



University of Mohammed Kheider- Biskra  
Faculty of architecture, urbanism, civil engineering and  
hydraulic  
Department of Architecture

# MASTER'S DISSERTATION

Domain: **Architecture, urbanism and city professions**

Field: **Architecture**

Specialization: **Architecture**

Theme: **Architecture, Environment, and Technologies**

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Presented and defended by:  
Khodja abir

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## **Theme:**

**towards a sustainability Assessment model for buildings  
in Algeria**

**The project: School of Architecture**

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### **Examiner's committee**

Dr.	Mezridi Toufik	MCA	University Of Biskra	President
Dr.	Bouzir Tallal Abdelkarim	MCA	University Of Biskra	Examinator
Dr.	Benferhat Mohamed Ladaoui	MCB	University Of Biskra	advisor

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## **GRATITUDE AND APPRECIATION**

In the name of Allah, the Most Gracious, the Most Merciful: “*My Lord, increase me in knowledge.*” (Taha: 114)

First and foremost, I thank Allah Almighty for granting me strength and guidance throughout this academic journey.

I am deeply grateful to my supervisor, **Dr. Benferhat Mohamed Ladaoui**, who played a pivotal role in guiding me throughout the year. I sincerely appreciate his unwavering support, whether through academic supervision or the invaluable knowledge he shared. His advice and guidance helped me overcome many challenges and shaped the course of my research.

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Finally, I extend my heartfelt thanks to everyone who offered help, guidance, or knowledge along the way.

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## **DEDICATION**

First and foremost, I thank **myself** for continuing despite the fatigue and challenges, believing that the path is worth the effort.

To my dear father, **Khodja Noureddine Omar**, and my beloved mother, **ouamane Nabila**, your love and constant support have been my greatest source of strength.

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And to the rest of my family, thank you for your love and encouragement.

***Abir-Khodja***

## Summary:

Sustainability has become one of the major challenges in the construction sector, especially in light of ongoing environmental, social, and economic transformations worldwide. In this context, this thesis aims to develop a sustainable building assessment model adapted to the Algerian context, considering its climatic, social, and regulatory specificities, while drawing on international experiences such as BREEAM, LEED, HQE, and PRS, and analyzing their local applicability.

The methodology is based on three main components: a theoretical part that explores the fundamental concepts of sustainability and assessment tools, an analytical part that examines the status of sustainability in Algeria, including government initiatives, international agreements, and the role of both the public and private sectors, and finally, an application part presents an applied case study in which the proposed system is tested on an architectural project for an educational institution in Biskra, considering the region's semi-arid climate.

This research aims to provide a practical framework that contributes to promoting sustainable building principles in Algeria by introducing an assessment tool aligned with international standards and responsive to the needs of the Algerian environment, thereby enhancing the environmental and functional quality of architectural spaces.

**Keywords:** sustainability, sustainable building, assessment systems, LEED, BREEAM, sustainability in Algeria, environmental assessment.

## **Résumé:**

La durabilité est devenue l'un des défis majeurs dans le secteur du bâtiment, notamment face aux transformations environnementales, sociales et économiques mondiales. Dans ce contexte, ce mémoire vise à développer un modèle d'évaluation propre à la construction durable en Algérie, tenant compte des spécificités climatiques, sociales et réglementaires du pays, tout en s'inspirant des expériences internationales telles que BREEAM, LEED, HQE et PRS, et en analysant leur applicabilité locale.

La méthodologie repose sur trois axes principaux : un axe théorique qui explore les concepts fondamentaux de la durabilité et les outils d'évaluation, un axe analytique portant sur l'état de la durabilité en Algérie à travers les initiatives gouvernementales, les accords internationaux et la contribution des secteurs public et privé, puis un axe pratique dans lequel le système proposé est appliqué à un projet architectural pour un établissement éducatif situé à Biskra, tout en tenant compte du contexte climatique semi-aride de la région.

Cette recherche ambitionne de proposer un cadre pratique contribuant à promouvoir les principes de la construction durable en Algérie, à travers la mise en place d'un outil d'évaluation conforme aux normes internationales et répondant aux besoins de l'environnement algérien, tout en améliorant la qualité environnementale et fonctionnelle des espaces architecturaux.

**Mots-clés** : durabilité, construction durable, systèmes d'évaluation, LEED, BREEAM, durabilité en Algérie, évaluation environnementale.

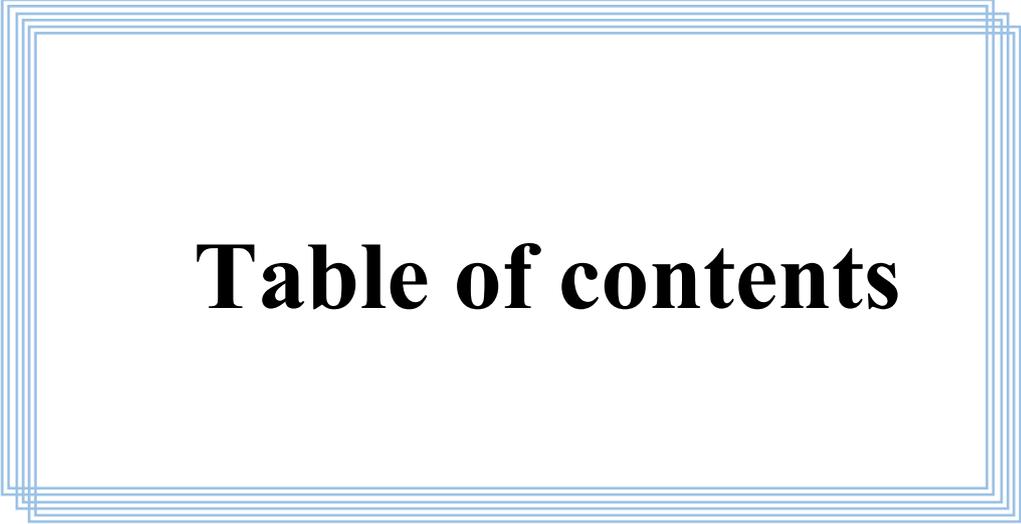
## الملخص:

أصبحت الاستدامة إحدى التحديات الأساسية في قطاع البناء، خاصة في ظل التحولات البيئية والاجتماعية والاقتصادية التي يشهدها العالم. في هذا السياق، تسعى هذه المذكرة إلى تطوير نموذج تقييم خاص بالبناء المستدام يتلاءم مع الواقع الجزائري، ويأخذ بالاعتبار خصوصياته المناخية، الاجتماعية، والتشريعية، مع الاستفادة من التجارب الدولية مثل ، وتحليل مدى قابليتها للتطبيق محلياً. BREEAM و LEED و HQE و PRS.

تعتمد المنهجية على (ثلاثة) محاور رئيسية: محور نظري يستعرض المفاهيم الأساسية للاستدامة وأدوات التقييم، ومحور تحليلي يتناول وضعية الاستدامة في الجزائر من خلال المبادرات الحكومية، الاتفاقات الدولية، ودور القطاعين العام والخاص، ثم محور تطبيقي يتم فيه تطبيق النظام المقترح على مشروع معماري لمؤسسة تعليمية في مدينة بسكرة، مع مراعاة السياق المناخي شبه الجاف للمنطقة.

تسعى هذه الدراسة إلى تقديم إطار عملي يساهم في تعزيز مبادئ البناء المستدام في الجزائر، عبر تقديم أداة تقييم تتماشى مع المعايير الدولية وتستجيب لاحتياجات البيئة الجزائرية، مما يعزز من جودة الفضاءات المعمارية بيئياً ووظيفياً.

**الكلمات المفتاحية:** الاستدامة، البناء المستدام، أنظمة التقييم، الاستدامة في الجزائر، التقييم البيئي, LEED , BREEAM



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# **General Introduction**

## 1. Introduction:

The global construction industry is undergoing a significant transformation as sustainability becomes a central focus in architectural and urban development. With increasing awareness of environmental degradation, resource depletion, and climate change, the concept of sustainable building has emerged as a critical approach to mitigating these challenges (Berardi, 2015). Sustainable buildings aim to minimize environmental impact, enhance energy efficiency, and promote social and economic well-being (Baba, 2023a). In this context, the development and implementation of sustainable building practices are essential for achieving sustainability goals.

Sustainability in construction encompasses three core elements: environmental, social, and economic dimensions. The environmental aspect focuses on reducing carbon footprints, conserving natural resources, and minimizing waste. The social dimension emphasizes creating healthy and comfortable living environments for users, while the economic aspect ensures cost-effectiveness and long-term viability (Kaddour & Teba, 2022). These elements are interconnected, and their integration is crucial for achieving holistic sustainability.

Globally, several international assessment systems have been developed to evaluate the sustainability of buildings, each with its unique criteria and methodologies. Among these, BREEAM (Building Research Establishment Environmental Assessment Method), HQE (Haute Qualité Environnementale), LEED (Leadership in Energy and Environmental Design), and PRS (Pearls Rating system) (Sartori et al., 2021). However, these systems are often designed based on the environmental and socio-economic conditions of the regions where they originated and thus may not fully address the particularities of other contexts, such as Algeria.

In Algeria, the adoption of sustainable building practices is still in its early stages, although progress has been made in recent years. The country's unique climatic, cultural, and economic conditions necessitate a more localized and adaptive approach. Researchers have noted the absence of a unified national framework or regulatory structure for green architecture, despite numerous initiatives (Kaddour & Teba, 2022). Moreover, existing international systems often reflect socio-cultural lifestyles and regional climate variations (Tebbouche et al., 2017). This highlights the need for a flexible, context-sensitive assessment model that reflects Algeria's specific challenges and opportunities in achieving sustainability. Ultimately, promoting and developing sustainable buildings in Algeria is essential for ensuring better resource efficiency, reducing environmental impact, and improving the quality of life for current and future generations.

## 2. Problematic:

The issue of building sustainability has become a central concern worldwide due to the environmental, social, and economic challenges faced by modern societies. Reducing the energy consumption of buildings, controlling their environmental impact, and promoting sustainable construction practices are major priorities of current energy and environmental policies. To achieve these goals, sustainability assessment frameworks have been developed to objectively evaluate resource use, ecological constraints, and indoor environmental quality throughout a building's life cycle from construction to demolition.

Existing international assessment systems, such as LEED, BREEAM, or HQE, while they are important references, do not always take into account the climatic, cultural, and regulatory specificities of the country. The research aims to answer the following key questions:

- What are the key elements of sustainability in the context of building construction?
- What is the role of sustainable building assessment methods? What are their specificities, and on what criteria are they based to define a sustainable building?
- What are the current achievements and challenges in Algeria's sustainable building development?

- **How can a sustainability assessment model be developed that is adapted to the Algerian context?**

### 3. Hypothesis:

The questions posed in this study prompted the formulation of hypotheses:

- Building sustainability assessment methods primarily aim to quantify the environmental impact of buildings and verify their compliance with the principles of sustainable development.
- The most relevant sustainability assessment criteria for the Algerian context are not necessarily the same as those used in developed countries.
- Adapting the sustainability assessment system to Algeria's context (climate, social, cultural, and economic conditions) will improve the accuracy of building evaluations and ensure its acceptance and efficiency.

### 4. Objectives:

Algeria recognizes the need for sustainable building practices due to increasing environmental challenges. However, current sustainability assessment methods lack local applicability. This study aims to bridge this gap by developing a building sustainability assessment tool specifically adapted to the Algerian context. Therefore, this research has the following objectives:

- Explore the Concept of Sustainability in Construction.
- Review and Analyze Global Sustainability Assessment Systems.
- Evaluate the current state of sustainable building practices in Algeria, including achievements, challenges, and gaps in implementation.
- Analyze the roles of both public and private sectors in promoting sustainable construction and identify areas for improvement.
- Determine the most relevant sustainability standards for Algeria.
- Propose a building sustainability assessment tool adapted to the local context.

### 5. Research Methodology:

This research employed a broad literature review consulting diverse sources such as books, documents, reports, theses, and websites to gain a thorough understanding of sustainability, existing assessment systems (LEED, BREEAM, HQE, Estidama), and their applicability within the Algerian context. The research is structured into four main chapters:

**General Introduction:** This chapter outlines the general framework of the study, including the research problem, hypotheses, objectives, and structure.

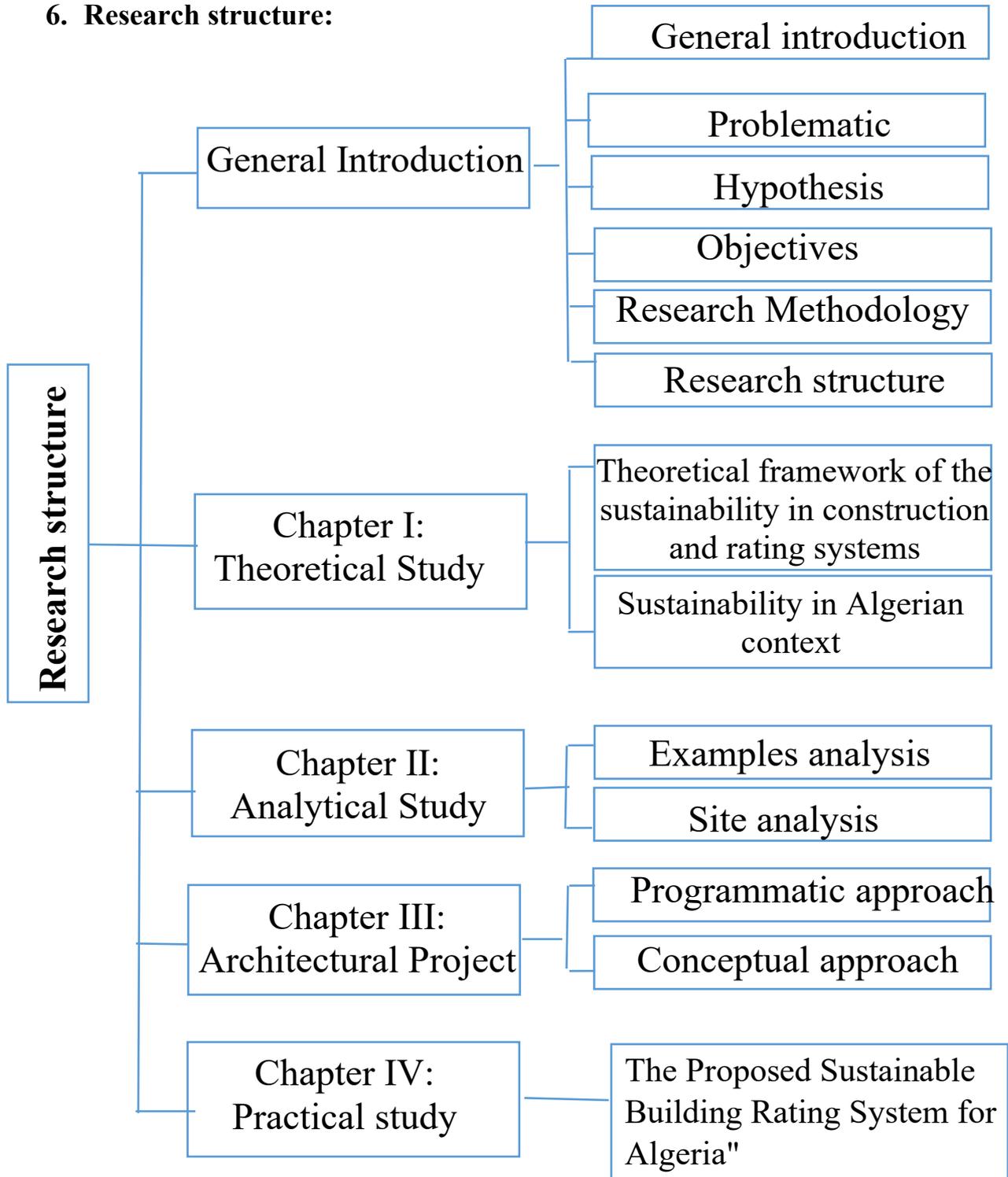
**Chapter I\_ Theoretical Study-**This Chapter is divided into two sections. The first section focuses on sustainability, its dimensions and sustainable building assessment systems and the second section addresses sustainability in Algeria, discussing the challenges and the initiatives taken by Algeria for sustainable buildings.

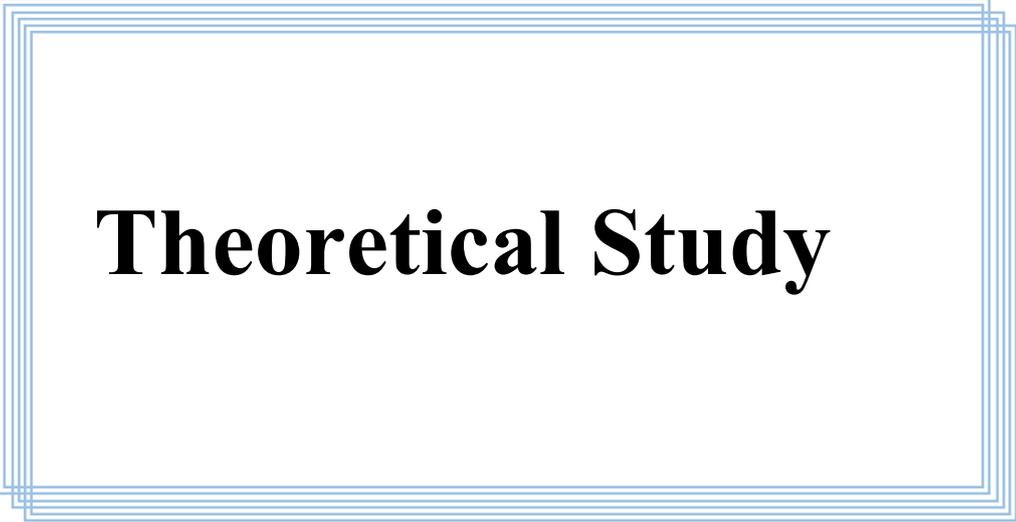
**Chapter II\_ Analytical Study:** This chapter analyzes project examples considering various parameters such as form, function, construction, structure and their environmental performance.

**Chapter III\_ Aarchitectural Project:** This chapter presents the proposed architectural project. It includes the programmatic approach, design concept, architectural drawings, and an application of the developed sustainability assessment system.

**Chapter IV\_ Practical Study:** This chapter applies the developed Algerian sustainability assessment system to the proposed architectural project. It aims to test the system's effectiveness, adaptability, and relevance in a real design context, using the project as a case study for validation.

**6. Research structure:**





# **Theoretical Study**

### **I.1 Introduction:**

The construction and building sector plays a pivotal role in global economic development, social progress, and environmental protection. However, it is also one of the largest contributors to environmental degradation, resource depletion, and greenhouse gas emissions. As the world faces increasing challenges such as climate change and resource scarcity, the adoption of sustainable construction practices has become more critical than ever. In response to these challenges, sustainable building assessment systems have emerged as essential tools to evaluate and promote sustainability in the built environment. These systems provide a structured framework for assessing the environmental, social, and economic performance of buildings. By offering clear criteria, these systems help stakeholders make informed decisions and achieve sustainability goals.

#### **First section: Theoretical framework of the sustainability in construction and rating systems**

### **I.2 Theoretical concept of sustainability:**

#### **I.2.1 Overview on Sustainability:**

Around the world, people are striving to live more sustainably to protect the future. Sustainability is a concept with multiple definitions that vary depending on the context. However, it is generally defined as "a system or process is sustainable if it can be continued indefinitely without depleting any of the material or energy resources required to keep it running"(Wright & Boorse, 2016).

And one of the most widely recognized definitions of sustainability was articulated by the World Summit on Sustainable Development, Agenda 21, and the Brundtland Report (WCED, 1987) "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs"(Kaddour & Teba, 2022).

Many countries have issued official declarations to define the key elements of sustainability. In 2005, the World Summit identified three main pillars of sustainability: economy, society, and environment.

In Abu Dhabi, a fourth pillar, culture, was added to the definition of sustainability. This addition emphasizes the significance of cultural identity and heritage in sustainable practices, as outlined in the Abu Dhabi 2030 Development Plan (Moktar, 2012)

#### **I.2.2 Dimensions of sustainability:**

Sustainability is often described through its three core dimensions: Environmental, Social and Economic. These dimensions are deeply interconnected and must be addressed collectively to achieve true sustainability (Kaddour & Teba, 2022).



**Figure 1:**The tree pillars of sustainability. Source: Author

### **a. Environmental Sustainability:**

The environmental dimension focuses on identifying innovative ways to enhance energy and water efficiency in buildings while minimizing waste through the use of renewable energy sources and eco-friendly materials. Evaluating a building's environmental impact is essential, as it reveals its energy performance and carbon footprint.

Factors such as thermal comfort, indoor air quality, and lighting quality significantly influence user satisfaction and have a considerable impact on environmental performance.

Moreover, the environmental aspect aims to protect and improve environmental conditions. Key strategies for achieving this include minimizing the use of toxic materials, mitigating the urban heat island effect, and carefully selecting energy-efficient materials and appliances.

### **b. Economic Sustainability:**

The economic dimension of sustainable building emphasizes the potential for significant financial returns through improved energy efficiency, reduced maintenance costs, and lower operational expenses when buildings are effectively designed. This includes consideration of factors such as life-cycle costs, durability, and adaptability.

Recognizing that buildings, like living organisms, have a finite lifespan, it is essential to prioritize the use of durable and environmentally friendly materials throughout the entire building lifecycle to ensure long-term sustainability.

### **c. Social Sustainability:**

The social dimension of sustainability has received growing attention from academics, organizations, and stakeholders in recent years. It aims to promote equitable and inclusive development that meets the needs of all individuals. The social dimension in sustainable development focuses on improving the quality of life of individuals and communities, enhancing social cohesion, ensuring equal opportunities for all, and meeting basic needs.

## **I.2.3 Sustainability in the Construction and Building Sector:**

Sustainability in the construction and building sector is a critical area of focus due to the industry's substantial environmental, social and economic impacts.

The construction industry plays a vital role in driving economic growth, promoting social progress, and supporting environmental protection. However, it also has significant negative impacts on human health and the environment throughout a building's lifecycle, including design, construction, operation, and maintenance. Buildings account for 32% of global energy consumption and use substantial natural resources, including 25% of wood and steel products and 70% of cement. In developed countries, the sector extracts 40% of natural resources, consumes 70% of electrical energy, and uses 12% of drinking water while generating 45-65% of total waste sent to landfills. Additionally, buildings contribute significantly to greenhouse gas emissions, with 30% occurring during the operational phase and 18% from material consumption and transportation. These emissions exacerbate climate change, degrade air quality, and pose risks to human health, highlighting the urgent need for sustainable practices in the construction industry to mitigate its environmental and social impacts.(Baba, 2023b).

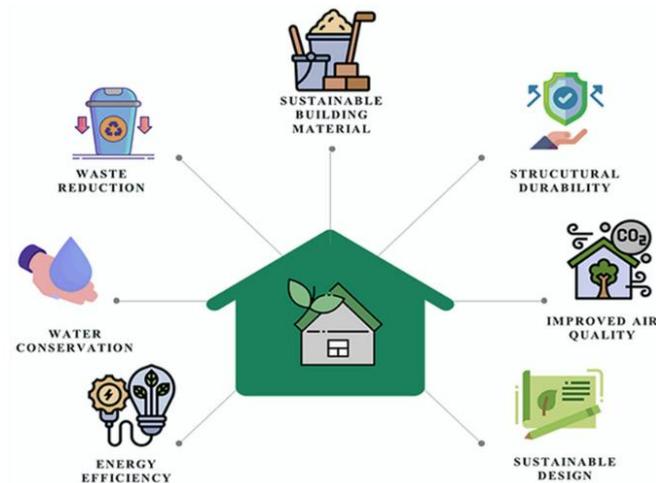


Figure 2: essential components of sustainable construction . (source: Vijayan et al., 2023)

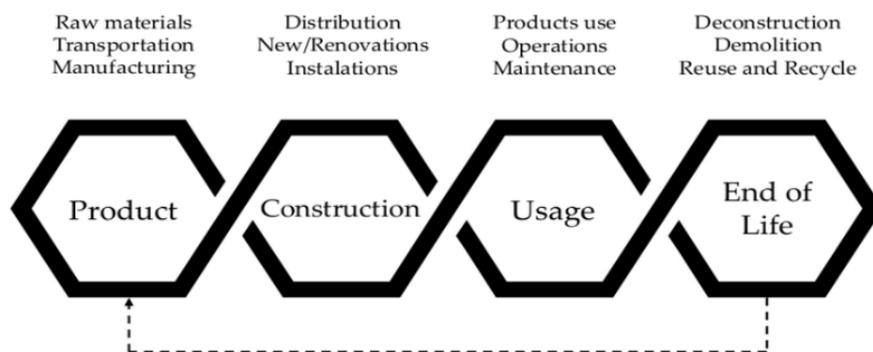


Figure 3: life Cycle assessment of sustainable construction . (source Vijayan et al., 2023)

## I.2.4 Benefits of Sustainable Construction:

### d. Environmental Benefits:

Sustainable buildings significantly reduce environmental impact. By incorporating energy-efficient technologies and renewable energy sources, they minimize carbon emissions, a key contributor to climate change. These buildings also emphasize the use of low-carbon materials and sustainable construction methods, reducing waste and environmental pollution. Furthermore, practices such as strategic site selection and the integration of green infrastructure help protect ecosystems and mitigate the urban heat island effect.



Figure 4: key benefits of sustainable construction . (source: <https://worldgbc.org/>)

### e. Social Benefits:

Sustainable buildings offer notable social advantages. They prioritize occupant health and well-being by enhancing indoor environmental quality (IEQ), including improved air quality, better natural and artificial lighting, and healthier indoor environments. These improvements lead to greater occupant satisfaction, reduced absenteeism, and increased productivity. Moreover, sustainable construction contributes to social equity by fostering healthier and more inclusive built environments.

### f. Economic Benefits:

Sustainable buildings also provide economic advantages. Increased energy and water efficiency result in lower operating costs, reducing utility bills and the total cost of ownership.

Additionally, these buildings tend to have higher property values and rental rates, particularly when green-certified, making them attractive to investors. Improved occupant health and productivity in sustainable workplaces further enhance business profitability (Wright & Boorse, 2016).

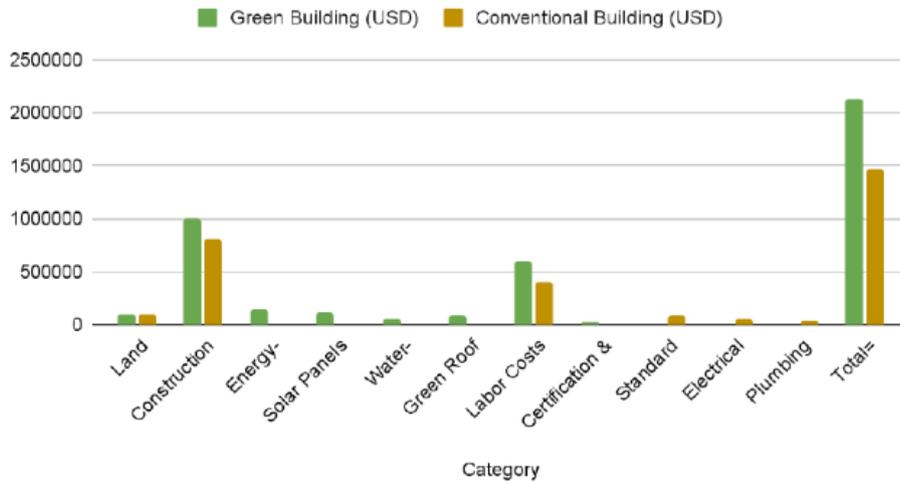


Figure 5: approx. cost of green building vs conventional building over 20 years. (Source (Parvez, 2024))

### 1.2.5 Challenges in Sustainable Construction:

Sustainable construction aims to minimize the environmental impact of buildings while promoting social equity and economic viability. However, the industry faces numerous challenges that hinder the widespread adoption of sustainable practices. These challenges can be categorized into **economic**, **technical**, and **social** barriers.

#### g. Economic Challenges:

- **High Initial Costs:** sustainable construction often requires higher upfront investments in energy-efficient technologies, eco-friendly materials, and advanced construction techniques. For example, the cost of installing solar panels or high-performance insulation can be significantly higher than traditional alternatives (Omer & Noguchi, 2020).

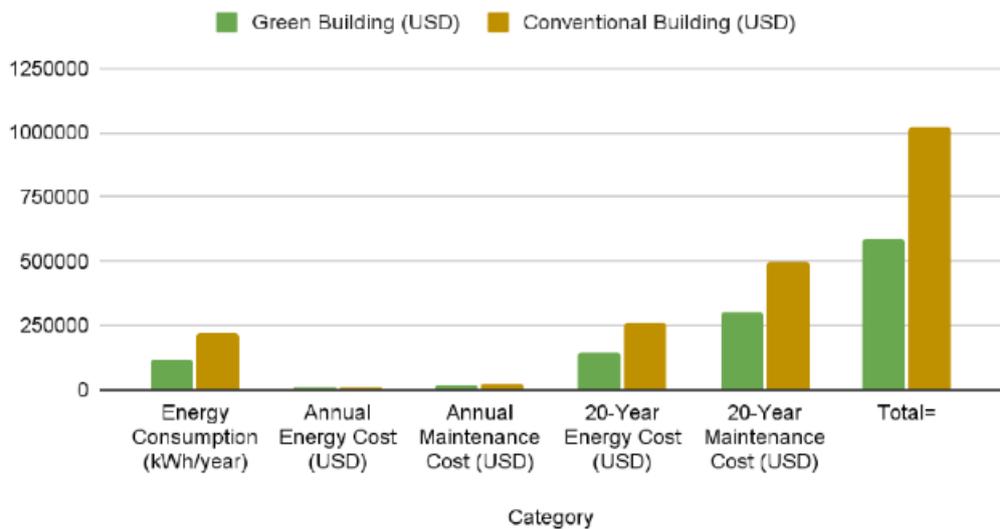


Figure 6: Energy and maintenance cost of green vs conventional building. Source (Parvez, 2024)

- **Lack of Financial Incentives:** In many regions, there is a lack of government incentives, subsidies, or tax breaks to encourage sustainable construction practices.

Without financial support, developers and builders may be reluctant to invest in green building projects.(Omer & Noguchi, 2020)

### h. Technical Challenges:

- **Limited Availability of Sustainable Materials:** Sustainable materials such as recycled steel or low-carbon concrete are not always readily available or cost-competitive compared to traditional materials. This limitation hinders their widespread adoption in construction projects.(Ding, 2008)
- **Complexity of Green Technologies:** Integrating advanced technologies such as Building Information Modeling (BIM), energy-efficient HVAC systems, or renewable energy solutions requires specialized knowledge and expertise. However, many construction firms lack the technical skills to implement these technologies effectively.(Kibert, 2016)

### i. Social Challenges:

- **Lack of Awareness and Education:** Many stakeholders, including architects, builders, and clients, lack awareness of the benefits of sustainable construction. This often results in a preference for conventional methods and materials over sustainable alternatives.(Berardi, 2013)

## I.2.6 Concepts and bases of sustainability in construction:

According to Kibert (2016b), (Shushunova et al., 2024), (Bovill, 2015), sustainability in construction is founded on several key concepts and principles, including:

- **Passive Design Strategies:** Passive design strategies utilize natural elements such as sunlight, wind, and vegetation to reduce energy consumption and enhance indoor comfort. Example:
  - Orientation: Positioning buildings to maximize natural daylight and ventilation.
  - Insulation: Using high-performance insulation to minimize heating and cooling needs.
  - Shading: Incorporating overhangs, louvers, and vegetation to reduce direct sunlight and cooling loads.
- **Bioclimatic Architecture:** Bioclimatic architecture aims to harmonize building design with the local climate and environmental conditions. It uses natural elements like sunlight, wind, and vegetation to improve comfort and reduce energy consumption. Example:
  - In hot climates, designs may include shading devices, thermal mass, and cross-ventilation.
  - And in cold climates, buildings may be oriented for solar gain and insulated to retain heat.(Shushunova et al., 2024)
- **Ecological Footprint:** The ecological footprint of a building measures the total environmental impact throughout its life cycle, construction, operation, and demolition.
- **Vernacular Climate Strategies:** Vernacular strategies refer to traditional construction techniques adapted to local environmental conditions. They often use local materials and passive design principles for thermal comfort. Example:
  - In desert areas, thick earthen walls and small windows help keep interiors cool.

- While in tropical areas, elevated structures and wide overhangs enhance airflow and protect from rain.
- **Sustainable architecture:** Sustainable architecture is a holistic design approach balancing environmental, social, and economic dimensions. It emphasizes energy and resource efficiency, climate resilience, and occupant health through strategies like renewable energy use, sustainable materials, and indoor environmental quality.
- **Positive Energy Building (BEPOS):** A building that produces more energy than it consumes annually, covering all energy needs through on-site renewable sources like solar or wind....etc.
- **Autonomous Building:** A building entirely self-sufficient, not reliant on external utilities. It meets all energy needs locally, ideal for remote locations.
- **Zero Utility Cost House:** A house with a no-net utility bill, achieved by exporting surplus energy to offset energy consumed. This model is often applied in social housing.
- **Carbon Neutral House:** A building with net-zero carbon dioxide emissions, often achieved through both design and lifestyle changes (low-impact transportation and consumption habits...).
- **Green Building:** A building with a low environmental impact is often achieved through the use of sustainable materials. This term is broad and can encompass various aspects of sustainability.
- **Intelligent Building:** A building equipped with advanced systems (programmable controls, sensors...) that optimize energy use, indoor comfort, and management, primarily focused on efficiency and user comfort.

### I.2.7 Methods of assessing and tracking sustainability in buildings:

Environmental assessment tools and methodologies are essential for evaluating the environmental impact of buildings, infrastructure, and other projects. These tools help stakeholders identify potential environmental risks, optimize resource use, and implement sustainable practices.

