects of significant value that can be considered landmarks, including the Marriott hotel, the SAA Bank headquarters, the airport headquarters, the Mobiles headquarters, and a shopping center.

Figure 53: Landmarks of business district. Source: open street, Wikipedia. Modify by author.

✓ **Building density and template:** Most major equipment in the business district 60 to 70% form the plot.Template: **R+12 to R+15.**

Figure 54: building template. Source: authors

✓ **Building condition:** All the buildings are in good condition, thanks to the district's national and international importance.

Figure 55: building conditions. Source: authors.

✓ **Alignment**: Most sites have setbacks of 6 to 10 meters to improve visibility and create a buffer zone between the public road and buildings. This space serves as a transition area between public and private spaces.

Figure 56: Alignments. Source: google earth. Modify by author.

✓ **Façade:** the façades of buildings in the business district are modern, characterized by large bay windows and clean, dynamic lines. They feature concepts derived from international architectural trends, with a variety of approaches such as horizontality, verticality and strong architectural rhythms. There's also a mastery of the classic division into base, body and head.

Figure 57: facades. Source: authors

In conclusion, the building system is synthesized and presented in the table below for a clearer understanding of its organization and characteristics.

✓ **Materials:**

The three main materials used in the building industry are concrete, glass, and steel.

✓ **Architectural style and Ornamentation**

Most buildings are inspired by global architectural trends and feature large expanses of glass. However, some incorporate elements of local or traditional architecture, such as arches or moucharabiehs.

✓ **Openings**

1. Large bay windows, glass facades.
2. Traditional openings (classical windows).

3.5.6. Plot System:

The plot system started with large, rectangular plots that were laid out before construction to organize the space. Over time, these plots were progressively divided according to construction needs, resulting in several smaller, rectangular plots. This division follows a clear geometric logic based on the shape of the rectangle. The surface area generally varies between 4,000 and 20,000 square meters**.** The following figure showing the plot system pf the district.

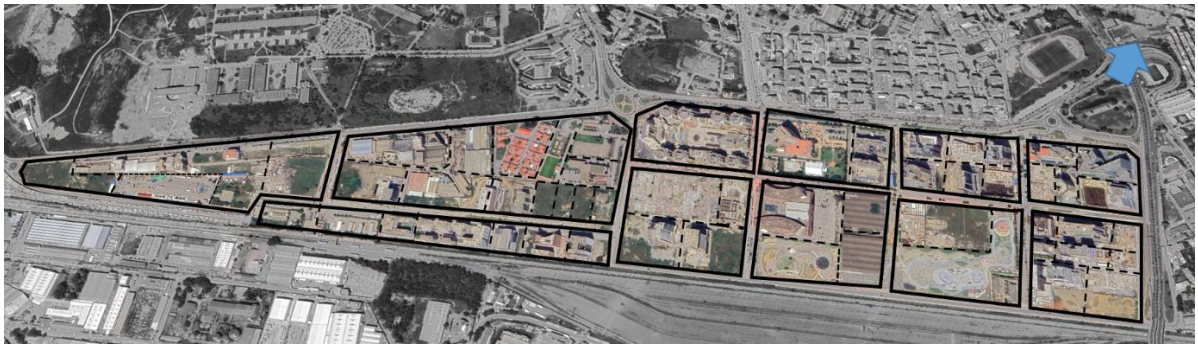


Figure 58: plot system. source: google earth pro. modify by author

3.5.7. Public spaces

There is only one park, as well as a few outdoor amenities linked to public projects such as the shopping mall, despite the large amount of undeveloped empty space in the business district. This represents a real opportunity to create new public spaces, which would energize the district and improve quality of life.

Figure 59: public spaces , source: google earth pro. Modify by author

3.5.8. Synthesis of each system:

- ✓ **Road system:** The district has a complete network of main roads that act as structuring axes, organizing the various sectors of the district. These main roads are connected to secondary roads that link the neighborhood's internal spaces. In turn, tertiary roads provide access to more distant areas. However, the district suffers from traffic congestion and road safety problems, particularly at peak times.

These problems could be alleviated by the creation of new, wider parking spaces, to relieve congestion and improve traffic flow.

- ✓ **Building system:** The building system of the business district follows international standards and trends. Facades are entirely glazed, with modern, flowing designs. Building heights are substantial, varying mostly between R+10 and R+15.
- ✓ **Plot system:** The plot system features very clear, homogeneous and geometric divisions, reflecting a rational organization of space.
- ✓ **Public spaces :** There is a lack of landscaped public spaces, despite the presence of numerous empty areas in the neighborhood.

3.5.9. Sequential analysis*:*

Figure 60: sequential card. Source: google earth pro, modify by author.

- ✓ **The first sequence** :This urban sequence is characterized by a high visual quality, shaped by the architectural aesthetics of the buildings, well-designed façades, project-specific setbacks, and the presence of vegetation, all of which help define the road and guide pedestrian movement. Predominantly administrative in function, the area experiences heavy mechanical flow—estimated at 15 to 20 vehicles per minute and increasing during peak hours—due to its direct connection to major roads. However, the sequence suffers from high noise levels, reaching up to 80 dB, largely due to traffic and the nearby airport. Pedestrian safety and comfort are compromised by disorganized parking and narrow sidewalks, resulting in limited foot traffic.
- ✓ **The second sequence**: Visual quality is also high in this sequence. The dominant function remains administrative, although leisure functions are also present. Mechanical flow is lower than in the first sequence, estimated at between 10 and 15 vehicles per minute. Pedestrian traffic is still disrupted by disorganized parking, but is greater thanks to the presence of the park.

- ✓ **Third sequence**: This sequence is distinguished by its enhanced visual quality, thanks to the diversity of its architectural languages, which makes it easier to identify spaces and read the site. It is characterized by a predominance of accommodation and leisure functions. Noise levels are relatively low, influenced mainly by moderate road traffic and occasional passing aircraft. Mechanical traffic is moderate, estimated at between 7 and 12 vehicles per minute. Pedestrian traffic remains moderate, sustained by the frequentation of nearby commercial and leisure facilities.

3.5.10. SOWT analyses:

In this analysis, we identified the strengths, weaknesses, opportunities and threats specific to each of the four systems studied: road, plot, built and empty space. We then cross-referenced these data to identify concrete actions aimed at improving the urban quality of the district. This cross-analysis led to the definition of a coherent overall strategy, geared towards the functional, aesthetic and environmental upgrading of the site.

Strengths

1. Road system:

- Greater accessibility:
  - ✓ Proximity to major routes such as the RN05 and secondary roads, facilitating accessibility and connectivity.
  - ✓ Road hierarchy (following a grid)
- Flow management: Main and secondary nodes optimize movement within and around the district.
  - ✓ Tracks 12 metres wides, ensuring smooth circulation.
- Public transport: Diversity of means of transport

2. Plot system:

- Functional organization: Rectangular plots simplify land use. They improve the urbanization of the district and make it more homogeneous.
- Circulation effect: The hierarchical layout of the plots makes it possible to organize traffic flows, structure roadways and better manage flows in the district.

3. Building system:

- Architectural diversity: Some buildings feature modern architecture and facades, while others are inspired by a more classical style.
- Condition and quality of buildings: All the building of the district in good condition.
- Mixed use: Buildings dedicated to business (offices, head offices) and places for leisure, restaurants and shops.

4. Public spaces:

- Green spaces and public spaces: Presence of a park, and some outdoor spaces in certain projects.

Weaknesses

1. Road system:

- Insufficient parking: The lack of parking lots and parking spaces causes traffic problems during rush hours.
- Traffic problems :
  - ✓ Difficulties in controlling traffic flows during rush hours.
  - ✓ Pedestrian mobility is limited in some parts of the district due to a lack of wide sidewalks.
- Noise pollution: Significant noise generated by heavy traffic and planes.

2. Parcel system:

- Limitations of current organization: The dynamism and fluidity of the public spaces are restricted by the rectangular shape of the plots, which makes them less attractive.

3. Built system:

- Lack of architectural identity: The variety of architectural styles and facades results in an inhomogeneous urban ensemble.
- Building climatic problems: The focus on plot shape in the design process has led to a neglect of building orientation, which reflects an absence of consideration for bioclimatic design principles.

4. Public spaces :

- Insufficient green spaces: There is a lack of landscaped public spaces.

Opportunities

1. Road system:

- Strategic connectivity: Proximity to major national routes (RN24, RN05, and East-West freeway), reinforcing regional and national accessibility.
- Rich mobility: Multiple transportation options: metro, streetcar, train and bus.
- Future development: Opportunity to develop additional roads or widen existing ones to reduce congestion.

2. Parcel system:

- Exploiting strategic nodes: opportunity to create public spaces and amenities at nodes, to make the area more attractive and lively.
- Alignment and visual continuity of plots: opportunity to create building setbacks to create green spaces, which would improve the visual quality of the district.

3. Built system:

- Architectural Diversity as an opportunity: a variety of architectural styles, from modern to classic, and a diversity of architectural volumes and forms, as well as functions, can make a neighbourhood more attractive.

4. Public spaces:

- Improving relations between neighbourhoods: Opportunity to develop green corridors linking existing urban parks to encourage soft mobility.
- Urban parks: Potential for transforming existing parks into multifunctional spaces, integrating playgrounds, sports areas and relaxation zones.

Threats

1. Road system:

- Noise pollution:
  - ✓ Noise pollution due to the proximity of the freeway, rail traffic and air activity (airport).
  - ✓ Constant noise can also reduce the attractiveness of public spaces and buildings for professional use.
- Risk of mechanical densification:
- Road accidents: The large influx of vehicles on the main routes (RN05, RN24, East-West freeway) increases the risk of accidents, particularly at peak times.

2. Plot system:

- Loss of functional balance**:** The development of several plots without prior planning can lead to an imbalance between urban functions.
- Excessive surface area occupied by certain functions: The USTHB occupies a considerable surface area, but its direct impact on the local economy remains limited.

3. Building system:

- The lack of homogeneity in the architecture of the business district's buildings can detract from the district's overall image and weaken its visual coherence.

4. Public spaces:

- Rapid urbanization effect: Rapid, unplanned urbanization limits the presence of landscaped green spaces.
-

Table 20: SWOT crossing. Source: made by author.

	Strengths	**Weaknesses**
Opportunity	**Road system :**Use the hierarchical, multimodal road network to strengthen regional connectivity **Built system:** developing public spaces and improving visual quality. **Plot system:** Promote the architectural and functional diversity of buildings to enhance the attractiveness of the business district. **Public space** :Enhancing Community Interaction and Green Infrastructure	**Road system:** Optimize parking and create green barriers to minimize car noise. **Plot system: The** aim is to take advantage of the setbacks of the parallels to create more attractive, fluid urban layouts, and thus improve the quality of life for residents. **Built system:** Promoting the integration of sustainable development and bioclimatic design principles. **Public space:** Enhance urban voids with structuring landscaping schemes
Threats	**Road system:** Vegetated separations along mechanical lanes should be reinforced to enhance pedestrian security and reduce noise. **Plot system: Ensure** functional balance by implementing integrated planning for empty plots. **Built system:** Define unifying architectural standards that reinforce the neighborhood's visual coherence. **Public space:** Promote the integration of green spaces and outdoor amenities into future urban development projects.	**Road system:** Develop parking lots, vehicle parking areas and public transit Stations. **Plot system: Enhance** the value of large, little-used plots of land, particularly around the USTHB, by introducing complementary functions (shops, services, public spaces). **Built system:** Promote bioclimatic renovation of buildings to unify architectural identity and improve climatic comfort. **Public space:** Planning and developing public green spaces

After cross-referencing the elements of the SWOT analysis, we came up with a global strategy: **to humanize Bab Ezzouar by creating attractive, green and**

multifunctional public spaces, while reinforcing the social mix and architectural identity for a sustainable and inclusive living environment.

3.6. Site analyses:

3.6.1. ***Location:*** *Our site is located to the north-east of the business district, at the intersection of the secondary roads of the district. It also enjoys a privileged view of Skyboard Park.*

3.6.2. Raison for select:

Our site benefits from a strategic location, at the crossroads of secondary roads and an important junction in the district. This configuration guarantees excellent accessibility to the entire area, putting our plot in an advantageous position. What's more, the slower traffic flow around the ronda-point as an opportunity to define our project. This naturally led us to orient the main facade on this side, in order to take advantage of this dynamic, to offer the project greater visibility and to give it a more enhanced image than that of other developments in the business district.

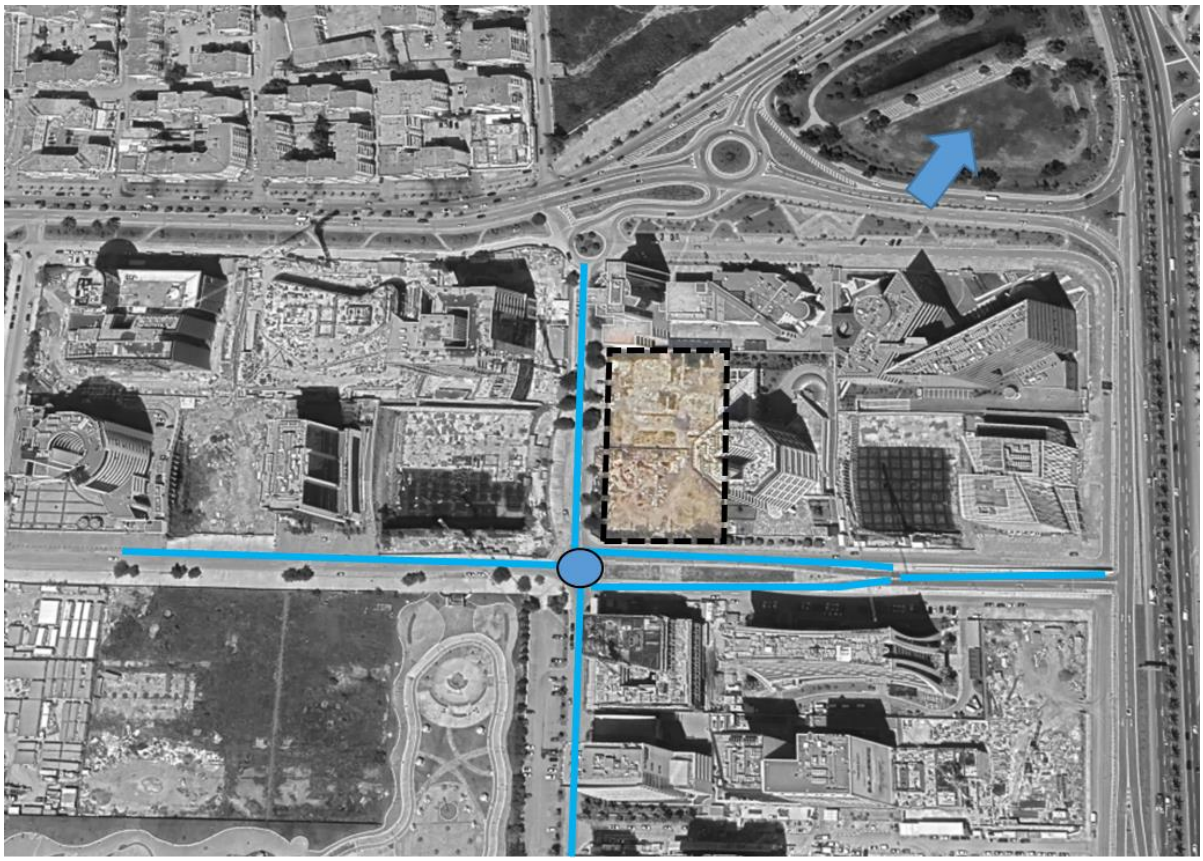


Figure 61: presentation of the site area. Source: google earth pro, modify by author

3.6.3. Site characteristics and geometry

- **Shape**: Rectangular.
- **Surface area**: 6,365.25 m^2.
- **Morphology:** flat terrain.

- **Immediate environment**: Our site is surrounded by administrative buildings with heights reaching R+12 and R+13. On the southern side, there's also a skateboard park.

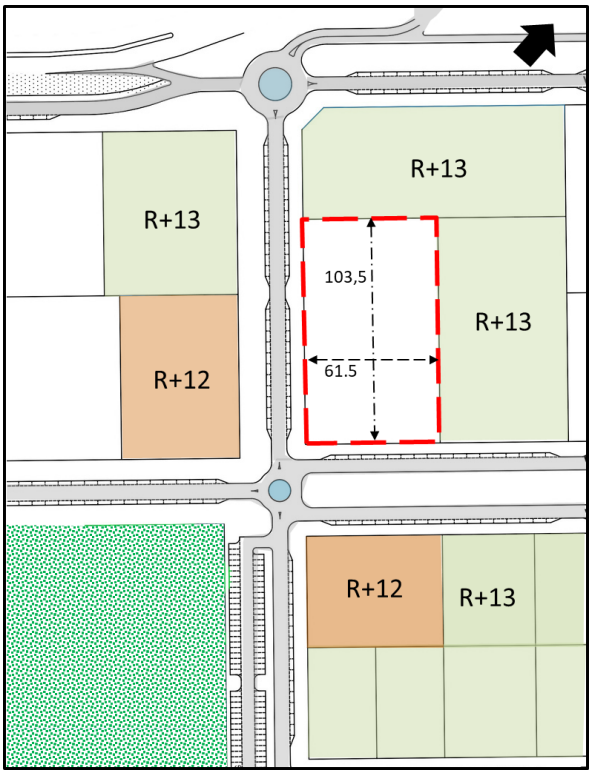


Figure 62: : site characteristics. Source: POS, modify by author.