<b>Methodology/Tool</b>	<b>Description</b>	<b>Key Applications</b>
<b>1. Life Cycle Assessment (LCA)</b>	A systematic methodology for evaluating the environmental impacts of a product, process, or building throughout its lifecycle, from raw material extraction to disposal.	Assessing energy use, carbon emissions, water consumption, and waste generation in buildings.
<b>2. Environmental Impact Assessment (EIA)</b>	A process used to predict and evaluate the environmental consequences of proposed projects, such as construction or infrastructure development. It aims to prevent avoidable environmental damage.	Evaluating the environmental impact of large-scale construction projects.
<b>3. Carbon Footprint Assessment</b>	Quantifies the total greenhouse gas (GHG) emissions associated with a product, organization, or activity. It identifies opportunities to reduce carbon emissions and mitigate climate change.	Measuring emissions from building construction, operation, and demolition.
<b>4. Cost-Benefit Analysis (CBA)</b>	Compares the costs and benefits of projects to determine their economic viability. It evaluates the financial feasibility of implementing green technologies or practices.	Assessing the economic viability of energy-efficient systems or renewable energy solutions.
<b>5. Strategic Environmental Assessment (SEA)</b>	This is similar to Environmental Impact Assessments (EIA); the only difference is that EIA is on a project level, while SEA is on a higher level of assessment for policies, plans, and programs.	Urban planning, large-scale infrastructure projects, and policy development.
<b>6. Environmental Management Systems (EMS)</b>	Frameworks that help organizations manage their environmental responsibilities systematically. Often based on the ISO 14001 standard, which provides guidelines for environmental management.	Monitoring and improving energy efficiency, waste management, and water conservation in buildings.
<b>7. Post-occupancy evaluation</b>	A method for assessing how well buildings perform once they are occupied, especially in terms of energy use, indoor environmental quality, and user satisfaction	Evaluating whether sustainability goals have been achieved in practice and identifying areas for improvement after building occupancy.
<b>8. Sustainable Building Rating Systems (Green Building Rating Systems)</b>	Frameworks that assess and certify the sustainability of buildings based on criteria such as energy efficiency, water conservation, materials, and indoor environmental quality.	Certifying green buildings and promoting sustainable construction practices.

**Table 1:** Environmental Assessment Tools and Methodologies in Sustainable Building Practices. (Source: Author)

### I.3 Sustainability Assessment Tools (Building Rating Systems):

#### I.3.1 Definition of Sustainable Assessment Tools:

Over the past three decades, researchers have paid special attention to the environmental performance of buildings. This has resulted in the implementation of new measures to monitor and indicate environmental burden, including the development of many sustainability assessment tools (Mahdavejad et al., 2020).

These voluntary tools serve as crucial instruments for evaluating the environmental, social, and economic performance of buildings and infrastructure projects (Zarghami & Fatourehchi, 2020). They aim to measure and assess a project's sustainability performance against established standards and benchmarks, ensuring alignment with sustainable development goals and principles. (Y. Zhang et al., 2019).

Green building rating systems achieve this by assigning credits and weights to various environmental and social factors within a structured framework (Sartori et al., 2021). By offering a standardized approach to project evaluation, these tools enable comparisons and informed decision-making. They foster sustainable practices such as energy efficiency, renewable resource utilization, and waste reduction. Additionally, they prioritize social equity by considering the needs of diverse communities (Baba, 2023b).

The widespread development and application of these methods have provided valuable insights and practical experience in promoting greener and more sustainable building practices (Rezaallah et al., n.d.).

Various sustainability assessment tools include LEED (Leadership in Energy and Environmental Design), BREEAM (Building Research Establishment's Environmental Assessment Method), France's HQE (High Environmental Quality), Germany's DGNB (Deutsche Gesellschaft für Nachhaltiges Bauen e.V.), Australia's Green Star, New Zealand's Green Star, Japan's CASBEE (Comprehensive Assessment System for Building Environmental Efficiency), Hong Kong's BEAM (Building Environmental Assessment Method), Singapore's BCA (Building and Construction Authority)... By adopting these tools, building owners and developers can reduce their environmental impact, improve occupant health and well-being, and enhance the overall sustainability of their projects (Feijão et al., 2024).

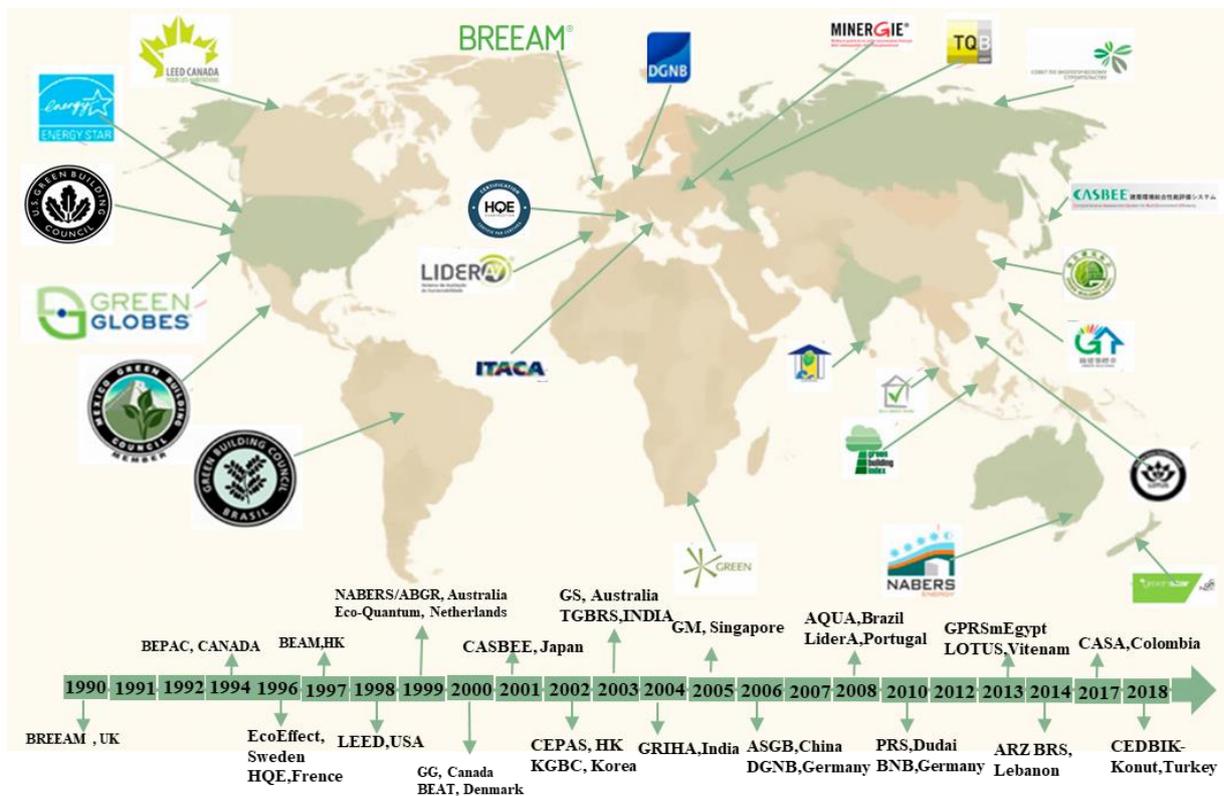


**Figure 7:** Example of a sustainable building certified by LEED (Platinum Level): Lakeside Senior Apartments, California, United States. Source: Lakeside Senior Apartments | U.S. Green Building Council and Lakeside Senior Apartments | David Baker Architects

While these systems offer significant benefits, challenges remain, such as the need for adaptation to local contexts and the standardization of evaluation criteria. Additionally, increased initial costs and potential time delays associated with implementation can be drawbacks. The proliferation of different classification systems can also lead to confusion and hinder harmonization efforts (Baba, 2023b).

### I.3.2 Development of Sustainable Building Rating Systems:

In recent years, sustainable building rating systems have seen remarkable development worldwide, driven by a growing interest in tools and methods for analyzing the environmental performance of buildings. As the demand for environmentally friendly construction strategies continues to rise, designers and developers now have access to a wide range of evaluation tools. These systems have been adopted across various regions of the world, with differing methodologies and standards, reflecting ongoing progress in the global pursuit of sustainability in the construction sector (Tebbouche et al., 2017).



**Figure 8:** Geographical and Chronological Map of Green Building Rating Systems. Source: Created by the authors based on (*Guide to Sustainable Building Certifications*, 2018) and Garcia & Farnell, n.d.

### I.3.3 Sustainability Indicators:

To effectively measure the sustainability of buildings throughout their lifecycle, common and clearly defined indicators are required. Building certification systems use various indicators as metrics, each with its own weighting and scoring system. However, these indicators are influenced by factors such as local conditions, government policies, and the geographical context. This implies that there is no universally agreed-upon set of indicators or a fixed number of them. Furthermore, there is also no global consensus on how these indicators should be assessed, whether through ratios, numerical values, or other metrics (Baba, 2023b).

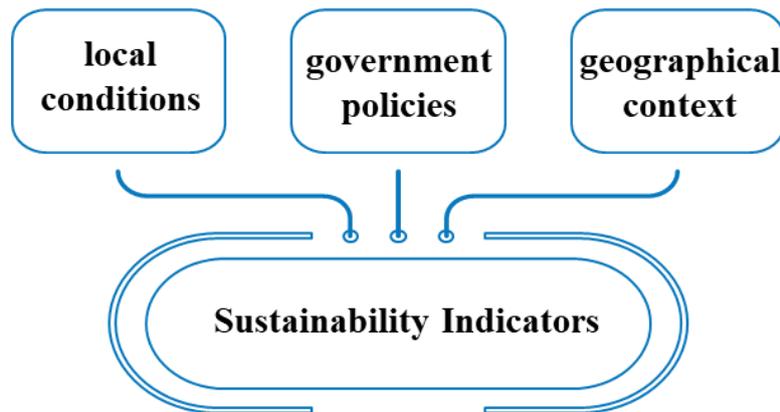


Figure 9: Contextual Factors Influencing Sustainability Indicators (Source : Author).

To ensure their effectiveness and reliability, sustainability indicators must demonstrate the following key characteristics:

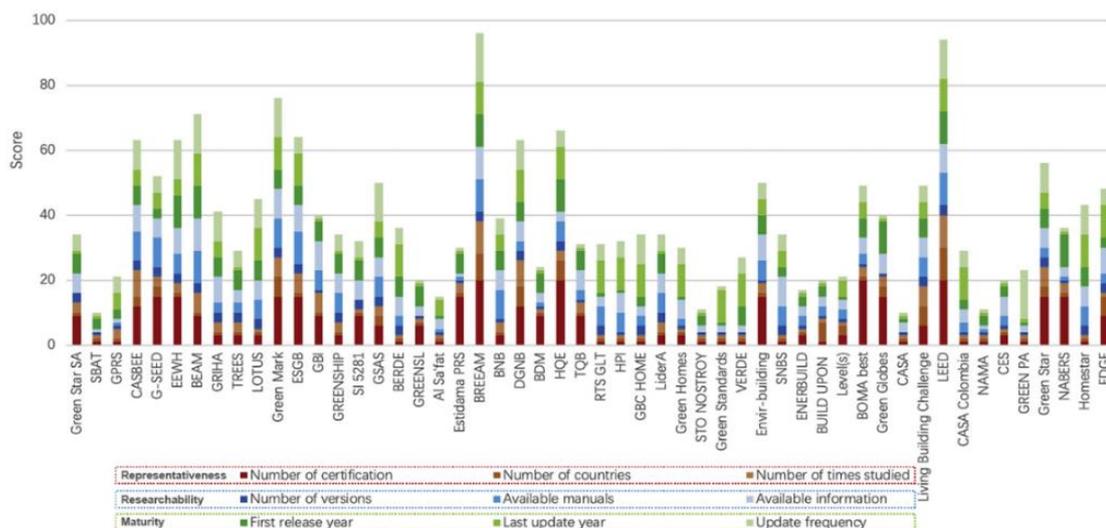
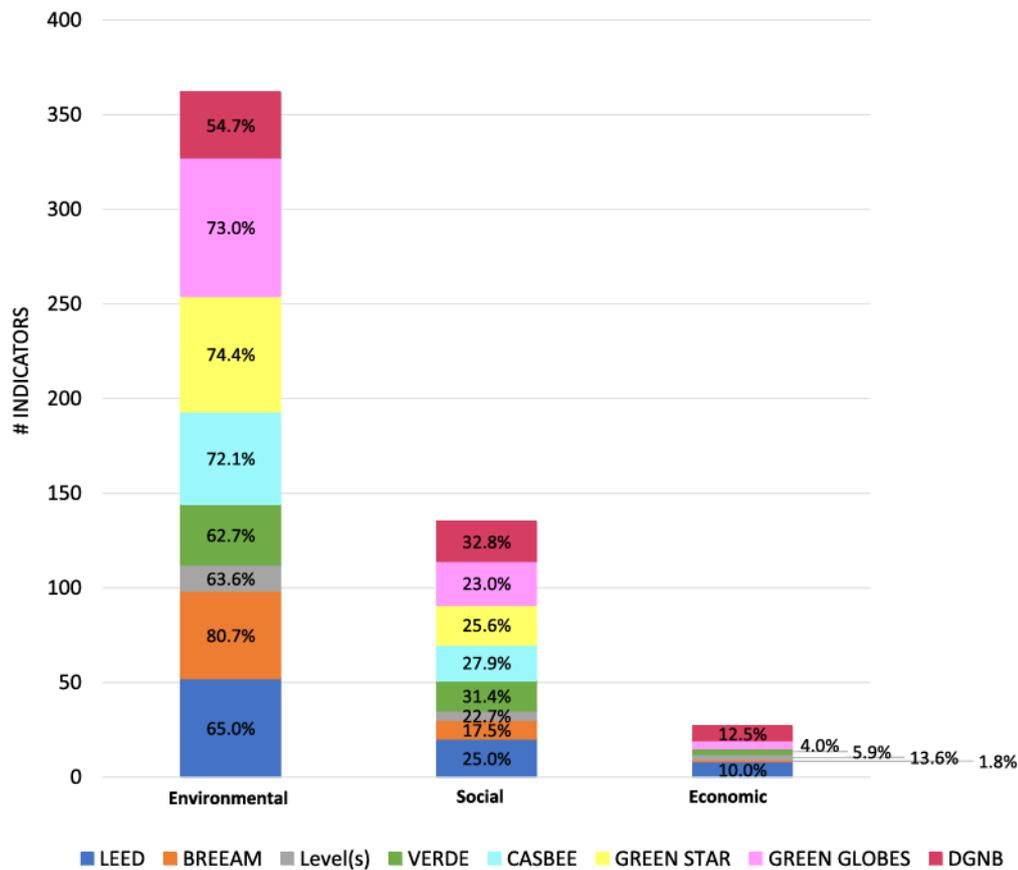


Figure 10: Analysis of the Evolution of Green Building Rating Systems: Representativeness, Research ability, and Maturity. source : (Wen et al., 2020)

- **Relevant and Aligned:** Indicators must be directly related to the project's goals and reflect its intended sustainability impacts.
- **Specific and Clear:** Indicators should be clearly and precisely defined to prevent ambiguity and ensure consistent interpretation across various contexts.
- **Holistic Approach:** A comprehensive set of indicators should address all dimensions of sustainability, including environmental, social and economic aspects.
- **Stakeholder Involvement:** Input from experts, practitioners, and affected communities is essential to ensure the indicators' relevance and acceptance.

- **Adaptable and Evolvable:** Indicators should be flexible enough to accommodate local conditions, cultural contexts, and evolving knowledge, technologies, and best practices in sustainable development (Reid & Rout, 2020).



**Figure 11:** Distribution of Sustainability Indicators by Dimension in Global Rating Systems. (Source: Braulio-Gonzalo et al., ZA, 2022)

- The figure demonstrates the dominance of environmental indicators in most rating systems, compared to the relatively lower emphasis on social and economic aspects. It also reveals variations in the distribution of the three sustainability dimensions (environmental, social, and economic) across different systems, reflecting their differing priorities and methodological approaches. This divergence makes direct comparisons between systems particularly challenging.

#### I.4 Overview of Key Sustainable Building Rating Systems:

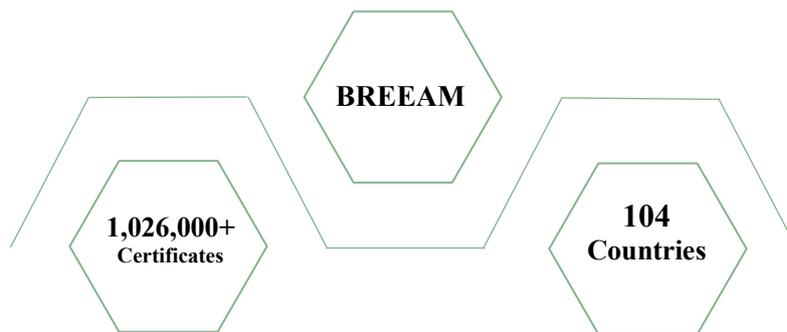
This section presents the key green building certification systems selected for comparative analysis due to their global influence and regional relevance. The most known systems; like “*LEED*” for U.S and “*BREEAM*” for UK, as internationally recognized systems, provide established frameworks for environmental performance and energy efficiency, reflecting decades of iterative refinement. another system that is fairly well known throughout the world, which has been developed in France, namely HQE, which offers a rather European approach to the design and construction of sustainable buildings.

The *"ESTIDAMA"* system was developed for hot climate. This regional system has been developed for the Gulf region, and it provides relevant insights for Algeria due to its similar climatic conditions and regional context.

### I.4.1 BREEAM Rating system:

#### a. Overview of the system:

BREEAM (Building Research Establishment’s Environmental Assessment Method) is the first international standard and certification system for sustainable buildings. It was developed and is administrated in the United Kingdom by BRE (Building Research Establishment) , a subsidiary of the largest UK charity dedicated to research and awareness in the built environment sector . The system was created in the late 1980s and launched in 1990 (Feijão et al., 2024). Today, BREEAM is applied in over 104 countries worldwide, with a wide range of certified projects.

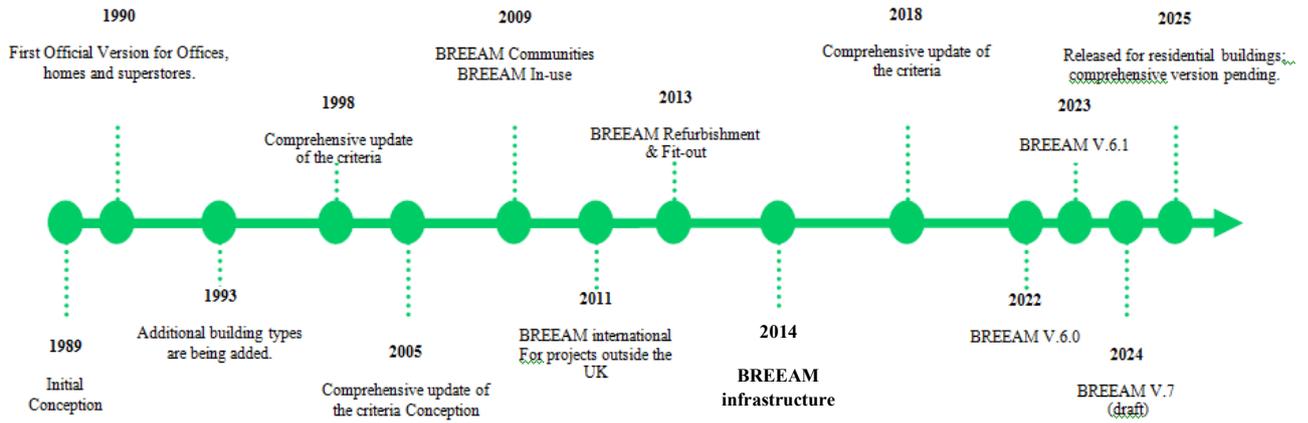


**Figure 12:** Global Reach and Impact of BREEAM. Source: Created by the authors based on the BREEAM Official Website, <https://www.breeam.com>



**Figure 123:** Global Distribution of BREEAM Certifications. Source: BREEAM Official Website, <https://www.breeam.com>

Since its inception in 1990, BREEAM has continuously evolved through periodic updates. Maintained by BRE Global, the system is regularly revised to remain aligned with contemporary sustainability challenges and international best practices. Each new version reflects progressive refinements in assessment criteria and evaluation methodologies, driven by stakeholder feedback, technological advancements, and shifting sustainability priorities.



**Figure 13:** Timeline of BREEAM versions. Source: Created by the authors based on multiple sources, including the official BREEAM website and BRE Group reports

**b. BREEAM Standards:**

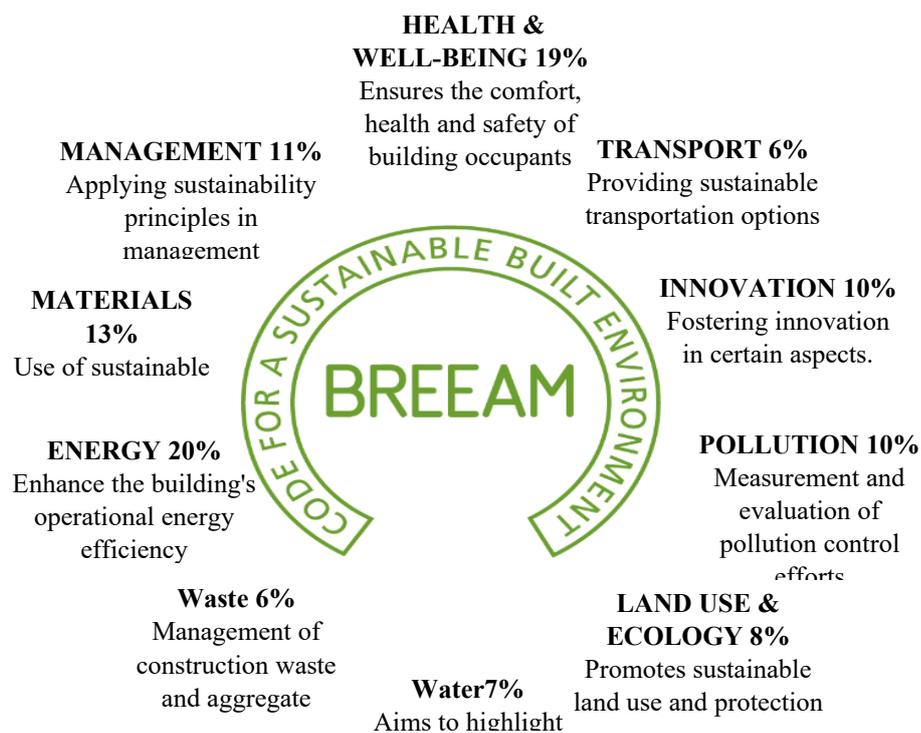
BREEAM includes several technical standards tailored to different project stages and building types, such as new construction, refurbishment, in-use buildings, infrastructure, and large-scale community developments.

These standards are further divided into schemes based on building function (e.g., offices, schools, healthcare) and geographical region (e.g., UK-specific and international versions). (Rezaallah et al., n.d.)

The detailed classification of BREEAM standards and schemes is provided in Annex 1.

**c. BREEAM categories:**

The BREEAM system is based on several categories to address all aspects of buildings, such as: Health, Transport, Building material, ...etc. Each category has different considerations involved in the assessment process (figure 15).



**Figure 14:** BREEAM Assessment Categories Source: Created by the authors based on BRE Global, 2023

**d. BREEAM System Evaluation Process:**

The BREEAM system evaluation process is the main tool adopted to obtain project certification. This process has several stages, which can be summarized as follows:

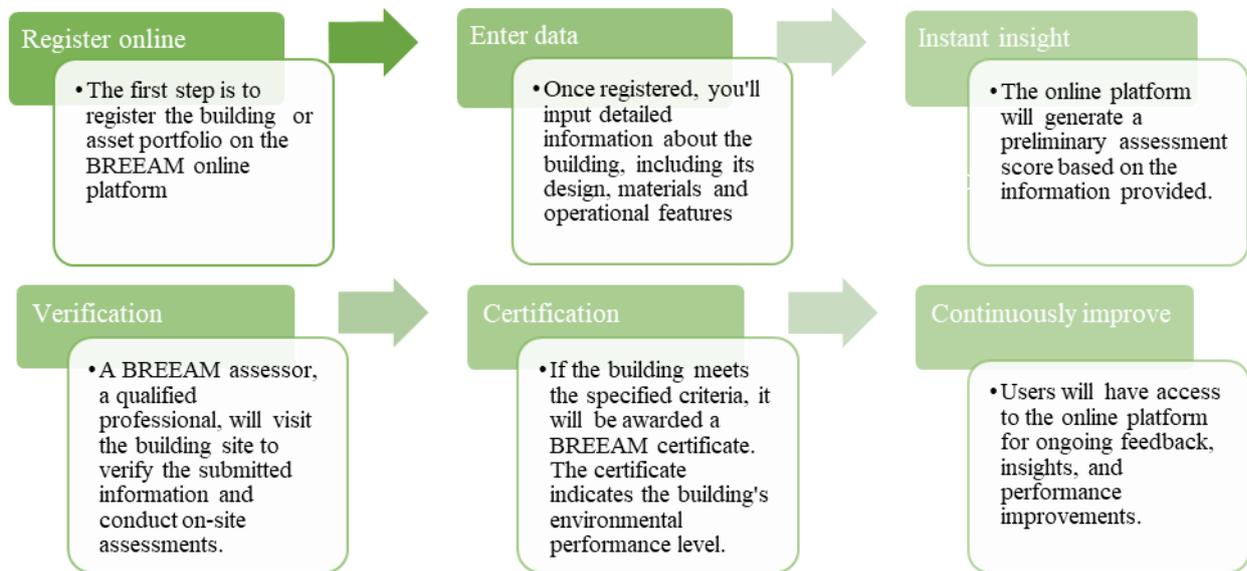


Figure 15: Steps of the BREEAM Certification Process. Source :Created by the authors based on BRE Global, 2023



Figure 16: Example of Interim Certificate at Design Stage. Source: BRE Global, 2023



Figure 17: Example of Final Certificate at Post-construction stage. Source: BRE Global, 2023

**e. Calculation Method:**

**-Check Mandatory Criteria:** First, ensure that all mandatory criteria (including those without associated credits) are met. Failure to meet any mandatory criterion results in a rating of zero.

**-Calculate Category Scores:** For each environmental category:

- Divide the number of credits achieved by the total available credits.
- Multiply the result by the category's weighting factor.
- Round the resulting score down to two decimal places.

- Calculate Total Score: Sum the rounded scores of all categories.
- Round the total score down to the nearest whole number.
- Determine Sustainability Level: Use the final total score to determine the appropriate BREEAM rating level(Rezaallah et al., n.d.).



Figure 18: Elemental Skanste– A business complex located in Riga, Latvia, awarded the BREEAM International New Construction 2016 certificate at the 'outstanding' level in 2024

### I.4.2 LEED Rating system:

#### f. Overview of the system:

LEED (Leadership in Energy and Environmental Design) was first introduced in the United States in 1998 by the U.S. Green Building Council (USGBC), a non-profit organization dedicated to promoting sustainable building practices. It is considered the most flexible green building rating system, currently used in 167 countries, and is the most widely recognized certification system worldwide(Sartori et al., 2021).

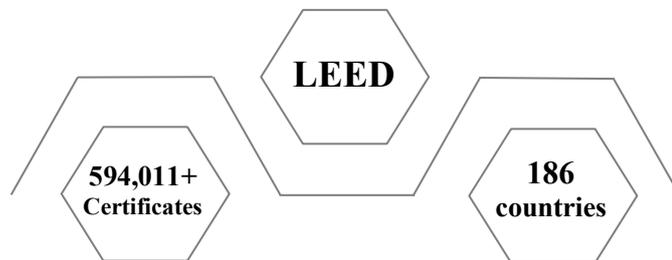


Figure 19: Global Reach and Impact of BREEAM.source:Created by the authors based on the LEED rating system | U.S. Green Building Council

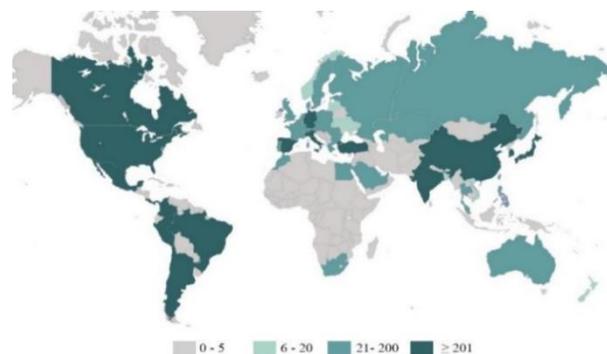


Figure 20: Countries with LEED certificates in the world and the number range source : (Kutlu & Bekar, 2023)

Since its inception in 1998, LEED has undergone continuous development through periodic version updates. Maintained by the U.S. Green Building Council (USGBC), the system is regularly revised to address emerging sustainability challenges and integrate global best practices (Amiri et al., 2019). Each version introduces enhanced criteria, reflecting advancements in building technologies, environmental policies, and stakeholder feedback. This ongoing evolution ensures that LEED remains a dynamic and globally relevant framework for assessing and promoting sustainable building practices.

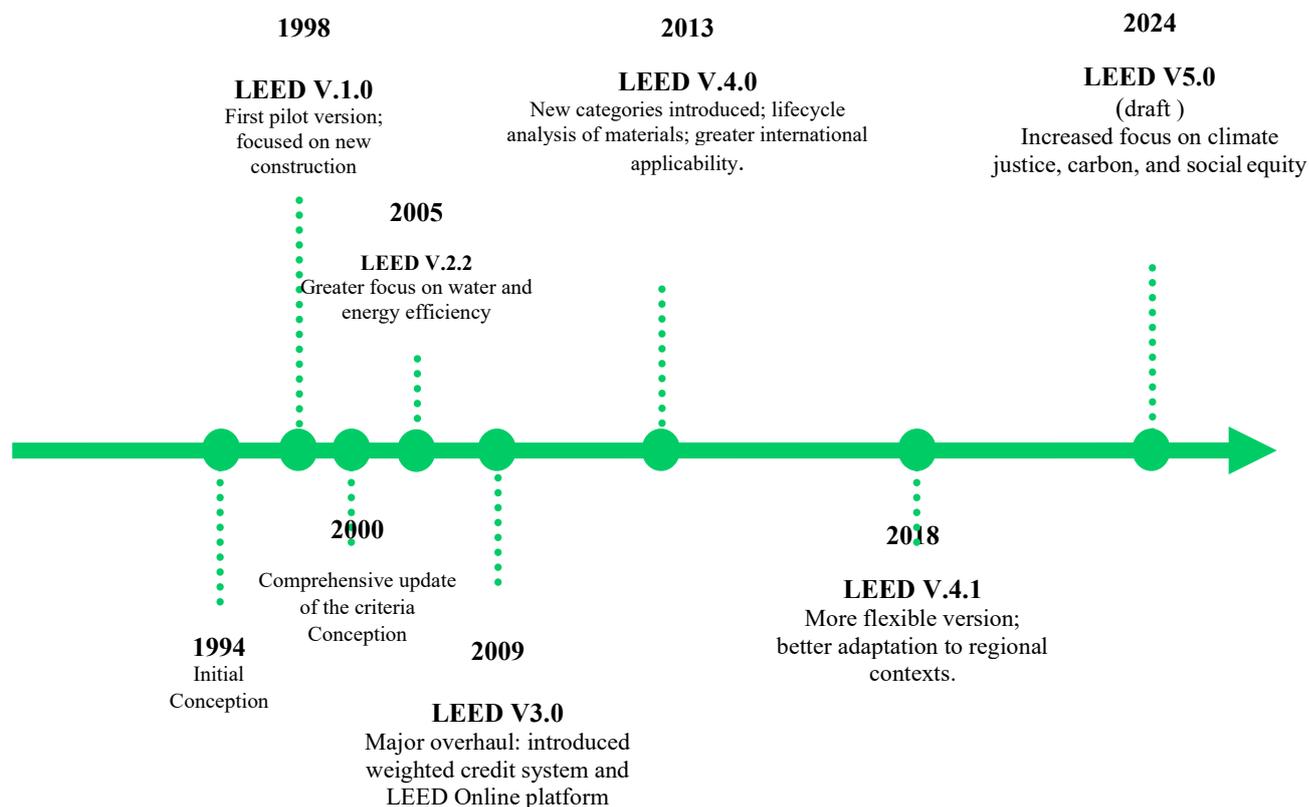


Figure 21: Timeline of LEED versions. Source: Created by the authors based on the LEED rating system | U.S. Green Building Council <https://www.usgbc.org/leed>

**g. LEED Standards:**

The LEED certification system includes a variety of rating systems tailored to different building types and project scopes, such as new constructions, existing buildings, schools, neighborhoods, and healthcare facilities. It has been adapted in several countries to suit local conditions, including India (LEED India), Italy (LEED Italy), and Canada (LEED Canada). Moreover, LEED has served as a reference for the development of regional frameworks such as Estidama in Abu Dhabi. Further details on the ten LEED rating systems are provided in Annex 2. (Rezaallah et al., n.d.)

**h. LEED categories:**

As THE BREEAM system, the LEED system of classification take into consideration several categories, which could be summarized as follows:

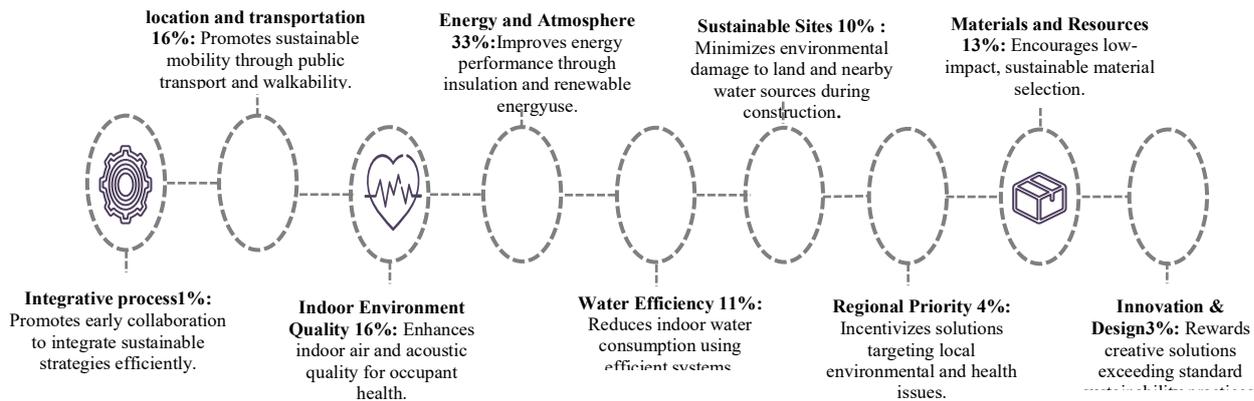


Figure 22 LEED Assessment Categories Source: Created by the authors based on on LEED rating system | U.S. Green Building Council <https://www.usgbc.org/leed>

Note: The weightings of the assessment categories in LEED may vary depending on the building type (e.g., offices, residential, educational, healthcare) and the specific version of the LEED standard. In this research, the reference used



Figure 23: LEED certification levels- a visual guide

**i. LEED System Evaluation Process:**

To certify a building using the LEED system, which is similar to the BREEAM system, special professionals called LEED Accredited Professionals (LEED APs) assist in collecting evidence and submitting the required documentation to the Green Building Certification Institute (GBCI). The GBCI is a non-profit organization affiliated with the U.S. Green Building Council (USGBC). Initially, the USGBC was responsible for all aspects of the LEED system, including developing the rating system, providing education and training, administering exams, and issuing certifications.