3.6.4. Climatic analysis of our site:

- **Sunshine:** We present our site's specific solar diagram, showing the sun's evolution from sunrise to sunset over two periods: the short duration in winter, and the long duration in summer. This analysis gives us a better understanding of solar exposure in different seasons.
- **Prevailing winds**: Winds do not strongly affect our site, mainly because of the urban density around it, which acts as a natural barrier. Busy urban planning creates a kind of protection against prevailing winds.
- **Masking effect:** The built-up environment around the site generates a significant masking effect, with the sun shining in mainly from the south, where the park is located.

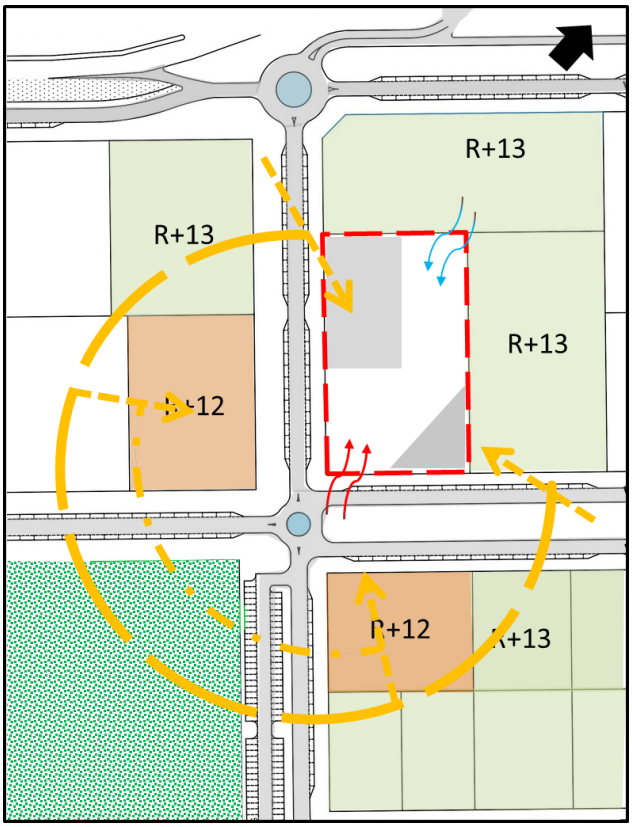


Figure 63: site analyses. Source: google earth pro.modify by authors

*3.6.5. **Intervention phase**:*

In this phase, we cross-referenced the summaries of the overall urban and climate analysis with those of the site analysis, which enabled us to put forward a number of recommendations for the design of our project.

3.6.5.1. Overall summary of the urban and climate analysis

Based on the various systems studied and the sensory and SWOT analyses, several relevant interventions were identified for our site:

- ✓ **Road system:** We proposed accesses adapted to the site, taking into account the major road flows. These accesses are placed at a distance from the roundabout to limit traffic problems and ensure greater safety for pedestrians. And an underground parking lot is also envisaged to reduce the problem of uncontrolled parking on the roads.
- ✓ **Plot system:** A building setback is proposed to preserve the visual continuity of the urban fabric and enhance the attractiveness of the site as a whole.
- ✓ **Building system:** In harmony with the surrounding buildings, the shape of the project follows the geometry of the plots. A rectangular form has been adopted as an initial proposal to ensure smooth integration into both the urban context and the site's climatic conditions. The strategic positioning of the building mass responds to local environmental factors, while a welcoming form oriented towards the park to the south is also envisioned. This orientation aims to maximize natural light and ventilation, while attracting the attention of users and encouraging them to explore the project.

- ✓ **Public space:** Landscaped green spaces are created in the set-back areas defined in the plot system. They act as a filter against hot winds and reinforce the relationship between the building and its landscaped environment.

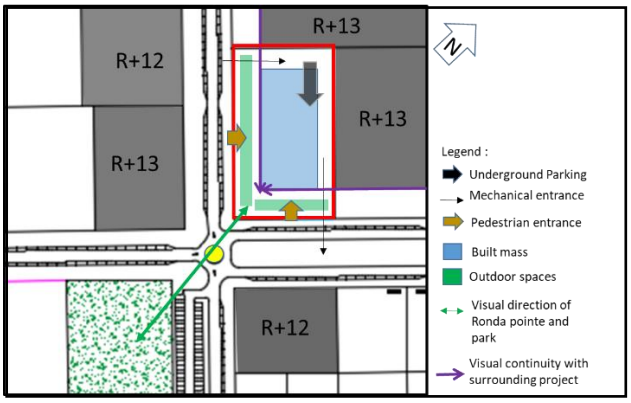


Figure 64: : intervention in the site areas. Source: POS, modify by author.

3.6.6. Fundamental concept of project:

3.6.6.1. Urban and architectural concepts:

- ✓ **Integrating into the urban context through:** (i) the materialization of visual continuity with surrounding projects and the park. (ii) The geometry of the building, adapted to the shape of the plot.
- ✓ **Thresholds treatment** to clearly materialize entrances and mark the transition from public to private space.
- ✓ **Integration of dynamic movements** and a modern architectural language arouses curiosity and brings greater distinction to our project in terms of form, encouraging users to discover it.
- ✓ **Intentional visual framing** of the project within its surroundings, through carefully designed sight lines and perspectives especially from traffic circles, where users naturally slow down or pause.
- ✓ **Humanizing** our project by integrating the human scale, through green spaces, public spaces and lighting effects.
- ✓ **Materialization of the interplay between solids and voids** to maximize the entry of natural light and ventilation.
- ✓ Project design based on the **use of preferential orientations** specific to each space

3.6.7. Program concepts:

- ✓ **The centrality** of the lobby is the structuring element of the project, facilitating the functional organization of the hotel and the orientation of users.
- ✓ The program is based on **the complementarity of spaces**, enabling fluid circulation between the different functions, and minimizing traveler movement.

- ✓ **A hierarchy of accesses:** a main access dedicated to hotel guests, another separate access for business areas, and finally, a separate technical access for employees.
- ✓ **A vertical hierarchy of functions:** public spaces are positioned on the lower levels, while accommodation functions are located on the upper floors, ensuring calm and privacy.
- ✓ **Mastering the concept of "Humanizing the hotel" in program term:** The project is part of an approach to environmental integration: through the creation of green spaces, the opening up of the hotel to its urban environment, and the enhancement of natural lighting through panoramic entrances and generous bay windows. With a view to opening up to the city, part of the program was customized to accommodate a public space independent of the hotel's operations. This space, dedicated to relaxation, leisure or culture, offers a place accessible to all, reinforcing the social and convivial dimension of the project. It also constitutes a strategic strong point for attracting residents and visitors, offering the hotel increased visibility and free publicity. This choice helps to distinguish the project from conventional hotels in the area, asserting an open, inclusive and human architectural identity, consistent with the values of sustainable urban development.

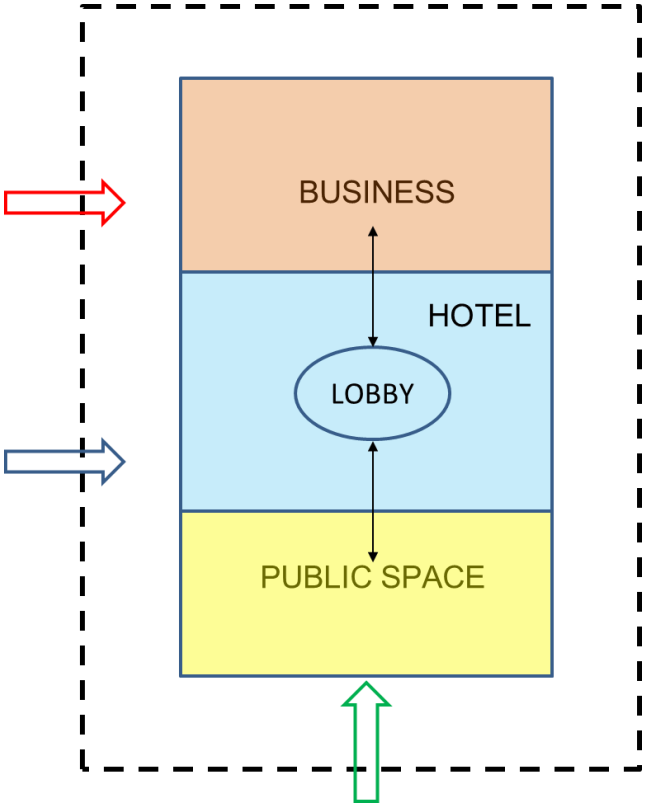


Figure 65: PROGRAM SYNTHESIS. Source: authors.

3.7. Genesis of the form

Based on the overall synthesis of our various analyses (urban, environmental and programmatic), several interventions were identified and translated into site-specific design principles. These elements formed the basis of the design process for our hotel. Following this logic, we developed four primary formal proposals, each incorporating the key concepts previously defined. Each form was critically analyzed, identifying its advantages, limitations and degree of suitability for the site. A comparison between the different proposals was then carried out, in order to identify the fundamental qualities to be retained. This comparative work enabled us to select a final form, which represents the most coherent solution with our overall strategy, in terms of urban integration, climatic response and functional organization.

3.7.1. OUR FIRST PROPOSAL (Centralized compact form):

Our first proposal (as shown in the following illustration) attempts to integrate all the concepts previously discussed in our syntheses. However, it presents several disadvantages, such as: (i) lacks balance between base and shaft. (ii) The base value reduced and lost in size with urban background. (iii)North light problem in "O" form. (v) Not prioritizing favored orientation for views. (vi) No interesting perspective and elevated platform.

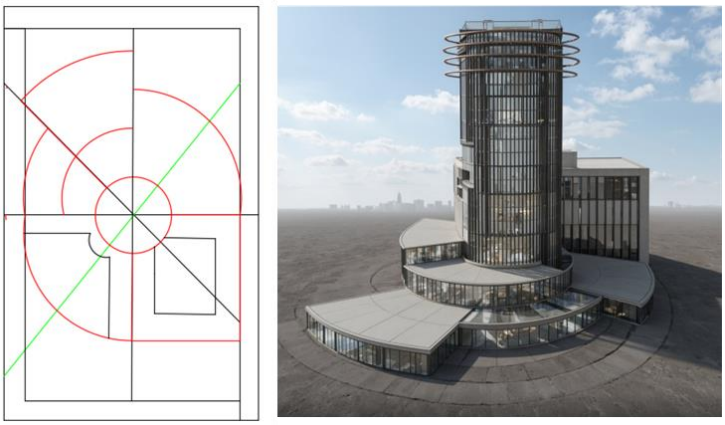
- 

Figure 66: first proposal. Source: made by authors

3.7.2. OUR SECONDE PROPOSAL (Atrium distribution):

This second proposal offers greater visual appeal compared to the first, notably through improved perspectives and the integration of elevated terraces. However, it also presents several disadvantages that ultimately led us to reconsider this option. These include:

- ✓ North façade problem
- ✓ Less rooms in favoured view orientation.
- ✓ Imbalance between base and shaft
- ✓ Considering the background, the public and business entities can be removed and not much lost in richness to the form

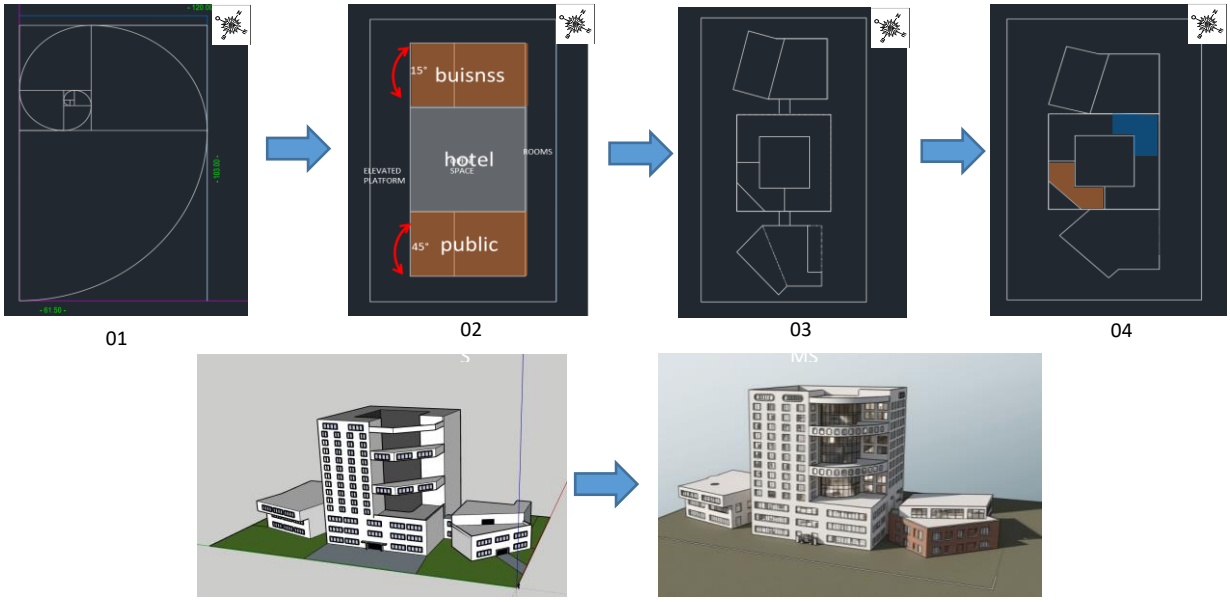


Figure 67: : second proposal. Source: authors.

3.7.3. ***OUR THIRD AND FORTH PROPOSAL (Atrium distribution)****: To fix previous form weakness, tries to develop it further. With solving north problem.*

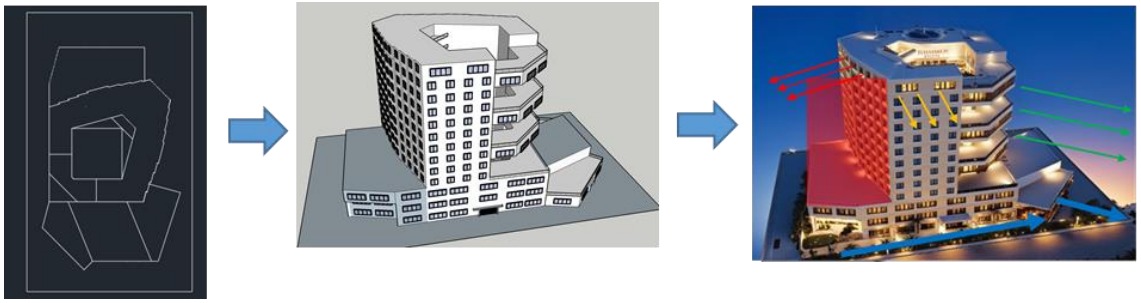


Figure 68: third proposal. Source: authors.

- Another proposal addressing balance between base and shaft.

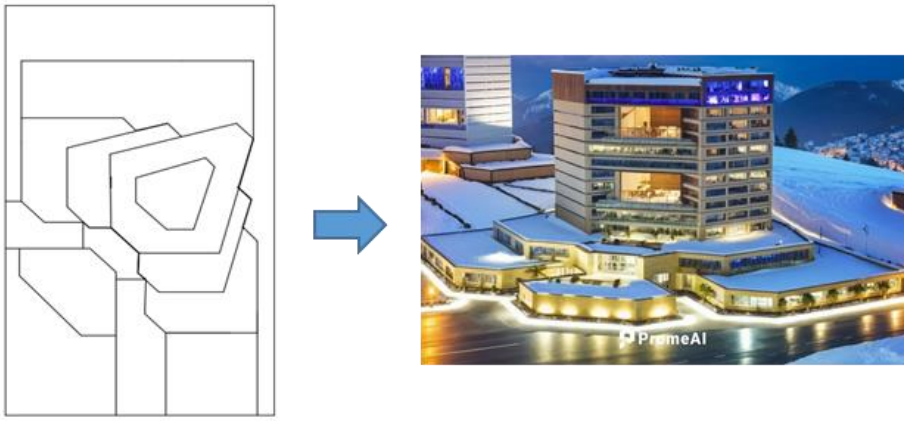


Figure 69: forth proposal, source: authors.