(Rezaallah et al., n.d.)



Figure 24 Example of GOLD LEED Certificate

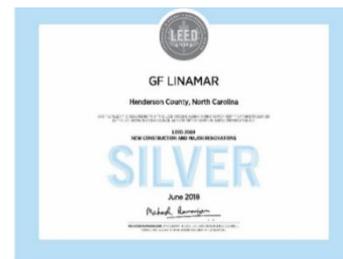


Figure 25 Example of SILVER LEED Certificate

**j. Calculation Methods:**

- LEED is a points-based system. Projects earn points by meeting specific criteria within various categories, All LEED rating systems have 100 base points, with Innovation and Regional Priority credits providing opportunities for up to 10 bonus points.
- There are mandatory requirements within each credit category that must be met. These prerequisites do not earn any points, but they establish the minimum level of sustainability performance required.
- All-or-Nothing Principle: In general, LEED criteria are binary; you either meet the requirements and earn the points, or you don't.
- Exceptions: There are exceptions to the all-or-nothing rule in three key areas:
  - Water Use Reduction
  - Optimize Energy Performance
  - On-Site Renewable Energy

These credits allow for partial points based on the level of performance achieved.

- Unlike some other rating systems, such as BREEAM, LEED does not use a multiplier system for points. The total score is simply the sum of all points earned across the categories

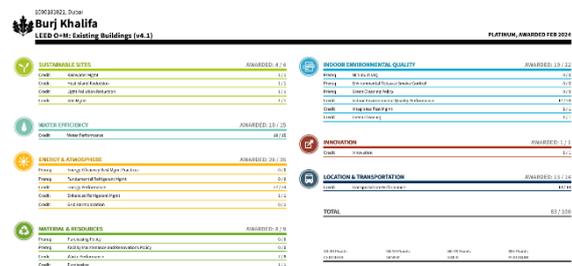


Figure 26: Burj Khalifa – Dubai, UAE – Certified LEED Platinum under LEED v4.1 for Existing Buildings in 2024

### I.4.3 HQE Rating system:

#### a. Overview of the system:

The High Environmental Quality (HQE) approach is the French model for applying sustainable development in the building sector. Initiated in 1996 by the HQE Association, it is a voluntary method that integrates environmental, economic, and social dimensions throughout the building's life cycle, from design to demolition. It helps project owners make sustainable choices at each phase, aiming to improve environmental performance, enhance user comfort, and ensure cost efficiency. (Tebbouche et al., 2023a)

In France, HQE is managed by three certification bodies: CertiVéA for non-residential buildings and urban planning, Cerqual for residential buildings, and Cequami for detached houses. Internationally, the certification is managed by Cerway and adapted to each country's context.

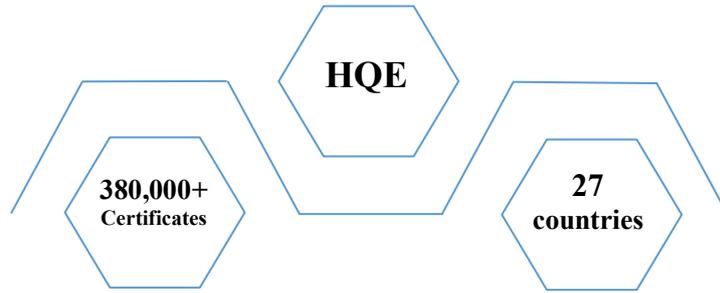


Figure 27: Global Reach and Impact of HQE. source: Created by the authors based on Certiv ea. (2023). HQE Certification: <https://www.certivea.fr>



Figure 28: Map of Some Countries with HQE Certified Projects. source: <https://www.qualitel.org/professionnels/certification-hqe-residential-international> (*Guide to Sustainable Building Certifications*, 2018)

To better respond to emerging environmental requirements and keep pace with social and technological developments, several HQE reference frameworks have been developed and are regularly updated.

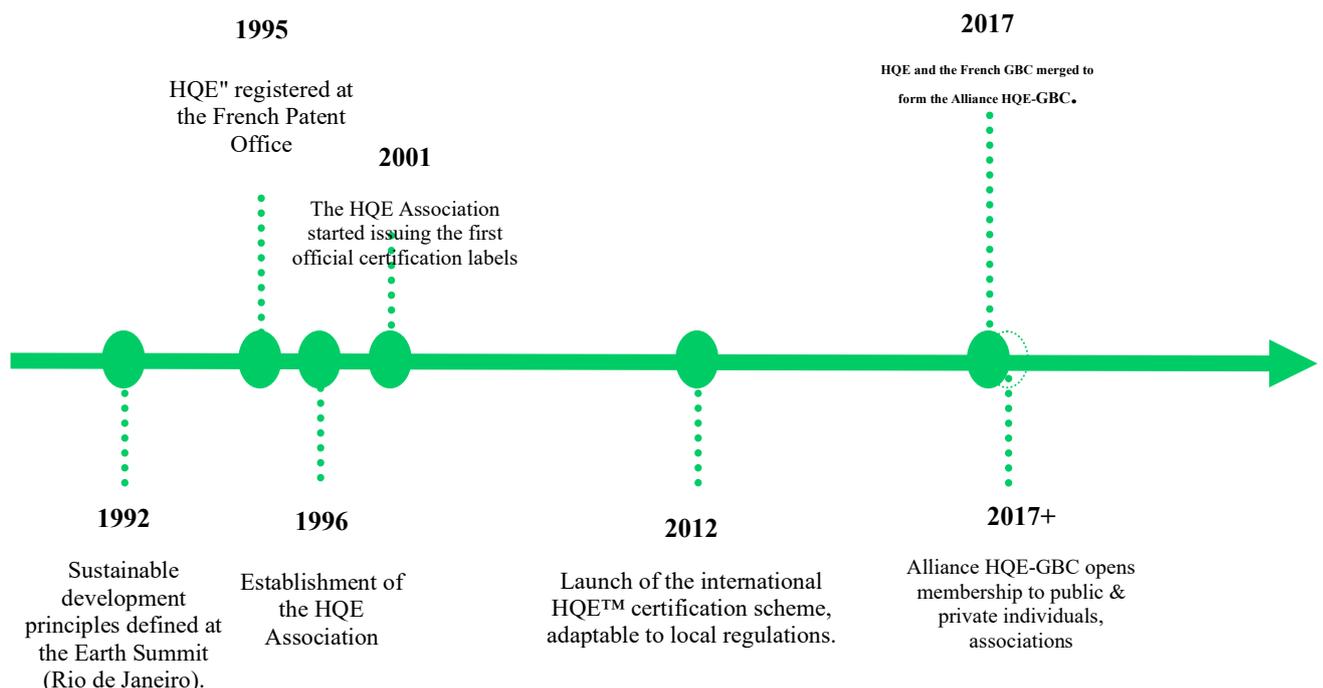


Figure 29: timeline of BREEAM versions. source: Created by the authors based on(Guide to Sustainable Building Certifications, 2018).

**b. HQE Standards:**

The HQE approach supports various building types and project phases by using reference standards that tailor environmental quality requirements to the specific context of each project, whether in construction, renovation, or operation. The table below outlines the key HQE reference standards developed for different building types and project phases:

Standards	Applications
NF - Individual House	New construction or renovation of individual homes
NF - Habitat & Environment	Residential housing with an environmental focus
NF - Housing	General housing projects
NF - Tertiary Buildings	Commercial, administrative, and service-sector
HQE Construction - NF Tertiary Buildings	New construction and renovation (non-residential)
HQE Operation - NF Tertiary Buildings	Existing buildings in operation
NF - Sports Facilities	Sports and athletic buildings
NF - Development (Aménagement)	Urban and infrastructure development

Table 2: HQE Standards. Source: <https://www.hqegbc.org/en/qui-sommes-nous-alliance-hqe-gbc/our-history-alliance-hqe-gbc/>

**c. HQE categories:**

The HQE certification system defines 14 main targets, which are grouped into four major thematic categories. Each of these targets is further divided into specific sub-targets, resulting in a total of 49 performance indicators. These sub-targets serve as detailed benchmarks for evaluating and

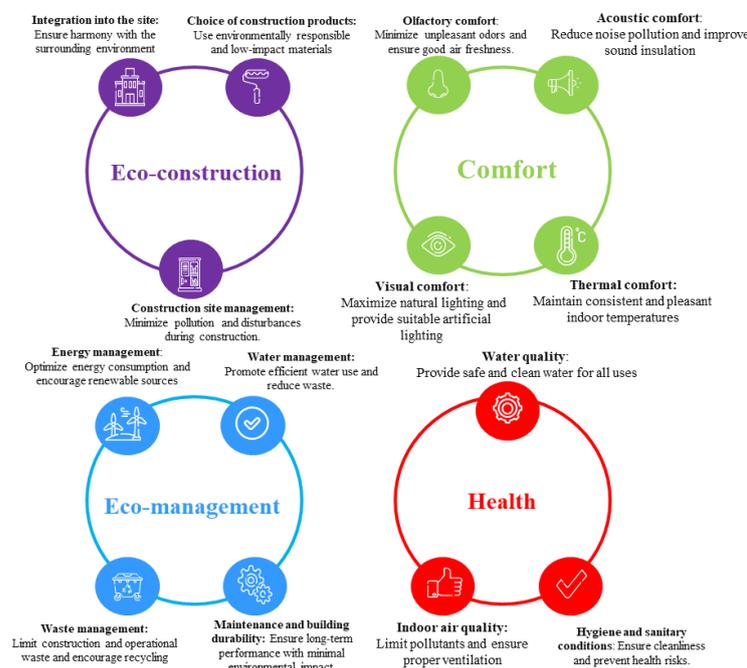


Figure 30: HQE Certification Categories and Targets. source: Created by the authors based on VMZINC & HQE® | VMZINC World

measuring the environmental, health, comfort, and management performance of a building.

**d. HQE rating benchmarks:**

HQE does not use a point-based or percentage-based system like LEED or BREEAM. The evaluation of the requirements contained in the HQE targets and sub-targets can be either quantitative or qualitative, depending on the nature of each indicator. Each target is assessed

individually, and the certificate issued indicates the level of performance achieved for that specific target.

To assess the building's performance, the calculated values of the indicators are compared with both the constraints imposed on the building and with benchmark reference values. Based on this analysis, one of three performance levels can be awarded for each target:

Performance level	Description
Base level (B)	Minimum acceptable performance. Often aligned with regulatory standards if they are sufficiently strict.
Performant level (P)	Represents good practices in the domain.
Very Performant level (VP)	Reflects the highest levels of performance observed in exemplary HQE projects.

Figure 31: HQE Performance level.

**e. Certification Conditions:**

To achieve HQE certification (for example, in the “NF Tertiary Buildings – HQE” framework), a building must meet the following criteria:

- Achieve at least 3 targets at the **Very Performant level**.
- Achieve 4 targets at the **Performant level**.
- Fulfill the remaining 7 targets at the **Base level**.

Each target is evaluated individually, allowing stakeholders the flexibility to prioritize specific aspects based on the project’s context. If these requirements are met, the building becomes eligible for HQE certification.

It is important to note that this evaluation method does not apply weighting factors to the different categories or targets. All targets are considered equally important within the overall assessment



Figure 32: Example of an NF HQE™ Tertiary Buildings certificate with 4 targets at the "Very Performant" level, 4 targets at the "Performant" level, and 6 targets at the "Base" level. Source: (Brochure\_enviroennementale\_technique\_eurocoustic, n.d.).

framework. (Tebbouche et al., 2023a)

-In the international version of the HQE system, building performance is assessed across four major themes. Each theme is rated on a scale from 0 to 4 stars, based on the number of points accumulated from the targets it contains. The overall performance of the building is then expressed as the sum of the stars earned across all four themes, with a maximum possible total of 16 stars (4 stars per theme).

Based on this total score, buildings are classified into five distinct performance levels, reflecting their degree of compliance with environmental quality objectives.

N°	Categories	Number of targets	Rate (%)
1	Site	01 of 14 targets (Harmonious relationship between building and neighborhood)	7%
2	Management	02 out of 14 targets (Maintenance management and low impact construction)	14%
3	Energy	01 of 14 targets (Energy management)	7%
4	Water	02 of 14 targets (Water management and sanitary water quality)	14%
5	Materials	01 of 14 targets (Choice of construction processes and products)	7%
6	indoor Environmental Quality	06 targets out of 14 (hydrothermal comfort, acoustic comfort, visual comfort, olfactory comfort, sanitary conditions of spaces, indoor air quality)	44%
7	Waste	01 of 14 targets (Activity waste management)	7%
	total		100%

Table 3: Weighting of the HQE approach categories. source: HQEGBC, 2015b

Level	Total stars
pass	4 to 6 stars
good	7to9 stars
Very good	10to12 stars
Excellent	13to 14 stars
exceptional	14to 16 stars

Table 4: Performance Levels for International HQE Certification.

**f. Comparison between HQE Classic and HQE International Certification:**

Criteria	HQE Classic (France)	HQE International
Managing Organization	Certivéa (France)	Cerway (International)
Assessment Approach	Qualitative (descriptive evaluation only)	Qualitative + Semi-Quantitative (stars, performance levels)
Performance Levels	No standardized levels	5 Levels: Pass, Good, Very Good, Excellent, Exceptional
Scoring System	Based on target compliance (no numeric scoring)	Star-based system: 0 to 4 stars per target
Main Categories	4 Categories, 14 Targets	Same: 4 Categories, 14 Targets
Calculation Method	Descriptive compliance for each objective	Star ratings + weighted evaluation of objectives

Table 5: Comparison between HQE Classic vs HQE International Certification. Source Author

Notes: the International HQE version was created to adapt the certification for non-French buildings and



Figure 33: Attijariwafa Bank Regional Headquarters in Souissi, Rabat – Morocco, certified HQE at "Excellent" level. Source : <https://www.financialafrik.com/en/2018/10/02/morocco-attijariwafa-bank-wins-new-certification/>

international regulatory contexts.

#### I.4.4 Estidama (Pearls Rating system):

##### a. Overview of the system:

ESTIDAMA, meaning "sustainability" in Arabic, represents the first environmental framework specifically developed to evaluate building sustainability within an Arab country in the Middle East. Launched in May 2008 as part of the strategic initiative “Plan Abu Dhabi 2030,” ESTIDAMA was introduced by the United Arab Emirates to promote advanced environmental standards in the built environment. This initiative was designed to address the unique challenges of sustainable development in the region, including harsh climatic conditions, as well as local cultural and social values. (Tebbouche et al., 2023b)

To operationalize its vision, ESTIDAMA established a comprehensive set of guidelines, regulations, and performance criteria aimed at measuring and guiding sustainability practices across various project phases. Its central tool, the Pearl Rating System (PRS), first released as Version 1.0 in April 2010 and updated in December 2016; serves as a sustainability assessment system promoting environmentally responsible building design, construction, and operation. The system is designed to be adaptive and continuously evolving to reflect advancements in sustainability practices. Furthermore, multiple benchmarks within the PRS have been tailored to accommodate a diverse array of building typologies across the Emirate of Abu Dhabi. (Australia, 2016)

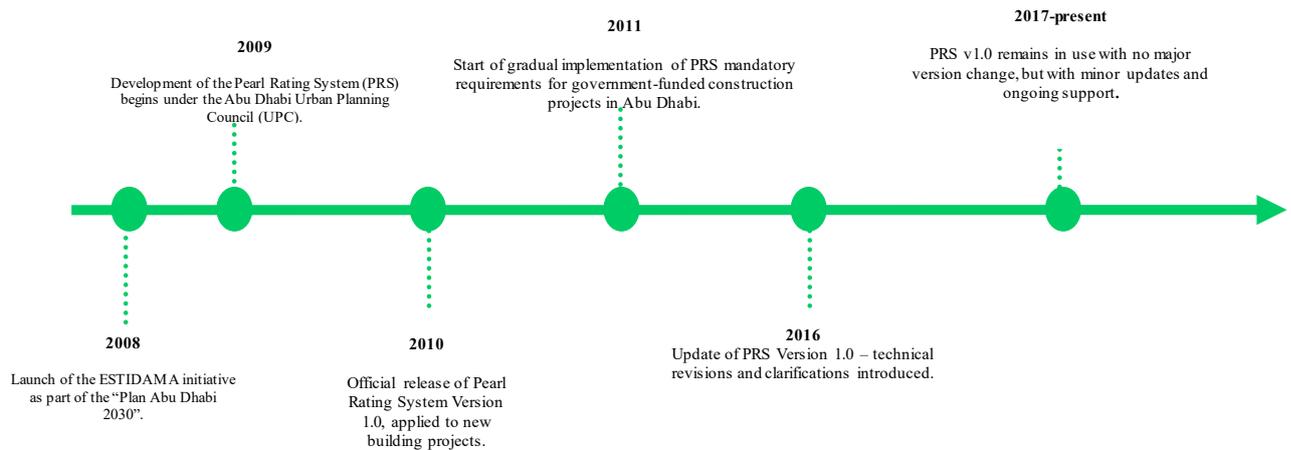


Figure 34: Timeline of PRS version . source :(Australia, 2016)

Since 2011, the Estidama program has been implemented as a mandatory sustainability assessment system within the urban planning framework of Abu Dhabi. Under this system, all new buildings are required to achieve at least a 1 Pearl Rating, while government-funded buildings, including public villas, must obtain a minimum of 2 Pearls. Compliance with the Pearl Rating System (PRS) is a prerequisite for obtaining building permits and completion certificates in the emirate. (<https://u.ae/>)

##### b. PRS Standards:

The Pearl Rating System includes three main guidelines, each addressing a distinct project category during the design and construction phases:

- Pearl Community Rating System

- Pearl Building Rating System
- Pearl Villa Rating System



Figure 35: Midfield Terminal Building, located at Abu Dhabi International Airport, UAE, was awarded the 3 Pearl Design Rating under the Estidama Pearl Rating System in 2013. Source: <https://www.gtrmag.com/assets/pdf/gulf-africa/business->

**c. PRS categories:**

The Pearl Rating System (PRS) outlines a comprehensive set of performance requirements organized into eight core categories and a total of 86 criteria. These categories include:



Figure 36: PRS Certification Categories. source: Created by the authors based on (Australia, 2016)

N°	Categories	Number of possible credits	Rate (%)
1	Integrated development process	13	8%
2	Natural systems	12	7%
3	Habitable building: Exterior	13	8%
4	Habitable building: Interior	23	12%
5	Precious water	43	24%
6	Energy resources	44	25%
7	Materials management	28	16%
	Total	177	100%
	Innovative practice	06 points awarded as bonus credits	

Table

6: Weighting of the PRS categories. source : (Australia, 2016).

Each category contains a mix of mandatory and optional credits. Points are awarded for fulfilling the optional credits, with a total of 177 points available. An additional 6 bonus points may be earned under the special category of Innovative Practices, recognizing advanced or exceptional sustainability strategies.

**d. PRS Evaluation Process:**

To certify a building under the Pearl Rating System (PRS), the process involves the following steps:

- Appointment of a PQP (Pearl Qualified Professional): A certified expert is required to lead the project's sustainability compliance.
- Design Rating Submission: The PQP prepares and submits required sustainability documentation at the design stage to the Department of Municipalities and Transport (DMT).
- Construction Rating Submission: After project completion, documentation and evidence (including photos and site audits) are submitted for the construction phase.
- Review and Site Audit: DMT conducts a review and may perform an on-site audit to verify compliance.
- Certification Awarded: Based on the credits achieved, the building is awarded a Pearl rating from 1 to 5.



Figure 37: Example of a Pearl Rating System Certificate

### e. Calculation Methods:

The Pearl Rating System uses a credit-based evaluation method to assess the sustainability performance of buildings:

- Mandatory Requirements: These are essential prerequisites that every project must fulfill to be eligible for certification. They do not earn points, but failure to meet them disqualifies the project from obtaining any rating.
- Optional Credits: Projects earn these by implementing sustainable strategies in various categories such as energy efficiency, water conservation, material selection, indoor environmental quality, and site ecology.
- The total number of credits achieved determines the final rating, which ranges from 1 to 5 Pearls. The more sustainability measures a project implements beyond the minimum, the higher the rating it can achieve.



Figure 38: Sheikh Zayed Desert Learning Centre – 5 Pearl Rating in Design Phase

### I.4.5 Comparison between these systems:

	<b>LEED</b>	<b>BREEAM</b>	<b>HQE</b>	<b>ESTIDAMA (PRS)</b>
<b>Full Name</b>	Leadership in Energy and Environmental Design	Building Research Establishment's Environmental Assessment Method	High Quality Environment	Pearl Rating System
<b>Country</b>	US	UK	France	Abu Dhabi
<b>Developed Year</b>	1998	1990	1996	2010
<b>Organizations</b>	USGBC (US Green Building Council)	BRE (Building Research Establishment )	ADEME (Agence de l'Environnement et de la Maîtrise Del 'Energie)	UPC (Urban Planning Council)
<b>Flexibility</b>	International	International	International	local
<b>Sustainability Categories</b>	-Integrative process -location and transportation - Indoor Environment Quality - Water Efficiency - Energy and Atmosphere - Sustainable Sites - Regional Priority - Materials and Resources - Innovation & Design process	- Health & Well-Being -Transport -Innovation -Pollution -Water -Waste -Energy -Materials -Management -Land Use & Ecology	-Integration into the site - Choice of construction products - Construction site management - Olfactory comfort - Acoustic comfort - Thermal comfort - Visual comfort - Energy management - Waste management - Energy management - Water management - Indoor air quality - Hygiene and sanitary conditions	-Integrated development process -Natural Systems - Habitable building: Exterior - Habitable building: Interior - Precious water - Energy resources - Materials management - Innovative practice
<b>Type of Buildings</b>	Residence, School, Retail, Commercial Building, Healthcare, Multifunction Building,Neighborhoods Development...	Office,Industrial,Education,Residential,Retail,Healthcare, Prison, Multifunction Building,Neighborhoods ...	Residential, Office, retail,Industrial, Education, Healthcare	-Offices ,Retail, Multi-residential, Schools
<b>Scope</b>	-New construction	-New construction	-New construction	-New

## Chapter I: Theoretical study

	-Refurbishment -Existing buildings	-Refurbishment -Existing buildings	-Refurbishment -Existing buildings	construction -Existing buildings
<b>No. of Certified Buildings</b>	594,011	79,418 (2021) +1,026,000 (till 2025)	380.00+	Not available
<b>No. of Countries Used</b>	186	104	27	Not available
<b>Ratings</b>	<ul style="list-style-type: none"> <li>• Certified 40-49 Points</li> <li>• Silver 50-59 Points</li> <li>• Gold 60-79 Points</li> <li>• Platinum 80+ Points</li> </ul>	<ul style="list-style-type: none"> <li>• Unclassified &lt; 30</li> <li>• Pass <math>\geq 30</math></li> <li>• Good <math>\geq 45</math></li> <li>• Very Good <math>\geq 55</math></li> <li>• Excellent <math>\geq 70</math></li> <li>• Outstanding <math>\geq 85</math></li> </ul>	<ul style="list-style-type: none"> <li>• Exceptional</li> <li>• Excellent</li> <li>• Very Good</li> <li>• Good</li> <li>• Pass</li> </ul>	<ul style="list-style-type: none"> <li>• 1 Pearl</li> <li>• 2 Pearl</li> <li>• 3 Pearl</li> <li>• 4 Pearl</li> <li>• 5 Pearl</li> </ul>

Table 7: Comparison Table of Major Sustainable Building Rating Systems. Source: Author

To better visualize how different sustainable building rating systems prioritize each criterion, the following graphs provide a comparative breakdown of individual categories across LEED, BREEAM, HQE, and Estidama.

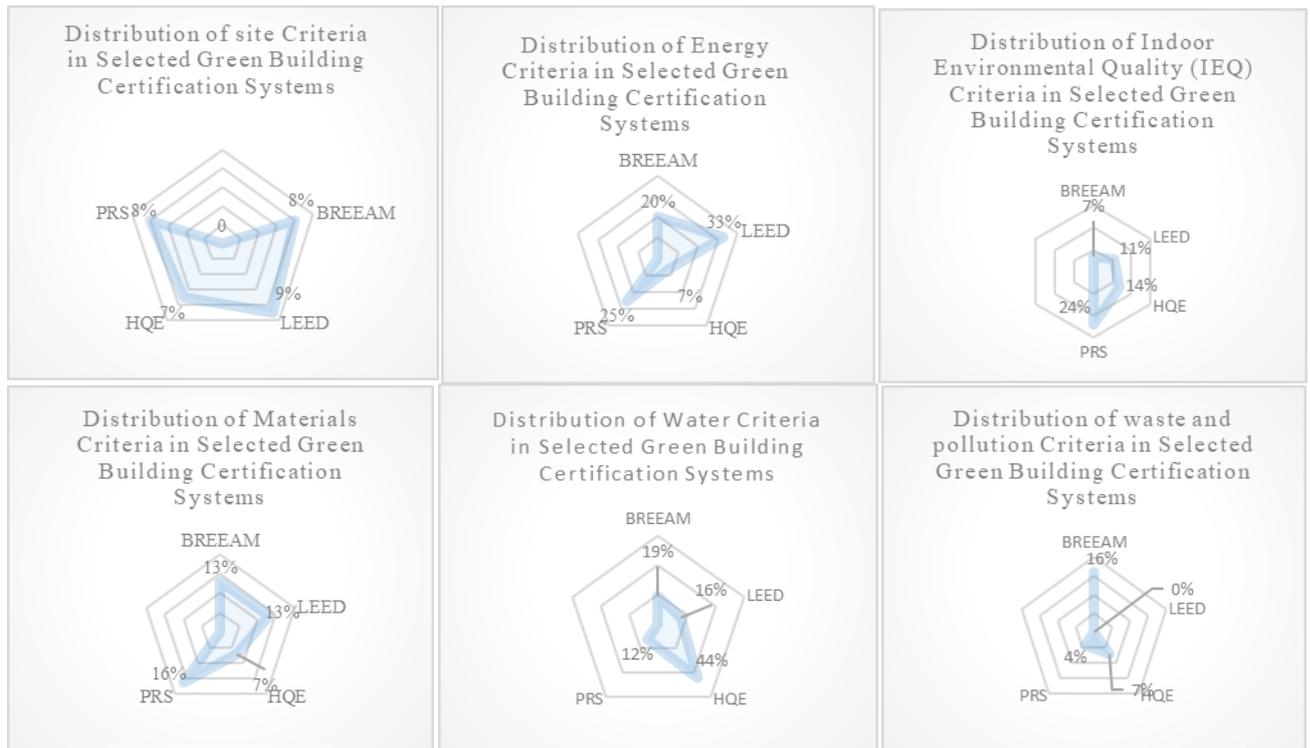


Figure 39 : Graphical Comparison of Sustainability Criteria Across Rating Systems. Source: Developed by Author

### I.4.6 Multi-Certified Sustainable Buildings:

In recent years, a growing number of buildings have pursued multiple sustainability certifications such as LEED, BREEAM, HQE, and others. This trend reflects not only a desire to validate a building's environmental performance across various international standards but also aims to increase marketability, attract global investors, and comply with different regional or institutional requirements. By obtaining more than one certification, developers seek to showcase comprehensive sustainability efforts, covering diverse aspects such as energy performance, indoor environmental quality, water efficiency, and innovation. (Suzer, 2019)



Figure 40: Challenger Headquarters, France – First building globally to achieve triple sustainability certification: LEED Platinum, BREEAM Outstanding, and HQE Exceptional"



Figure 41: City Hall (formerly The Crystal), London – A globally recognized sustainable building certified with both BREEAM Outstanding and LEED Platinum levels. source: City Hall: a world-leading sustainable building in the heart of the Royal Docks | Royal Docks

It is important to note that a building achieving a high rating under one certification system does not necessarily receive an equivalent score under another. This discrepancy stems from the different methodologies, weightings, and assessment criteria applied by each system. For instance, LEED places significant emphasis on energy and innovation, whereas BREEAM may assign more weight to management, land use, and ecological aspects. These divergent priorities can lead to variations in final scores for the same building. Additionally, contextual factors such as location, available materials, and local regulations can affect how credits are awarded, further contributing to score differences across systems. Therefore, while multi-certification can enhance a project's sustainability credibility, it also highlights the complexity of cross-comparison between

PROJECT	LOCATION	CERTIFICATE SYSTEM	SCHEME	YEAR AWARDED	OVERALL SCORE	RATING	AWARD LEVEL																
1	THE BLACKHORNS HEAD, LONDON/UK	LEED	COMMERCIAL INTERIORS v2	APRIL 2013	87 / 110	PLATINUM	I	11	GUINNESS BREWERY BUILDING, DUBLIN/IRELAND	LEED	NC v4	2013	90 / 110	PLATINUM	I	12	HERMAN MILLER HQ VILLAGE GREEN, CHIPPENHAM/UK	LEED	NC v 2.1	DECEMBER 2007	09 / 60	GOLD	II
		BREEAM	OFFICES	2014	70.68 / 110	EXCELLENT	II			BREEAM	COMMERCIAL (INDUSTRIAL) 2006	SEPTEMBER 2014	91 / 110	PLATINUM	I			BREEAM	OFFICES 2005	MAY 2006	72 / 110	EXCELLENT	II
2	BLOOMBERG ROBINVILT OFFICE, BUDAPEST/HUNGARY	LEED	COMMERCIAL INTERIORS v1	DECEMBER 2014	88 / 110	PLATINUM	I	13	HEWLETT PACKARD ENTERPRISE OFFICE, LONDON/UK	LEED	COMMERCIAL INTERIORS v3	SEPTEMBER 2016	84 / 110	PLATINUM	I	14	HYPERKAA KAUPPAREISETO BREA SHOPPING CENTRE, HYVINKAA/FINLAND	LEED	COMARSHILL 2013	JANUARY 2013	56 / 110	SILVER	III
		BREEAM	IN USE 2015	2015	87 / 110	VERY GOOD	III			BREEAM	OFFICES 2005	MAY 2006	72 / 110	EXCELLENT	II			BREEAM	INTERNATIONAL	JULY 2017	57.7 / 110	VERY GOOD	III
3	CAYLEN, LONDON/UK	LEED	COMMERCIAL INTERIORS v1	DECEMBER 2013	95 / 110	SILVER	III	15	JOHN LANG LASALLE OFFICE, MOSCOW/RUSSIA	LEED	COMMERCIAL INTERIORS v3	APRIL 2013	62 / 110	GOLD	II	16	CONCEPT TOWER, WARSAW/POLAND	LEED	COMARSHILL v3	2016	72 / 110	GOLD	II
		BREEAM	OFFICES	2012	80.13 / 110	VERY GOOD	III			BREEAM	OFFICES	2014	70.59 / 110	EXCELLENT	II			BREEAM	INTERNATIONAL	2013	47.75 / 110	GOOD	IV
4	CHALLENGER, VVELINES/FRANCE	LEED	NC v3	2014	91 / 110	PLATINUM	I	17	HYPERKAA KAUPPAREISETO BREA SHOPPING CENTRE, HYVINKAA/FINLAND	LEED	COMARSHILL 2013	JANUARY 2013	56 / 110	SILVER	III	18	CHALLENGER, VVELINES/FRANCE	LEED	NC v3	2014	91 / 110	PLATINUM	I
		BREEAM	INTERNATIONAL	2014	85.5 / 110	EXCELLENT	I			BREEAM	INTERNATIONAL	JULY 2017	57.7 / 110	VERY GOOD	III			BREEAM	INTERNATIONAL	2014	33.4 / 110	PASS	V

Table 8: Comparative Table of Buildings Certified with Both LEED and BREEAM. source: (Suzer, 2019)

rating tools.(Suzer, 2019)

#### I.4.7 Benefits of Environmental Rating Systems:

- **Recognize and Reward:** Publicly acknowledge buildings that demonstrate minimal environmental impact, thereby encouraging environmentally responsible design and construction.
- **Professional Guidance:** Provide clear and structured guidance for architects, builders, and other professionals on integrating green building principles into their projects. This includes practical recommendations such as using energy-efficient appliances and selecting environmentally friendly materials...
- **Promote Best Practices:** Encourage the adoption of environmentally sound practices throughout the entire building lifecycle, from planning and design to construction, operation, and maintenance.
- **Drive Innovation:** Stimulate the market to develop cost-effective and innovative solutions that minimize the environmental footprint of buildings.
- **Raise Awareness:** Educate building owners, tenants, designers, and developers about the long-term benefits and added value of environmentally sustainable buildings.(Feijão et al., 2024).

#### I.4.8 Disadvantages of Environmental Rating Systems

- **Time and Cost:** One of the main criticisms of environmental rating systems is the significant amount of time and money required for their implementation. For example, hiring specialized consultants to assist with the certification process can be costly.
- **Initial Costs:** Constructing a high-performance, sustainable building often involves higher upfront expenses. Estimates suggest that initial costs can increase by 12 to 14%, primarily due to consultancy fees and the need for high-quality, energy-efficient materials and systems.
- **Criticism from Experts:** Some well-known architects, such as Frank Gehry, have voiced concerns about these systems. Frank Gehry once stated that following systems like LEED

might be a waste of time and money. However, he later clarified that while he respects such systems, he cautions against becoming overly dependent on them. In his view, they should support sustainable design without becoming its sole focus. (Moktar, 2012)

### **Second section: sustainability in the Algerian context**

#### **I.5 sustainability in the Algerian context**

##### **I.5.1 Government Initiatives for Sustainable Buildings:**

Algeria has taken important steps toward integrating sustainability into its national development policies, particularly in the building and construction sector. As part of its environmental protection goals, the government seeks to balance urban expansion with the preservation of natural resources and improved energy efficiency in buildings.

###### **a. Legal and Regulatory Framework:**

Algeria enacted Executive Decree No. 05-16 (2005) related to energy efficiency in buildings, which mandates the integration of thermal insulation and energy performance considerations in architectural design

Law 04-09 makes it compulsory to incorporate renewable energy and energy efficiency standards in various sectors, including housing and construction.

Despite this legal framework, a large portion of state-sponsored housing projects (such as social housing and AADL) still fail to meet international environmental performance standards, resulting in excessive energy and resource consumption. (MCPCPD, n.d.)

###### **b. National Programs and Institutions:**

The National Agency for the Promotion and Rationalization of Energy Use (APRUE), established in 1985, oversees programs like the National Energy Management Program (PNME), funded up to 80% by the National Fund for Energy Management (FNME). (Razika, n.d.)