Disadvantages: The design includes large interior spaces, which may pose difficulties in terms of natural lighting and ventilation. And difference in elevation is noticeable and create imbalance.

3.7.4. ***OUR FINAL PROPOSAL (LINEAR distribution):*** *we use the linear block form in this proposal like we see in the following illustration. This form can be adapted to our site condition, and reduce his disadvantage.*

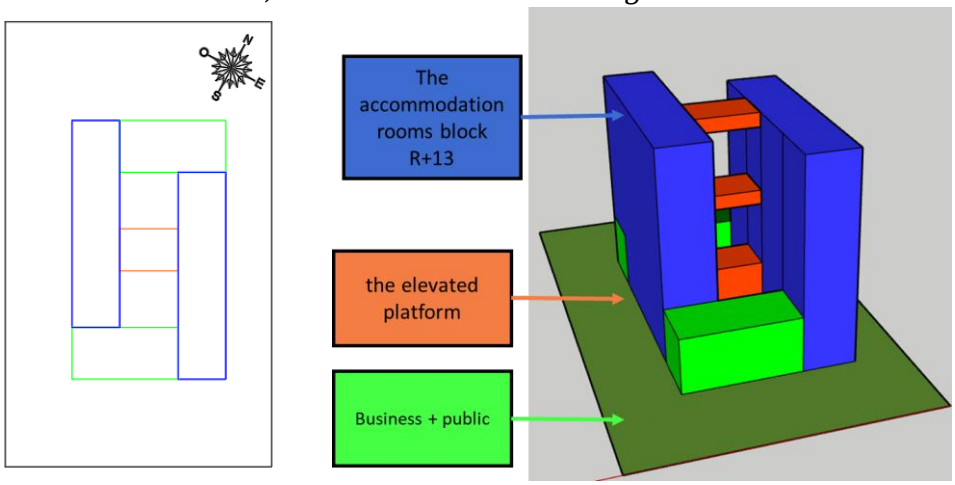


Figure 70: our final proposal (first try).SOURCE: authors

Our first initial drawing in paper, this form presented some weaknesses such as:

- Preferred orientation.
- North façade (naturel lighting in winter).
- Imbalance between the base and the block.

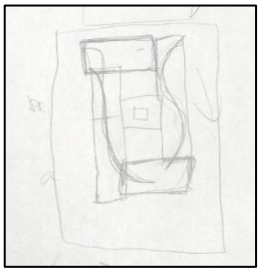


Figure 71: initial drawing. Source: authors

As solution we change the shape of linear block addressing previous weakness.

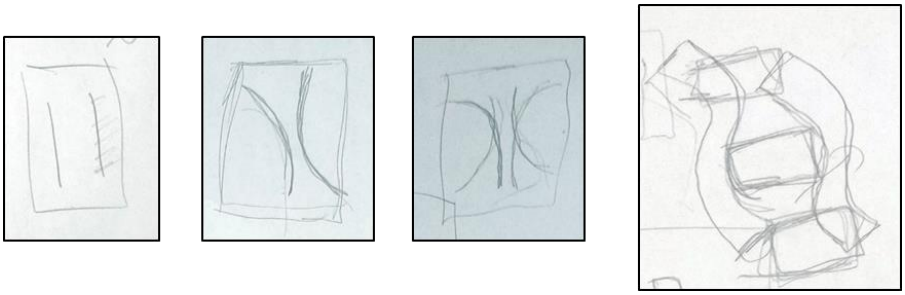


Figure 72: improve the initial drawing. Source: author

Best solution was to transform the linear block with curves similar to shape "S"

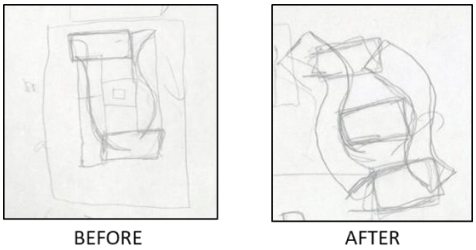


Figure 73: before and after improvement, SOURCE: authors

- **Form geometry evolution :**

✓ Base level

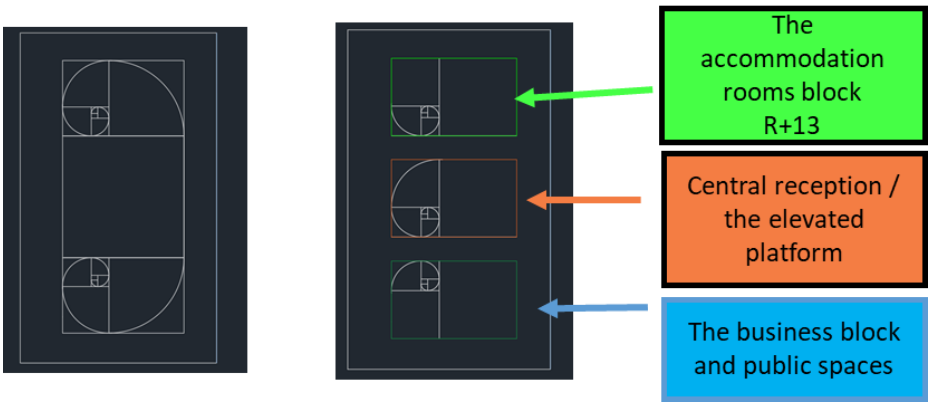


Figure 74: base level geometry. Source: authors.

✓ Shape 's' :

1. Rectangle of the bases used as sample.
2. Adjust the quarter circle base on "a".
3. Diagonal on "A" square.
4. Remove the upper part of the quarter circle of "A".
5. Duplicate the lower shape to create an "S".
6. The upper and lower ends of the block curves can be improved by removing the last quarter circle and extending the centre.

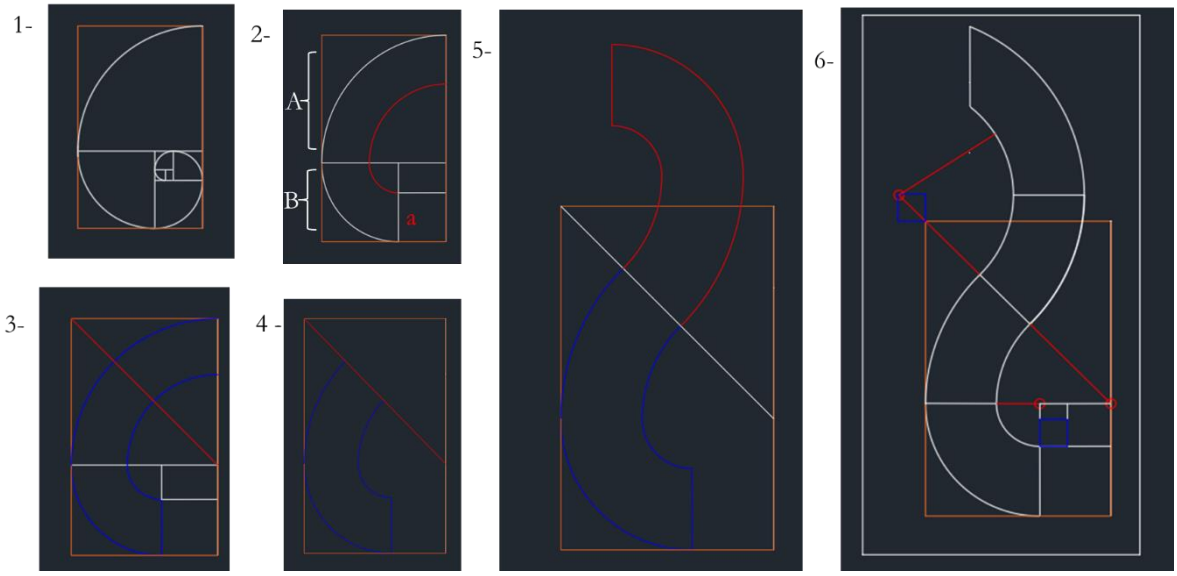


Figure 75: geometry steps of 'S' shape. Source: authors.

After defining the 2D form as a geometric base adapted to the criteria of our site, we moved on to volumetric modifications aimed at balancing and harmonizing the built mass. These adjustments take account of the hotel's main functions, enhance the value

of the main facades through a hierarchy of their divisions, and give particular importance to the main entrance in order to give it a distinctive identity.

- **Initial volumetric form:**

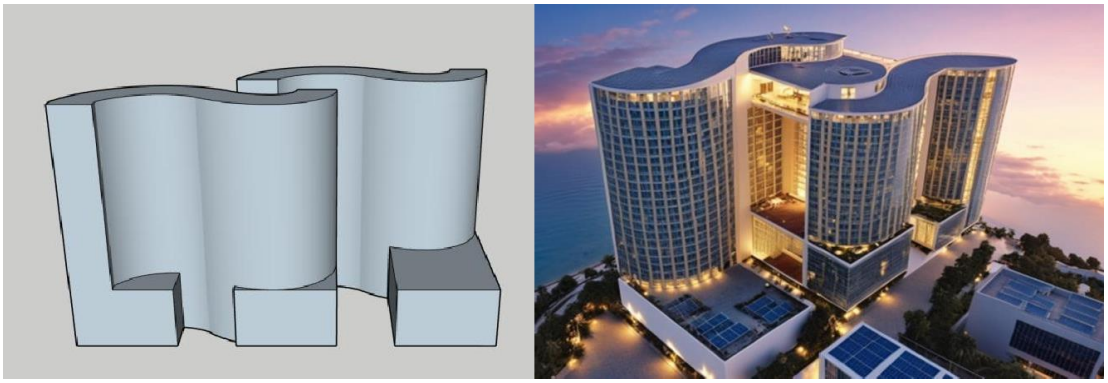


Figure 76: 3D initial form. SOURCE: authors

We've already noted that the "L" shape on the facade was not in balance with the rest of the composition, and that the voids created between the rectangular bases seemed more appropriate for accommodating entrances than the locations originally intended for this purpose.

So we eliminate the rectangle bases in the façade and create a welcoming shape in the entrance as a solution.

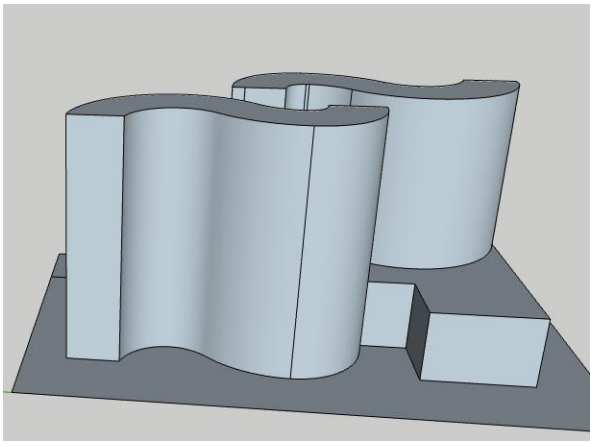


Figure 77: : first treatment of form 3D views. Source: author.

Additional volumes on the first and second floors were introduced to break up the monotony of the “S” shape and better define the entrance at facade level.

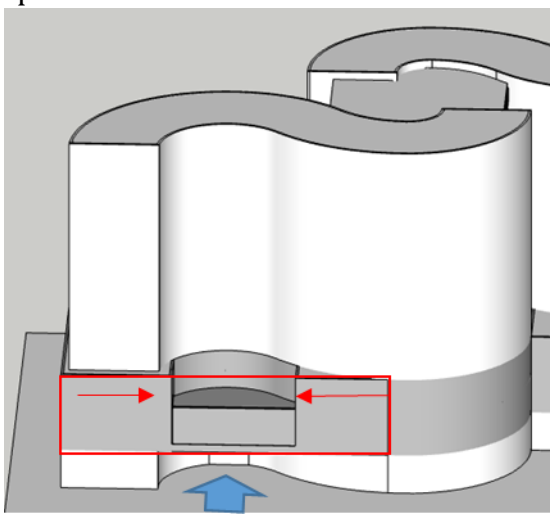


Figure 78: : improve the business entrance. Source: authors.

The main entrance was starting to feel less expressive compared to the one dedicated to the business area. To address this, we proposed softening the right angles of the public volume by making them slightly curved. This approach helps create a more welcoming and visually appealing entrance that stands out more than the business access. In addition, we suggested designing the surrounding public space based on its functions, in a way that enhances user experience and strengthens the identity of this part of the project.

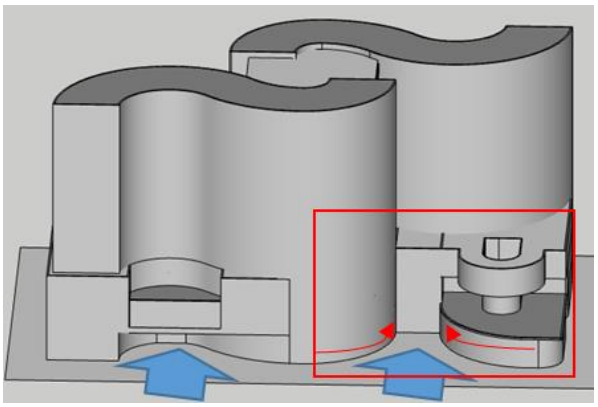


Figure 79: improve the main entrance. SOURCE: authors.

We tried to treat the entrance to the public space better, so that it would be well separated from the hotel's other entrances, and easily recognizable. The idea was to make it more welcoming and pleasant, especially as this space is open to everyone, not just hotel guests. So we thought about its layout in relation to the functions we wanted to use it for.

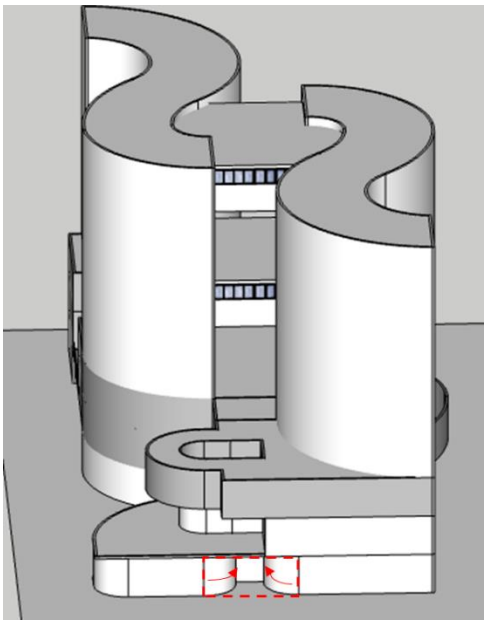


Figure 80: public entrance treatments. Source: authors

3.7.5. Summary of form evolution:

After testing several forms with different distribution systems, we selected the one that best responds to the specific conditions of the site. The evolution of the chosen form is presented in detail, and to better understand its development, a brief synthesis is illustrated in the following figure.

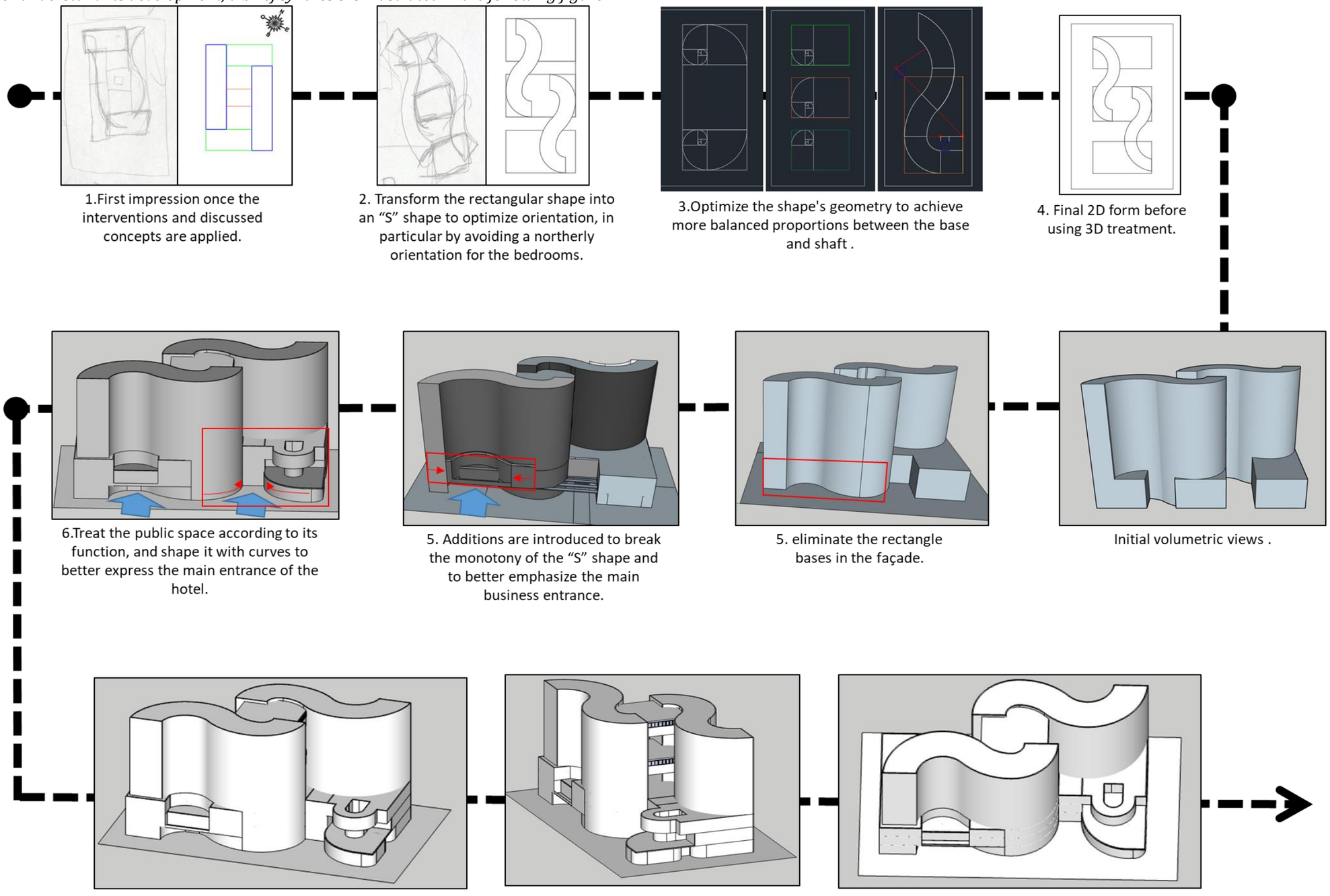


Figure 81: form evolution. Source: authors.