In 2022, Algeria launched the National Action Plan for Sustainable Production and Consumption (MCPD), which includes 42 measures across three pillars: governance, energy transition, and waste management. It promotes training, performance indicators, and sustainable public procurement. (*Programme National d'appui à La Mise En Œuvre de La Contribution Déterminée Au Niveau National (PNA-MCPD)*, n.d.)

###### **c. Energy Sector and Sustainable Construction:**

Algeria launched the AREP – Algeria Renewable Energy Program (2015–2030), aiming to produce 13.5 GW of solar energy by 2030. This program, through public-private partnerships, paves the way for integrating renewable energy into new buildings and urban developments. (Tedjani, n.d.)

In addition to solar energy, Algeria promotes the use of photovoltaic panels, solar water heaters, and wind energy systems in both public infrastructure and new urban developments. The ECO BAT project has significantly reduced heating and cooling energy consumption by up to 40% through improved thermal insulation, glazing, and solar technologies. (APRUE)

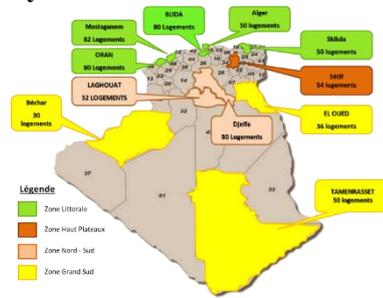


Figure 42: Geographic Spread of the ECO BAT Program in Algeria. source: APRUE

Stricter insulation standards are being enforced to reduce energy demand and improve building performance, aligning with Algeria’s goal to reduce reliance on fossil fuels and meet international sustainability standards. (APRUE)

Some of the projects that implemented the following solutions:

- Solar protection using light shelves
- Thermal inertia: Exterior and interior walls constructed with stabilized compressed earth blocks (BTS), and flooring made of terracotta tiles
- Double glazing and white-painted facades on sun-exposed orientations
- Use of solar water heaters (chauffe-eau solaires) for environmentally-friendly hot water provision.

	<p>30 HPE (High Environmental Performance) housing units in Djelfa.</p>		<p>82 housing units in Mostaganem: 1-40 (HPE) housing units in the Wilaya of TAZGAIT</p> <p>2-42 (HPE) housing units in the Wilaya of Hassi Mamache.</p>
	<p>80 HPE housing units in Blida.</p>		<p>54 HPE housing units in Sétif</p>
	<p>32 HPE housing units in Laghouat.</p>		<p>30 HPE housing units in Bechar</p>

Table 9: Some Projects in Algeria That Implemented Sustainable Solutions. source: APRUE

### **I.5.2 International Collaborations and Agreements:**

Although Algeria is not among the leading countries in international sustainable building partnerships, it has made significant contributions and established partnerships in the fields of energy, climate change, and environmental planning, which form the foundation for driving the building sector towards sustainability.

#### **A. International Agreements Algeria Has Joined:**

- **Agenda 2030 for Sustainable Development:** Algeria is committed to implementing the Sustainable Development Goals (SDGs), particularly Goal 11 (Sustainable Cities and Communities) and Goal 13 (Climate Action). (*Algeria - \_algeria\_renewable\_energy\_program\_arep\_-\_g-Dz-Fz0-Pre-001\_-\_par\_-\_sefa*, n.d.)
- **Paris Climate Agreement (COP21):** Algeria has submitted its Nationally Determined Contribution (NDC) to reduce emissions, opening the door for the promotion of green buildings. (*Programme National d'appui à La Mise En Œuvre de La Contribution Déterminée Au Niveau National (PNA-MCPD)*, n.d.)
- **Participation in Rio+20** and Implementation of the Ten-Year Framework of Programmes on Sustainable Consumption and Production (10YFP) under the United Nations Environment Programme. (*Programme National d'appui à La Mise En Œuvre de La Contribution Déterminée Au Niveau National (PNA-MCPD)*, n.d.)

#### **B. Technological and Financial Partnerships:**

- **SwitchMed Program (funded by the European Union):** Direct support for the development of public policies on sustainable consumption and production. This program is executed in collaboration with UNEP (United Nations Environment Programme) and UNIDO (United Nations Industrial Development Organization). (*Programme National d'appui à La Mise En Œuvre de La Contribution Déterminée Au Niveau National (PNA-MCPD)*, n.d.)
- **African Development Bank (AfDB):** Support for Algeria's Renewable Energy Program (AREP), with funding for the development of the legal and technical framework for independent solar energy projects that will be used in sustainable buildings. (Tedjani, n.d.)
- **The German Agency for International Cooperation (GIZ)** plays an indirect but strategic role in Algeria's sustainable transition. While not directly involved in green building projects, GIZ supports initiatives related to renewable energy, energy efficiency, and environmental governance. Through training programs, policy advisory, and technology transfer, it helps strengthen Algeria's institutional capacity to manage resources sustainably. These efforts lay the groundwork for future integration of sustainable construction practices in national development strategies. (*Algeria - \_algeria\_renewable\_energy\_program\_arep\_-\_g-Dz-Fz0-Pre-001\_-\_par\_-\_sefa*, n.d.)

### **I.5.3 Private Sector and NGO (Non-governmental organization) Contributions:**

In Algeria, various non-governmental organizations, private sector actors, and grassroots initiatives have played a vital role in supporting sustainable development. Their contributions span across multiple fields including renewable energy, waste management, environmental preservation, and public awareness. The following classification highlights key initiatives based on their area of impact:

#### **a. Renewable Energy Initiatives**

- **National Renewable Energy and Sustainable Development Organization (Noresd):** This NGO focuses on promoting awareness of renewable energy and supporting the energy

transition at the local level, particularly in regions like El Bayadh. It plays a central role in fostering a sustainable energy culture in Algeria.

- **EnviroTech International Exhibition:** An international platform hosted in Algeria that showcases the latest technologies and solutions in renewable energy, environmental protection, and water treatment. It gathers participation from both private companies and institutional actors to promote innovation in the green sector.

### b. Waste Management and Recycling Initiatives

- **Moustafi Application:** A digital platform that connects truck owners with individuals or institutions in need of recyclable waste collection (such as plastics and cardboard). It provides an economic opportunity for transporters while contributing to environmental preservation through waste reduction and recycling.
- **Dzayer Bénévole Association:** A youth-led volunteer initiative that organizes clean-up campaigns on beaches and in forests. The association also promotes recycling and environmental education through its nationwide awareness activities.

### d. Tree Planting and Environmental Preservation Initiatives

- **Dzayer Bénévole Association:** In addition to clean-up efforts, this association carries out large-scale tree-planting campaigns aimed at restoring green spaces and enhancing environmental resilience.
- **Green Bike Association :** Based in Annaba, this initiative combines eco-friendly mobility and volunteer action. Members use bicycles to move between clean-up sites and promote sustainable transport, while engaging in environmental campaigns and community events.

### e. Environmental Awareness and Education Initiatives

- **Environmental Awareness Programs in Schools:** Several organizations and institutions lead awareness campaigns targeting school children. These programs aim to educate future generations about the importance of environmental protection, renewable energy, recycling practices, and sustainable living.

## I.5.4 Challenges in Achieving Sustainability in Algeria:

Although Algeria has progressed in implementing sustainable construction principles, multiple barriers impede their widespread adoption and effective application. These challenges include institutional, economic, and technological issues, as well as challenges related to public awareness and media.

### A. Institutional and Organizational Challenges:

- **Weak coordination between institutions:** Poor inter-ministerial collaboration (particularly between Energy, Environment, and Housing ministries) in executing sustainable construction policies has led to disjointed strategies and limited private sector engagement in sustainable projects. (*APRUE*.)
- **Gap between legislation and implementation:** Although Algeria has adopted some legal texts and national initiatives related to energy efficiency and environmental protection, the actual enforcement remains weak. This is due to the lack of effective monitoring mechanisms and the absence of penalty or incentive systems that would ensure compliance. (*Algeria - algeria\_renewable\_energy\_program\_arep - g-Dz-Fz0-Pre-001 - \_par - \_sefa*, n.d.)

### B. Economic and Financial Challenges:

- **Difficulty accessing financing:** Private developers encounter substantial hurdles in securing affordable funding for sustainable construction, as conventional banks prioritize short-term ROI projects over long-term sustainable investments. (Razika, n.d.)
- **Lack of strong financial incentives:** The private sector lacks the financial incentives and tax benefits that encourage investment in advanced environmental technologies such as green building and renewable energy. (Tedjani, n.d.)

### C. Technological and Technical Challenges:

- **Lack of technical expertise:** While Algeria possesses academic knowledge in sustainability, practical expertise in sustainable construction remains limited. The lack of specialized training programs for architects and contractors in green building technologies hinders practical implementation. (Besbas et al., 2022)
- **Limited availability of sustainable construction materials:** There is a shortage of eco-friendly and energy-efficient building materials in Algeria, such as thermal insulators, certified low-carbon concrete. Many sustainable products are imported at a high cost, making them unaffordable for most public and private projects. (APRUE.)

### D. Social and Cultural Challenges:

- **Lack of awareness about sustainability and its benefits:** Sustainable building concepts are still not widely adopted, mainly due to insufficient awareness of the importance of this field and its environmental, economic, and social benefits. (*Programme National d'appui à La Mise En Œuvre de La Contribution Déterminée Au Niveau National (PNA-MCPD)*, n.d.)
- **Traditional architectural culture:** Traditional architectural styles remain a key element in building design in Algeria, which presents a challenge in transforming these buildings to be more sustainable using modern and environmentally friendly techniques. (*Algeria - \_algeria\_renewable\_energy\_program\_arep\_-g-Dz-Fz0-Pre-001\_-par\_-sefa*, n.d.)

## I.5.5 Limits and Challenges of Applying Global Sustainability Systems in Algeria:

Despite the valuable frameworks offered by international sustainability standards such as LEED, BREEAM, and HQE, their application in Algeria faces several challenges. One of the primary limitations is the lack of adaptation to Algeria's specific climatic and cultural conditions, particularly the country's semi-arid climate. These systems were designed with temperate climates in mind and often overlook the unique environmental factors that impact building performance in Algeria.

Furthermore, the current stage of development and available technology in Algeria, combined with locally available materials, make it difficult to fully apply these methods. The high implementation costs, including specialized materials, training, and technical expertise, make these methods less practical for many local projects, especially in the public sector. (Tebbouche et al., 2017)

In response to similar challenges, several countries have developed national sustainability assessment systems tailored to their own environmental, social, and economic contexts. A notable example is the United Arab Emirates, which created the Pearl Rating System, designed to suit the country's arid climate and strategic development goals.

Available data comparing key indicators before and after the implementation of this national system demonstrate significant improvements in sustainability performance; particularly in energy efficiency and CO<sub>2</sub> emissions as presented in the following table:

Before Implementing the System	After Implementing PRS (Since 2010)
High Energy Consumption: According to the UAE Ministry of Energy, before the implementation of the environmental rating system, the building sector in the UAE consumed approximately 70% of the total electricity used in the country.	Improved Energy Efficiency: Following the implementation of the PRS system, energy consumption in green buildings decreased by approximately 30%.
High Carbon Emissions: A report from the UAE Federal Authority for Electricity and Water indicated that buildings were responsible for approximately 40% of the carbon emissions in the country.	Reduced Carbon Emissions: Carbon emissions from buildings were reduced by approximately 20% following the implementation of the environmental rating system.
High Operating Costs: According to the UAE Green Building Council, the operating costs of conventional buildings were 25% higher compared to green buildings.	Reduced Operational Costs: The operational costs of green buildings decreased by approximately 20% to 40%, resulting in significant financial savings.
	Increased Market Value of Buildings: Green buildings became more attractive to investors, with an increase in market value of approximately 15%.
	Job Creation: the implementation of the environmental rating system contributed to the creation of thousands of jobs in the renewable energy, sustainability, and green building sectors.

Table 10: Impact of Implementing Environmental Rating Systems on Building Performance in the UAE. source: Created by the authors based on multiple sources, including Official Websites of the UAE Ministry of Energy, UAE Federal Authority for Electricity and Water, UAE Green Building Council

## **I.6 Conclusion:**

In this chapter, we laid the theoretical groundwork necessary for understanding and applying sustainability in the construction field. We explored the core concepts and dimensions of sustainability, its integration in the building sector, and the challenges and benefits it presents. We also reviewed the main international sustainability assessment systems; such as BREEAM, LEED, HQE, and ESTIDAMA; highlighting their structures, indicators, and relevance. Finally, we examined how sustainability is approached in the Algerian context, through governmental policies, international cooperation, and civil society initiatives.

This theoretical foundation will serve as a guide for the next chapters, where we move into the analytical and practical application phases, in order to propose a sustainability assessment model adapted to Algeria's specific context and integrate it into an architectural design project.



# **Analytical Study**

## **II.1 Introduction:**

This chapter focuses on a comprehensive analysis of several literary and existing examples of architectural schools to gain a deeper understanding of the current state of architectural education in relation to sustainability. But first, we will provide an overview of architectural schools. Then, we will analyze the examples. This analysis will also explore the functioning of these spaces. Then, we will conduct a contextual analysis, specifically focusing on data from the city of Biskra. This includes a climate analysis and a thorough site analysis. The objective of this analysis is to integrate the specific climatic and morphological data of the region into the design phase, which will be important for making design decisions .

## **II.2 Overview of Architectural Education:**

### **II.2.1 Definition of teaching :**

According to Gérard Barnier (2001), the term "teaching" can be understood in three main ways:

1. **Transmitting knowledge:** The traditional view where the teacher clearly delivers accurate information to students.
2. **Training behaviors:** Teaching aims to shape learners' habits and behaviors through repetition and practice.
3. **Constructing knowledge:** A learner-centered approach where students actively build their own understanding through discovery and collaboration.

#### **- Teaching levels:**

Pre-primary education

Primary education

Middle school education

Secondary education (high school)

Tertiary (higher) education – university or college:

- **Faculty:** A major academic division within a university covering a broad field of study. It often includes several schools or departments (e.g., Faculty of Science, Faculty of Engineering).
- **School:** A subdivision within a faculty, focused on a specific discipline (e.g., School of Architecture within the Faculty of Engineering).
- **Department:** The smallest academic unit, dealing with a specialized subject area within a school or faculty.

### **II.2.2 Definition of architecture :**

Architecture is the art and science of designing and organizing buildings. It combines creativity, technical knowledge, and engineering. Architecture reflects culture, history, and technology, and can serve functional, symbolic, or societal roles. (*Arch Définition*, n.d.)

And **according to Marcus Vitruvius**, a great Roman architect and historian, architecture should have three qualities : firmness, utility, and beauty.

- Firmness means the building is strong and will last.
- Utility means it does its job well.
- beauty means it's pleasing to look at and makes people feel good.

### **Architecture according to Larousse :**

The art of building

Character, order, style of a construction : Monument of beautiful architecture

### **II.2.3 History of Architecture:**

#### **1. Prehistoric and Ancient Civilizations:**

Architecture began with basic shelters. As civilizations advanced (Mesopotamia, Egypt, Indus Valley), they built monumental structures like ziggurats, pyramids, and temples.

#### **2. Classical and Medieval Periods:**

Greek architecture emphasized harmony and proportion with columns and temples.

Romans introduced arches, vaults, and domes (e.g., Pantheon).

The Middle Ages saw Romanesque and Gothic styles—stone cathedrals with pointed arches, ribbed vaults, and flying buttresses.

#### **3. Renaissance and Baroque:**

The Renaissance revived classical principles (symmetry, geometry) through architects like Brunelleschi.

Baroque architecture added grandeur, movement, and ornamentation, as seen in Versailles and the Trevi Fountain.

#### **4. Industrial Revolution & Modernism:**

New materials (steel, glass) enabled skyscrapers and bridges.

Movements like Bauhaus and Modernism emphasized minimalism, function, and clean forms, led by figures like Le Corbusier and Mies van der Rohe.

#### **5. Postmodernism to Contemporary Architecture:**

Postmodernism reintroduced history, color, and symbolism as a critique of Modernism.

Today, digital design, sustainability, and innovations like 3D printing are shaping architecture.

#### **6. Sustainable Architecture and Beyond:**

In the 21st century, sustainability is key. Projects like the LEED-certified One World Trade Center embody ecological responsibility and cultural remembrance.

### **II.2.4 History of Teaching Architecture:**

From ancient apprenticeships to modern digital studios, architectural education has evolved with humanity's relationship to space and culture.

1. **Ancient Times:** Learning happened through hands-on apprenticeships on construction sites.

2. **Medieval Era:** Knowledge passed through guilds and religious institutions using geometry in spiritual and structural designs.

3. **Renaissance:** Architecture became a scholarly pursuit. Drawing and theory were central, and academies emerged.
4. **Beaux-Arts Model (18th–19th c.):** The École des Beaux-Arts system formalized studio-based training, classical drawing, and competitions
5. **Bauhaus and Modernism:** The Bauhaus school merged art, craft, and industrial design, rejecting classical traditions
6. **Postmodernism (1960s–1980s):** Introduced cultural critique and embraced diversity, symbolism, and contradiction
7. **Today:** Education includes digital tools (e.g., Revit, Rhino), sustainability, and global collaboration. It is increasingly interdisciplinary.

### II.2.5 Definition of Architecture school

An architecture school (also known as a school or college of architecture) is a professional institution dedicated to training future architects. It offers rigorous academic programs that combine:

Theoretical studies: such as history of architecture, design theory, building technology, structural engineering, urban planning, and environmental studies.

Practical training: including architectural drawing, 3D modeling, design studios, model making, and site visits.

Students develop creativity, analytical thinking, and technical skills to design buildings that are both aesthetically pleasing and functionally effective. Architecture schools also emphasize sustainability, environmental impact, and legal/regulatory aspects of the profession.

### II.2.6 Design Guidelines and Space Requirements for Educational Spaces:

Designing educational spaces involves a detailed approach that ensures environmental comfort, spatial efficiency, and the well-being of users. Different educational spaces, such as classrooms, studios, and libraries, have distinct requirements that must be met to facilitate effective learning experiences. The following table combines both the design guidelines and specific space requirements for various educational space types, summarizing essential factors such as space dimensions, acoustics, lighting, and other relevant considerations.

Space Type	Activity	Shape	Area per Student	Lighting	Acoustics	Other Notes
<b>studio</b>	Drawing, information exchange between student and teacher	Square or rectangular	3.5 m <sup>2</sup> – 4.5 m <sup>2</sup>	500–850 lux	Max 40 dB(A); reverberation ≤ 0.8 sec	North-facing windows; flexible furniture
<b>Classroom</b>	Teaching, communication, information exchange	Square or rectangular	2.2 m <sup>2</sup> per student	325 lux	Max 35–40 dB(A); reverberation ≤ 0.6 sec	Windows ≥ 20% of floor area; height ≥ 2.7 m
<b>Amphitheater / Lecture Hall</b>	Lectures, information exchange	Various	1 m <sup>2</sup> per student	80 lux	Max 40–45 dB(A); reverberation ≤ 1.0 sec	Tiered seating; good sightlines; strong sound system
<b>Library</b>	Reading, consultation, research	Flexible	1.2 m <sup>2</sup> per student	500 lux	Max 35 dB(A); reverberation	Quiet zones; mix of natural and artificial light

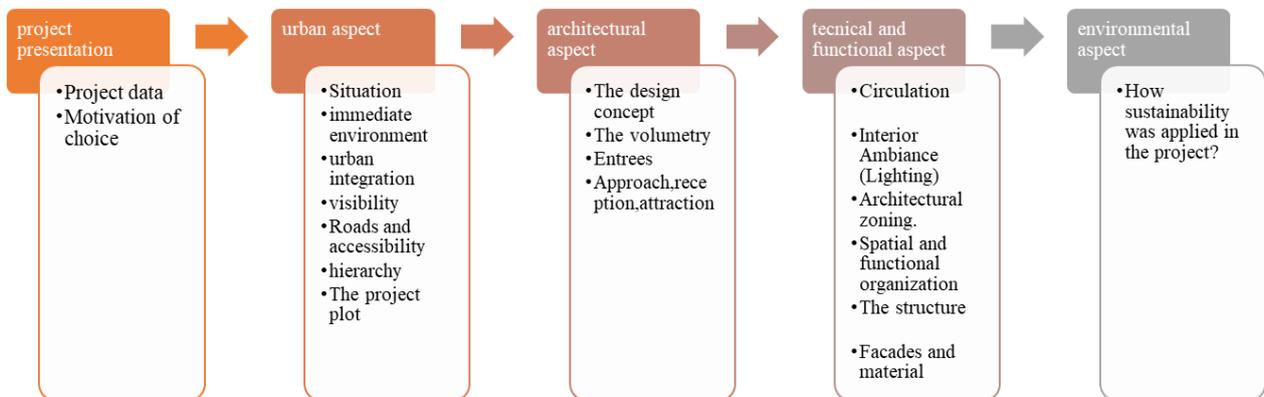
					≤ 0.5 sec	
<b>Exhibition Area</b>	Display of student works – may include circulation	Various	Not specified	425 lux	Max 40 dB(A); good insulation	Non-slip floors; high ventilation (15–20 L/s per person)
<b>Circulation Spaces</b>	Space Hallways, stairs – movement between areas	Linear / stepped	Depends on use	80–250 lux	Max 45 dB(A)	Accessible ramps, elevators, wide doorways

### II.3 Analysis of examples:

• **The list of examples:**



• **The elements to be analyzed:**



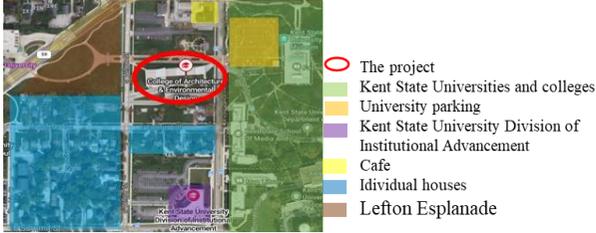
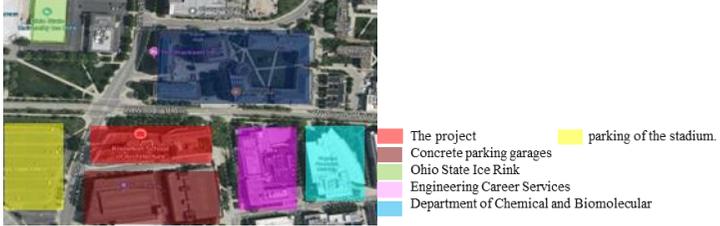
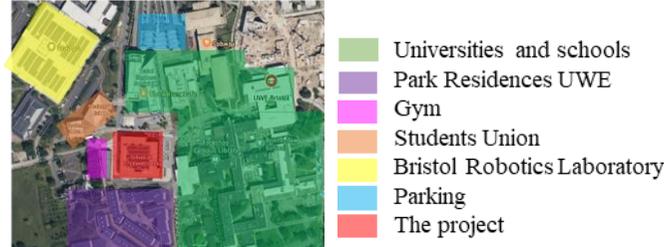
II.4 The examples analysis (bookish +existing):

The Project	Project data	Motivation of choice
 <p>Faculty of Architecture, Civil Engineering, and Hydraulics Engineering</p>	<p>-<b>Category</b> : Faculty of Architecture, Civil Engineering and Hydraulics Engineering .                      -<b>Date of realization</b> : 2009                      -<b>Architect</b> : oumane abd karim and ariouet brahim                      -<b>Area</b> : 10039.26 m2                      -<b>Location</b> : Situated in the east of Biskra , Algeria                      -<b>Number of storeys</b> : Ground floor + 3 floors                      -<b>capacity</b> : 1500 students (It was calculated based on the students capacity of workshops , classrooms and lecture halls)</p>	<p>The faculty was selected due to its strategic location within an arid climatic zone, offering a distinctive context for examining sustainable architectural practices, as well as the presence of on-site student, which facilitates comprehensive spatial and environmental analysis</p>
 <p>Kent State Center for Architecture and Environmental Design</p>	<p>-<b>Category</b> : Center for Architecture and Environmental Design (Educational : University )                      -<b>Date of realization</b> : 2016                      -<b>Architect</b> : Weiss/Manfredi                      -<b>Area</b> : 10869.66m2                      -<b>Location</b> : Kent, Ohio , United States                      -<b>Number of storeys</b> : Ground floor + 3 floors + basement                      -<b>capacity</b> : 650 students</p>	<p>The selection of this project is due to its distinctive architecture and its LEED certification, making it an ideal subject for study</p>
 <p>Knowlton school</p>	<p>-<b>Category</b> : a school of architecture, landscape architecture and city and regional planning                      -<b>Date of realization</b> : 2004                      -<b>Architect</b> : Mack Scogin Merrill Elam Architects                      -<b>Area</b> : 12541.905 m2                      -<b>Location</b> : Columbus, Ohio , United States                      -<b>Number of storeys</b> : Ground floor + 4 floors + basement                      -<b>Capacity</b> : 900 students</p>	<p>The project was selected because of its beautiful and unique design as well as its impressive spaces .</p>
 <p>School of Engineering</p>	<p>-<b>Category</b> : School of Engineering (Aerospace ,Civil ,Mechanical ,Robotics and Electronics, Automotive and Environmental Engineering)                      -<b>Date of realization</b> : 2020                      -<b>Architect</b> : AHR team                      -<b>Area</b> : 8500 m<sup>2</sup>                      -<b>Location</b> : Bristol, United Kingdom                      -<b>Number of storeys</b> : Ground floor + 2 floors                      - <b>Capacity</b> : 1600 students</p>	<p>Given its sustainable design and BREEAM certification, this project has been selected for analysis</p>

## Chapter II: Analytical study

 <p>National School of Architecture of Nantes</p>	<p>-<b>Category</b> : National School of Architecture of Nantes          -<b>Date of realization</b> : 2009          -<b>Architect</b> : Lacaton &amp; Vassal          -<b>Area</b> : 15150 m2          -<b>Location</b> : France          -<b>Number of storeys</b> : Ground floor+6 floors          -<b>capacity</b>: 850 students</p>	<p>The selection of the project is due to its architecture and its different context</p>
 <p>Polytechnic School of Architecture and Urban Planning –EPAU</p>	<p>-<b>Category</b>: Polytechnic School of Architecture and Urban Planning          -<b>Date of realization</b>: in 1970          -<b>Architect</b>: OSCAR NEMEYER /JAQUES DELLUZ          -<b>Area</b>:3.75 ha          -<b>Location</b>: Algiers. Algeria          -<b>Number of stories</b>: ground floor + 2floors          - <b>Capacity</b> : + 1600 student</p>	<p>The selection of the Polytechnic School of Architecture and Urban Planning (EPAU) is justified by its prominent national reputation, positioning it as a comprehensive and influential case study for advancing sustainability in architectural education.</p>

The project	Situation and climate	The immediate environment
<p>Faculty of Architecture, Civil Engineering, and Hydraulics Engineering</p>	<p>It is situated on a university campus in the eastern part of Biskra.</p>  <p>The project  university campus </p> <p>Biskra has a <b>hot desert</b> climate :</p> <p>Extremely Hot Summers: Summers are hot and dry with temperatures often exceeding 40°C .</p> <p>Mild Winters: Winters are mild and relatively dry .</p> <p>Low Rainfall: Rainfall is scarce throughout the year .</p>	 <ul style="list-style-type: none"> <li> The project</li> <li> Parking</li> <li> Auditorium</li> <li> The ancient college of architecture</li> <li> computer science department</li> <li> Department of Mechanical Engineering</li> <li> green spaces</li> <li> Campus Store</li> <li> stadium</li> </ul> <p>-the project located among various academic and community buildings , creates a lively and connected space this encourages teamwork .</p>

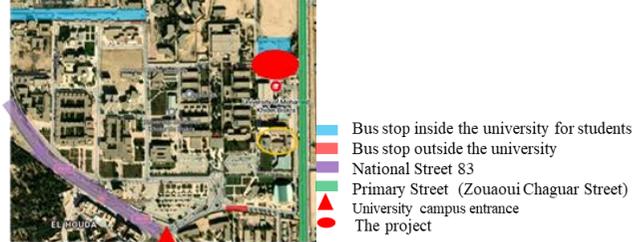
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Kent State Center for Architecture and Environmental</p>	<p>The project is located in an urban site near downtown Kent Ohio. Situated at the intersection of the campus and the city, it creates a new hub that connects Kent State University with the Kent community.</p>  <p> <span style="color: blue;">■</span> Kent State University  <span style="color: red;">■</span> the project         </p> <p>Kent, Ohio has a <b>humid continental climate</b> :</p> <p>Hot and humid summers: Temperatures often reach the 80 and 90 °F (27-32 °C)</p> <p>Cold and snowy winters: Temperatures frequently below freezing .</p> <p>spring and fall: Moderate temperatures with varying levels of precipitation .</p>	 <p>The building is designed to connect seamlessly with the campus grid and the city of Kent. Its location near the Lefton Esplanade ensures it serves as a bridge between the university and the downtown area , enhancing urban integration.</p>
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Knowlton school</p>	<p>Knowlton school is situated in a diverse urban site on the western side of Ohio State University's older campus.</p>  <p> <span style="color: red;">□</span> the project         </p> <p>Columbus, Ohio has a <b>humid continental climate</b>.</p> <p>Summer: Hot and humid with highs around 86°F (30°C)</p> <p>Winter: Cold and snowy with highs around 37°F (3°C) with occasional snowfalls</p> <p>Spring: Mild and wet with temperatures rising from 49°F (9°C) to 72°F (22°C)</p> <p>Autumn: Cool and pleasant, with temperatures dropping from 76°F (24°C) to 49°F (9°C)</p>	<p>The surroundings are a mix of different buildings and spaces:</p>  <p>The project positioned within a network of academic and community buildings cultivates a dynamic and interconnected atmosphere conducive to teamwork.</p>
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">School of Engineering</p>	<p>Located in an urban context on the main Frenchay Campus of the University of the West of England (UWE) , a suburban area of Bristol.</p>	

	 <p>the project</p> <p>Bristol, United Kingdom has a <b>temperate oceanic climate</b>  Mild Winters :Winters are mild and wet with average temperatures ranging from 2.3–8.1°C . Snowfall is infrequent and light when it occurs.  Cool Summers : Summers are cool and often overcast with average highs of 18.6–21.7°C  Frequent Rainfall : Rainfall is distributed evenly throughout the year with slightly higher amounts in autumn and winter .</p>	<p>The building seamlessly integrates with existing facilities .</p>
<p><b>National School of Architecture of Nantes</b></p>	 <p>the project</p> <p>The Nantes School of Architecture is located in Nantes, France, on the banks of the Loire River, in a former industrial zone that has been undergoing urban renewal. The site lies in a transitional area between the historic city center and the Ile de Nantes redevelopment district.  Nantes, France has <b>Temperate oceanic (Cfb)</b> :  Mild winters and cool summers  Frequent rainfall throughout the year  Moderate wind exposure, especially from the Atlantic west  Relatively high humidity levels due to proximity to the river</p>	 <ul style="list-style-type: none"> <li><span style="color: red;">■</span> The project</li> <li><span style="color: yellow;">■</span> university hospital center</li> <li><span style="color: orange;">■</span> courthouse</li> <li><span style="color: green;">■</span> parc</li> <li><span style="color: lightgreen;">■</span> school of fine arts</li> <li><span style="color: purple;">■</span> business</li> <li><span style="color: pink;">■</span> commercial court</li> </ul> <p>The Nantes School of Architecture is situated in a post-industrial riverfront area on the Île de Nantes, surrounded by a mix of open plots, contemporary developments, and repurposed industrial structures. Positioned along the Loire River, the building benefits from wide visual connections to both the urban landscape and natural surroundings. Its elongated east–west orientation enhances daylight penetration and supports natural cross-ventilation throughout the structure.</p>
<p><b>Polytechnic School of Architecture and Urban Planning –EPAU</b></p>	 <p>The Polytechnic School of Architecture and Urbanism (EPAU) is located in El Harrach, a suburb east of Algiers, Algeria. It sits within a major university cluster that includes other national institutions.  Algiers has a Mediterranean climate.  Summers are hot and dry.  Winters are mild and rainy.</p>	 <p>EPAU is located in a university environment. It is surrounded by other schools such as ENV, INA, ENP as well as the presence of the Bouraoui Ammar University City which provides accommodation and catering to students</p>

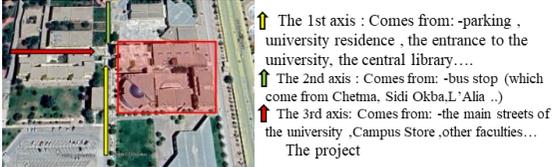
The project	urban integration	visibility
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Faculty of Architecture, Civil Engineering, and Hydraulics</p>	 <p>The project respected the grid of the university campus. But the project was integrated in contrast to its university environment due to its modern architectural design, featuring a play of volumes while the rest of the faculties on this campus exhibit a simpler architectural style.</p>	 <p>The university entrance offers a direct view of the project. The project is visible and distinct due to its architectural style, characterized by distinctive shapes and colors which differentiate it from the other departments.</p>
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Kent State Center for Architecture and Environmental</p>	 <p>The Kent State University College of Architecture and Environmental Design successfully balances integration with contrast. It fits seamlessly into the campus by aligning with the existing grid, matching the scale of nearby buildings, and using traditional materials like brick. At the same time, it distinguishes itself through a modern design featuring glass, metal, and bold cantilevered forms, reflecting the innovative spirit of the college.</p>	 <p>The building's prominent location along major roads and its dynamic design—featuring cantilevered volumes and expansive glass facades—make it a highly visible landmark on the Kent State University campus. Its transparency showcases interior activities and fosters a sense of openness, especially at night when interior lighting enhances its presence as a focal point.</p> 
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Knowlton school</p>	<p>The building integrates with the urban fabric of the campus by connecting to pedestrian pathways and creating a dialogue with adjacent structures . The architect confirms that the school of architecture has a commitment to teach by example . To this end , the school of architecture's form and urban positioning are strategically active and interactive.</p> 	  <p>This project is highly visible due to its size and architectural design , standing out across the main , secondary and tertiary streets surrounding it .</p>

<p style="text-align: center;"><b>School of Engineering</b></p>	 <p>The School of Engineering at the University of Bristol is seamlessly integrated into the city's urban fabric, located within the central "University Precinct" amidst residential and commercial areas. Its buildings reflect a blend of historic and modern architecture, with the Queen's Building serving as a central hub. The campus is walkable, well-connected, and closely linked to Bristol's sustainable transport network.</p>	 <p>-The building is highly visible on campus due to its contemporary design and large glass facades . - It serves as a landmark for the School of Engineering .</p>
<p><b>National School of Architecture of Nantes</b></p>	 <p>Located in the redeveloped industrial zone of Île de Nantes, the school integrates seamlessly into its urban context. Its open ground floor and public spaces connect it to the city, encouraging interaction and reinforcing its role as a civic and cultural hub.</p>	 <p>With its elevated, greenhouse-like form and transparent façades, the building is highly visible along the Loire River. Its orientation and distinctive design make it a strong urban landmark, easily recognizable from various points in the city.</p>
<p><b>Polytechnic School of Architecture and Urban Planning – EPAU</b></p>	 <p>The Polytechnic School of Architecture and Urbanism is well integrated into the urban fabric of El Harrach, within a university cluster that promotes academic synergy. while the campus layout balances built structures with green spaces, creating a smooth transition between the school and its surrounding urban context.</p>	 <p>The Polytechnic School of Architecture and Urbanism enjoys strong visibility due to its strategic location in El Harrach. Positioned along a main road and close to the upcoming Bouraoui metro station, the campus is easy to locate and access. Its distinct architectural identity and open layout also enhance its presence within the urban landscape.</p>
<p><b>The project</b></p>	<p><b>Roads and accessibility</b></p>	<p><b>hierarchy</b></p>

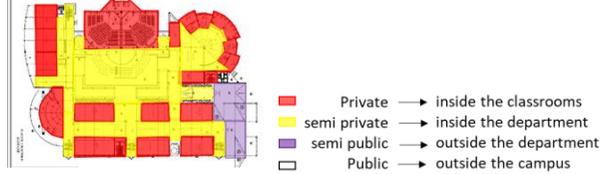
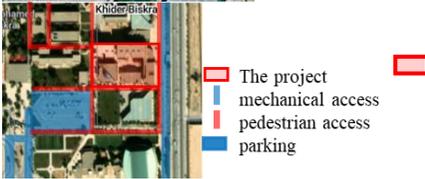
Due to the project being located within the university campus it is easily accessible by public transportation and on foot.