3.8. Balancing visual comfort with thermal comfort using smart envelope.

*3.8.1. **Simulation procedure***

In order to optimize natural lighting and achieve better interior light quality while maintaining thermal comfort indoors without increase of cost and energy consumption on cooling and lighting , we have mentioned in state of art the changeable variables and their effects on the matter using software (**Meteonorm** and **Climate Consultant V6** for site climate data, **Design Builder** for volume and characteristics) we aim to determine the best settings through simulation of multiple scenarios utilizing every changing variable

The simulation for hotel bedroom naturally of north south axe as shown in figure below:

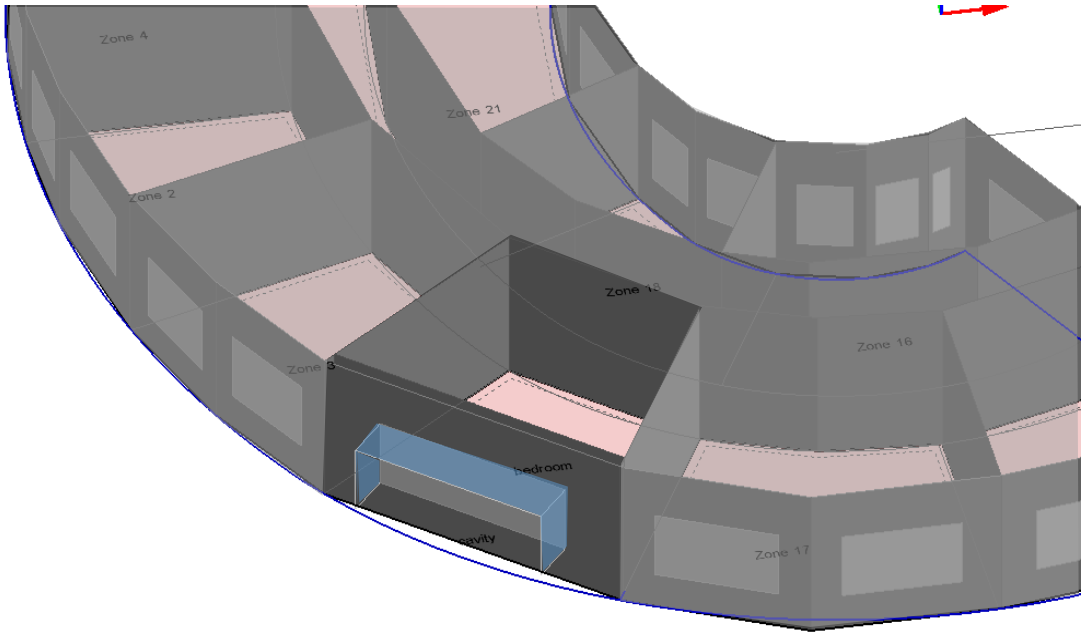


Figure 82: : zone selected for simulation. Source: design builder. Modify by authors.

3.8.1. The input parameters for the simulations

We have 1440 scenarios and 5 changeable options shown in table below ,after crossing each variable forming different set of combinations and giving the results based on cooling and lighting energy usage in order to figure out what's best we need to isolate variables to conclude their effects on results.

Table 21: simulation parameters. Source: authors.

input	variables	N
External wall construction	Double Brick with air cavity (U= 1.2 to 1.6 W/m²·K) Double Brick with (biosourcee) insulation (U ≈ 0.35 to 0.45 W/m²·K) Double Brick with pcm + (biosourcee) insulation (U-value ~0.30 – 0.40 W/m²·K) Double skin facade (U ≈ 0.2 to 0.5 W/m²·K)	4
Window to wall	20%/30%/40%/50%/60%/70%	6
Glazing type	Single blue 6mm (Uw=5.7 – 6.0 (W/m²·K) LT ~87 – 89 % and SG ~81 – 84 %) Single clear 6mm (Uw=5.7 – 6.0 (W/m²·K) Double blue argon 6/13/6mm (Uw=1.1 – 1.3(W/m²·K) Thermometric (Uw=1.0 – 1.2(W/m²·K) Triple blue 3mm/13mm Arg (Uw=1.1 – 1.3(W/m²·K)	5
Site orientation	North / east /south /west	4
Window frame	Fiberglass window frame (with thermal break)	1
Local shading	Side fines + overhang 1 meter Louvre, 0.5m projection + 0.5m overhangs and sidefins No shading	3

3.8.2. Summary of the influential factors for each output

a) Cooling (Electric)

is most strongly influenced by Window to wall %. The input and output are directly related. Increasing Window to wall % leads to increase in Cooling (Electric). Cooling (Electric) is also strongly influenced by Local shading type, Glazing type and External wall construction. Building rotation does not have a notable influence on Cooling (Electric), therefore, this input can be ignored in further analysis of Cooling (Electric) for this model.

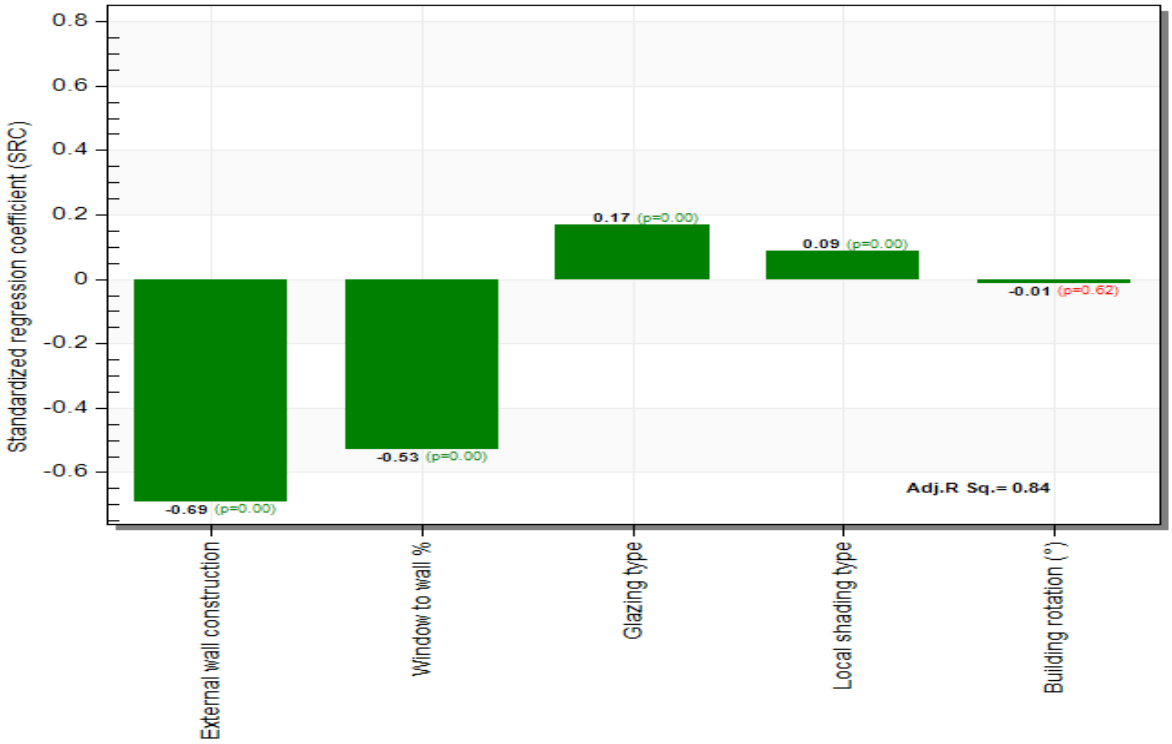


Figure 83: : sensitivity analysis result for lighting energy (kWh).SOURCE: desgin builder.

Standardized regression coefficient (SRC)

(High Importance: **Green**, Medium Importance: **Yellow**, Low Importance: **Red**).

1. **External wall construction**
2. **Window to wall %**
3. **Glazing type**
4. **Local shading type**
5. **Building rotation**

b) Lighting Energy

Most strongly influenced by External wall construction, however there is an inverse relationship. Increasing External wall construction leads to a decrease in Lighting Energy. Lighting Energy is also strongly influenced by Window to wall %. Lighting Energy is also moderately influenced by Glazing type and Local shading type. Building rotation does not have a notable influence on Lighting Energy, therefore, this input can be ignored in further analysis of Lighting Energy for this model.

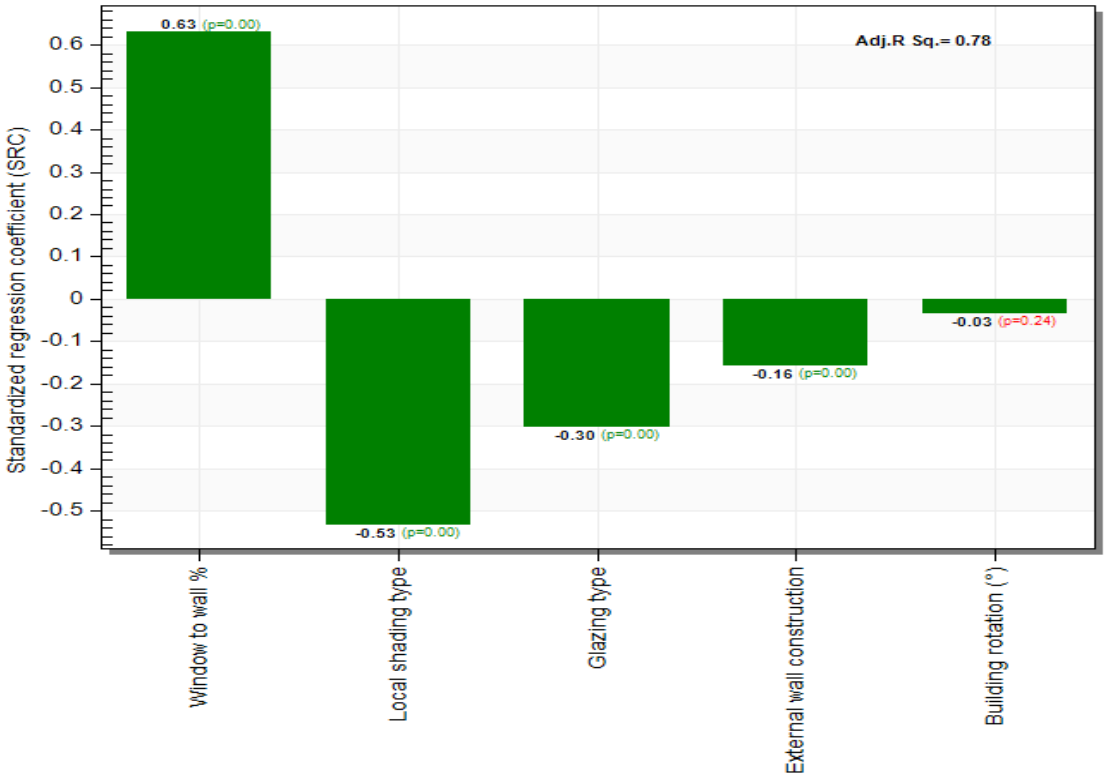


Figure 84: sensitivity analysis result for cooling (electric)(kWh).source : desginbuilder

Standardized regression coefficient (SRC)

(High Importance: **Green**, Medium Importance: **Yellow**, Low Importance: **Red**).

1. **Window to wall %**
2. **Local shading type**
3. **Glazing type**
4. **construction**
5. **Building rotation**

c) External wall Simulation protocol

To be able to conclude which are the best variable we will isolate one variable at time fixate the other variables that may effect and synthesis that particular variable effect based on **Cooling (Electric) (kWh)** and **Lighting Energy (kWh)** performances

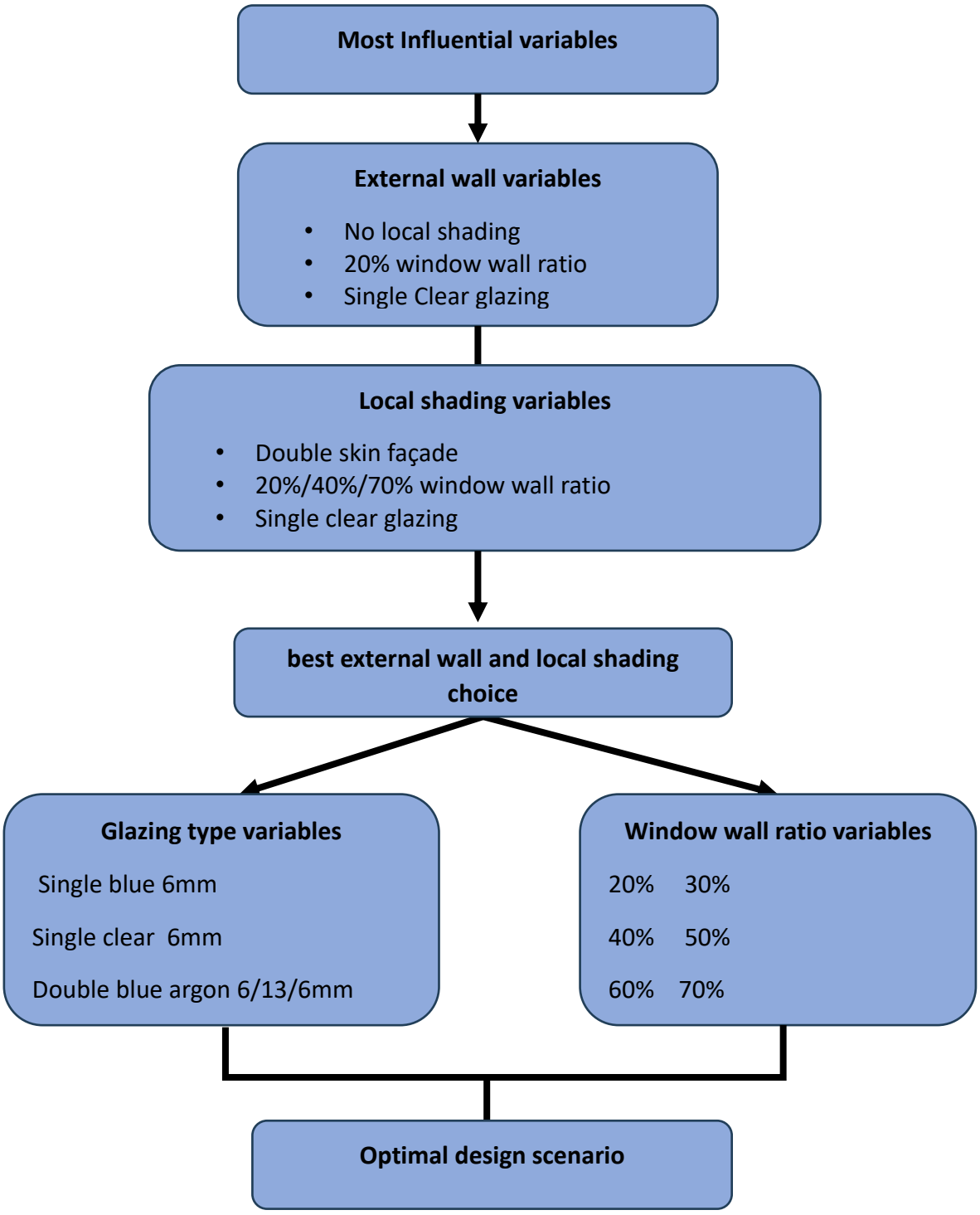


Figure 85: External wall Simulation protocol. source: authors.

✓ External wall

To determine the best external wall choice we isolated the external by fixing other variables that effect the results as the graph in figure () show case Cooling (Electric) (kWh) performance with each external wall option with following fixated variables : (No shading / 20% window wall ratio /Single clear glazing 6mm)

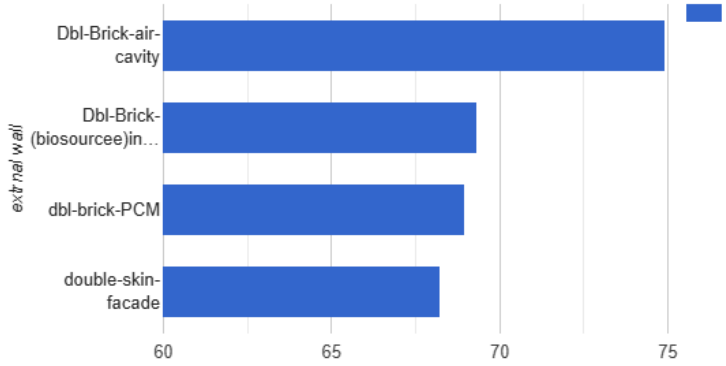


Figure 86: cooling (electric) (kWh).source: authors from desginbuilder.

Conclusion: Double brick with air cavity as insulation is worst preforming and the double skin façade is the best preforming and a noncable 20% performance enhancement.

✓ Local shading options

And for the best local shading option once again we isolated the local shading options No shading / Louvre + overhangs and side fins 0.5m / Overhang + side fins 1m and fixing the other variables that might effect : Single clear glazing / double skin façade the results the graph figure(75) below showcase Cooling (Electric) (kWh) values of the shading options With different WWR percentages .

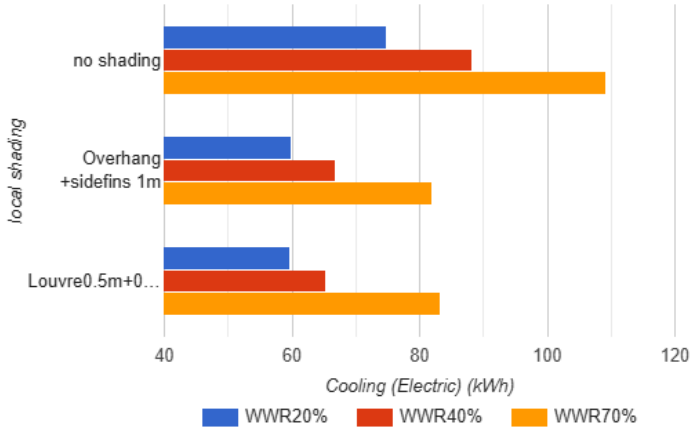


Figure 87: Cooling (Electric) (kWh) values of the shading options with different WWR percentages. Source: Authors based on simulation results.

Conclusion: When applying shading option we see Cooling (Electric) decrease by 25% compared to no shading on all window wall ratio applied.

✓ Glazing type / window wall ratio

Fixating double skin façade with no shading to be able to see the correlation between glazing type and window to wall ratio based on Cooling (Electric) (kWh) and Lighting Energy (kWh) performances.

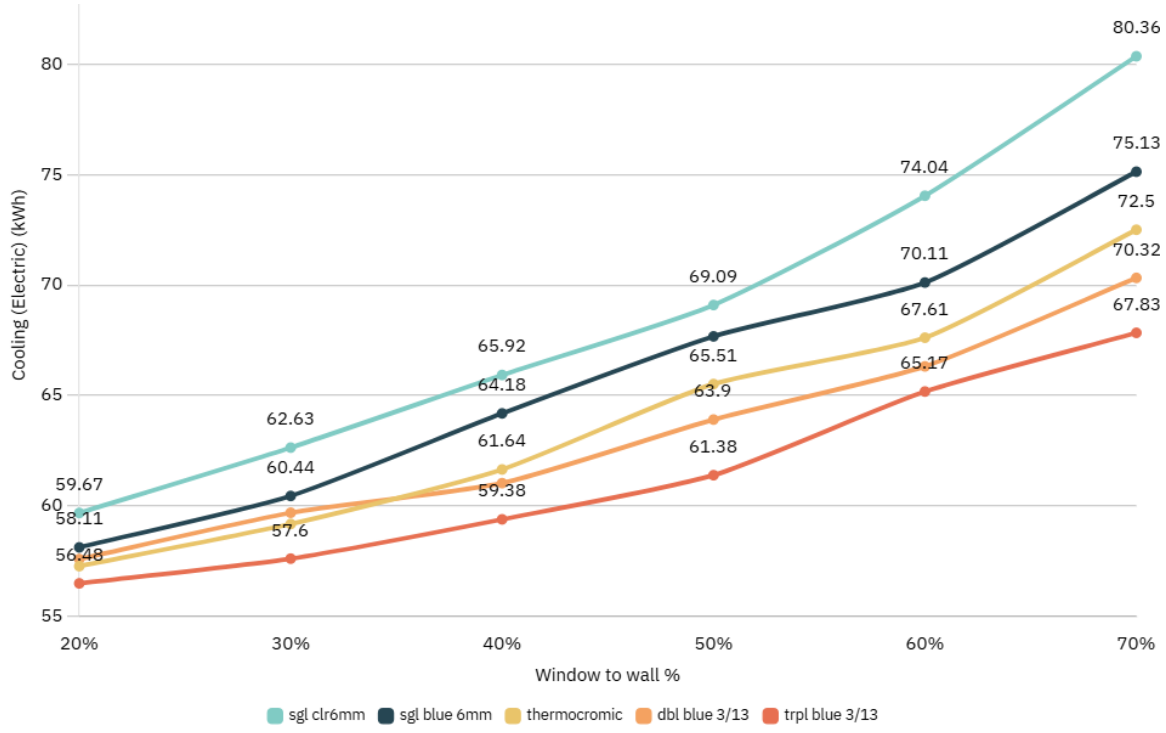


Figure 88: Glazing type/ window wall ratio. Source: desginbuilder, modify by authors.

Conclusion: Triple blue 3mm/13mm Arg out preform other glazing type in every window wall ratio and the single clear 6mm gives the worst performance however we can notice:

1. The more increase in window to wall ratio cooling electricity needed increase.
2. The performance gape widen between (double and triple glazing and thermochromic) and (single glazing) due to absent of insulation gases like argon.
3. When window surface area is small the difference is not noticeable however past 50% all glazing type spike

✓ Lighting energy

Change in lighting energy of different types of glazing based on window to wall ratio in graph of figure (77) below:

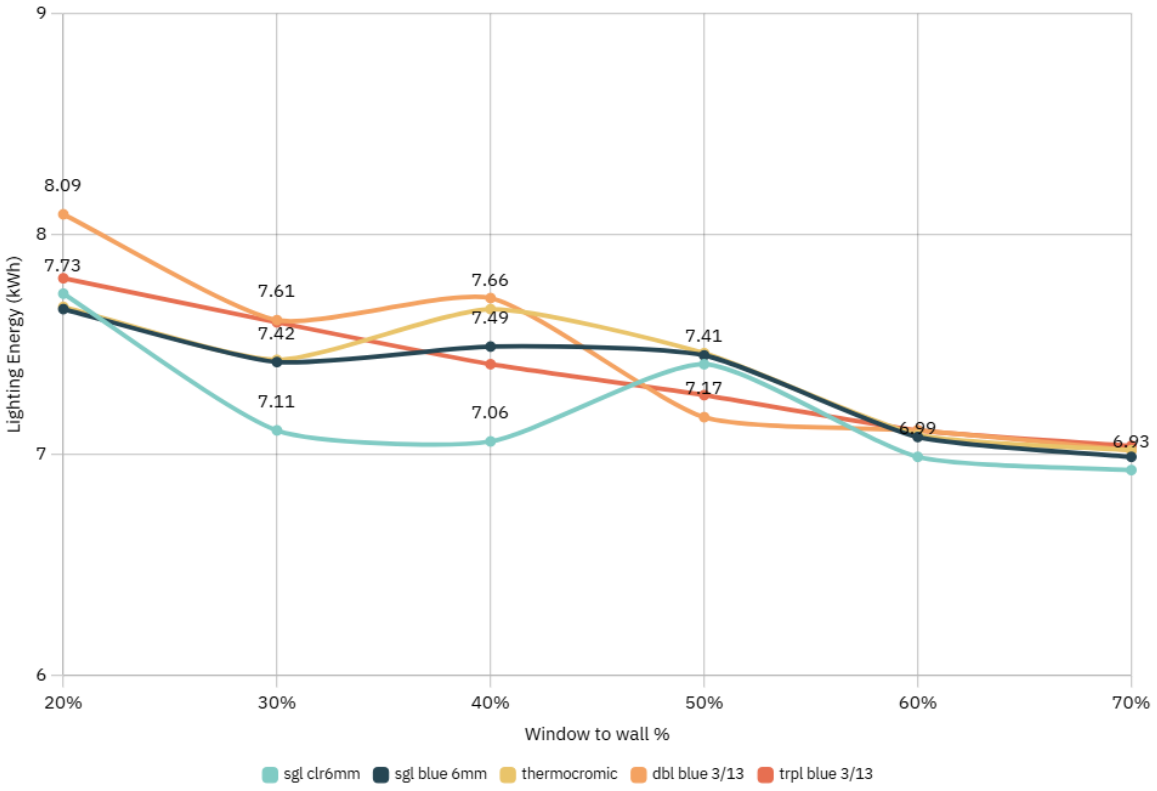


Figure 89: Change in lighting energy of different types of glazing based on window to wall ratio. Source: desginbuilder, m77odify by author.

Conclusion: The contradiction between heating / cooling (thermal gains) and lighting (visible light) .

Is noticeable in Lighting Energy (kWh) :

1) The higher WWR is the less energy required for lighting.

2) Beyond 50% WWR there isn't much improvement.

3) Double glazing in worst preforming.

4) Less thermal insulation in glass mean more visible light transmission.

- ✓ **Comparison between best option variables scenario and basic options**

Table 22: : comparison between best option variables scenario and basic option in glass type. Source: authors.

input	Best case scenario	Basic case scenario
External wall	Double skin facade	Double brick with cavity
Window to wall %	30%	30%
Glazing type	Triple blue 3mm/13mm Arg	Single clear 6mm
Window frame	Fiber glass window frame (with thermal break)	Fiber glass window frame (with thermal break)
Local shading	Side fines 1 meter	No shading

Table 23: Comparison Physical properties of chosen materials. Source: authors.

External wall	Double skin facade	Double brick with cavity	Comparison
Thermal Conductivity (k) [W/m·K]	0.5	0.12	Double-skin has much lower conductivity due to biosource insulation and ventilated gap.
U-value [$W/m^2 \cdot K$]	0.239	1.135	Double-skin provides ~4.7× better insulation (higher R = better thermal resistance).
R-value [$m^2 \cdot K/W$]	$R_{total} \approx 4.18$	$R_{total} \approx 0.88$	Double-skin is ~4.75× more insulating (lower U = better performance).
Specific Heat Capacity (c) [J/kg·K]	850	1000	Similar thermal mass, but double-skin has slightly higher capacity due to biosource insulation.
Thermal Diffusivity (α) [m^2/s]	0.5×10^{-6}	0.2×10^{-6}	Double-skin heats up slower (better thermal lag).
Emissivity (ε)	0.9	0.7	Double-skin radiates less heat (better for cooling).
Density (ρ) [kg/m^3]	1700	500 - 800	Double-skin is lighter due to biosource insulation.
Solar Reflectivity	0.4	0.5	Double-skin reflects more sunlight, reducing heat gain.

Conclusion double skin façade thermal properties are better the basic double brick cavity wall in all aspects however it cost more

Table 24:: comparison between single clear and triple blue glazing. Source: author

Glazing type	Single clear 6mm	Triple blue 3/12	Comparison improvements
SHGC	0.588 higher than 0.8	0.438	-25.5% (Less solar heat gain)
Direct solar transmission	0.482 higher than 0.8	0.340	-29.5% (Less direct heat entry)
Light transmission	0.534 I think 0.8-0.9	0.467	-12.5% (Slightly less daylight)
U-value ($W/m^2 \cdot K$)	6.121	1.512	-75.3% (Best insulation metric)

Conclusion The triple blue 3/12 glazing is better on all aspects only less daylighting which is good as it protect for the glare

- ✓ **Comparison of daylighting performance in space 21 JULY at noon hour**

Table 25: Comparison of daylighting performance in space 21 JULY at noon hour. Source: author.

indicators	Worst scenario	Best case scenario	results
Cooling (Electric) (kWh)	81.67	58.24	29% reduction
Lighting Energy (kWh)	7.63	7.31	No improvement as this indicator is related with WWR
Average Daylight Factor (%)	7.087	3.546	Based on EN 17037 (EU) DF avg ≥ 2%, Sustainable buildings
Minimum Daylight Factor (%)	2.417	1.387	Minimum df is low for standard but its suitable for bedroom
Maximum Daylight Factor	27.634	10.456	5% – 10% Excellent daylighting Anything beyond 10% can cause overheating
Uniformity ratio (Min / MAX)	0.87	0.6	0.5 – 0.7 Good uniformity
Min Illuminance (lux)	238	102	Minimum lux reduction that meet with space need
Max Illuminance (lux)	2721.8	764	Glazing type and shading in best case scenario reduce significantly the glare that was passing before

3.8.3. General conclusion of simulation:

The scenario with best variables synthesized from the analysis upgrade the indoor quality significantly specially on thermal aspect regulate overheating and risk of glare and this because the glazing type external wall superior thermal priorities and local shading for glare passive control this certainly reflect on energy cost used for cooling and heating

More over the visual comfort standards has been met while improving the thermal comfort the WWR is kept at 30% as it satisfy the visible light needs both in daylighting factor uniformity ratio and glare risks and follow the regulation based on space surface area .

3.8.4. Passive shading simulation

In order to decide what passive shading to apply using facade manipulation we need to understand its effect, we took cafeteria 165m^2 as space to analyze passive shading of 0.5 over hang and 0.5m side fines of 0.1m thickness in each window opening using exterior glazing placement within the wall.

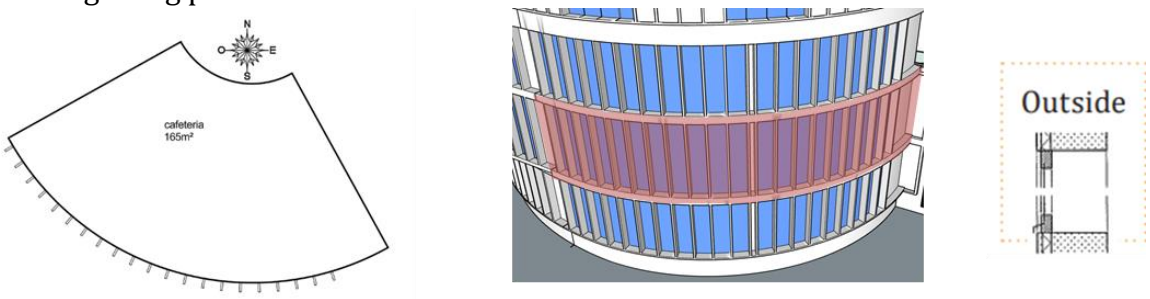


Figure 90: Cafeteria plan & facade. Source: authors

The surface of the exterior wall of cafeteria is 95.32 m^2 with curtain wall glazing the window to wall ratio stand at 93% near 100% ,however when the side fines applied to the facade the window to wall ratio reduced to only 77.6% with glazing occupy 74m^2 of exterior wall.

The sun altitude change based on time in day and day/month of the year, in summer=76.52° in autumn/spring= 53.22° and winter =29.77°.