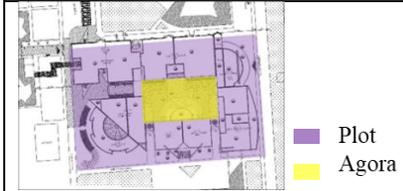
The mean axes:



- ↑ The 1st axis : Comes from: -parking , university residence , the entrance to the university, the central library....
- ↑ The 2nd axis : Comes from: -bus stop (which come from Chetma, Sidi Okba,L'Alia ..)
- ↑ The 3rd axis: Comes from: -the main streets of the university ,Campus Store ,other faculties...  
The project



Project plot:



the department occupies 80% of its plot , with the remaining unbuilt section featuring an agora and green spaces...

Kent State Center for Architecture and Environmental



- The project
- mechanical access
- pedestrian access

Easily accessible via campus roads and pedestrian pathways. The area offers ample parking and public transportation



- Primary Street
- secondary street
- tertiary street
- parking
- Bus stops



Public areas are located outside the college semi-public areas are located on the ground floor (cafe, library...) while private spaces are located on the upper levels (studio, classrooms..).

**Project plot :**



- Plot
- Built surface

The project occupies 43% of its plot because the building's design prioritizes integration with both the campus and the city of Kent. This prioritization includes creating public spaces, a pedestrian walkway, and green spaces to enhance connectivity between the university and the city.

Knowlton school

Knowlton school located at the busy intersection of West Woodruff Avenue and Tuttle Park Place



- Primary Street (West Woodruff Avenue)
- secondary street (Tuttle Park Place)
- tertiary street (Ives Dr)
- pedestrian access

The site is very active: Major pedestrian walkways pass through and around it



- private → inside the classrooms
- semi private → inside the department
- semi public → Outdoor courtyards
- Public → Outside the school

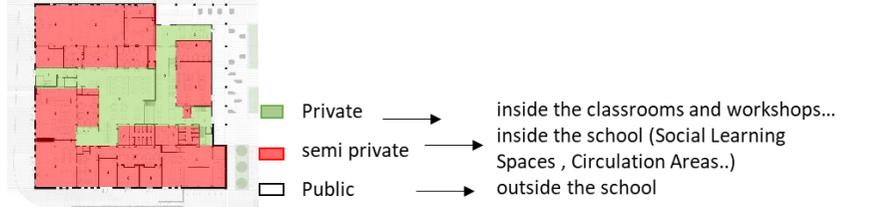
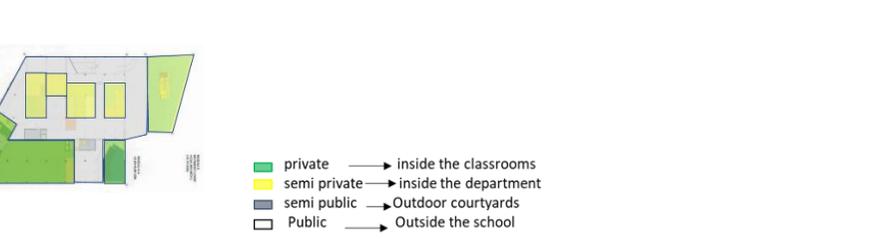
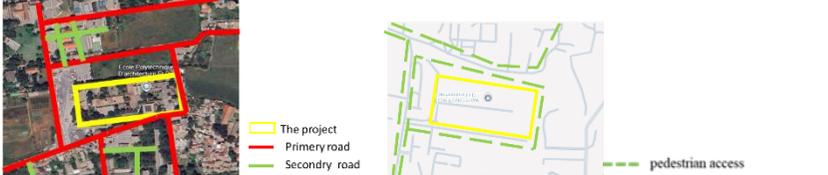
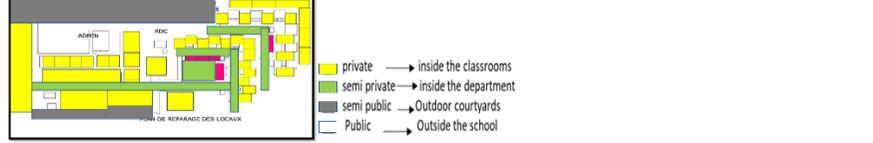
**The project plot :**

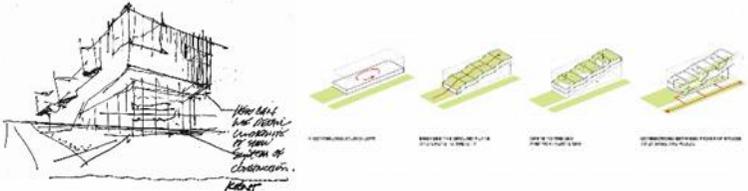
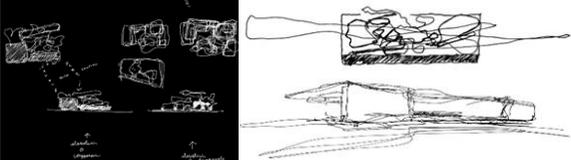
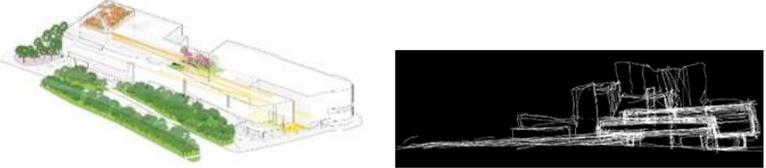
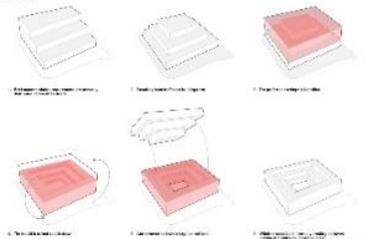
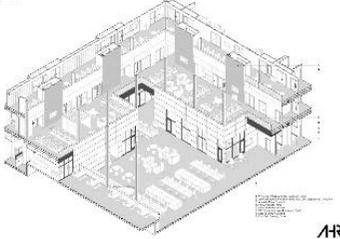


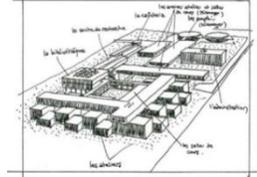
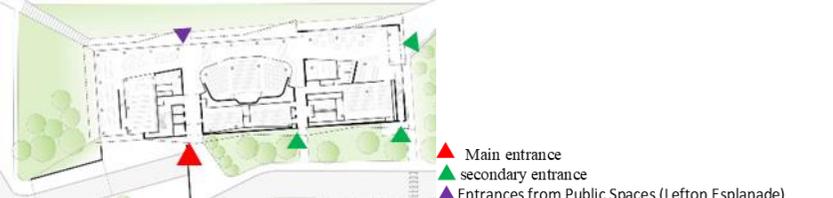
- Plot
- Built surface
- Unbuilt surface

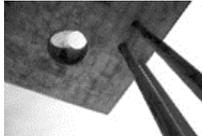


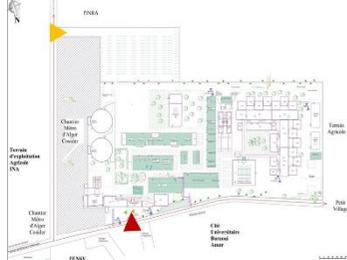
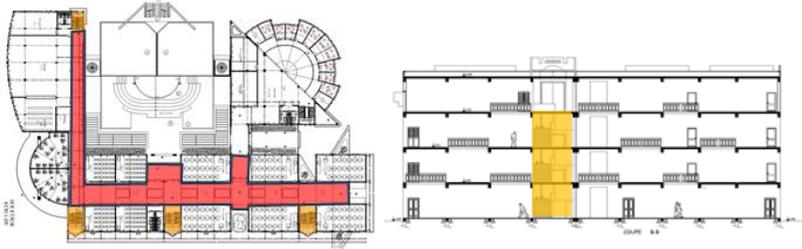
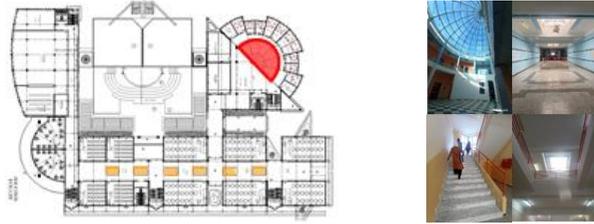
project occupies 85% of its plot, with the remaining unbuilt section featuring a sculpted green space

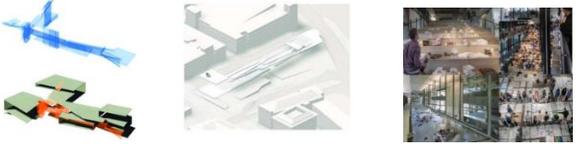
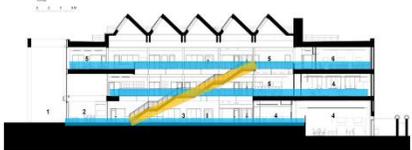
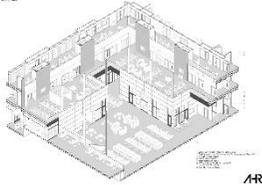
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">School of Engineering</p>	 <ul style="list-style-type: none"> <li><span style="color: green;">●</span> The project</li> <li><span style="color: red;">—</span> mechanical access</li> <li><span style="color: blue;">—</span> parking</li> <li><span style="color: yellow;">—</span> bus stop</li> <li><span style="color: yellow;">—</span> bus station</li> <li><span style="color: green;">- - -</span> pedestrian access</li> </ul> <p>- Easily accessible by road with parking facilities nearby.          - Well connected to public transport including buses and cycling routes.          - Pedestrian pathways link it other campus areas.</p>	 <ul style="list-style-type: none"> <li><span style="color: green;">—</span> Private → inside the classrooms and workshops...</li> <li><span style="color: red;">—</span> semi private → inside the school (Social Learning Spaces , Circulation Areas..)</li> <li><span style="color: white;">—</span> Public → outside the school</li> </ul> <p><b>The project plot :</b>          The project occupies approximately 90% of its plot, with the remaining unbuilt area dedicated to entrance spaces and public access zones</p> <ul style="list-style-type: none"> <li><span style="color: yellow;">—</span> plot</li> <li><span style="color: red;">—</span> Built surface</li> <li><span style="color: blue;">—</span> unBuilt surface</li> </ul>
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">National School of Architecture of Nantes</p>	 <ul style="list-style-type: none"> <li><span style="color: red;">●</span> The project</li> <li><span style="color: blue;">—</span> Primary road</li> <li><span style="color: blue;">—</span> Secondary road</li> <li><span style="color: yellow;">—</span> Parking</li> <li><span style="color: green;">- - -</span> pedestrian access</li> </ul> <p>The Nantes School of Architecture is well-connected to the city center and public transport, with nearby tram and bus stops. Its open ground floor design allows easy pedestrian access and flow.</p>	 <ul style="list-style-type: none"> <li><span style="color: green;">—</span> private → inside the classrooms</li> <li><span style="color: yellow;">—</span> semi private → inside the department</li> <li><span style="color: grey;">—</span> semi public → Outdoor courtyards</li> <li><span style="color: white;">—</span> Public → Outside the school</li> </ul> <p><b>The project plot:</b>          The Nantes School of Architecture occupies a rectangular plot.</p> <ul style="list-style-type: none"> <li><span style="color: yellow;">—</span> plot</li> <li><span style="color: red;">—</span> Built surface</li> <li><span style="color: blue;">—</span> unBuilt surface</li> </ul>
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Polytechnic School of Architecture and Urban Planning – EPAU</p>	 <ul style="list-style-type: none"> <li><span style="color: yellow;">—</span> The project</li> <li><span style="color: red;">—</span> Primary road</li> <li><span style="color: green;">—</span> Secondary road</li> <li><span style="color: green;">- - -</span> pedestrian access</li> </ul> <p>The Polytechnic School of Architecture and Urbanism benefits from easy access via main roads and the nearby Bouraoui metro station. Pedestrian paths and connections to surrounding university facilities ensure smooth circulation.</p>	 <ul style="list-style-type: none"> <li><span style="color: yellow;">—</span> private → inside the classrooms</li> <li><span style="color: green;">—</span> semi private → inside the department</li> <li><span style="color: grey;">—</span> semi public → Outdoor courtyards</li> <li><span style="color: white;">—</span> Public → Outside the school</li> </ul> <p><b>The project plot :</b>          The project occupies approximately 85% of its plot, with the remaining unbuilt area dedicated to entrance spaces and parking</p> <ul style="list-style-type: none"> <li><span style="color: yellow;">—</span> The project plot</li> <li><span style="color: red;">—</span> Built surface</li> </ul>
<p><b>The project</b></p>	<p><b>The design concept</b></p>	<p><b>The volumetry</b></p>

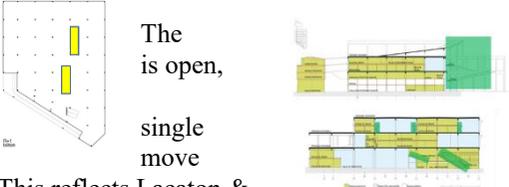
<p>Architecture and civil engineering department at University of Biskra</p>	<p>The architect's idea was to use modern architectural forms , materials... , And to integrate several cultures into the department by using Roman columns, a Greek agora , sabat (froum oued souf)</p> 	<p>It is composed of several geometric shapes : triangle, circle and non-regular geometric shapes.</p> 
<p>Kent State Center for Architecture and Environmental Design</p>	<p>The CAED building at Kent State University reflects innovative architectural education through its sustainable design (LEED Platinum), urban integration, and collaborative learning spaces. Its central Design Loft promotes openness, natural light, and peer interaction, supported by shared work areas and exposed structural elements that embody creative and educational values.</p> 	 <p>The volumetry of Kent State's CAED building features a cascading, cantilevered form that blends solids and voids to promote transparency, collaboration, and urban integration. This sculptural design enhances daylighting and visual flow, making the building a distinctive campus landmark.</p>
<p>Knowlton school</p>	<p>The design concept of Knowlton Hall is to create a building that teaches by example. Through green spaces, urban views, and interconnected spaces, it fosters community engagement and blends education with environment, tradition with innovation, and art with technology.</p> 	<p>The design features a sculptural, fluid form with interlocking volumes that break from traditional geometry. Using raw concrete and glass, it creates a dynamic contrast of solid and void, while actively engaging and shaping its urban context.</p> 
<p>School of Engineering</p>	 <p>The design of UWE's School of Engineering follows four principles: stacking heavier functions below lighter ones, a central atrium for light and interaction, a corridor-free plan promoting openness, and a service ring that clears the perimeter for learning and collaboration.</p>	 <p>The volumetry of the school features a <b>tiered, stacked massing</b>, with heavy workshops at the base and lighter functions above. A <b>rising central atrium</b> acts as a social and daylight-filled core, while the <b>corten-clad colonnade and glazed façades</b> enhance transparency and connection to the urban context, giving the building a distinct and sculptural presence on campus.</p>

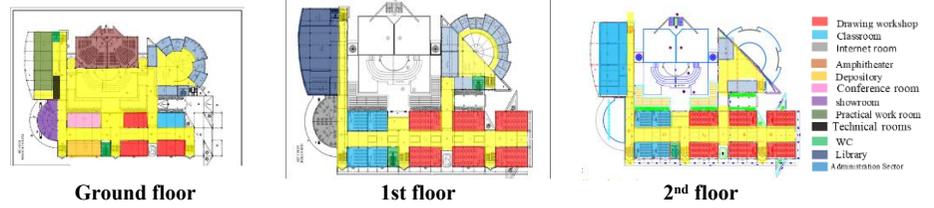
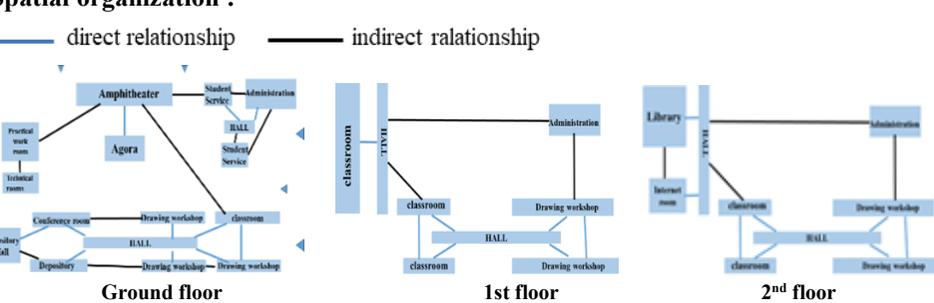
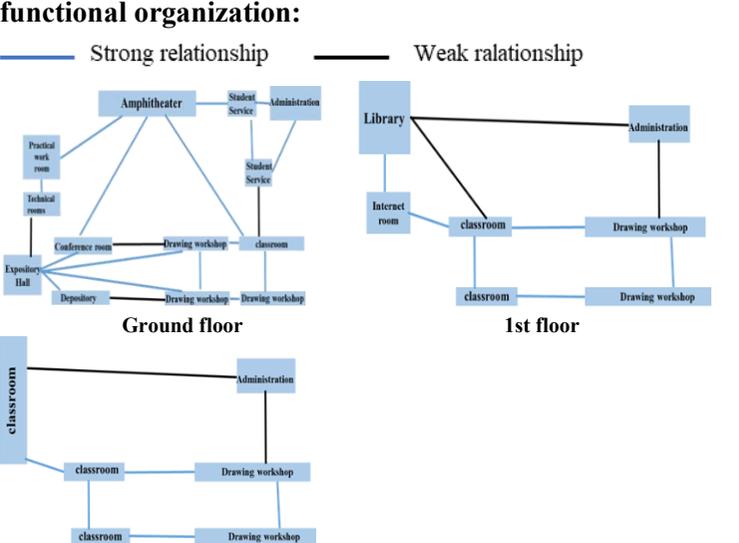
<p>National School of Architecture of Nantes</p>	 <p>The Nantes School of Architecture's design emphasizes flexibility, openness, and transparency. Raised on pilotis with a double façade, it supports passive climate control and informal learning, reflecting Lacaton &amp; Vassal's philosophy of maximizing space and light with minimal intervention.</p>	 <p>The volumetry of the Nantes School of Architecture is a simple, elongated rectangular form raised on pilotis, emphasizing openness and horizontality. Its transparent double-skin façade and repetitive structural grid create a light, flexible volume that reflects Lacaton &amp; Vassal's minimalist and adaptable design philosophy.</p>
<p>Polytechnic School of Architecture and Urban Planning – EPAU</p>	 <p>The design concept focuses on clarity, functionality, and integration with the educational mission. The architecture reflects simplicity in form, with a strong emphasis on spatial hierarchy between public, semi-public, and private zones. Open courtyards, shaded walkways, and generous outdoor areas support interaction, learning, and reflection key values in architectural education.</p>	 <p>The volumetry of the EPAU campus is composed of low- to mid-rise blocks arranged in a linear and functional manner. The buildings are organized around internal courtyards and open spaces, creating a rhythm of solids and voids that ensures good ventilation and daylight. This modular arrangement responds to academic needs while maintaining human scale and walkability across the site.</p>
<p>The project</p>	<p>Entrees</p>	<p>Approach, reception, attraction</p>
<p>Architecture and civil engineering department at University of Biskra</p>	 <p>The architect originally intended <b>Entrance 2</b> to serve as the <b>main access point</b>, guiding users into the central agora and then toward key facilities such as the administration, amphitheater, classrooms, and library. <b>Entrance 3</b> was designated as an emergency exit, while the remaining entrances were meant to function as secondary access points. However, in current practice, <b>only Entrance 1 remains open</b>, with all other entries closed, deviating from the original circulation concept.</p>	 <p>The attractive elements for the main entrance: the use of large orange and yellow elements to mark the entrance.</p>
<p>Kent State Center for Architecture and Environment and Environmental Design</p>	 <p> <span style="color: red;">▲</span> Main entrance  <span style="color: green;">▲</span> secondary entrance  <span style="color: purple;">▲</span> Entrances from Public Spaces (Lefton Esplanade)         </p>	

	<p>To encourage social interaction and collaboration by connecting indoor and outdoor spaces and To strengthen the link between the building and its urban environment. -The building has five entrances, making it easily accessible from all sides.</p>	<p>The main entrance located on the south facade is particularly prominent featuring a cantilevered volume that acts as a visual marker and draws attention to the entrance</p>
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Knowlton school</p>	 <ul style="list-style-type: none"> <li>▲ Main entrance</li> <li>▲ Entrance directly to the cafeteria</li> <li>▲ Entrance directly to the administration</li> <li>▲ Entrance directly to the basement</li> <li>▲ emergency exit</li> </ul> <p>This building is highly functional with multiple access points .That ensure safety and make all areas easily accessible .</p>	 <p>The entrance in this building is a striking and prominent feature . Its scale defined by towering columns and an imposing overhead structure creates a sense of grandeur and immediately draws the eye .</p>   <p>And The circular opening in the ceiling (oculus) is designed to allow natural light to enter the entrance space creating dynamic and ever-changing atmospheres that depend on the movement of the sun.</p>
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">School of Engineering</p>	 <ul style="list-style-type: none"> <li>▲ The main entrances</li> <li>▲ Entrance to automotive teaching</li> <li>▲ Entrance to lab space</li> </ul> <p>the entrance strategy of this building is designed to manage various user flows, clearly differentiating between general public access, specialized teaching areas, and laboratory zones, likely optimizing functionality and safety within the complex.</p>	 <p>the architect marks the entrances of the School of Engineering through a combination of recession and transparency, material and color contrast, clear signage, subtle overhead definition, deliberate ground plane design, and strategic illumination, all working together to create inviting and easily identifiable entry points.</p>

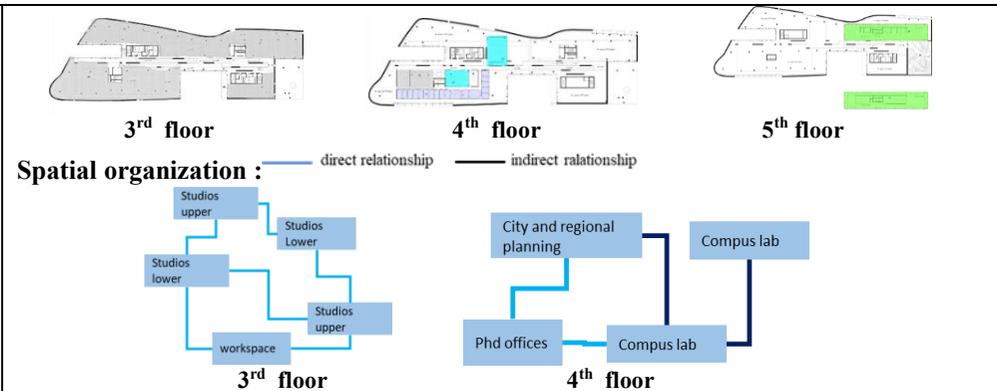
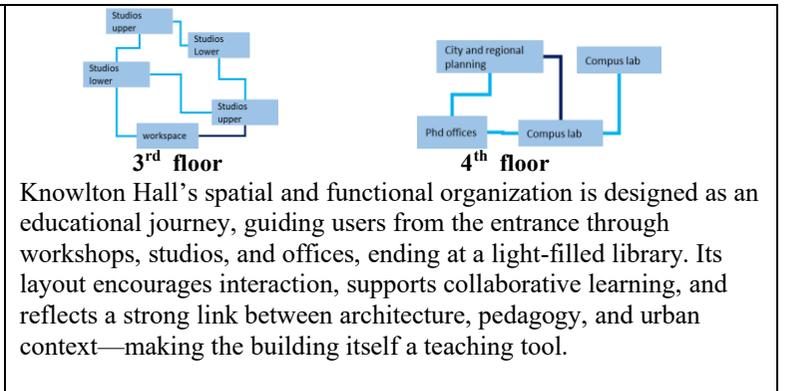
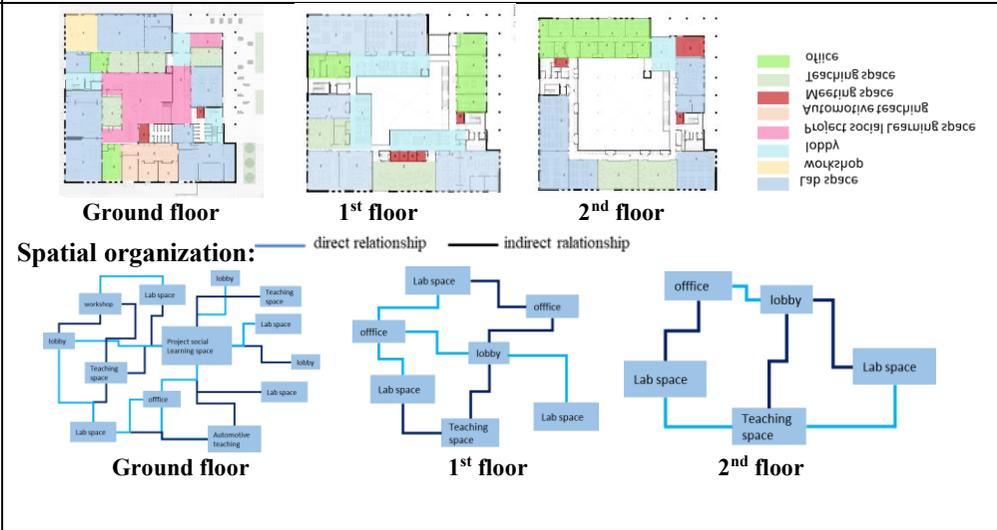
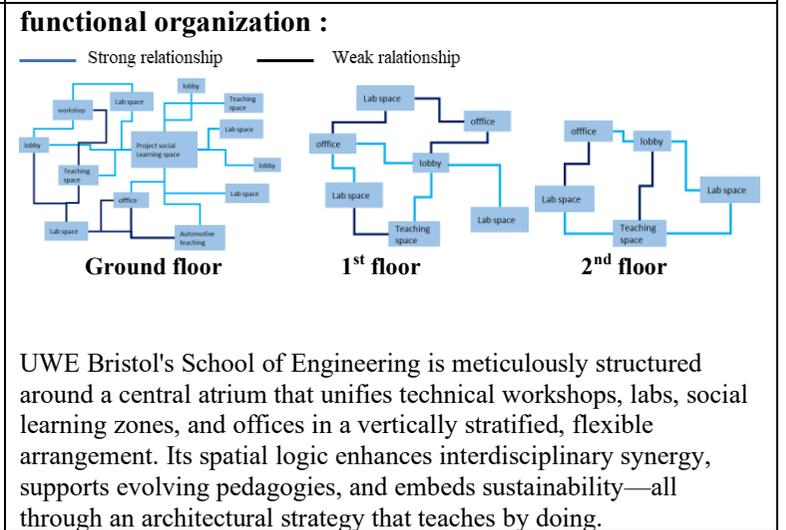
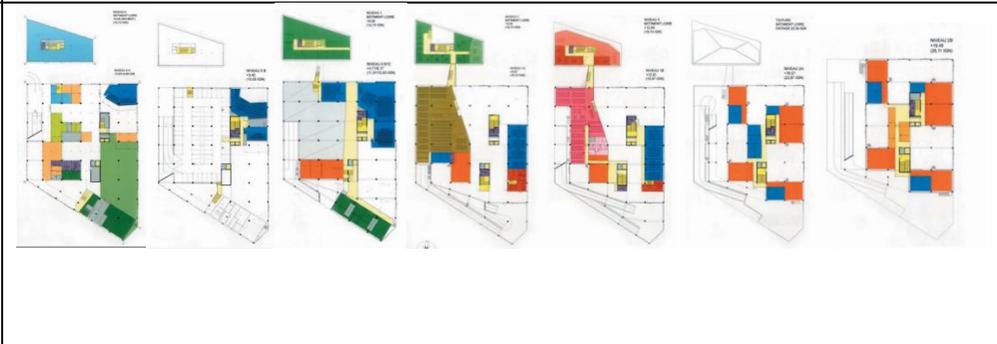
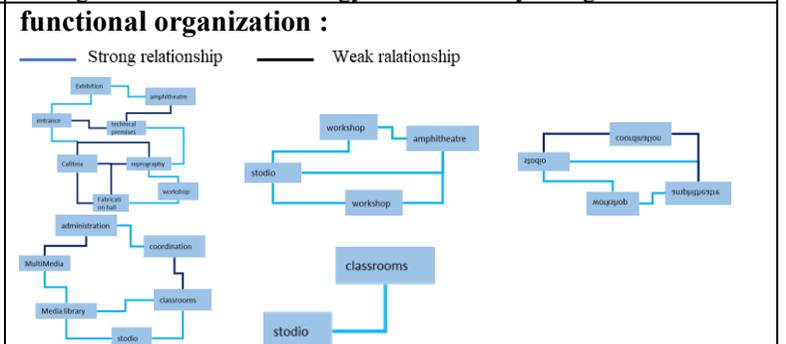
<p>National School of Architecture of Nantes</p>	 <p>The Nantes School of Architecture features multiple entrances, with the main access located beneath the raised structure, taking advantage of the open ground floor created by pilotis. This transparent and permeable base invites visitors into the building naturally, without formal barriers, reinforcing its civic and educational role.</p>	 <p>The architects, Lacaton &amp; Vassal, deliberately chose not to mark the entrances with monumental or formal elements. Instead, they emphasized transparency, openness, and continuity to make the entrances feel natural and accessible. The ground floor, completely open and elevated on pilotis, creates a seamless transition between the exterior public space and the building's interior. This approach reinforces the building's democratic and inclusive spirit, making it feel welcoming from all sides, with no single dominant "front" or privileged access point.</p>
<p>Polytechnic School of Architecture and Urban Planning – EPAU</p>	 <p>The entrances of EPAU are clearly defined and functional, with the main entrance facing the road for easy access. It features a wide gate and security point, welcoming both students and visitors. Secondary pedestrian entries connect to internal campus paths, ensuring smooth circulation throughout the site.</p>	 <p>The architect marked the entrance with a wide gate, recessed façade, and open transition space. Signage and landscaping help guide visitors and highlight the main access point.</p>
<p>The project</p>	<p><b>Circulation</b></p>	<p><b>interior ambience</b></p>
<p>Architecture and civil engineering department at University of Biskra</p>	 <p> <span style="color: yellow;">■</span> vertical circulation  <span style="color: red;">■</span> horizontal circulation         </p> <p>The circulation is linear and centrally located and the classrooms are distributed on both sides.</p>	 <p><b>Natural Light:</b> Patios in the educational areas enhance openness and visual clarity by allowing natural light to enter freely. In the administrative zone, a skylight dome diffuses daylight, creating a bright and pleasant atmosphere.</p> <p><b>Material Palette:</b> The building uses mainly concrete and aluminum, offering a modern, robust appearance.</p> <p><b>Color Scheme:</b> Light tones, especially white, dominate the space, while bold accents of yellow, orange, and green add vibrancy and warmth.</p>

<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Kent State Center for Architecture and Environmental Design</p>	 <p>The building's circulation prioritizes clarity and interaction, with an amphitheater-style staircase that serves as both a vertical connector and social hub. Secondary stairs and elevators ensure accessibility, while wide horizontal paths and tiered studios support seamless movement and collaboration.</p>	<p>The building optimizes natural light with large glass facades and energy-efficient lighting for comfort and efficiency. Neutral colors with bold and soft accents define different zones, while materials like exposed concrete, wood, and metal highlight texture, durability, and sustainability.</p> 
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Knowlton school</p>	<p>Circulation in Knowlton Hall is structured around an inclined plane that unifies horizontal and vertical movement for intuitive flow. Studios, offices, and the library are linked through this system, with faculty spaces placed for visibility. Ramps, stairs, and elevators ensure accessibility and strong visual connections across levels.</p> 	<p>The building uses large windows and glass facades to <b>maximize natural light</b> and create a bright, <b>open atmosphere</b>. Visual connections between spaces provide views of the campus, enhancing integration with the surroundings. <b>Artificial lighting complements daylight</b>, while a neutral color palette and exposed concrete add texture and emphasize raw, honest materiality.</p> 
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">School of Engineering</p>	 <p>The circulation in the building is not just functional it's an integral part of the pedagogical and spatial strategy, creating a fluid and inclusive learning environment</p> <p>The design prioritizes <b>universal accessibility</b>, with ramps and lifts integrated into circulation paths to equitable access across all building</p>  <p>ensure zones.</p>	<p>The building's interior benefits from abundant <b>natural light</b> through large glazed façades and a central atrium, creating a bright and uplifting atmosphere. This is complemented by <b>artificial lighting</b> that balances ambient, task, and accent sources to ensure consistent illumination. Together, they enhance <b>visual comfort</b> by minimizing glare and shadows, supporting both focused work and collaborative activities.</p> 