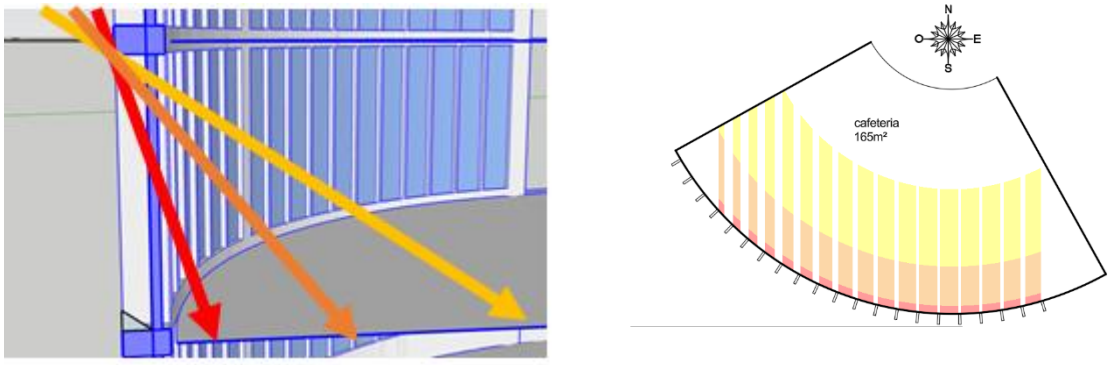


Figure 91: direct sunlight projected on surface floor. Source: author

in summer only 23m^2 of 74m^2 glazing meaning 32% of glazing under direct sunlight, 0.3m direct sun light into surface floor and can accounted as 0 if we count the exterior wall thickness in autumn and spring 34m^2 of the 74m^2 glazing which translate to 46.6% have direct sunlight and project 2.26m inside the space, covering 29m^2 of the 165m^2 cafeteria.

In winter 38m^2 of 74m^2 about 52% glazing surface receive direct sun however the low sun project direct sun light into space by 5.96m covering 76m^2 of the 165m^2 making it 46%.

✓ Conclusion:

We regard these results as positive the space in summer is well shaded no risk of glare the facade and glazing receiving direct sunlight has been reduced which minimize the overheating and for the winter where temperature drop below the comfort zone the sun exposer projecting into space becomes passive heating achieving all this while minting 74% of window to wall.

3.9. Architectural aspect:

3.9.1. The structure:

We opted for a lightweight metal structure that allows for large spans. This structure is combined with collaborative slabs that support the loads.

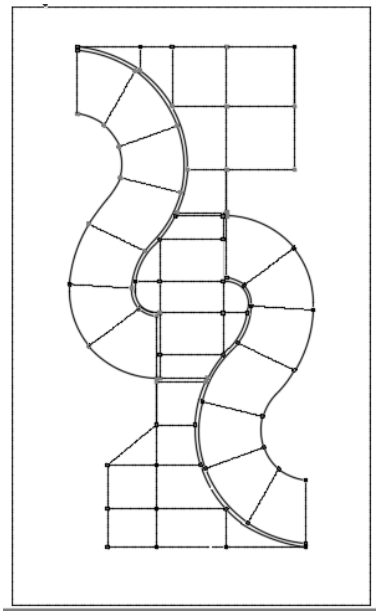


Figure 92: structure plan. Source: authors.

Regarding fracture joints, we incorporated one to separate the "S" shape from the rest of the building because this part is taller than the rest. And used another fracture joint to support the raised terraces.

From the third floor to the top floor, the existing metal structure mainly supports vertical loads. However, Vierendeel beams have been incorporated into the form of partitions in certain strategic spans to provide horizontal bracing as well. Rigid frames (column-beam assemblies with rigid joints) complement this system, contributing to the structure's overall stability against horizontal loads.

3.9.2. Façade:

In form evolution of our hotel, we took into consideration the main divisions of **Tripartite façade** (the base, the shaft and the crown), trying to give each part a different treatment according to its function and importance in the architectural expression.

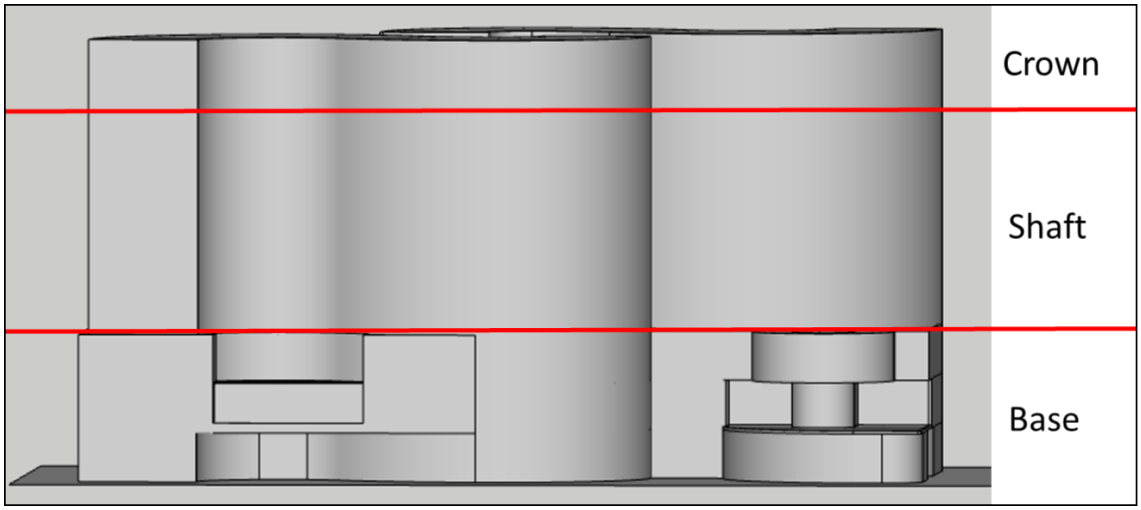


Figure 93: facade treatment. SOURCE: authors.

3.9.2.1 Facade Composition:

- **Key Concepts:**
  - **Transparency:** Ensure unobstructed panoramic views from above and strengthen the relationship between the interior and exterior on the lower floors to create a more positive perception of space.
  - **Horizontality and verticality treatments:** Creating hierarchy and guiding the eye.
  - **Controlled repetition**: This creates visual harmony and reduces the cognitive load of the façade elements.
  - **Adaptation to the climate through sun protection:** This ensures thermal comfort while adding an aesthetic touch.

- **Façade description** (see annexes):

The façade is composed of three main sections: **the base, the body, and the head**. Each section has its own design to ensure the composition is easily understood.

- **The base:** It is treated with great transparency to symbolize accessibility and welcome, as well as the strong link between the interior and the surrounding urban context. The repetition of glazed modules creates a visual rhythm that structures the façade and emphasizes its horizontal design. Integrated sun protection ensures thermal comfort and plays an aesthetic role, contributing to the building's overall elegance.

- **Shaft:** A moderate level of transparency differentiates the internal functions, which are mainly dedicated to accommodation. The interplay between opaque and glazed surfaces gives rhythm to the façade, reducing monotony.

- **Crown:** Maximum transparency evokes lightness and elegance. It benefits from abundant natural light and unobstructed views.

General conclusion

4. General conclusion

4.1. General conclusion:

For our Master's 2 thesis in the architecture technology program, we selected the city of Bab Ezzouar for our study, focusing specifically on its business district. This choice is explained by the district's importance on a national and international scale, as well as its strategic role and strong image in the Algerian landscape.

Through studies and site visits, we acquired in-depth knowledge of the district. We also selected this area because of its historical and cultural richness and because it is the economic heart of eastern Algiers. Bab Ezzouar stands out for its strategic location, connectivity with neighboring municipalities, and proximity to the airport. These factors reinforced our conviction that Bab Ezzouar was the right choice compared to other options. Furthermore, the presence of a rapidly developing business district with high-value projects positions Bab Ezzouar as a major future business destination in Algiers.

Through our analyses of the business district, we identified an overall strategy that informed our design approach. The city's historical evolution shows that Bab Ezzouar is the result of development policies implemented after independence to meet the growing need for housing.

A typomorphological analysis of the city enabled us to better understand the four systems of the business district and identify the characteristics of each. Thanks to the SWOT analysis, we classified the key elements according to their strengths, weaknesses, threats, and opportunities and cross-referenced them to develop an overall strategy based on humanizing the district and creating a more human-centered way of life.

After gathering these elements, we expanded our study to a finer scale, focusing on the site itself. Through an urban analysis and cross-analysis of the various elements, we identified intervention strategies that guided our project.

Our response to this strategy was an architectural design that considered the site's specific features, users' needs, and sustainable development challenges.

Our project selection was based on our research into tourism, specifically business tourism, and its development prospects in Algeria. We concluded that an eco-friendly business hotel could attract visitors to Algiers. Our urban analyses and in-depth knowledge of the Bab Ezzouar business district reinforced this choice.

Our project is grounded in targeted research on the concepts of hotels and businesses to understand the specific needs of business visitors. Analyzing real cases enabled us to identify the organization, program, functions, and allocation of spaces in a business hotel. This gave us a comprehensive and coherent vision of the project.

These studies also revealed that hotels are among the world's biggest consumers of energy. This prompted us to address visual and thermal comfort to limit electricity consumption and reduce air-conditioning losses.

4. General conclusion

Finally, our business hotel is eco-friendly, designed on a human scale, and attentive to the needs of its guests. It is carefully designed to be an attractive business destination. Its program has been carefully designed to meet the specific expectations of this audience.

In conclusion, we hope to have covered all the important data necessary for this project. We aim for this project to promote the development of business tourism in Algeria and the Bab Ezzouar business district while fostering environmental respect. We hope it improves the national and international image of Bab Ezzouar and its business district and becomes an essential business destination.

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ANNEXE :

6.ANNEXE :

- **Analyzing examples is a key part of understanding business hotels. It helps us understand how they operate, how their spaces are organized, and their environmental impact. In Chapter 2, we presented each hotel and conducted a general analysis. However, certain equally important elements deserve further exploration in this section.**

a. AVASA BUSINESS HOTEL : Based on the analysis of the plans and the organization of the spaces, as can be seen in the following figure:

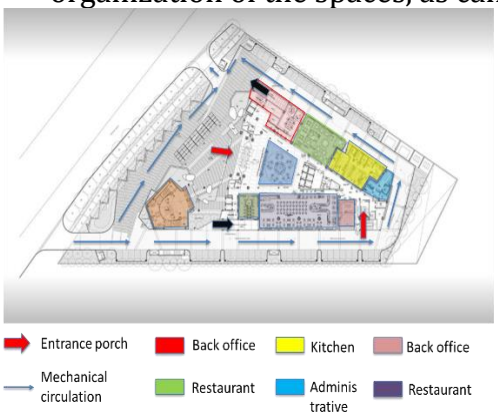

Figure 94Ground floor. Source: arch daily, modify by author

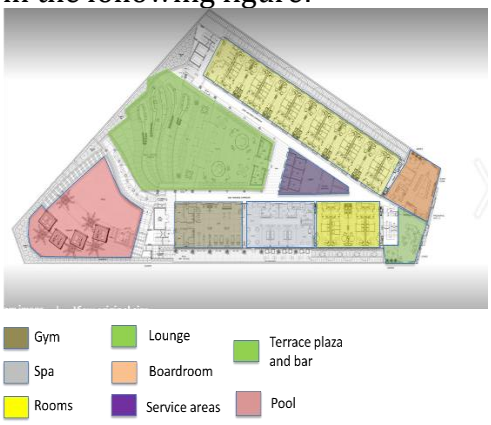

Figure 95:: first floor. Source: arch daily, modify by author

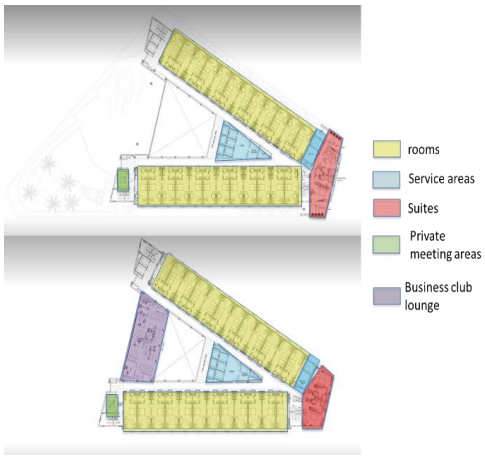

Figure 96: second and third floor. Source: archdaily.modify by author

Figure 97: 4th & 5th floors. SOURCE: arch daily, modify by author

- The layout of the Avasa Hotel is based on a hierarchy of public, semi-public, and private areas. The upper floors are designed to offer greater privacy. We noticed that the rooms make up the largest part of the hotel, and the overall design follows this logic by adapting to their needs.
- **An eco-friendly approach:** The Avasa Hotel stands out for its eco-friendly and energy-efficient design, surpassing the standards of traditional hotels. It incorporates passive techniques, including: Stepped terraces, which maximize natural light and ventilation on the upper floors. A patio connected to the ground floor (GF), promoting the chimney effect for better use of natural ventilation. The following figure illustrates these principles for a better

understanding:

Figure 98: sections. SOURCE: arch daily. Modify by author

- The architect designed these terraces in tiers around a central open patio. This patio connects several levels of the hotel, creating: A high-end leisure area incorporating luxury elements (premium lounge areas, sky bar) and remarkable visual perspectives (panoramic views of the surroundings).

Figure 99: sections. SOURCE: arch daily. Modify by author

In summary, the Avasa Hotel is a leading business hotel capable of becoming a preferred destination for professionals. The hotel's strengths include an intelligent distribution of functional areas, spaces adapted to professional and leisure needs, an eco-friendly design in harmony with nature, and a particular focus on well-being and personalized comfort.

6.ANNEXE :

Sheratone Annaba business hotel :

The hotel offers a spatial **layout centered around a central core**—a common area surrounded by functional zones. To optimize sun exposure, the architect designed a specific layout that avoids exposing the rooms to the north, adapting the shape of the building to the sun's orientation. See figure below:

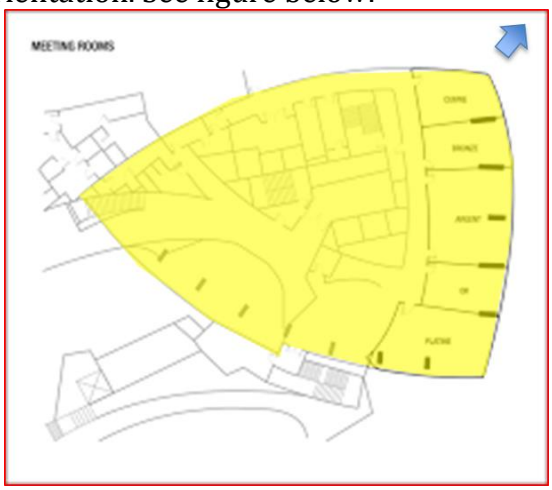

Figure 100:tower shape. Source: fabrispartners

- ✓ **As part of an environmental approach** aimed at reducing the project's energy consumption, an optimized orientation towards solar gain is favored in order to improve thermal comfort in winter. The building is equipped with double-skin facades and smart glazing, which also help to maintain a good level of comfort in summer.

Figure 101: Sheraton Annaba hotel. Source: fabrispartners

6.ANNEXE :

a. Hyatt Regency Pune and Residences

The hotel's layout adopts a radial organization, centred around a main lobby connected to several secondary lobbies leading to different functional areas. When there is a change in function, a transition space—often in the form of a secondary lobby—facilitates this transition. This system improves the clarity of the design and makes circulation more intuitive and fluid for users.