<p style="writing-mode: vertical-rl; transform: rotate(180deg);">National School of Architecture of Nantes</p>	 <p>The is open, single move</p> <p>This reflects Lacaton &amp; Vassal's philosophy of encouraging exploration, spontaneity, and interaction. Circulation is not just a means of getting from point A to B it's part of the educational experience.</p> <p>overall mode of circulation fluid, and non-hierarchical. There is no dominant path users can freely between spaces. Vassal's philosophy of</p>	<p>The interior lighting ambience is defined by abundant, soft natural light that fills the open spaces through large glazed façades and a transparent double skin. This creates a bright, diffused atmosphere that enhances spatial openness and comfort. The minimal use of artificial lighting preserves the building's daylight-focused design, resulting in a calm, luminous environment ideal for learning, creativity, and interaction.</p> 
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Polytechnic School of Architecture and Urban Planning – EPAU</p>	 <p>The circulation in EPAU is clear and functional, with linear pathways connecting classrooms, studios, and open courtyards. Covered walkways and corridors support easy movement between blocks while promoting interaction among users.</p>	 <p>The interior lighting relies heavily on natural light, with large windows and courtyards allowing sunlight into studios and classrooms. This creates a bright, comfortable atmosphere ideal for learning, while artificial lighting is used mainly for evening or shaded areas.</p>

<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Architecture and civil engineering department at University of Biskra</p>	<p style="text-align: center;"><b>1 Spatial and functional organization</b></p>  <p><b>Ground floor Spatial organization :</b></p> <p>— direct relationship    — indirect relationship</p>  <p>the administrative facilities were grouped together in one section while the educational</p>	<p><b>functional organization:</b></p> <p>— Strong relationship    — Weak relationship</p> 
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	 <p><b>3<sup>rd</sup> floor</b>      <b>4<sup>th</sup> floor</b>      <b>5<sup>th</sup> floor</b></p> <p><b>Spatial organization :</b> — direct relationship    — indirect relationship</p> <p><b>3<sup>rd</sup> floor</b>      <b>4<sup>th</sup> floor</b></p>	 <p><b>3<sup>rd</sup> floor</b>      <b>4<sup>th</sup> floor</b></p> <p>Knowlton Hall's spatial and functional organization is designed as an educational journey, guiding users from the entrance through workshops, studios, and offices, ending at a light-filled library. Its layout encourages interaction, supports collaborative learning, and reflects a strong link between architecture, pedagogy, and urban context—making the building itself a teaching tool.</p>
<p>School of Engineering</p>	 <p><b>Ground floor</b>      <b>1<sup>st</sup> floor</b>      <b>2<sup>nd</sup> floor</b></p> <p><b>Spatial organization:</b> — direct relationship    — indirect relationship</p> <p><b>Ground floor</b>      <b>1<sup>st</sup> floor</b>      <b>2<sup>nd</sup> floor</b></p>	<p><b>functional organization :</b></p> <p>— Strong relationship    — Weak relationship</p>  <p><b>Ground floor</b>      <b>1<sup>st</sup> floor</b>      <b>2<sup>nd</sup> floor</b></p> <p>UWE Bristol's School of Engineering is meticulously structured around a central atrium that unifies technical workshops, labs, social learning zones, and offices in a vertically stratified, flexible arrangement. Its spatial logic enhances interdisciplinary synergy, supports evolving pedagogies, and embeds sustainability—all through an architectural strategy that teaches by doing.</p>
<p>National School of Architecture of Nantes</p>		<p><b>functional organization :</b></p> <p>— Strong relationship    — Weak relationship</p>  <p><b>functional organization :</b></p>

	<p><b>Spatial organization:</b> — direct relationship — indirect relationship</p>	<p>The spatial and functional organization of the Nantes School of Architecture is based on open, flexible floorplates that allow studios, classrooms, and workshops to adapt freely over time. Public functions are located on the transparent ground floor, while academic and administrative areas rise above in a clear vertical structure. At the top, the rooftop greenhouse adds a multifunctional space for informal learning and experimentation, supporting a dynamic and evolving educational environment.</p>
<p><b>Polytechnic School of Architecture and Urban Planning – EPAU</b></p>	<p><b>Spatial organization :</b></p>	<p><b>functional organization:</b></p> <p>The project is organized into separate blocks for classrooms, studios, administration, and common areas. These are arranged around open courtyards, ensuring clear zoning between academic and service spaces while supporting smooth circulation.</p>

<p><b>The project</b></p>	<p><b>Facades</b></p>	
<p>Architecture and civil engineering department at University of Biskra</p>		<p><b>architectural style: Modern</b></p> <p>The facades are composed of multiple rectangular and square blocks, creating a dynamic and somewhat fragmented appearance. There are a variety of window and door openings, including large and small windows. The color palette: The dominant colors are white, gray and beige creating a neutral and simple aesthetic.</p>

<p>Kent State Center for Architecture and Environmental Design</p>		<p>The building's north façade features expansive glass curtain walls that bring in soft northern light and offer panoramic views of the campus and city. Staircases along both the north and south façades ensure continuous circulation across studio levels, with a cantilevered south stair offering elevated campus views. The library, located on the west side, faces the city. Externally, the building combines glass curtain walls with solid masonry, using iron-spot brick and custom brick fins fired locally to harmonize with the campus context. The brick fins also provide effective solar shading on the south, east, and west façades.</p>
<p>Knowlton school</p>		<p>The façades of the Knowlton School of Architecture are <b>clad in white marble</b> shingles arranged as a ventilated rain-screen system, combining durability with a didactic expression of construction. <b>The building's façades are not uniform</b>; they vary in composition and <b>rhythm depending on orientation</b> and contextual relationships some are solid and monolithic, while others are perforated with irregular windows or open voids. These shifts <b>respond to natural light</b>, urban surroundings, and interior functions, enhancing spatial diversity and environmental performance. Cut-outs introduce terraces and light wells, while recessed openings create dynamic lighting and frame key views. Altogether, the façade composition reinforces the school's pedagogical focus on materiality, contextual design, and experiential architecture.</p>
<p>School of Engineering</p>		<p>The façades feature a bold contrast of glazed <b>curtain walls</b> and <b>Corten steel cladding</b>, reflecting both transparency and structural solidity. <b>North-facing glass walls</b> flood studios with soft daylight and offer views of the campus, while <b>Corten panels</b>, chosen for their weathered texture and low maintenance, wrap the building in a warm, industrial character. <b>Vertical and horizontal fins</b> provide solar shading on sun-exposed sides, and the <b>modular grid</b> of openings reveals the building's internal logic, creating a façade that is both functional and expressive.</p>
<p>National School of Architecture of Nantes</p>		<p>The façades of the Nantes School of Architecture are treated with a transparent, industrial aesthetic using a double-skin system made of glass and polycarbonate. This design allows for natural light, passive ventilation, and thermal buffering, while expressing the building's structural rhythm. The façades vary slightly depending on orientation, balancing openness with environmental performance, and reinforcing the school's identity as a light, adaptable, and energy-efficient structure.</p>
<p>Polytechnic School of Architecture and Urban Planning – EPAU</p>		<p>The façades are simple and functional, with regular openings that provide natural light and ventilation. Shading elements and concrete frames give the buildings a modern yet modest architectural identity suited to the climate and educational purpose.</p>

The project	Sustainable environmental aspect
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Kent State Center for Architecture and Environmental Design</p>	 <p>The project achieved <b>LEED Platinum</b> certification reflecting its commitment to environmental stewardship . The design presents an integrated approach to sustainability that maximizes passive opportunities including daylight and natural ventilation , employs efficient strategies for building and landscape systems , maximizes the use of regional and recycled materials and supports sustainable maintenance and operations for future generations :</p> <p><b>Energy Efficiency :</b></p> <ul style="list-style-type: none"> <li>- Use of high-performance glazing to reduce heat gain and loss</li> <li>- Installation of energy-efficient HVAC systems and LED lighting.</li> <li>- Incorporation of natural ventilation strategies to reduce reliance on mechanical systems</li> <li>- Integration of renewable energy sources such as solar panels</li> <li>- The building incorporates a geothermal system with 130 wells providing all heating and cooling needs sustainably.(geothermal heating and cooling system)</li> </ul> <p><b>Water Conservation :</b></p> <ul style="list-style-type: none"> <li>- Implementation of rainwater harvesting systems for irrigation and non-potable uses .</li> <li>-"living Machine" Water Filtration System</li> </ul> <p><b>Material Selection :</b></p> <ul style="list-style-type: none"> <li>- Use of sustainable and recycled materials such as FSC-certified wood and recycled steel.</li> <li>- Selection of locally sourced materials to reduce transportation emissions.</li> <li>-The exterior contains 91,000 custom bricks produced by Ohio’s Belden Brick Company (a 15,000-gallon gray tank that recycles rainwater for irrigation and flushing bathroom fixtures)</li> </ul> <p><b>indoor Environmental Quality :</b></p> <ul style="list-style-type: none"> <li>- Use of low-VOC (volatile organic compound) materials for paints and finishes.</li> <li>- Maximization of natural light through large windows</li> <li>- Installation of high-efficiency air filtration systems to improve indoor air quality.</li> </ul> <p><b>Site Sustainability :</b></p> <ul style="list-style-type: none"> <li>- Preservation of existing green spaces and integration of native landscaping</li> <li>- Creation of green roofs to improve insulation and reduce the urban heat island effect</li> <li>-Local plants</li> </ul> <p><b>Waste Reduction :</b></p> <ul style="list-style-type: none"> <li>- Implementation of construction waste management plans to recycle and reuse materials during construction.</li> <li>- Design for flexibility and adaptability to extend the building’s lifespan and reduce future waste.</li> </ul> <p><b>innovative Design Strategies :</b></p> <ul style="list-style-type: none"> <li>- Use of passive design strategies such as building orientation and shading devices to optimize energy performance.</li> <li>- Design of multi-functional spaces to maximize resource efficiency</li> </ul>

<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Knowlton school</p>		<p>Knowlton Hall, home to the Knowlton School of Architecture at Ohio State University, integrates sustainability directly into its architecture and teaching mission:</p> <p><b>Ventilated rain-screen marble facade:</b> Clad in white Georgia marble shingles on a separate structure, with an air cavity improving insulation and moisture control .</p> <p><b>Daylighting and glare control:</b> Large windows, interior voids, and courtyards bring daylight deep into studios and shared areas. Deep recesses and properly oriented openings reduce glare and unwanted heat .</p> <p><b>Natural ventilation:</b> Building layout supports cross-ventilation in studios and common areas, minimizing the need for mechanical cooling .</p> <p><b>Compact vertical massing &amp; thermal zoning:</b> The building’s vertical form reduces its footprint; though not explicitly zoned by heat-producing functions, its design responds passively to environmental conditions .</p> <p><b>Pedagogical clarity:</b> Sustainability features are visible—facade, light wells, ventilation shafts—turning the building into a hands-on learning lab for students .</p>
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">School of Engineering</p>		<p>-The architect of the University of the West of England’s School of Engineering integrated several sustainable environmental strategies to reduce the building’s ecological footprint and promote long-term efficiency:</p> <p><b>Passive Design Strategies:</b> The building uses natural daylighting through large glazed areas and skylights, significantly reducing dependence on artificial lighting. Its compact, stacked form minimizes heat loss and enhances energy efficiency.</p> <p><b>Natural Ventilation &amp; Mixed-Mode Systems:</b> Operable windows and strategically placed vents support natural cross-ventilation, while mechanical systems are used efficiently where needed, creating a comfortable indoor climate with reduced energy use.</p> <p><b>Thermal Mass &amp; Material Choice:</b> Exposed concrete structures contribute to thermal mass, regulating indoor temperatures naturally. The use of corten steel and locally sourced materials reduces embodied carbon and enhances durability.</p> <p><b>Smart Lighting &amp; Energy Systems:</b> The building employs LED lighting, daylight sensors, and energy management systems to optimize electrical usage and minimize waste.</p> <p><b>Water Efficiency:</b> Low-flow fixtures and efficient plumbing systems help reduce water consumption.</p> <p><b>BREEAM Excellent Rating:</b> These strategies contributed to the building achieving a BREEAM ‘Excellent’ certification, a leading sustainability assessment for buildings in the UK.</p> <p>- the architect applied sustainability by combining passive design, efficient systems, responsible material choices, and certified performance standards, making the building a model of environmentally responsible educational design.</p>

<p>National School of Architecture of Nantes</p>		<p>The Nantes School of Architecture by Lacaton &amp; Vassal features a double-skin facade of glass and polycarbonate with an air cavity for natural ventilation—a passive greenhouse-like buffer that reduces mechanical heating/cooling needs . The building prioritizes natural lighting and diffused materials for visual comfort, while cross-ventilation and thermal chimneys ensure efficient air exchange. Its envelope-centric passive design minimizes energy systems, reduces carbon footprint and maintenance, and the open, durable structure allows future reconfiguration—achieving sustainable adaptability .</p>
<p>Polytechnic School of Architecture and Urban Planning – EPAU</p>		<p>Passive Ventilation: The design includes large windows, open corridors, and internal courtyards, promoting cross-breezes and reducing reliance on mechanical cooling—appropriate for Algiers' mild coastal climate .</p>

- Synthesis

	<b>Synthesis</b>
<b>Situation</b>	The colleges are strategically located within diverse contexts, responding to geographic and climatic conditions. The design promotes passive energy efficiency through solar orientation and integration with public infrastructure.
<b>Immediate Environment</b>	The buildings benefit from their surroundings, enhancing social and environmental connectivity, creating microclimates that improve thermal comfort and natural shading.
<b>Plot</b>	The plot usage balances built and open spaces, incorporating green areas, natural ventilation, and rainwater harvesting for a more sustainable footprint.
<b>Volumetry</b>	Designs vary from simple geometric forms to dynamic structures that reduce heat gain, maximize airflow, and enhance thermal efficiency.
<b>Design Concept</b>	Each building integrates sustainability through courtyards, vegetation, and natural shading, making the building environmentally responsive and active within its context.
<b>Accessibility</b>	The design ensures inclusive access, connecting key areas and promoting social equity, while maintaining an accessible and sustainable environment.
<b>Entrances</b>	Entrances are strategically placed to distribute traffic, enhance thermal comfort, and promote passive ventilation through natural airflow.
<b>Circulation</b>	Open galleries and central atriums enhance natural lighting and reduce reliance on artificial lighting, while ventilation systems support comfort.
<b>Spatial and Functional Organization</b>	The design promotes energy efficiency by clustering similar functions together and optimizing natural light and ventilation.
<b>Sustainability</b>	Educational buildings integrate sustainable design strategies such as passive design, efficient systems, and the use of local materials to reduce carbon emissions. Water-saving features like low-flow fixtures also contribute to resource conservation

## II.5 Context analysis

### II.5.1 Introduction

This analysis is composed of two parts: In the first part, we will analyze the data of the city Biskra, a climatological and bioclimatic analysis that will be organized into two sections: the first is an analysis of the climate of the city of Biskra, and the second is the analysis of the chosen site. The purpose of this analysis is to take into consideration the specific climatic data of the region and the morphological data to better define the choices of strategies at the design level

#### **Presentation of the city Biskra**

The city of Biskra is located in southeastern Algeria and is a vital gateway to the Sahara Desert. Administratively, it belongs to the Eastern Region and is approximately 400 km southeast of the capital, Algiers. The city enjoys a strategic geographical location at the confluence of the high plateaus and oases, giving it significant economic, agricultural, and tourism importance.

#### **Geographic location**

Total area: Approximately 1,282 km<sup>2</sup> (for the municipality of Biskra only). The entire Biskra province (which includes 33 municipalities) covers approximately 20,986 km<sup>2</sup>.

In terms of coordinates, Biskra is located at:

34°51' north latitude

5°43' east longitude

an elevation of approximately 87 meters above sea level.

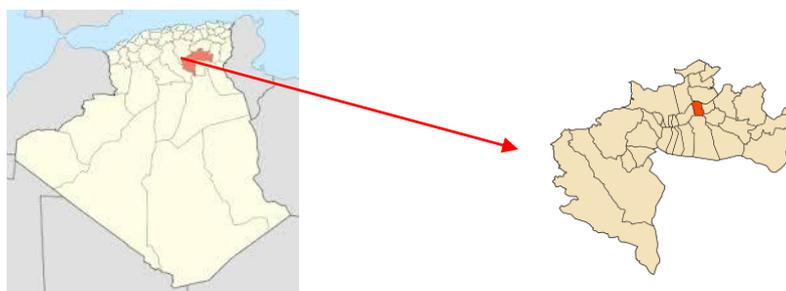


Figure 43 Geographic location of the city of Biskra

### II.5.2 Climatological analysis:

Biskra climate classification according to Köppen-Geiger:

#### **BWh – Hot Desert Climate**

B: Arid Climate

W: Desert

h: Hot – Average annual temperature above 18°C

Characteristics of this climate:

Long, very hot summers, with temperatures often exceeding

Mild to cold winters at night.

Very low rainfall (<100 mm annually).

Low humidity for most of the year.

Very high solar radiation.

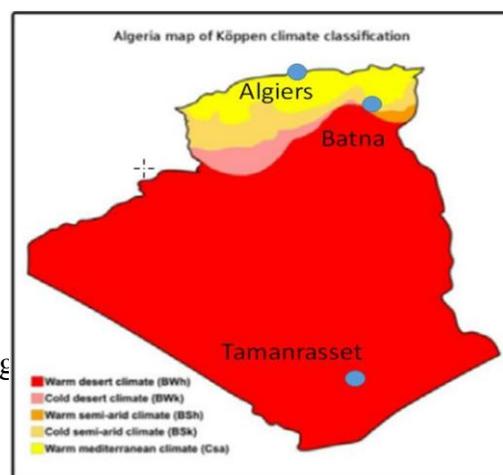
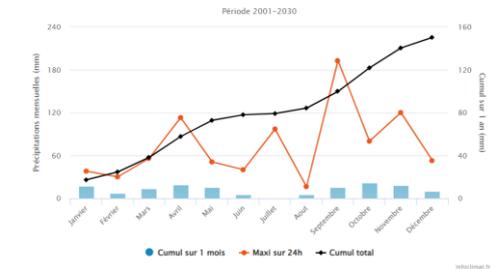
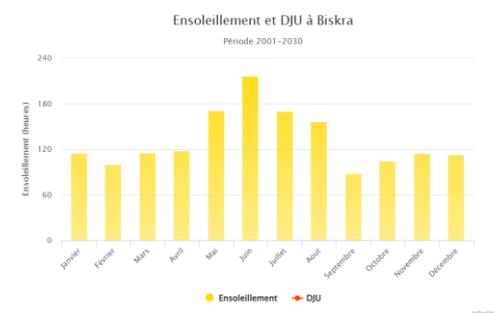
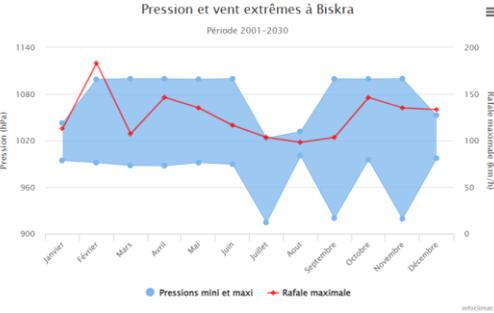


Figure 44 climate zones of Algeria

	Graphs	Observation
<p style="text-align: center;"><b>Temperature</b></p>	<p style="text-align: center;"><b>Températures à Biskra</b> Période 2001-2030</p>  <p style="text-align: center;">Average monthly temperature of the city of Biskra (2001-2030) source:infoclimat</p>	<p>Temperatures gradually rise from January through July–August (the height of summer), then gradually decline until December.</p> <p>The hottest months are: July and August, with average maximum temperatures (Txm) reaching around 40–42°C and minimum temperatures (Tnm) above 26°C, reflecting a harsh desert climate.</p> <p>The coldest months are: January and February, with minimum temperatures that can drop to around 5–7°C and maximum temperatures around 16–19°C.</p>
<p style="text-align: center;"><b>Precipitation</b></p>	<p style="text-align: center;"><b>Précipitations à Biskra</b> Période 2001-2030</p>  <p style="text-align: center;">average monthly precipitation diagramme</p>	<p>The precipitation profile shows an arid climate with a low annual average of no more than 160 mm. Rainfall is concentrated between autumn and spring, and is almost non-existent in summer. Despite the scarcity of rainfall, sudden peaks of rain are occasionally recorded within 24 hours, especially in September, indicating an irregular rainfall pattern.</p>
<p style="text-align: center;"><b>Sunhours</b></p>	<p style="text-align: center;"><b>Ensoleillement et DJU à Biskra</b> Période 2001-2030</p>  <p style="text-align: center;">average daily sunhours per month</p>	<p>The solar insolation curve for Biskra for the period 2001–2030 shows high solar radiation throughout the year, particularly between May and June, when it exceeds 200 hours per month, reflecting a dry and sunny climate. The lowest rates occur in winter, but they remain relatively high, making Biskra one of the sunniest regions in Algeria. This is an important factor in environmental architectural design and enhances the potential for solar energy exploitation.</p>
<p style="text-align: center;"><b>pressure and wind</b></p>	<p style="text-align: center;"><b>Pression et vent extrêmes à Biskra</b> Période 2001-2030</p>  <p style="text-align: center;">average daily pressure and wind per month</p>	<p>Atmospheric pressure: It tends to be high most of the time (over 1015 hPa), contributing to atmospheric stability and dryness.</p> <p>Winds: Usually light to moderate, ranging in speed from 5–15 km/h, but sometimes strong gusts (&gt;57 km/h) are recorded during stormy periods. Their direction is mostly northwesterly.</p>

## II.6 site location in relation to the city

- **site location in relation to the city**

The project site is located in the northeastern part of the city of Biskra, specifically on the Biskra-Sidi Okba road, approximately 8 kilometers from the city center. specifically in the university city.



Figure 46 Ground situation "university City  
MOHAMMED KHAIDAR-BISKRA



Figure 45 Site:the architecture department

The university is located near major national roads, making it easily accessible from within Biskra or from neighboring states. University transportation also connects the city's various neighborhoods to the university campuses.

- **why this land**

- It is situated in the heart of a university campus, supporting academic activities.
- The location is close to offices and engineering supply stores.
- The site is in a dense urban area with excellent transport connections.

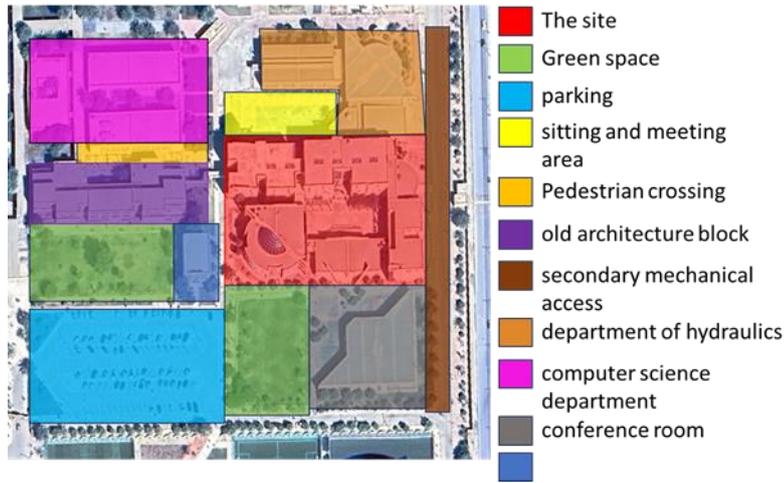
- **site morphology:**

The site boasts a naturally flat terrain, with a regular rectangular shape,



the site is flat and level with neighbouring sites and boasts with a regular rectangular shape

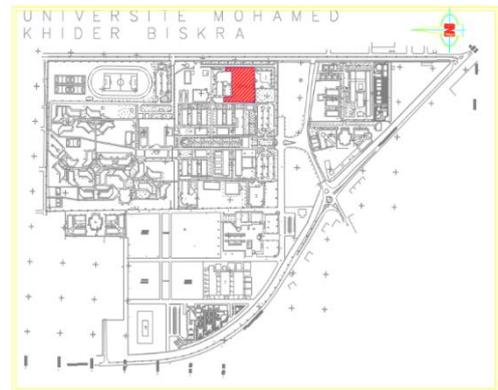
- **environment of the project**



A rich academic urban environment, surrounded by a group of buildings with a diverse functional character, enhancing the possibility of integrating services and spaces.

- **Mobility**

The site is located within an internal road network that connects all colleges and university facilities, making it easily accessible by walking or university transportation (bus).



- **Roads and accessibility**



➔ main entrance   ➔ Student buses entrance



— Pedestrian access   — Mechanical access

The connectivity within the site is excellent, with pedestrian pathways and vehicular roads ensuring easy access to the location.

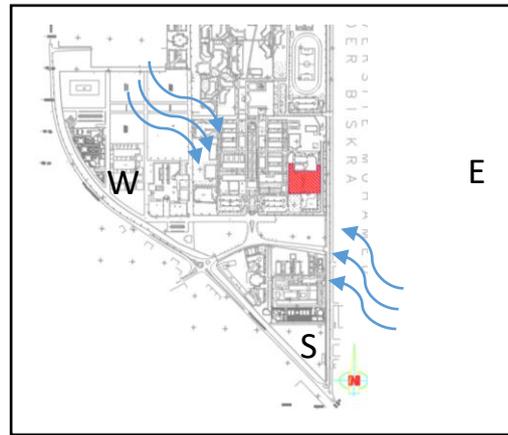
- **Green spaces**

The study area is surrounded by several green spaces, which is a positive aspect as it enhances the environmental quality and provides natural areas



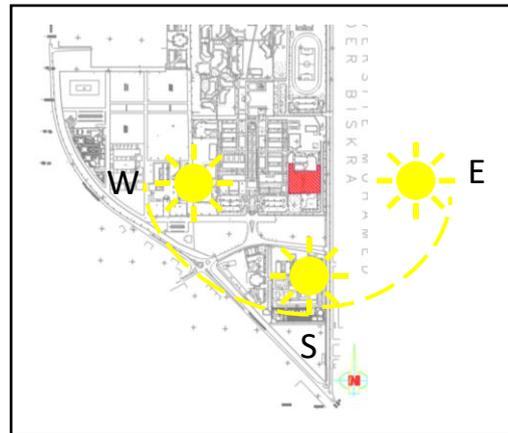
- Wind

The dominant wind directions are from the southeast and northwest

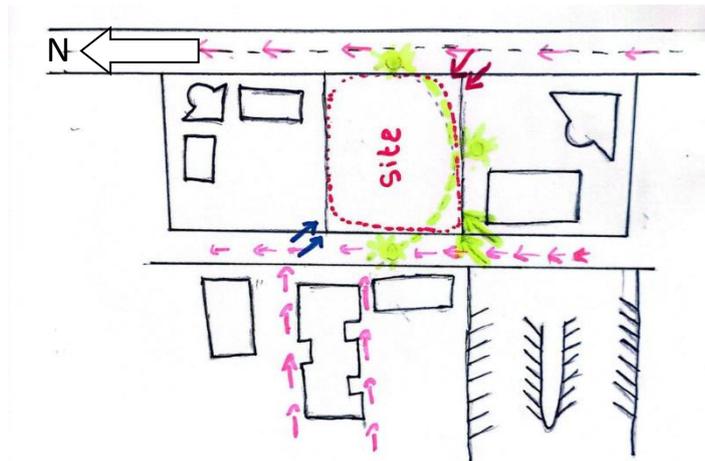


- Sun

the project benefits from sunlight in all directions



- Synthesis



Strength	Weakness	Opportunities
<p><b>Educational Location easily accessible</b>  <b>Available Space :</b> Provides sufficient space 6860m2  <b>Sunny Climate :</b> Offers good potential for solar energy and natural lighting .  <b>Public transportation service:</b> The site is well-served by public transportation.</p>	<p><b>Hot and Dry Climate:</b> Requires special designs for heat control and thermal comfort .  <b>Noise :</b> The site's proximity to roads may lead to noise issues.</p>	<p><b>Developing innovative educational spaces</b>  <b>Sustainable Designs</b>  <b>Research and Innovation :</b> The project can become a model for sustainability research in the region .</p>



# **Architectural Project**

## chapter III Architectural Project

### Introduction

The architectural project represents the practical culmination of theoretical reflections and contextual analyses developed throughout the research. It translates ideas, values, and sustainability strategies into a spatial and material reality. At the core of this process lies architectural programming, which serves as the foundational phase through which functional needs, user expectations, and environmental constraints are identified and organized. This phase precedes design itself, aiming to define the essential requirements that will guide the creative process.

The present chapter is structured around two major components: the programmatic approach, which outlines the functions, spaces, and organizational needs of the project, and the conceptual approach, which reflects the architectural vision and main ideas shaping the form and function of the building.

### III.1 Programmatic Approach:

Before defining the functional program of the proposed architectural project, a detailed study was carried out based on real data from the existing architecture school located on the same site. This study focused primarily on the evolution of student numbers over the past six academic years in both architecture and architecture-project management programs.

This analysis aimed to identify a realistic capacity for the new project, the following graphs illustrate the number of students enrolled in both programs over the last six academic years:

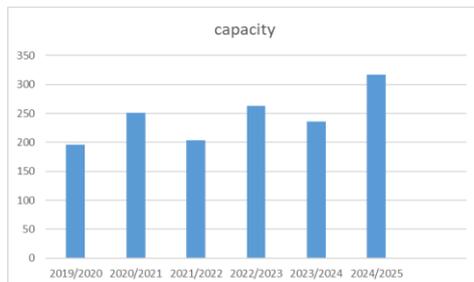


Figure 47: Architecture student capacity in the last six years

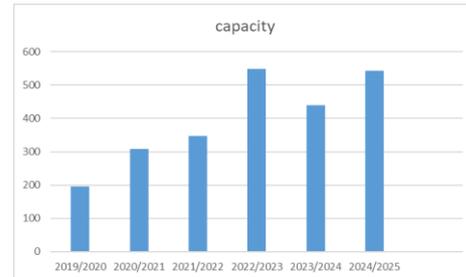


Figure 48: Architecture and Project Management student capacity in the last six years

The charts above reveal a gradual and consistent increase in the number of students, particularly in the Architecture program, which reached over 300 students by the year 2024/2025. This growing trend, led to the decision to set the new project's target capacity at 800 students in total. This figure ensures that the new facility will accommodate current needs while providing room for future development.

After analyzing the current state of the architecture school, evaluating the needs based on future student projections, and referring to international standards regarding space allocation per student, the following functional program was developed. It includes all necessary spatial components to support an efficient and sustainable learning environment, in line with the pedagogical and

institutional objectives of the new project

Function	Space Name	Number	Area	T.Area	Capacity
Teaching and learning	Lecture Halls	3	200 m2	600m2	100 students
	Conference room	1	300m2	300m2	250 person
	Classroom	8	80 m2	80m2	20 students
	Workshops( fab-lab)	3	40m2	120m2	25students
	Projection room	3	40m2	120m2	
	Exhibition Hall	1	+300	+300	+ 200 students
	VR Lab	1	100 m2	100m2	20 students
	Defense room	4	100	400m2	
	Computer lab	3	100m2	300m2	30students
	Studios	3	4.5 for student 130m2	3600m2	800 students
	PHD Laboratory	3	130m2	390m2	
	Critique Spaces	2	300 m2	600m2	100 students
Library	Individual reading area	1	350m2	350m2	100 students
	Group reading area	1	150m2	150m2	50 students
	Materials library	1	45m2	42m2	
	Computer area	1	25m2	25m2	7 students
	Browsing area	1	50m2	50m2	1-2 person
	Office	1	25m2	25m2	1-2 person
	Document storage Room	2	50m2	50m2	
	bookshelves	2	40m2	40m2	
Administration	Director's office	1	40m2	40m2	1 person
	Secretary's office	1	25m2	25m2	1 person
	Office for the deputy directors	3	25m2	75m2	1 person
	faculty Offices	20	20 m2	400m2	1 person
	Meeting rooms	3	50m2	100m2	15 person
	Admin Offices	5	40-70 m2		3-7 person
	Student services	1	80m2	80m2	2-3
	STAFF area	2	25m2	50m2	
Recreational Spaces	Cafeteria	1	200 m2	200m2	
	Games Room	1	60 m2	60m2	20 students
	Small cinema	1	80m2	80m2	15 students
	Prayer Room	2	35m2	70m2	

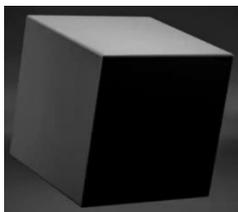
Technical/ Services Spaces	Printing room	3	40m2	120m2	
	Restrooms	10	15-30 m2	200m2	
	Agent's office	1	20m2	20m2	1-2 person
	Storage Rooms	2	50 m2	100m2	
	technical room	2	20m2	40m2	
<b>Total = 11010 m<sup>2</sup></b>					

### III.2 Conceptual approach:

#### 2) Idea:

“The project aims to design a school of architecture that represents a breakout of the box, encouraging students to be creative and innovative through a flexible learning environment that fosters free thinking and practical experimentation. The design focuses on breaking traditional educational space boundaries, integrating sustainable technologies suitable for the local environmental context, and utilizing natural lighting, and ventilation to enhance student comfort and inspire interaction with their surroundings, while fostering new ideas.”

**liberating the architect from the constraints of the “black box”**



**breaking boundaries :** removes traditional barriers allowing students to feel liberated to innovate and express themselves ( **roof , wall...**)

Those barriers limit the architect's imagination and creativity

To be creative → reliable work environment



this achieved through

openness

the creation of spaces for mental and physical relaxation



Because the architects engage in continuous intellectual effort they need this spaces to foster creativity

#### 3) Objectives and intentions :

Design a sustainable building that enhances user comfort and reflects modern architectural trends integrating sustainability with energy efficiency in the Algerian context

#### Objectives:

Enhance Environmental Sustainability: Design the building as a model of environmental sustainability by integrating renewable energy technologies such as solar panels and natural cooling

systems (e.g., the Hybrid IEC system), thereby reducing dependence on conventional energy sources.

**Promote Natural Ventilation and Daylight:** Ensure that interior spaces benefit from natural ventilation by strategically positioning openings for effective air circulation and maximizing daylight penetration to minimize reliance on artificial lighting during the day.

**Materials Used:** Low-carbon, recyclable materials were selected—such as modified concrete, low-emissivity glass, and treated wood—to reduce environmental impact, enhance thermal insulation, and uphold sustainability principles within the design.

**Create Flexible and Adaptable Spaces:** Design multipurpose spaces that can be reconfigured according to users' evolving needs, offering flexibility to accommodate various activities and seasonal changes.

**Harmonize with the Surrounding Nature:** Integrate the building into its natural context by analyzing wind patterns, utilizing natural shading, and incorporating local vegetation to create a healthy, comfortable learning environment.

**Prioritize Acoustic Comfort and Visual Quality:** Incorporate sound-absorbing materials and thoughtful spatial planning to ensure optimal acoustic comfort in lecture halls and administrative offices, while maintaining high-quality natural lighting in communal areas.

**Facilitate Efficient Internal Movement:**

Establish clear and efficient circulation paths to enhance user flow between different zones of the building, complemented by comfortable public spaces that encourage interaction and social engagement.

### 4) Concept design

The development of the project is based on three main foundations: the design concept, functionality, and sustainability.

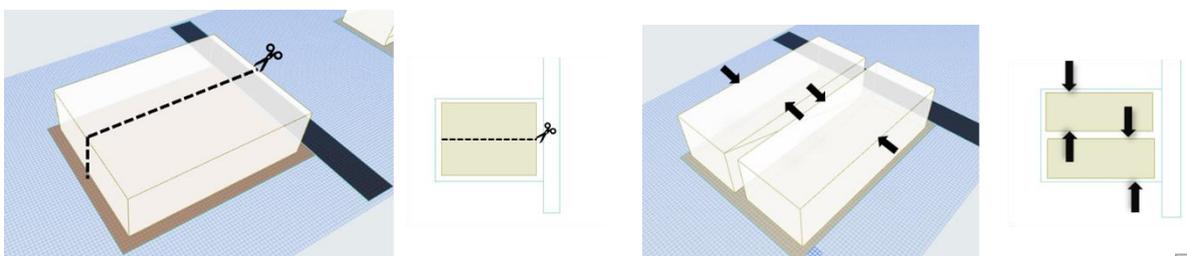
#### Step 1: Climatic Orientation

We began by placing a compact mass following the optimal north-south orientation, which is the most suitable for Biskra's semi-arid climate. This orientation reduces solar gain on the façades and allows for better thermal control.



#### Step 2: Longitudinal Cut

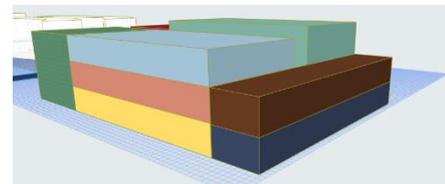
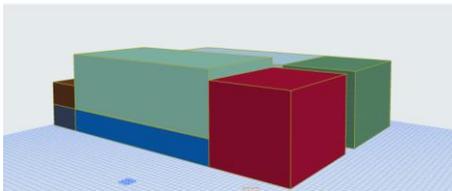
The initial volume was split longitudinally to create two separate blocks. This move improves natural lighting, allows cross ventilation, and creates a central space for movement and air circulation.



### Step 3: Functional Division

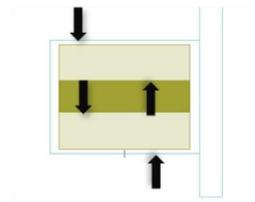
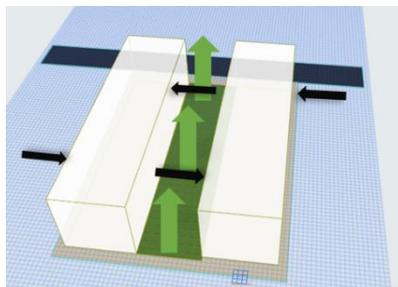
Each of the two volumes was functionally zoned, separating academic, administrative, and circulation areas. The in-between space acts as a climatic buffer and central artery for social interaction.

- |   |  |   |
|---|--|---|
| <span style="color: green;">■</span> Library          | <span style="color: red;">■</span> Administration    | <span style="color: lightblue;">■</span> Studio           |
| <span style="color: orange;">■</span> Classrooms      | <span style="color: blue;">■</span> Lecture Hall     | <span style="color: yellow;">■</span> Recreational Spaces |
| <span style="color: cyan;">■</span> PhD Research Labs | <span style="color: darkblue;">■</span> Defense Room | <span style="color: brown;">■</span> Internet Rooms       |



### Step 4: Green and Ventilation Spine

A green corridor was inserted between the two blocks, acting as a passive cooling element and social gathering zone. It channels prevailing winds to enhance natural ventilation while offering shaded outdoor space.

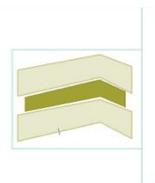
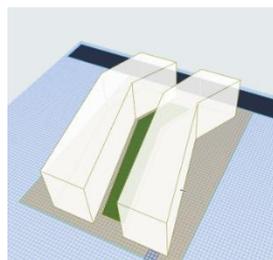


### Step 5: Sustainability Layer

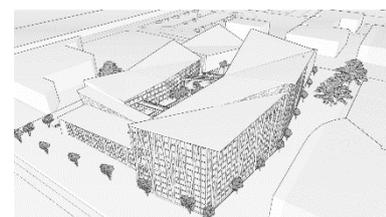
Several sustainable solutions were applied, such as double-skin façades, solar panels, natural ventilation, green corridors, rainwater harvesting, materials, smart systems, and a Hybrid IEC system for low-energy cooling.

### Step 6: Breaking the Rectangular Volumes

A slight break was introduced in the rectangular masses to reduce geometric rigidity. This added dynamism to the design, improved natural light and ventilation, and allowed for better integration of sustainable technologies.



### Shape developmen

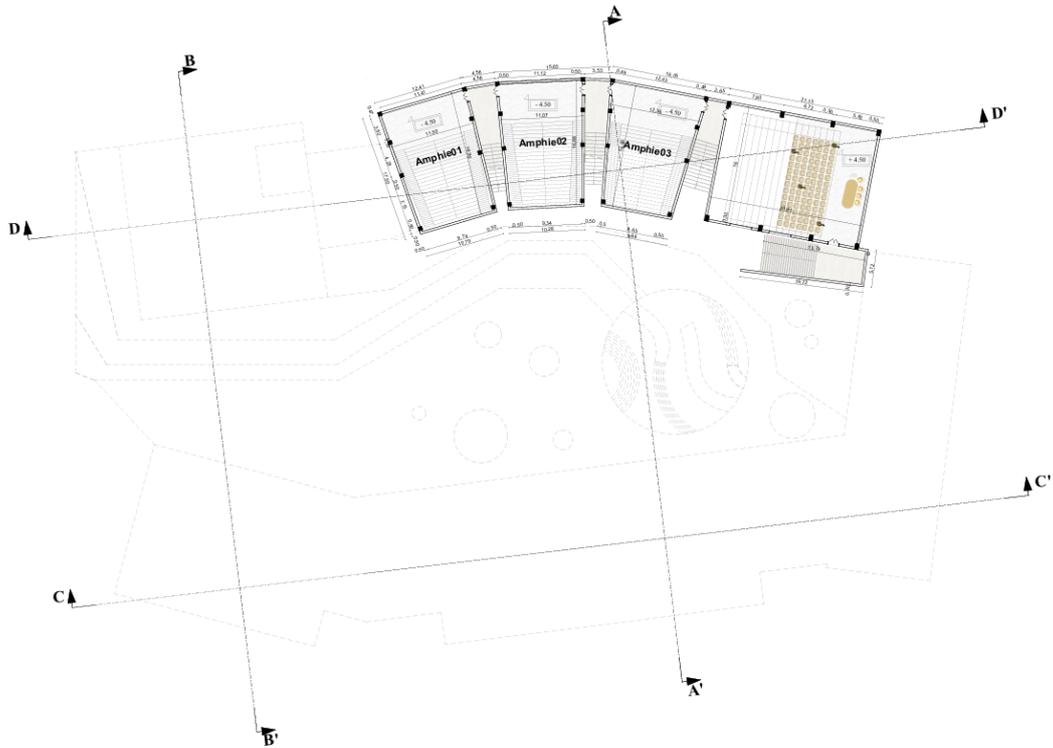




5) Project presentation



masse plan, scale 1/200.



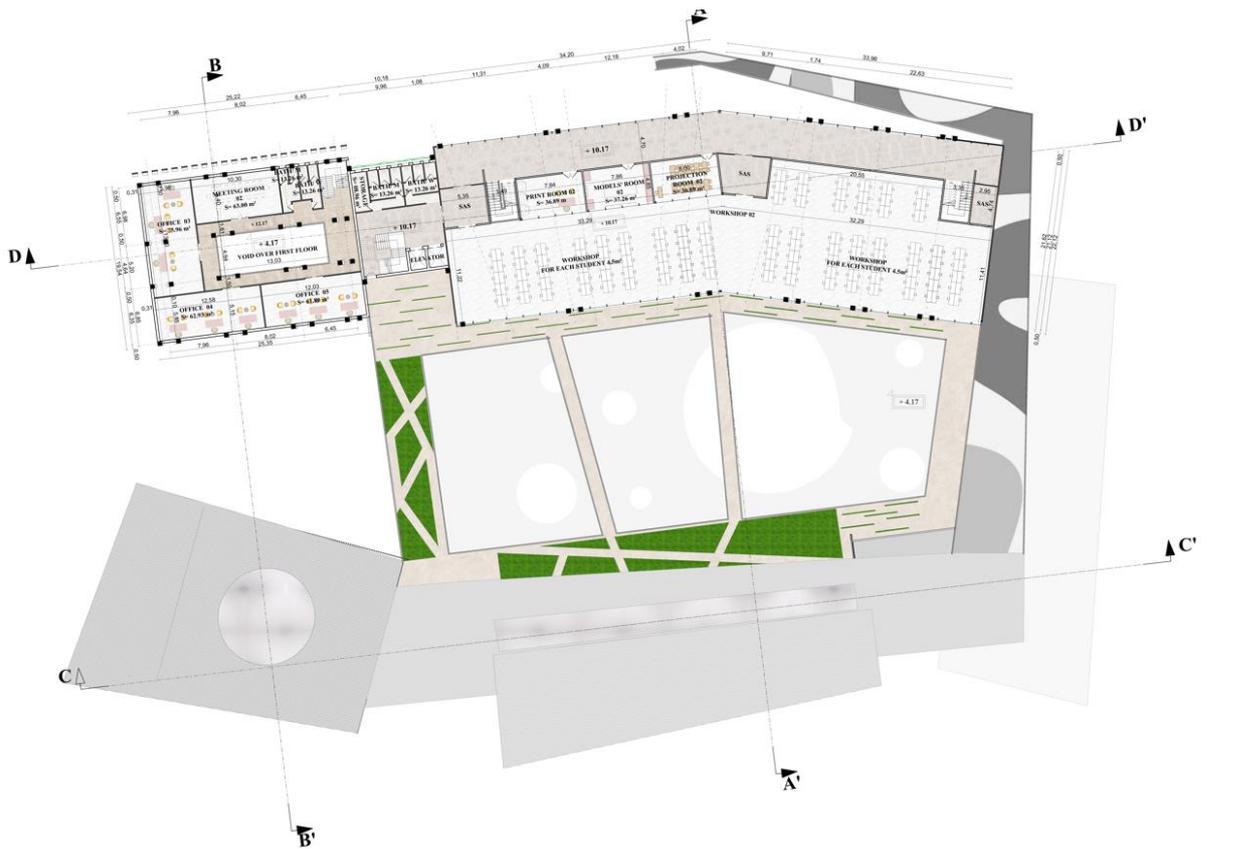
**BASEMENT FLOOR -4.5**  
**SCALE 1:100**



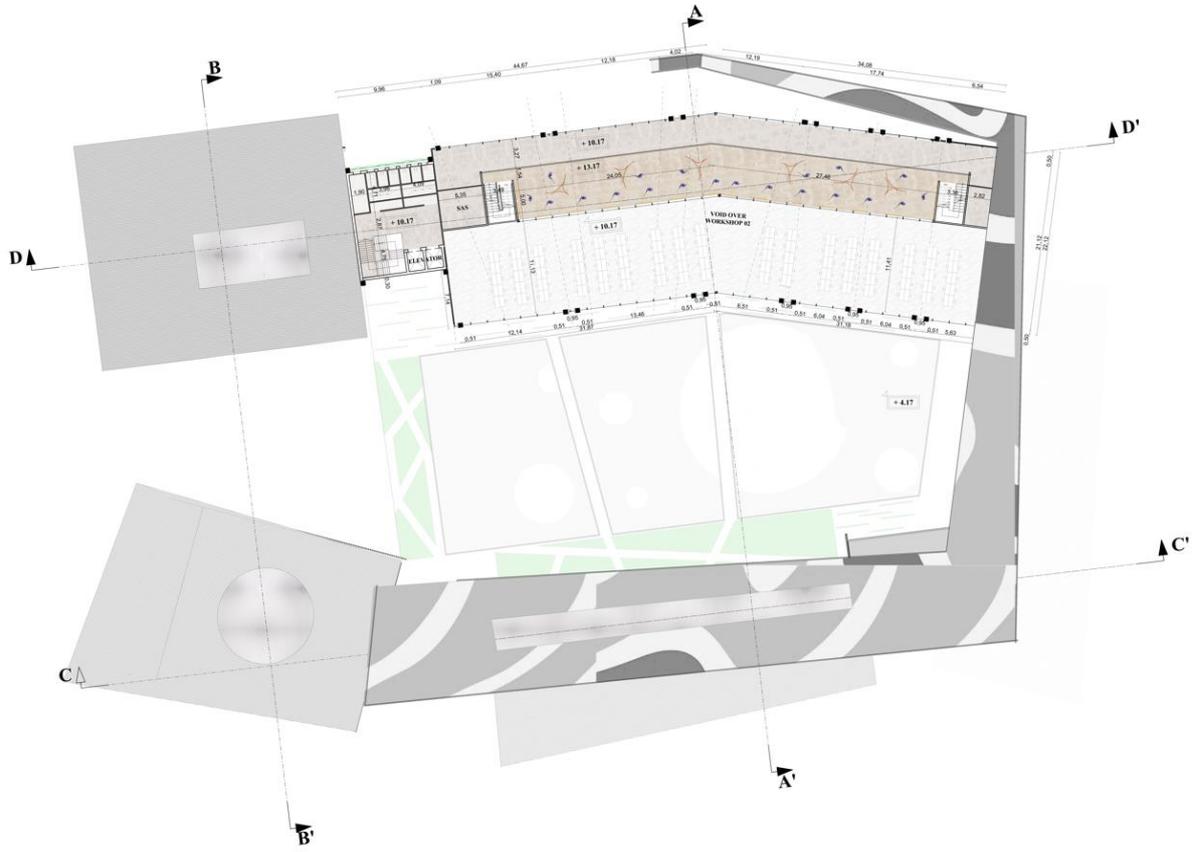
**Level +17**



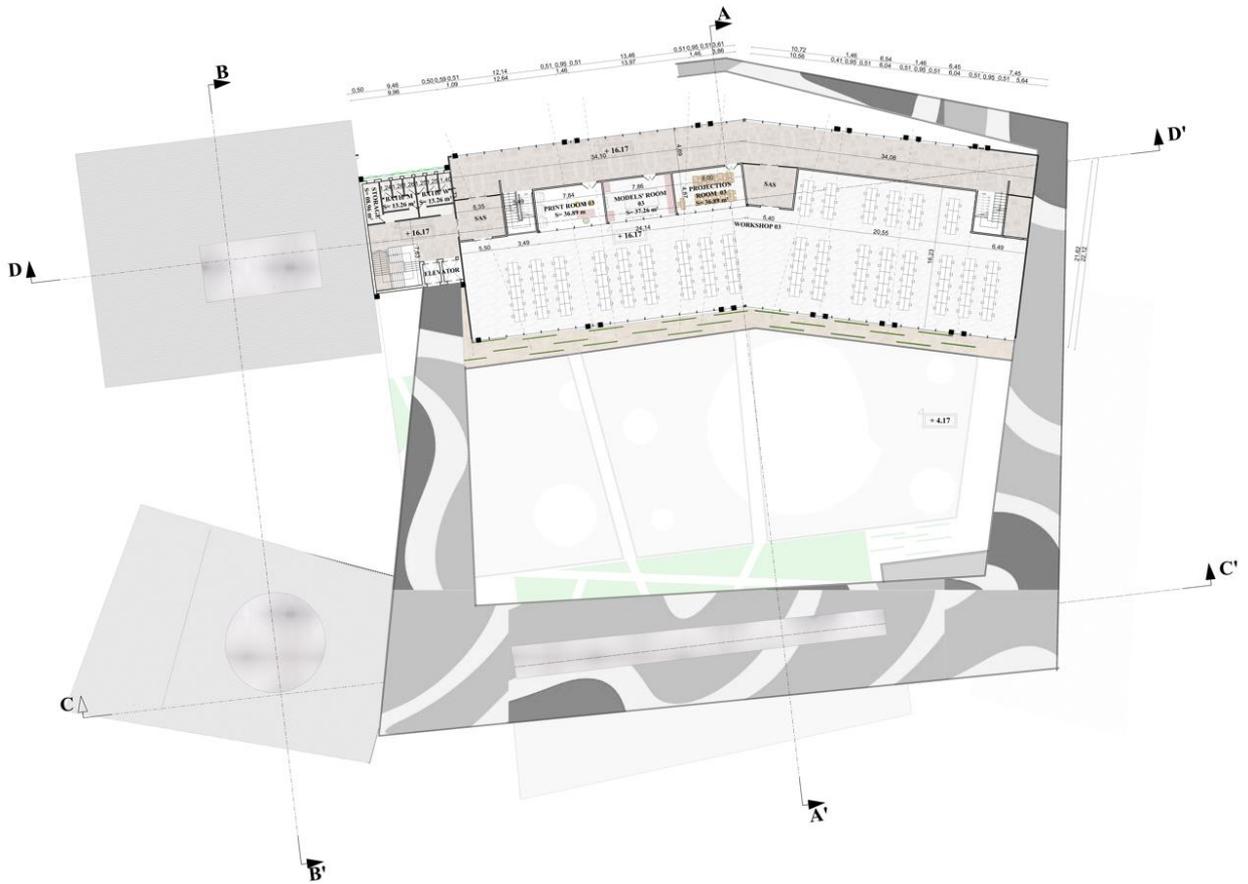
Level +4.17



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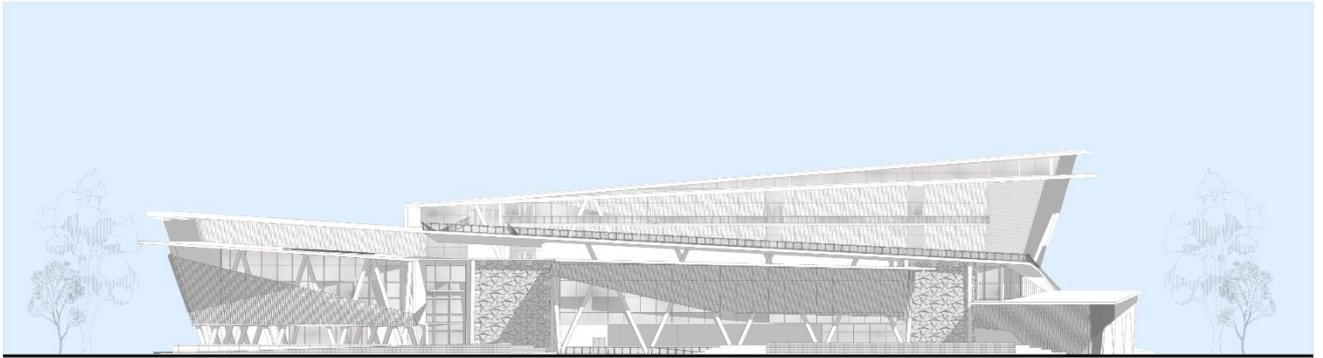


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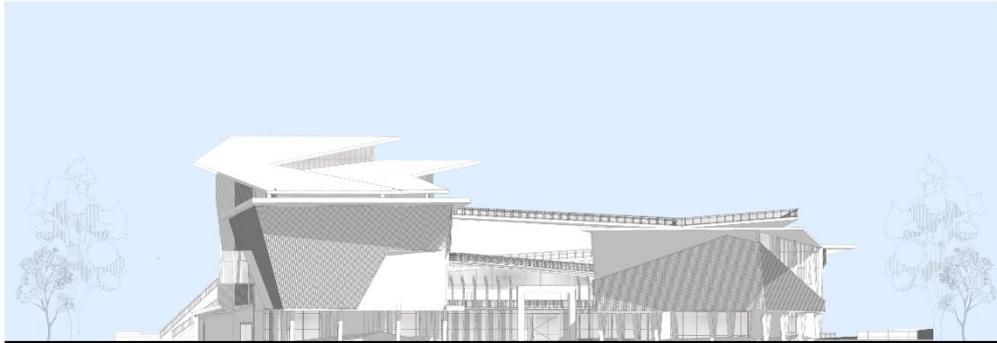


LEVEL +16.17

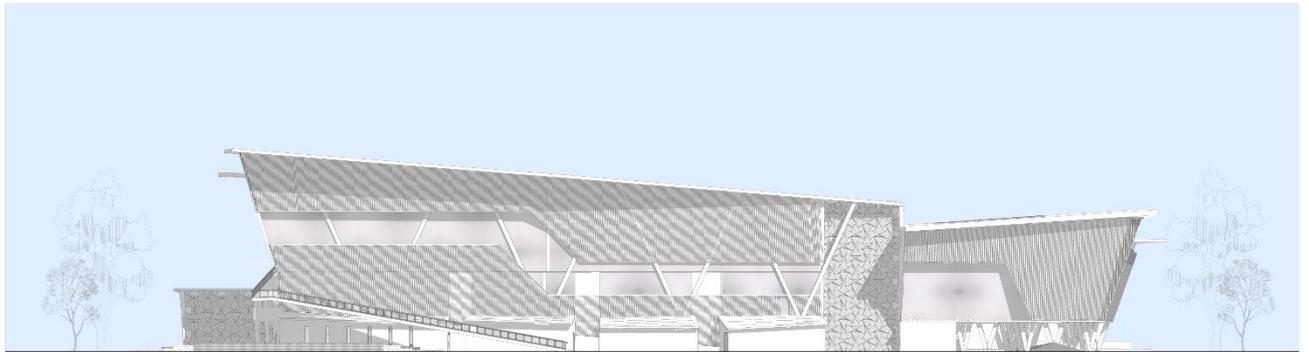




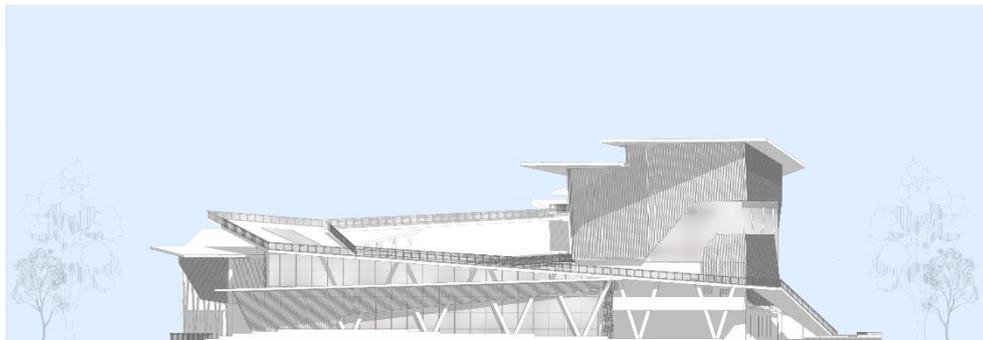
RIGHT SIDE ELEVATION SCALE: 1:100



MAIN ELEVATION SCALE: 1:100



LEFT SIDE ELEVATION SCALE: 1:100



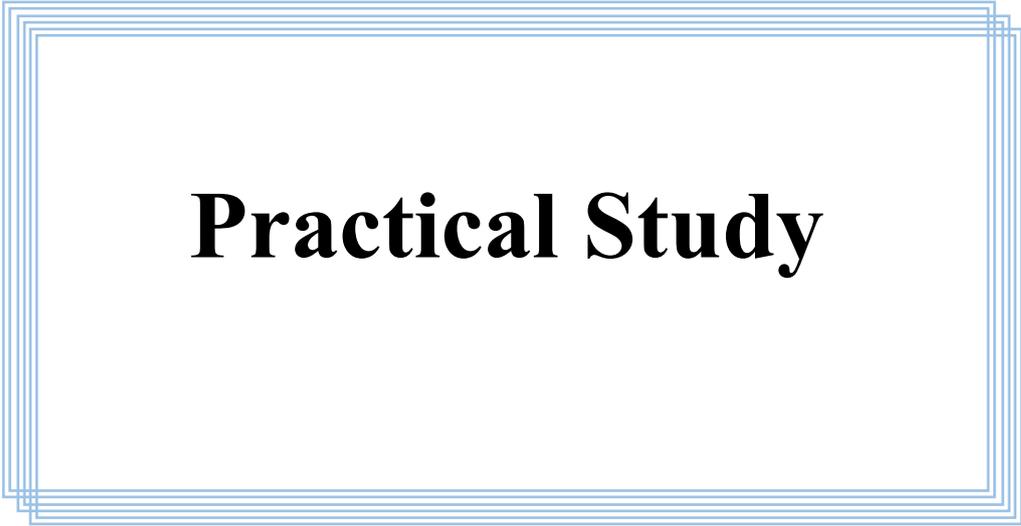
REAR ELEVATION SCALE: 1:100

- Exterior views



- Interior views



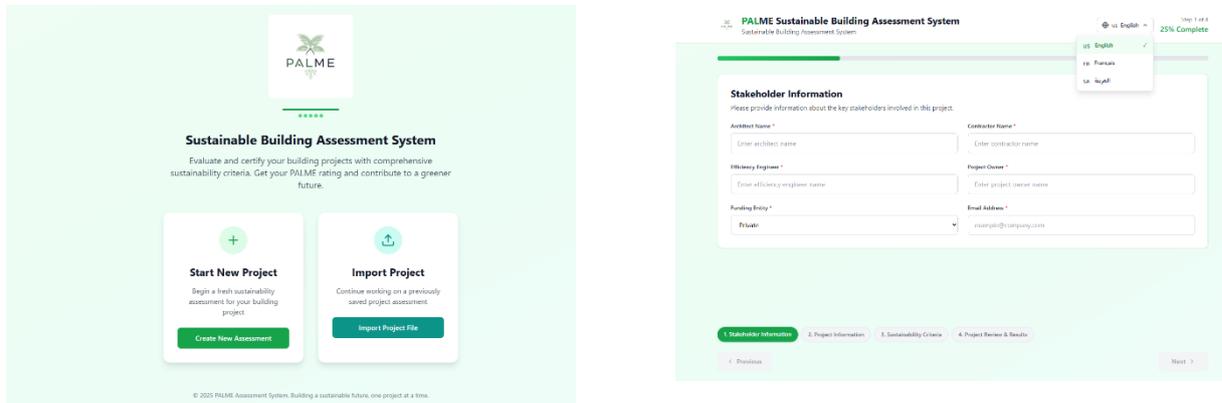


# **Practical Study**

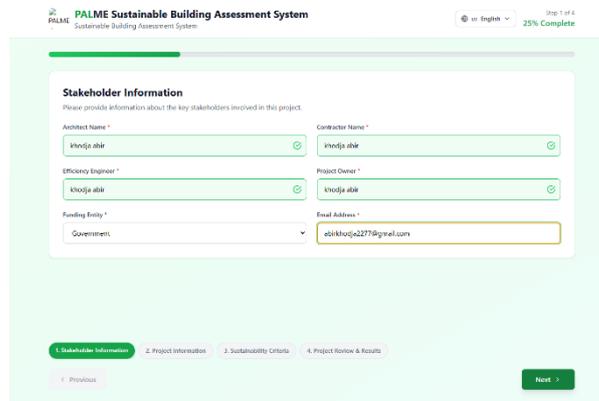
## IV.1 Application of the Assessment System on the Architectural Project:

Based on a detailed comparison of international sustainability assessment systems (LEED, BREEAM, HQE, PRS) a contextual analysis of the Algerian situation (regulations, climate, construction practices) (Annexe 3), and field surveys with professionals and experts (Annexe 2), we have developed a set of criteria specifically adapted to the local context.

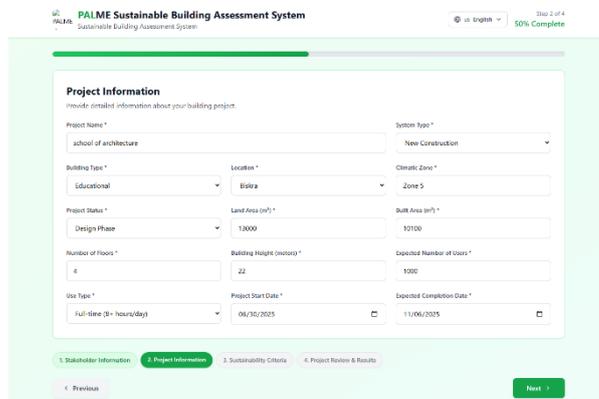
This model will be implemented on our project as a practical case study to validate its relevance in the Algerian context.



**Step 1:** Enter general information, such as the name of the architect, the construction company



**Step 2:** Fill in project-specific data (number of floors, building use, climate zone, etc.)



**Step 3:** Evaluate energy performance (thermal insulation, use of renewable energy, lighting systems, ventilation, etc.).

**Sustainability Criteria**  
Evaluate your project against sustainability criteria.

**Energy Efficiency**

**Thermal Design Performance**  
Assess the thermal efficiency of walls, roofs, windows and floor-to-ceiling heat transfer.

Score: **Max: 3**     
Current: 0/3

**Renewable Energy Systems**  
Integration of systems adding renewable energy sources, such as solar water heating or photovoltaic electricity production.

Score: **Max: 3**     
Current: 0/3

**Operational Electricity Usage**  
Reducing operational electricity consumption using efficient technologies.

Score: **Max: 3**     
Current: 0/3

**Natural Ventilation**  
Minimize natural ventilation or reduce reliance on air conditioning.

Score: **Max: 3**     
Current: 0/3

**HVAC System Efficiency**  
Use of highly efficient systems such as Inverter Compressor Cooling (ICC) or heat pumps with high COP/EER.

Score: **Max: 3**     
Current: 0/3

**Lighting Efficiency (Index/Outdoors)**  
Design that maximizes natural lighting and use efficient lighting systems.

Score: **Max: 3**     
Current: 0/3

**Energy Monitoring and Control Systems**  
Installation of smart systems such as a Building Management System (BMS) or smart meters that allow continuous monitoring, cost analysis and performance optimization.

Score: **Max: 2**     
Current: 0/2

**Reduction of CO<sub>2</sub> Emissions**  
This criterion measures the amount of CO<sub>2</sub> emissions resulting from the building's energy consumption directly per square meter.

Score: **Max: 3**     
Current: 0/3

**Energy Category Evaluation:** The project demonstrated strong performance in the energy category by integrating effective passive design strategies such as natural ventilation supported by the IEC Hybrid cooling system and proper thermal insulation. The use of LED lighting, natural daylighting, and solar panels contributed to reducing electricity consumption and carbon emissions. Additionally, energy monitoring systems ensured efficient operation.

**Step 4:** Evaluate water management (rainwater harvesting, water-saving technologies, greywater reuse, etc.).

**Water Efficiency**

**Efficient Fixtures**  
Water fixtures that use a minimal amount of water to reduce overall consumption. For example, sinks, showers, and toilets that consume no more than 4 liters per minute (L/min) for sinks are considered efficient.

Score: **Max: 6**     
Current: 0/6

**Greywater Reuse**  
Greywater reuse refers to the recycling of water from sinks, showers, and kitchens (non-contaminated) for other uses like irrigation or cleaning floors.

Score: **Max: 3**     
Current: 0/3

**Rainwater Harvesting**  
Rainwater harvesting refers to collecting and storing rainwater from building surfaces, such as rooftops, using specialized collection systems.

Score: **Max: 3**     
Current: 0/3

**Water Sub-metering**  
Water sub-metering refers to the installation of individual water meters for each unit or area within the building to measure water consumption separately.

Score: **Max: 3**     
Current: 0/3

**Efficient Irrigation**  
The use of irrigation systems that reduce water consumption, such as drip irrigation or smart control systems that adjust watering based on the actual needs of plants.

Score: **Max: 2**     
Current: 0/2

**Leak Detection System**  
A system designed to detect hidden water leaks within the building's plumbing network, such as in pipes or tanks, to minimize water loss and waste.

Score: **Max: 1**     
Current: 0/1

**Water Efficiency Category Evaluation:** It incorporates efficient plumbing fixtures consuming  $\leq 4$  L/min, a greywater reuse system covering more than 30% of non-potable needs, and a rainwater harvesting system with tanks exceeding 50 L/m<sup>2</sup> of roof area. Additional measures include water sub-metering for each unit, a smart drip irrigation system, and leak detection technologies. These strategies significantly reduce potable water consumption and promote sustainable water management across the building.

**Step 5:** Assess the materials used (local, recycled, low-emission materials...).

**Material Efficiency**

**Use of Local Materials**  
Refers to the use of materials sourced locally (i.e. 300 km from the site) to reduce transportation and support the local economy.

Score: **Max: 3**     
Current: 0/3

**Embodied Carbon Emissions**  
Measured by the carbon emissions associated with the production of the material.

Score: **Max: 3**     
Current: 0/3

**Material Lifespan or Recyclability**  
Measures the material's ability to be reused or withstand time without needing replacement.

Score: **Max: 3**     
Current: 0/3

**Reuse of Structural Materials**  
The use of salvaged structural components from old buildings or the site itself.

Score: **Max: 1**     
Current: 0/1

**Responsible Sourcing of Materials**  
Are materials purchased from independently certified suppliers or those with certification (e.g., FSC, ISO 14001)?

Score: **Max: 1**     
Current: 0/1

**Materials Category Evaluation:** The project utilized key materials such as treated wood, low-carbon concrete, and double glazing, which contributed to reducing the building's environmental footprint. These materials offer moderate durability and partial recyclability, with some sourced locally.

**Step 6: Evaluate indoor environmental quality (natural lighting, air quality, thermal and visual**

**Indoor Comfort**

**Criteria**

**Air Quality**

Air quality within a building refers to the rate of fresh air ventilation (or air changes), which is the number of times air is replaced per hour (ACH). The standard is 0.35 ACH as a minimum for fresh air inside the building.

Score: **Max: 4**

**03**  Upload Documentation (PDF) (Max: 2MB)  
Choose PDF file (Max: 2MB)

Current: 3/4

**Thermal Comfort**

Thermal comfort refers to how people feel about the thermal environment inside a building based on temperature, humidity, airflow, and clothing. PMV (Predicted Mean Vote) is the measure used for thermal comfort.