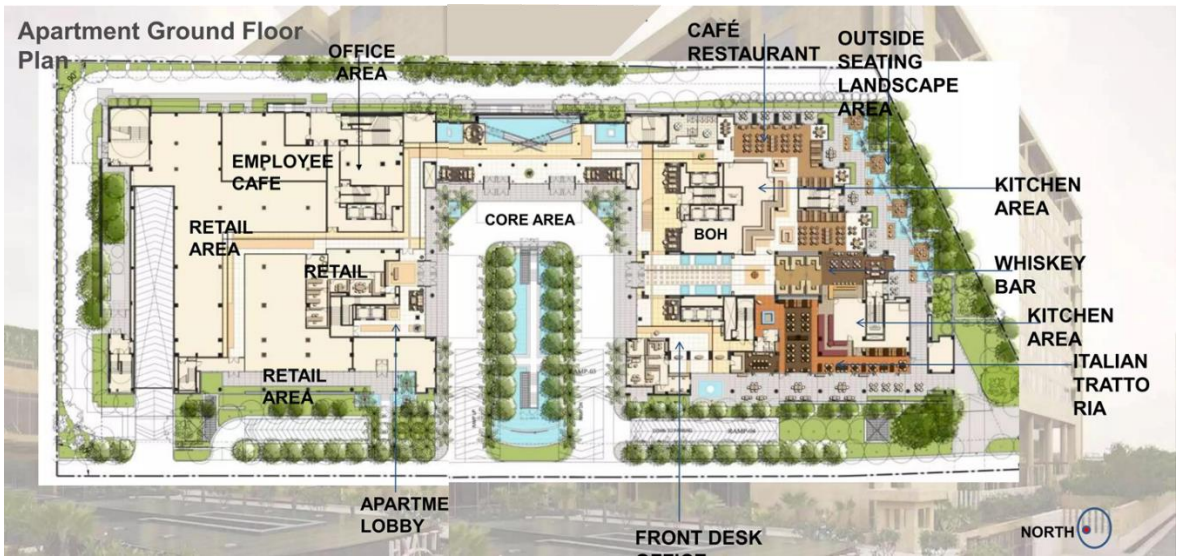

Figure 102: grouand floor plan. source: Shubh Mandal.2022, modify by author :

✓ **Hierarchy on Ground floor level**

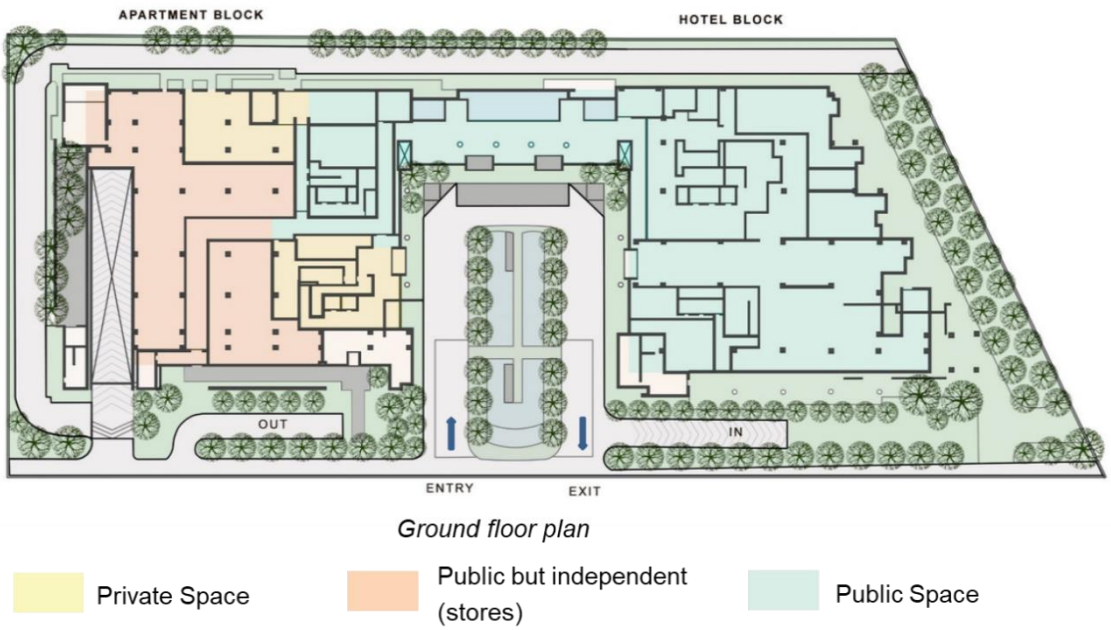

Figure 103: : ground floor plan. Source: Shubh Mandal.2022, modify by author :

6. ANNEXE :

The layout of the hotel rooms combines a linear L-shape with a main corridor providing access to the units.

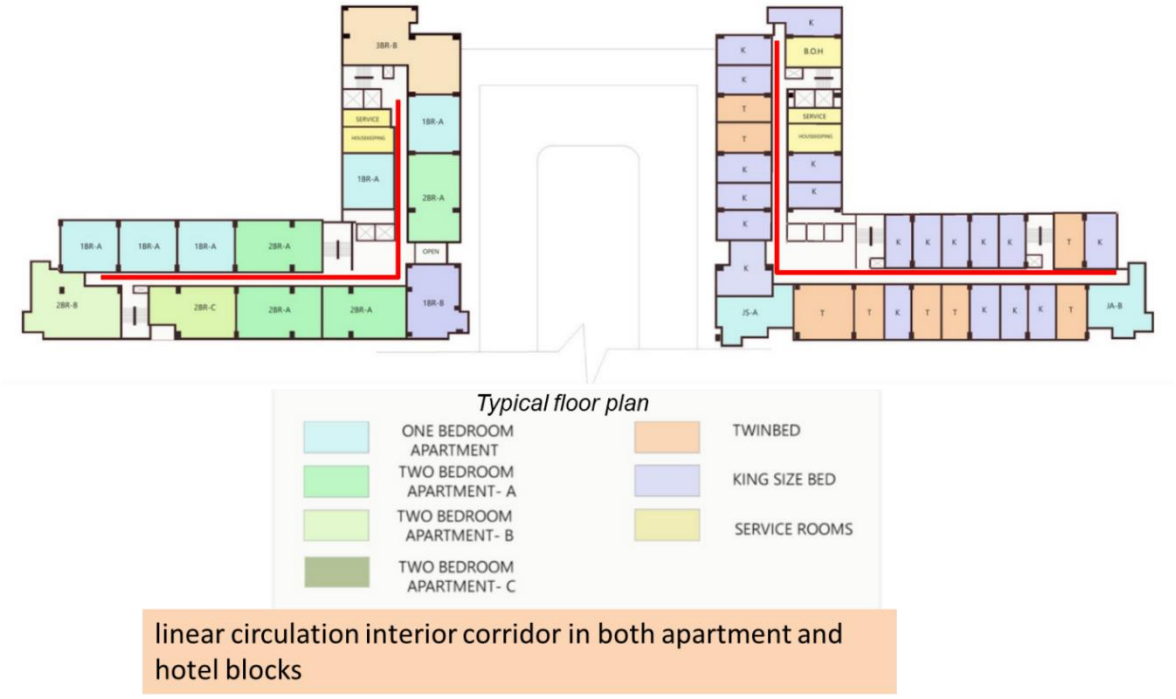

Figure 104: ground floor plan. Source: Shubh Mandal.2022, modify by author

In conclusion, this project incorporates all the details of the interior spaces and their architectural elements, giving us a better understanding of how the whole complex works. It also demonstrates a good grasp of the hierarchy of functions and the overall organization of the hotel.

✓ Summary of the examples analysed:

We studied three different hotels, each with its own architectural characteristics. Despite their differences, there are common steps in the design of a hotel:

First step: define the shape and layout of the rooms taking into account several essential criteria:

- Ensure optimal orientation to enhance the desired views;
- Avoid north-facing facades, which often lack natural light;
- Ensure good natural lighting in all spaces.

The layout of the rooms directly influences the overall shape of the building. There are three main types of layout:

Linear layout: the rooms are aligned along a single corridor, promoting simplicity and efficiency.

6.ANNEXE :

Centralized layout: rooms are organized around a central core, often used in high-rise hotels to optimize space.

Atrium layout: rooms are arranged around a central open space, creating a unique interior atmosphere.

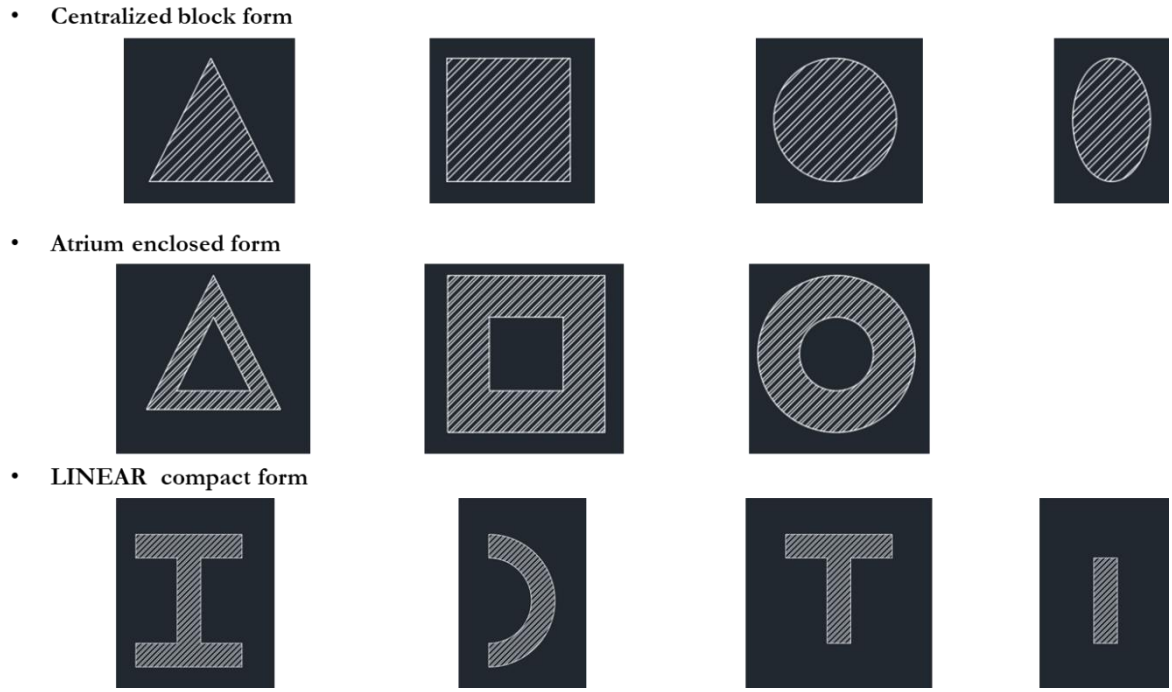

Figure 105: different the shape and layout of the rooms. Source: author

Given that the accommodation function occupies the largest area and directly translates into volume, its form becomes paramount and is generally the starting point for architectural design.

- ✓ **In form evolution:**

We applied the three types of room distribution on our site—linear, centralized, and atrium—in order to evaluate their advantages and disadvantages. Each configuration was tested according to the constraints and opportunities of the site.

Following this comparative analysis, we opted for the linear system, as it best suits the morphology of the terrain while offering the maximum number of preferred orientations available on the site.

- ✓ **General syntheses form example analyses:**

In the tables above, we have presented all the necessary and recommended data, derived from an in-depth and detailed analysis of each example studied.

6.ANNEXE :

Table 26: example analyses globale syntheesis

concept	SUMMRY
Urbain scale	
Percentage and occupance ratio (ces/cos/cbs)	• Percentage of built in area depend on regulations (60%) • the building is surrounded by vegetation and occupy about 10% • Outdoor planning (vegetation/water surfaces)linked with public functions
Accessbility	• Access points correspond with city mechanical and pedestrian flow and there is 4 type of accessibility : 1- mechanical into underground parking 2- mechanical/pedestrian (shape U) into main lobby 3- Pedestrian (public area) 4- pedestrian staff and workers backhouse access
implementation principles	• absence of alignments • building mass backed up from plot perimeter • fire truck accessibility within the plot around full perimeter • When the project is fully intact the central mass of the building is located near center of plot
Architecturale scale Formale aspect	
Project Idea	variety in adapted architecture style and their principles aesthetically and formerly of it support
Bioclimatique answers in form	• from that correspond with urban and climate situation • assure natural ventilation (tower vents) • maximize natural lighting with form manipulation • wind protection when necessary
Façade treatment	• hotel architecture facade treatment composed of 3 distinct sections "tripartite architecture " 3sections are • BASE 20-30% /SHAFT 60-70%/CROWN 10-15% and express different functions and distinguished by: 1-Change in formal mass 2-Texture and decoration or openings types and shape 3-Rhythm and repetition 4-Contrast with Difference in percentage of filled/vacant façade - Filled percentage BASED > CROWN > SHAFT

6.ANNEXE :

Architecturale scale <u>Functional aspect</u>

spatial distribution system	• Relation between Principle functions (reception /business/ restauration/accommodation-exclusive amenities) • hierarchy of principles function • Radial distribution system and the main lobby its starting central point • Public -> semi-private -> Private and exclusive with Linear circulation between function • vertical circulation within the same principle function • vertical circulation in, check points (lobbies /hallways) in change of hierarchy , to respect same radial layout in upper floors • Strategic placement of vertical circulation in each evacuation zone(isolated from source of ignitions) as countermeasure of fire spread
spaces Detailed characteristic	• **<u>Accommodation</u>** : ✓ has housekeeping space for maids in each floor and back office • **<u>Lobby (reception)</u>** ✓ Each lobby has vertical circulation point and either One main lobby or secondary lobbies all connected • **<u>Restaurants :</u>** ✓ include secondary spaces which is cuisine/boh/storage ✓ the cuisine is isolated from restaurant with double wall hallway that preserve the smell and control the fire from spreading • **<u>Administration :</u>** ✓ there is 3 administrations for each major function (business/accommodation/services) either grouped or distributed
programmation factors	**<u>Restaurants</u>** In restaurant design, the ratio of surface area dedicated to the dining area versus the kitchen - Dining Area (60%) / Kitchen Area (40%) - Restaurant capacity range between 75-120 - area per person between 1.5-3.5 and Depend of luxury **<u>Accommodation :</u>** Habitable surface combined is 50% plot surface Suit (apartments) : 5% number of rooms **<u>Parking</u>** ✓ Parking surface depend on numbers of spots ✓ Number of parking spot based on ratio of 1.25 parking per room and 1 parking spot per 20 m^2 commercial and its 70% of circulation ✓ 30% circulation

6.ANNEXE :

PROGRAM DISTRUBUTION

We have 5 main function in our program presented in the figure below:

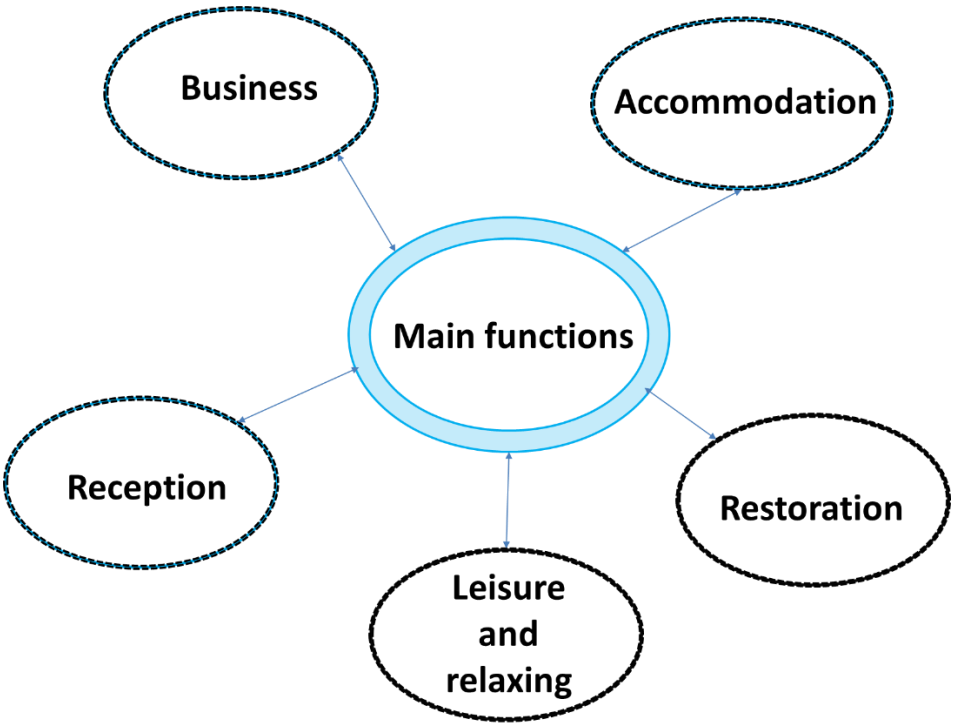

Figure 106: main functions, source: authors

Each function presents different spaces, and these spaces are organized in a specific way.

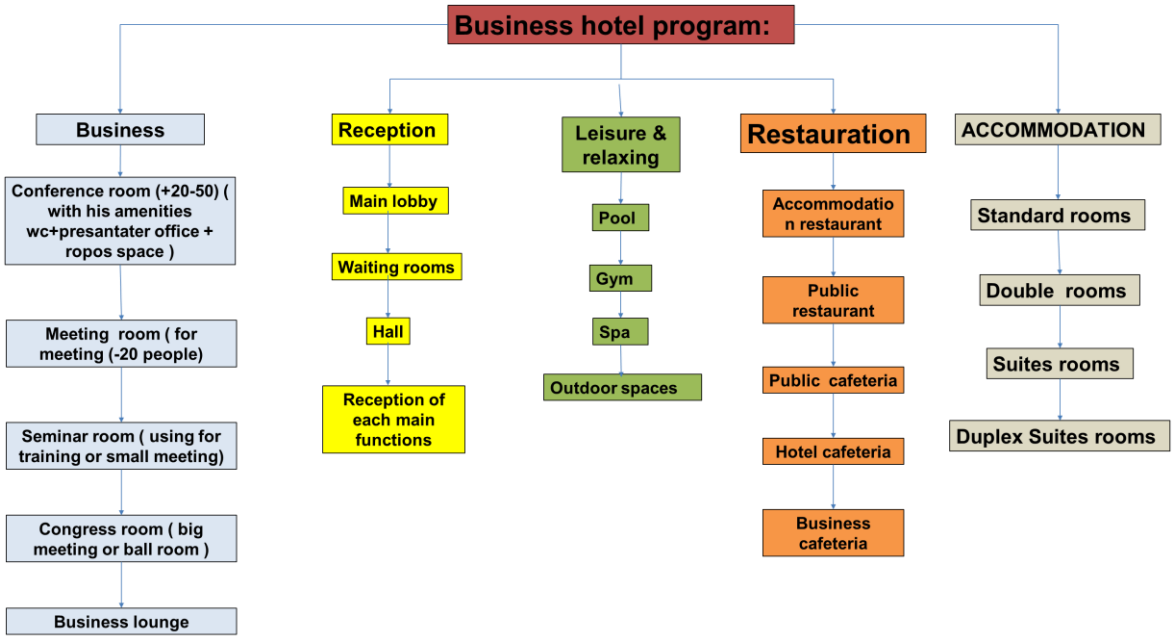

Figure 107: program distribution. Source: authors.

6.ANNEXE :

Table 27: final progam. source: authors.

Main functions	Activity	Space	NO space	NO users	Level	Accessibility	Surface areas
Accommodation	**sleep**	**Medium suite** (bed room+living room+bathroom)	8	2 to 3	R+11 AND R+12	**Linear distribution from a corridor**	85.1 sqm
		Large suite (bed room+living room+bathroom)	8	2 to 4	R+11 AND R+12		125.34 sqm
		Duplex suite (bed room+living room+bathroom)	6	2 to 4	R+11 AND R+12		117 sqm
		Double rooms (bedroom+bathroom)	220	2	From R+3 to R+10		**29,5 sq.m**
		Standard rooms (bedroom+bathroom)	80	1 to 2	From R+3 to R+10		**23 sqm**
Business	**Meeting Working**	**Meeting room**	4	20 to 40	Rdc and r+1	**Distribution from central hall**	**30 to 40 sq.m**
		Conference room	2	80 to150	R+1 and R+2		**100 to 150 sq.m**
		Ball room	1	180 to 200	R+2		**600 sq.m**
		Seminar room	4	30 to 50	R+1		**50 to 70 sq.m**
Restoration	**Eating**	**Restaurant** (kitchen+ coldroom+storage+ eating aeres+ bathroom+ respanasable office)	1	150 to 200	R+6 and R+7		**670 sqm**
		Cafeteria (kitchen+ coldroom+storage+ cafeteria)	2	60 to 80	RDC & R+1	**From main lobby**	**280 sq.m**
		• **Public Cafeteria**(kitchen+ coldroom+storage+ cafeteria)	1	120 to 150	R+1	/	**430 sqm**
		Public resaurante (kitchen+ coldroom+storage+ eating aeres+ bathroom+ respanasable office)	1	120 to 180	R+2	/	**500 sqm**
		Lounge	2	40	R+1 & R+2	**FROM CORRIDOR**	**79 sq.m**
Reception	**SEATING**	• **Main lobby** • **Reception of each function** • **Luggage room** • **Waiting room**	/		/	/	/
Leisure and relaxing	**RELAXING**	**Gym** (changing room+ reception+sprots areas)	1		R+2	FROM CORRIDOR	**200 sqm**
		SPA (changing room+ reception+massage aeres man/women +youga areas+ storage)	1		R+2	FROM CORRIDOR	**185 sqm**
		Pool (the pool +changing room+skybar)	1		R+12	/	**350 sq.m**
Technical services		• **Services rooms** in each floor of accommodation • **Technical room** (gaz,electricity,water) for each floor of accommodation • **Underground technical rooms** • **Waste storage** • **Employed services** (man/women)	/		/	/	/

6.ANNEXE :

AFFECTATION OF MAIN FONCTIONS

A vertical hierarchy distribution of function, from public to private spaces.

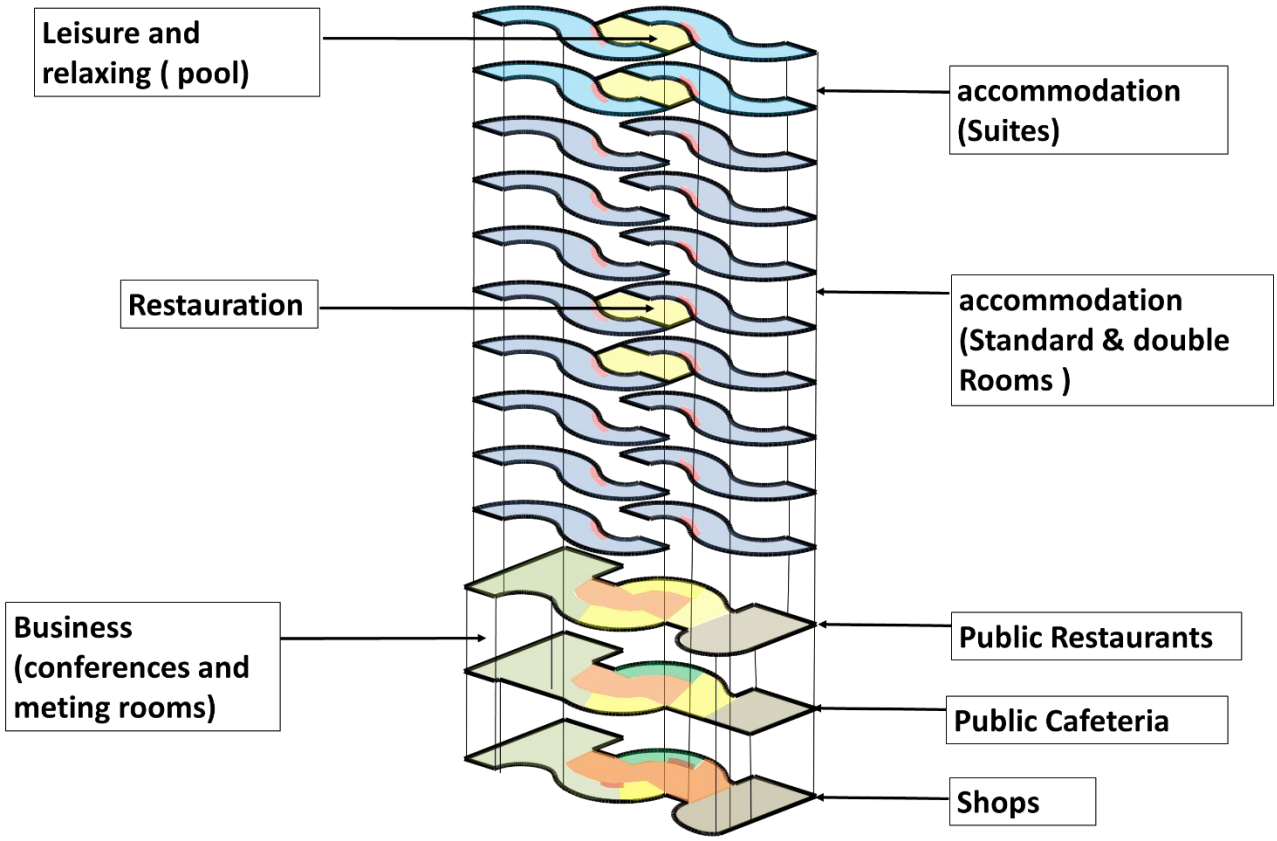

Figure 108: affectation of main functions, Source: authors

In the façade, we choose to reserve it for principal function accommodtion and business (business hotel) to expres the typologie of the projets from his façade.

6.ANNEXE :

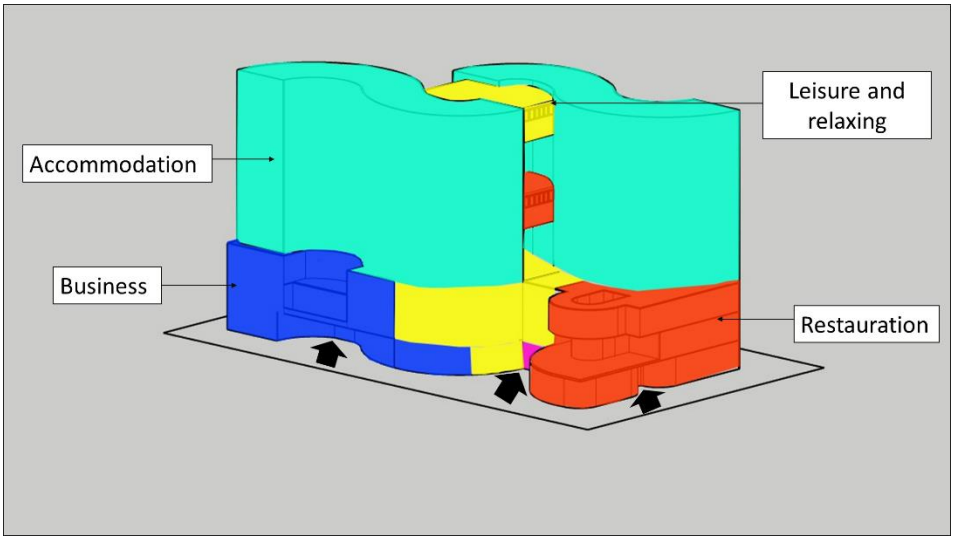

Figure 109: affectation of main functions, Source: authors

DISTRUBUTION SYSTEM

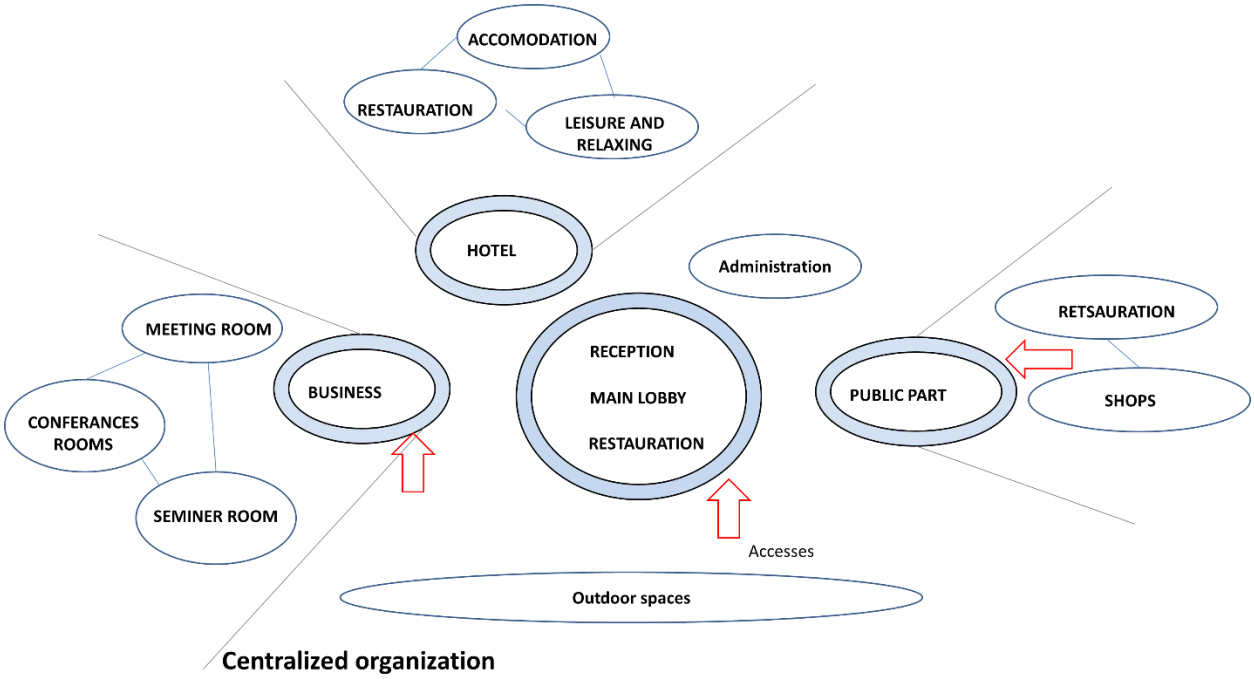

Figure 110: distribution system. Source: authors

6.ANNEXE :

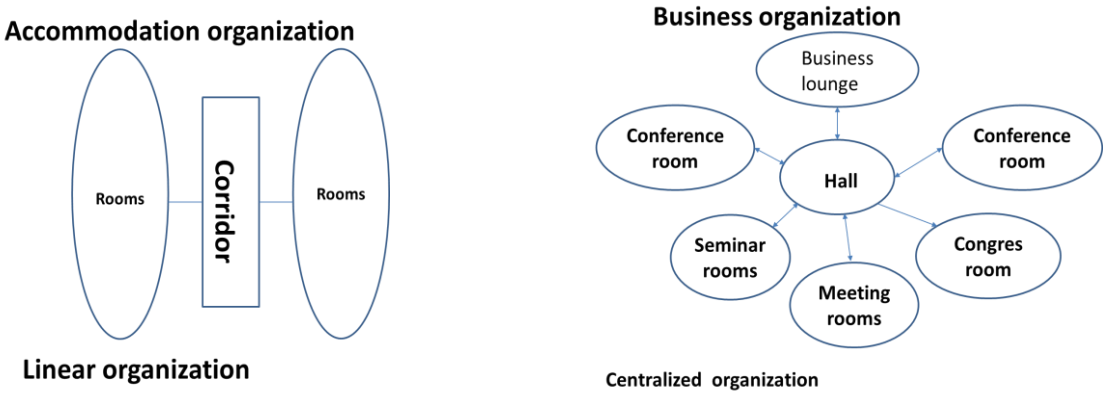

Figure 111: Accommodation & business organization. source : authors

Internal functional organization of rooms :

The layout of the hotel rooms is based on the principle of functional strips, with a repeated sequence: humid – humid – dry – dry.

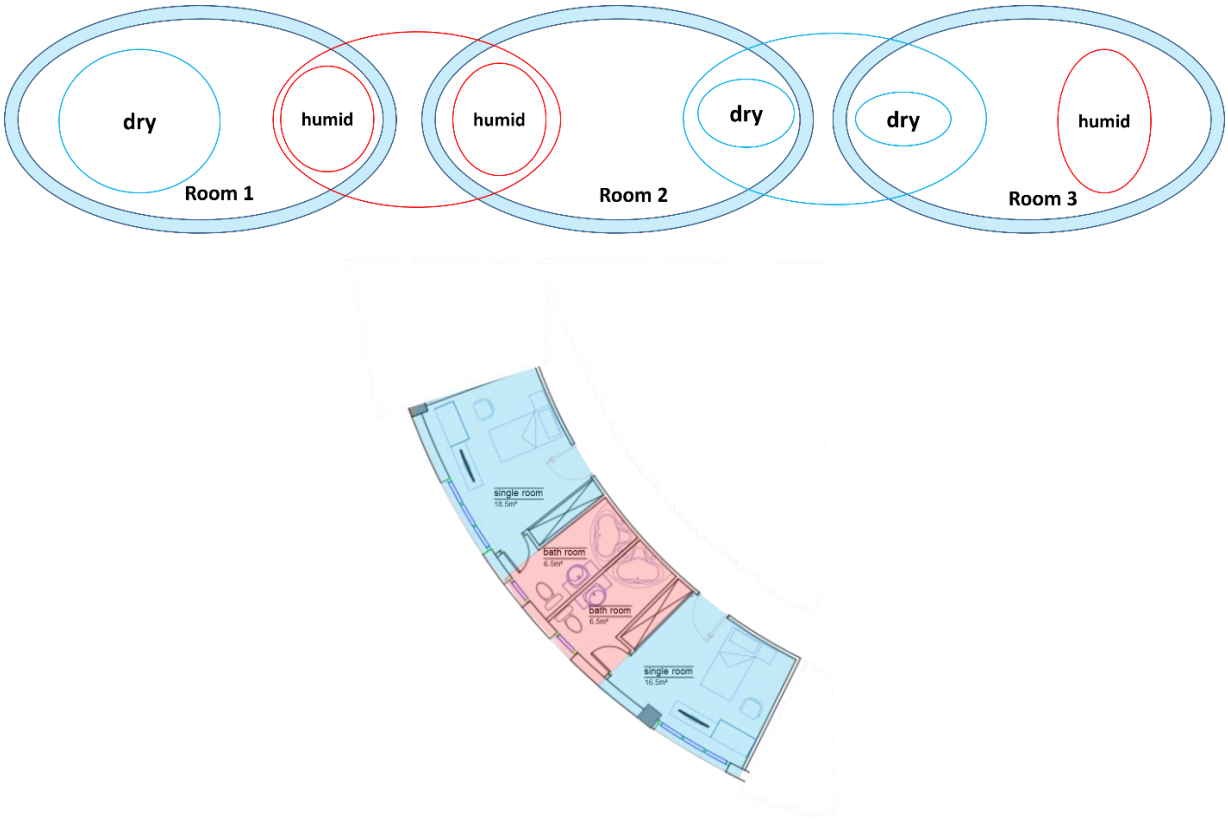

Figure 112: Internal functional organization of rooms (humid/dry).source: authors

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