Score: **Max: 3**

**0**  Upload Documentation (PDF) (Max: 2MB)  
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Current: 0/3

**Daylighting**

Daylighting refers to the use of natural light to illuminate the interior of a building, reducing the need for artificial lighting and creating a healthier, more comfortable environment.

Score: **Max: 3**

**02**  Upload Documentation (PDF) (Max: 2MB)  
Choose PDF file (Max: 2MB)

Current: 2/3

**Acoustic Comfort**

Acoustic comfort refers to reducing noise inside a building to provide a quiet and comfortable environment for the users. It aims to minimize the impact of external or internal noise.

Score: **Max: 2**

**02**  Upload Documentation (PDF) (Max: 2MB)  
Choose PDF file (Max: 2MB)

Current: 0/2

**Glare Control**

Glare control aims to reduce the impact of direct sunlight inside the building, which can cause discomfort or affect user comfort.

Score: **Max: 2**

**01**  Upload Documentation (PDF) (Max: 2MB)  
Choose PDF file (Max: 2MB)

Current: 1/2

**VOC Monitoring**

Volatile Organic Compounds (VOCs) are chemicals that evaporate easily and are found in many building materials, such as paints and adhesives. These compounds can affect indoor air quality and user health.

Score: **Max: 1**

**0**  Upload Documentation (PDF) (Max: 2MB)  
Choose PDF file (Max: 2MB)

Current: 0/1

**CO<sub>2</sub> Monitoring Sensors**

Monitoring Carbon Dioxide (CO<sub>2</sub>) inside the building to improve air quality. High CO<sub>2</sub> levels may indicate inadequate ventilation, affecting user comfort.

Score: **Max: 1**

**01**  Upload Documentation (PDF) (Max: 2MB)  
Choose PDF file (Max: 2MB)

Current: 1/1

**View Out**

View out refers to providing natural external views for users inside the building. Having natural views can improve psychological comfort and enhance the overall well-being of users.

Score: **Max: 1**

**01**  Upload Documentation (PDF) (Max: 2MB)  
Choose PDF file (Max: 2MB)

Current: 1/1

comfort...).

**Indoor Environmental Quality Evaluation:** The project achieved a perfect score in the indoor environmental quality category. It features effective natural ventilation supported by the IEC hybrid system, thermal comfort ensured through simulation analysis, and natural daylighting in over 75% of interior spaces. Glare and noise are well-controlled through architectural design. VOC and CO<sub>2</sub> sensors are installed to monitor indoor air quality, and external views are provided to enhance user well-being and visual comfort.

**Step 7: Assess social dimension**

**Social Impact**

**Criteria**

**Universal Accessibility**

Does the design facilitate movement for all users, including the elderly, children, and people with disabilities? The building promotes free and safe circulation for all individuals by incorporating wide corridors, non-slip flooring, clear signage, and appropriate vertical circulation elements such as elevators and ramps.

Score: **Max: 3**

**03**  Upload Documentation (PDF) (Max: 2MB)  
Choose PDF file (Max: 2MB)

Current: 3/3

**Psychological and Social Well-being**

Presence of rest areas, natural views, comfortable lighting, enhances the psychological well-being of users through clean, comfortable spaces and access to socially supportive environments and visual or sensory comfort.

Score: **Max: 2**

**0**  Upload Documentation (PDF) (Max: 2MB)  
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Current: 0/2

**Equity of Access**

Does the building serve everyone without discrimination? (Age, gender, social group). Ensures equal access to services and spaces for all users regardless of demographic, economic, or social background, promoting fairness and inclusion.

Score: **Max: 2**

**02**  Upload Documentation (PDF) (Max: 2MB)  
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Current: 0/2

**Local Community Engagement**

Does the project enhance employment, education, or cultural activities? Evaluate how the building contributes to stimulating local economic, educational and cultural development through its presence and operation.

Score: **Max: 1**

**01**  Upload Documentation (PDF) (Max: 2MB)  
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Current: 1/1

**Safety and Security**

Safe design, emergency exits, proper lighting, avoidance of isolated areas. Provides a secure environment for users and the surrounding community through preventive infrastructure, clear emergency pathways, and well-lit, inclusive public spaces.

Score: **Max: 2**

**02**  Upload Documentation (PDF) (Max: 2MB)  
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Current: 0/2

**Social Category Evaluation:** The project emphasizes human and social sustainability by ensuring universal accessibility for all users, including individuals with disabilities, the elderly, and children—through wide corridors, non-slip flooring, ramps, and elevators. Psychological well-being is enhanced by natural views, rest areas, and comfortable lighting. The design ensures equitable access to all services without discrimination. The building also contributes positively to local educational and cultural development. Additionally, it incorporates safety features such as clear emergency exits and well-lit pathways

**Step 8: Waste Management**

**Waste Management**

**Criteria**

**Construction Waste Recycling**

New Construction: Evaluated based on the stipulated waste management plans, particularly the projected percentage of materials to be recycled or reused from the total anticipated on-site waste. Existing Buildings: Assessed based on the percentage of waste generated by maintenance or minor modifications that is sorted and recycled rather than landfilled.

Score: **Max: 4**

**04**  Upload Documentation (PDF) (Max: 2MB)  
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Current: 0/4

**Reducing Daily Waste**

Planning buildings: The amount of construction waste sent to recycling centers (or reused) is calculated as a percentage of the total waste produced on-site. New construction: Evaluated based on having clear plans for managing and sorting daily waste within the building once operational.

Score: **Max: 2**

**02**  Upload Documentation (PDF) (Max: 2MB)  
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Current: 2/2

**On-site Waste Sorting Facilities**

Presence of designated waste sorting bins in all units or common areas.

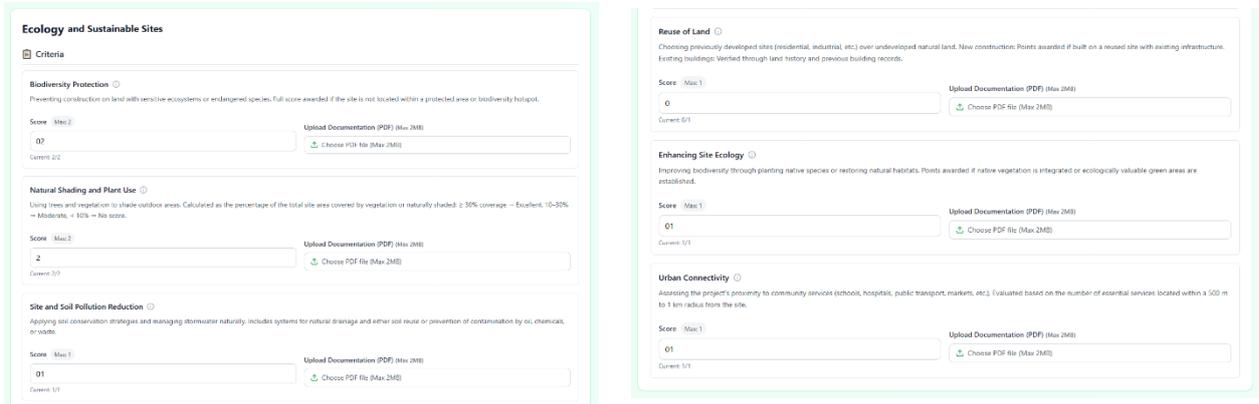
Score: **Max: 2**

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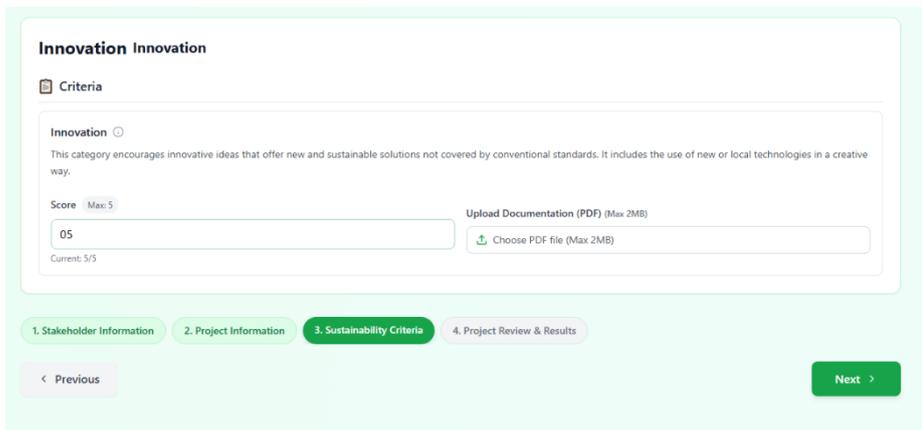
**Waste Category Evaluation:** The project includes a robust construction waste management plan, ensuring that over 50% of waste is recycled or reused. Daily waste reduction strategies were also incorporated through user awareness. However, no on-site waste sorting bins were provided in units or common areas

**Step 9: Site and Ecology.**



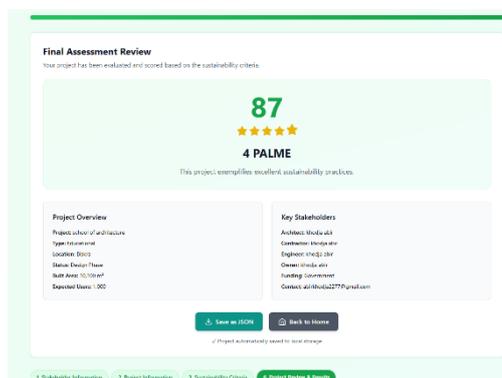
**Sustainable Site and Ecology Category Evaluation:** The project site was carefully selected to avoid ecologically sensitive or protected areas, earning full points for biodiversity protection. Green areas cover 10–30% of the total site, providing moderate natural shading. Natural drainage systems were integrated to reduce soil pollution. The site has good urban connectivity, being close to essential services. Additionally, the ecology was enhanced through native vegetation

**Step 10: Award bonus points for innovation (e.g., hybrid systems, unconventional solutions...).**



**Innovation in the Project:** The project incorporates the use of the Hybrid IEC cooling system, which integrates modern technologies to improve energy efficiency. Additionally, the cooling system will be enhanced with smart monitoring technologies to effectively track and improve the system's performance, contributing to energy savings and reducing environmental impact.

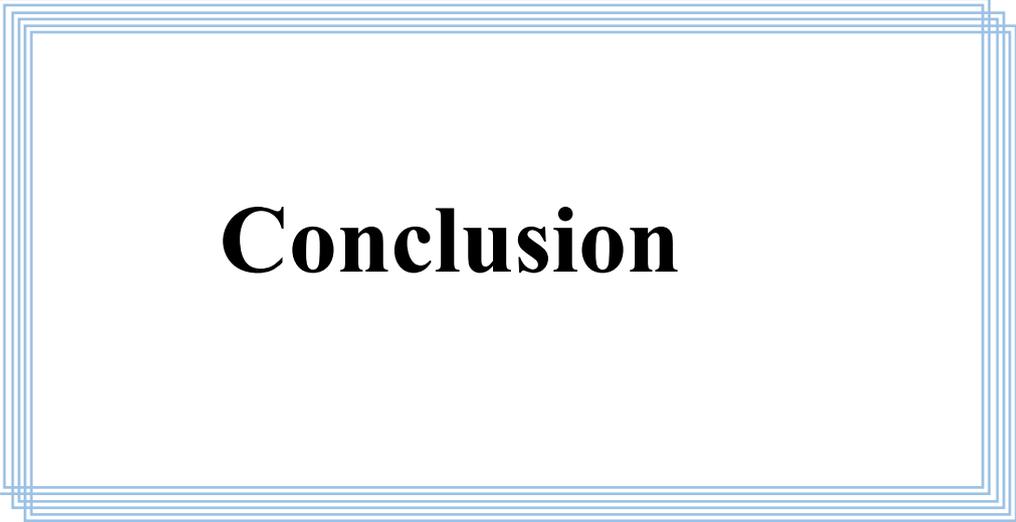
**Step 11: Final Score and Rating**



 <b>school of architecture</b> Biskra		<b>5 PALME</b> AWARDED JUN 2025	
 <b>WATER EFFICIENCY</b>	<b>AWARDED: 19 / 22</b>	 <b>ECOLOGY AND SUSTAINABLE SITES</b>	<b>AWARDED: 6 / 8</b>
Efficient Fixtures	5/6	Biodiversity Protection	2/2
Greywater Reuse	4/5	Natural Shading and Plant Use	1/2
Rainwater Harvesting	4/5	Site and Soil Pollution Reduction	1/1
Water Sub-metering	3/3	Reuse of Land	0/1
Efficient Irrigation	2/2	Enhancing Site Ecology	1/1
Leak Detection System	1/1	Urban Connectivity	1/1
 <b>ENERGY EFFICIENCY</b>	<b>AWARDED: 19 / 22</b>	 <b>WASTE MANAGEMENT</b>	<b>AWARDED: 6 / 8</b>
Thermal Envelope Performance	4/4	Construction Waste Recycling	4/4
Renewable Energy Systems	1/3	Reducing Daily Waste	2/2
Operational Electricity Usage	3/3	On-site Waste Sorting Facilities	0/2
Natural Ventilation	2/2		
HVAC System Efficiency	1/2		
Lighting Efficiency (Indoor/Outdoor)	3/3		
Energy Monitoring and Control Systems	2/2		
Reduction of CO <sub>2</sub> Emissions	3/3		
 <b>INDOOR ENVIRONMENTAL QUALITY</b>	<b>AWARDED: 15 / 17</b>	 <b>SOCIAL IMPACT</b>	<b>AWARDED: 10 / 10</b>
Air Quality	3/4	Universal Accessibility	3/3
Thermal Comfort	2/3	Psychological and Social Well-being	2/2
Daylighting	3/3	Equity of Access	2/2
Acoustic Comfort	2/2	Local Community Engagement	1/1
Glare Control	2/2	Safety and Security	2/2
VOC Monitoring	1/1		
CO <sub>2</sub> Monitoring Sensors	1/1		
View Out	1/1		
 <b>MATERIAL EFFICIENCY</b>	<b>AWARDED: 7 / 11</b>	 <b>INNOVATION</b>	<b>AWARDED: 5 / 5</b>
Use of Local Materials	2/3	Innovation	5/5
Embodied Carbon Emissions	3/3		
Material Lifespan or Recyclability	2/3		
Reuse of Structural Materials	0/1		
Responsible Sourcing of Materials	0/1		

After applying the local sustainable building assessment system to the Architecture School project in Biskra, the building’s performance was evaluated across various environmental, social, and technical categories. The project demonstrated a high level of commitment to sustainability standards, particularly in water management and indoor air quality, while also integrating innovative systems such as Hybrid IEC cooling and smart monitoring technologies.

The project achieved a total score of 84 out of 105 points, which places it in the highest classification level (FIVE PALME). This result reflects the project's strong alignment with local sustainability standards and highlights its success in embedding sustainability principles across all aspects of design and operation.



# **Conclusion**

## General Conclusion

This research was driven by a fundamental question: How can we develop a sustainability assessment model truly adapted to Algeria's unique context? The study addresses the critical limitations of global rating systems such as LEED, BREEAM, HQE, and PRS. While these systems offer comprehensive frameworks, they fall short when applied to Algeria's specific climatic conditions, socio-economic realities, and regulatory environment. Through a systematic investigation, we have demonstrated that sustainable building assessment requires tools specifically tailored to local contexts, rather than relying on imported solutions.

The research followed a rigorous methodological progression, starting with theoretical foundations that examined sustainability principles and existing international assessment systems. This analysis revealed significant mismatches between global standards and Algerian realities, particularly regarding resource availability, environmental priorities, and implementation capacities.

In the subsequent analytical phase, we focused on sustainable building examples from both international and national contexts, particularly those relevant to arid and semi-arid regions. A detailed climate analysis of Biskra, a city located in southeastern Algeria with a hot semi-arid climate, was carried out. The study incorporated valuable insights from architectural professionals and academics through targeted surveys. These steps were instrumental in developing context-specific sustainability criteria that genuinely reflect Algeria's actual needs and capabilities.

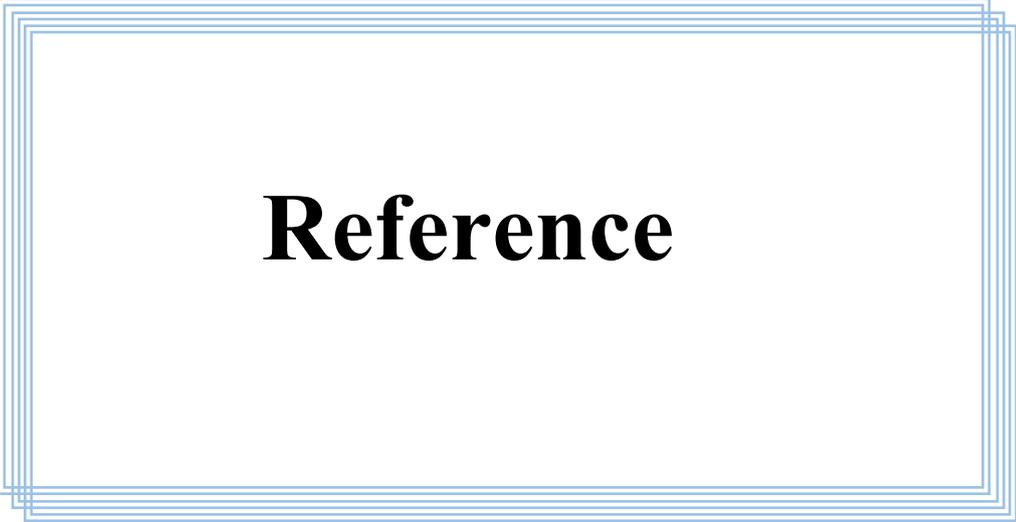
The practical implementation of the study was exemplified through the design of a sustainable architecture school in Biskra. This project served as a living laboratory for our proposed PALME (Performance Assessment for Local and Multidimensional Environments) system. The design successfully integrated bioclimatic strategies such as optimal building orientation, natural ventilation systems, locally appropriate materials, and innovative solutions like the Hybrid IEC cooling method. This real-world application provided crucial validation for the effectiveness of the PALME framework in Algerian conditions.

PALME is structured as an 11 step evaluation system that comprehensively addresses all critical sustainability dimensions: energy efficiency, water conservation, material selection, indoor environmental quality, waste management, site ecology, social impact, and innovation capacity. Its application to the Biskra case study confirmed both the technical feasibility and practical adaptability of the model to local constraints.

Looking forward, this research establishes multiple pathways for further development and implementation. The PALME system requires refinement for different building typologies and diverse climatic regions within Algeria. More significantly, it calls for institutional recognition and adoption as part of national sustainability policies. Beyond its immediate practical applications, this work represents a philosophical shift in how we conceptualize sustainable development—not as a universal standard, but as a responsive, context-sensitive practice that respects local conditions while maintaining scientific rigor.

In its ultimate implications, this study advocates for nothing less than a paradigm shift in Algerian architectural practice. PALME offers more than just an assessment tool; it provides a framework for rethinking sustainability from the ground up, developed by Algerians for Algerian conditions. The system's true value lies in its potential to inform policy decisions, guide professional practice, and ultimately transform how sustainability is understood and implemented across Algeria's construction sector.

Future research should explore digital integration through BIM platforms, conduct economic feasibility studies, and implement longitudinal performance monitoring, all while maintaining the system's fundamental commitment to contextual relevance and practical applicability.



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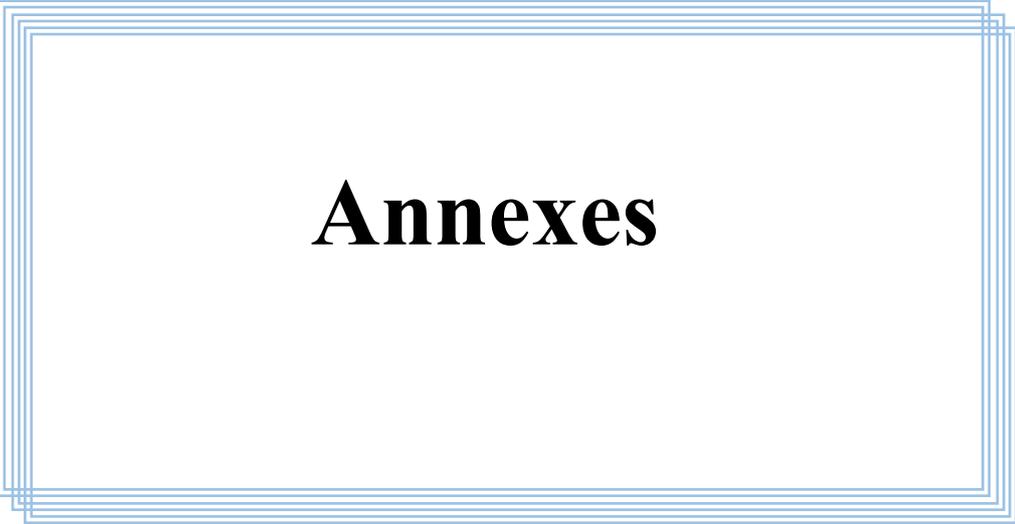
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# **Annexes**

## Annexe –1-

### Questionnaire Prepared by the Author Regarding Preferences for Educational Workshop Models (Atelier / Studio)

#### Enquête sur les Préférences des Étudiants et des Enseignants : Studio ou Atelier ?"

Dans le cadre du projet de fin d'études, dont il est question de concevoir une école d'Architecture, j'ai exploré différentes méthodes d'enseignement du projet architectural. En s'inspirant des réflexions sur la manière dont l'architecture peut évoluer et s'adapter aux besoins contemporains, j'ai été amenée à réfléchir sur la conception de l'espace clés, qui est l'Atelier. Deux configurations spatiales caractérisent cet espace; à savoir, un espace fermé (la conception classique d'atelier), et un espace plutôt ouvert, qui est le Studio. L'objectif de ce formulaire de questions, est de recueillir les opinions des enseignants et des étudiants, sur les avantages et les inconvénients que présente chacune des deux configurations. Votre avis est essentiel pour mieux comprendre les préférences et les besoins des étudiants et des enseignants dans le contexte de l'enseignement de l'Architecture.

vous êtes

enseignant(e)

étudiant(e)

#### Atelier

##### Atelier (Espace fermé)

L'atelier est un espace de travail fermé où les étudiants travaillent individuellement ou en petits groupes. C'est un environnement plus structuré et plus calme.

##### Avantages

Favorise la concentration et le calme.

Encadrement plus direct par les enseignants.

Moins de distractions, ce qui aide à rester concentré sur les projets.

##### Inconvénients

Moins de collaboration entre étudiants.

Manque de diversité d'idées et de perspectives.

Peut créer un sentiment d'isolement.

Espaces parfois restreints, limitant la liberté de mouvement.

atelier



## Studio

### Studio (Espace ouvert)

Le studio est un espace ouvert où les étudiants travaillent dans un environnement plus libre et collaboratif, souvent avec plus d'interaction entre eux.

### Avantages

Encouragement de la collaboration et de l'échange d'idées.

Plus d'interaction sociale et créative entre les étudiants.

Espace plus flexible et dynamique.

Permet une diversité de perspectives et de solutions créatives.

### Inconvénients

Difficulté de concentration en raison du bruit

Manque de tranquillité pour certains étudiants qui préfèrent travailler en silence.

### studio



Quel espace préférez-vous ?

atelier

studio

Pensez-vous qu'il soit préférable d'avoir les 2 possibilités ?

oui

Pensez-vous que la configuration en studio est plutôt réservée à

1er année

2eme année

3eme année

4eme année

5eme année

À votre avis, est-il envisageable de prévoir un espace flexible, un studio pouvant être transformé en plusieurs ateliers grâce à des séparations amovibles ?

oui

non

## Annexe –2-

Survey for Researchers, Professors, and Architects to Define Relevant Sustainability Criteria for the Algerian Context

### **La durabilité en Algérie**

La question de durabilité architecturale en Algérie est en évolution depuis les premiers textes parus le début du XXI<sup>e</sup> siècle. Etant relative aux conditions Sociales, Economiques et Environnementales; la Durabilité en Algérie nécessite un Système d'évaluation spécifique. Ce travail constitue une tentative pour répondre à cette nécessité.

Grace à ce formulaire de questions; nous envisageons sélectionner les critères les plus importants pour les intégrer dans une démarche d'évaluation de Durabilité en Algérie. Ce questionnaire s'inscrit dans le cadre de notre travail de recherche axé sur les systèmes d'évaluation de la durabilité des projets d'Architecture. Il est adressé uniquement aux experts dans le domaine du Développement Durable en Architecture (Chercheurs, Experts). A cet effet, Votre évaluation des différents critères ci-après, constitue un apport considérable à ce travail de recherche.

\* Indique une question obligatoire

Nom et prénom

Votre réponse

Nom et prénom

Votre réponse

votre spécialité \*

chercheur

professeur

Architecte

autre

Autre : \_\_\_\_\_

votre établissement

Votre réponse

#### **Section 1 : Classification des indicateurs générales de développement durable**

Nous vous invitons à répondre à ce formulaire qui vise à évaluer les critères de durabilité architecturale en Algérie. Ce travail de recherche se déroule en deux phases :

##### **Première phase :**

Dans cette première phase, nous vous demandons d'évaluer l'importance des caractéristiques générales de la durabilité dans les bâtiments. Une série de critères principaux vous sera proposée afin de vous permettre d'identifier les aspects que vous considérez comme les plus importants en Algérie.

	négligeable	sans importance	Neutre	Important	très important
Energie (Améliorer l'efficacité énergétique opérationnelle du bâtiment)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Eau (Réduction de la consommation globale d'eau dans le bâtiment)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Confort intérieur (Améliorer la qualité de l'environnement intérieur tels que l'air , lumière , son ...)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Matériaux durables	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sites durables et écologie (Réduire la pollution, préserver la biodiversité ...)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Transports (accès à des moyens de transport durables)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Déchets (Gestion des déchets utilisés dans le bâtiment)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pollution (mesure et l'évaluation des efforts de contrôle de la pollution)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gestion et entretien des bâtiments	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Innovation (innovation dans les matériaux de construction et les systèmes intelligents )	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## Section 2 : Classification des sous-indicateurs de durabilité environnementale.

### Deuxième phase :

Dans cette deuxième phase , je vous présenterai une liste plus détaillée de sous-critères pour chacun des critères principaux. Vous sera d'évaluer l'importance relative de ces sous-critères afin de hiérarchiser les différents aspects de la durabilité dans l'architecture.

**Catégorie 1 : Efficacité énergétique \***

	négligeable	sans importance	Neutre	Important	très important
Consommation totale d'énergie	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Consommation d'énergie pour HVAC	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Consommation d'énergie pour l'eau chaude	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
taux de ventilation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
production d'énergie renouvelable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
éclairage extérieur	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
éclairage intérieur	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Catégorie 2 : Efficacité de l'eau \***

	négligeable	sans importance	Neutre	Important	très important
Consommation totale d'eau	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Consommation d'eau chaude	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Consommation d'eau d'irrigation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
récupération de l'eau de pluie	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
recyclage des eaux grises	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Raccordement au réseau d'égouts public	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Catégorie 3 : Confort intérieur \***

	négligeable	sans importance	Neutre	Important	très important
Confort thermique	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Confort hygrométrique	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Confort acoustique (Pollution sonore intérieure)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Qualité de l'air intérieur	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
éclairage et illumination	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sécurité et sûreté	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Catégorie 4 : matériels et ressources \***

	négligeable	sans importance	Neutre	Important	très important
Matériaux à faible impact environnemental	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Composant de structure du bâtiment (isolation)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Réutilisation des matériaux de charpente	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Utilisation de matériaux vierges non renouvelables	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Efficacité des matériaux sur leur cycle de vie (LCA)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Matériaux locaux	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Catégorie 5 : utilisation des sites durables et écologie \***

	négligeable	sans importance	Neutre	Important	très important
choix du site	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Réutilisation des terres	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Densité environnante et utilisations diverses	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Espace vert	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Réduire l'impact environnemental	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Protection de la biodiversité	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Améliorer l'écologie du site	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Catégorie 6 : transports \***

	négligeable	sans importance	Neutre	Important	très important
Accessibilité	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Connectivité communautaire	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sécurité des piétons et des cyclistes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
capacité de stationnement des voitures	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Véhicules verts	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Catégorie 7 : déchets \***

	négligeable	sans importance	Neutre	Important	très important
Gestion des déchets de construction	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Traitement des déchets	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Installations de recyclage	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Catégorie 8 : pollution \***

	négligeable	sans importance	Neutre	Important	très important
Émissions de CO2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Émissions de NOx provenant d'une source de chauffage	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pollution des cours d'eau	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Risque d'incendie et Catastrophe naturelle	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Effet d'îlot de chaleur	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Catégorie 9 : gestion des bâtiments \***

	négligeable	sans importance	Neutre	Important	très important
Mise en service	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Guide des occupants du bâtiment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Plan de vie du bâtiment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gestion de l'entretien	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sécurité	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Catégorie 10 : innovation \***

	négligeable	sans importance	Neutre	Important	très important
Innover dans la conception	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Stratégies et technologies innovantes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Question finale pour les experts**

**Veillez nous suggérer des propositions de critère que vous jugez indispensable pour une évaluation de la Durabilité en Algérie**

Votre réponse \_\_\_\_\_

## Annexe –3-

### Comparative Analysis of Sustainable Building Rating Systems and Algerian Laws

#### The comparison of indoor environment quality category in selected assessment tools

Indicators of Indoor Environment Quality		BREEAM	LEED	HQE	PRS	The Algerian context
Lighting and Illumination	Lighting controllability	•	•	•	•	
	View out	•	•	•	•	
	Glare measure & control	•	•	•	•	
	Illumination level	•	•	•	•	
	Daylight factor (DF)	•	•	•	•	
Noise & Acoustics	Noise level	•	•	•	•	(law n° 2003-10 article 72)  (law n° 2003-10 article 73)  (law n° 91-175 article 4 )
	Sound insulation	•		•		(law n° 2003-10 article 72)
	Sound absorption	•	•	•	•	(law n° 2003-10 article 72)
	acoustic zoning			•	•	
Ventilation	Potential of natural ventilation	•	•	•	•	(law n° 2000-90 article 10,11,12,13 )  (law n° 90-175 article 35 )  The DTR C3-31 created on 12/04/2006
	Ventilation system	•	•	•	•	(law n° 2000-90 article 4,9)
	Air purification – supply of fresh air	•	•	•	•	(law n° 2006-02 articles 1-8)
	Air quality sensors- CO2 monitoring	•	•	•	•	(law n° 2003-10 article 2,45,46)

Thermal Comfort	Zoned control	•	•	•	•	
	Cooling/heating/ humidity control & comfort	•	•	•	•	(law n° 99-09 article 10) (law n° 99-09 article 11) (law n° 99-09 article 12) (law n° 2000-90 article 4,5,6,7,8 et 14)
Contamination Level	Volatile organic compounds (VOC)	•	•	•	•	(law n° 2003-10 article 2,4,5,46)
	Microbiological contamination level	•	•	•	•	
	Smoke Control		•	•	•	
	Legionella Prevention				•	

- **The comparison of sustainable site & ecology category in selected assessment tools.**

Indicators of Sustainable Site & Ecology		BREEAM	LEED	HQE	PRS	The Algerian context
Construction Site	Site Selection	•	•	•	•	(law n° 2003-10 article 60). (law n° 04-05 article 4) *( law n° 91-175 article 2, 4, 5, 21, 22, 24 ,23, 26, 30 , 35,38,39)
	Site protection	•	•	•	•	(law n° 2003-10 article 59) (law n° 90-29 article 47)
	Surrounding Density and Diverse Uses	•	•	•	•	(law n° 91-175 article 9)
Ecological Value	Contaminated land	•	•	•	•	
	Reuse of Land	•	•	•	•	
	Mitigation ecological impact	•	•	•	•	(law n° 2003-10 article 16) (law n° 2003-10 article 22)
	Enhance site ecology	•	•	•	•	

	Biodiversity protection	•	•	•	•	(law n° 2003-10 article 3) (law n° 2003-10 article 11) (law n° 2003-10 article 40)
	Habitat management plan	•			•	
Transport	Accessibility	•	•	•	•	(law n° 91-175 article 8)
	Density development	•	•	•	•	(Loi n° 91-175 article 9)
	Community connectivity	•	•	•	•	(law n° 91-175 article 9)
	Pedestrian & Cyclist safety	•	•	•	•	(law n° 91-175 article 8)
	Car parking capacity	•	•	•	•	(law n° 91-175 article 8)
	Green Vehicles	•	•	•	•	
	Travel plan	•			•	

• **The comparison of energy efficiency category in selected assessment tools**

Indicators of Energy Efficiency		BREEAM	LEED	HQE	PRS	The Algerian context
Energy Performance	HVAC system	•	•	•	•	(law n° 99-09 article 11)
	Ventilation rate	•	•	•	•	(law n°2009-90 article 11,12) The DTR C3-31 created on 12/04/2006
	Lighting: internal	•	•	•	•	
	Lighting: external	•			•	
	Hot water system	•	•	•	•	Aprue and CIZ
	Heat transmission	•	•	•	•	The DTR C3-2 created on 10/12/1997 * The DTR C3-4 created on 18/08/1998
	Vertical / horizontal Transportation			•	•	
Natural Resources	Renewable energy technology	•	•	•	•	(law n° 2003-10 article 2) (law n° 2003-10 article 3) (law n° 2003-10 article 11) (law n° 99-09 article 7 et 4) (law n° 04-09 articles 1-18)

Efficient Operation	Energy monitoring	•	•	•	•	(law n° 99-09 article 8 ) (law n° 99-09 article 16-20 ) (law n° 99-09 article 11 )
	Optimum performance and Energy saving	•	•	•	•	(law n° 99-09 article 6 ) (law n° 99-09 article 3 ) (law n° 99-09 article 26 ) (law n° 99-09 article 11) (law n° 99-09 article 13)
	CO2 mitigations strategy	•	•	•	•	(law n° 2003-10 article 2,45,46)
	Peak Load Reduction			•	•	
	eat Island Effect		•			

• **The comparison of water efficiency & waste management categories in selected assessment tools**

Indicators of Water Efficiency & Waste Management		BREEAM	LEED	HQE	PRS	The Algerian context
Water Efficiency	Water Consumption	•	•	•	•	
	Rainwater harvesting	•	•	•	•	
	Grey water recycling	•	•	•	•	
	Water fixture & conservation strategy	•	•	•	•	
	Irrigation system	•	•	•	•	
	Heat Rejection				•	
	Innovation wastewater technology	•	•	•	•	
	Leak Detection	•			•	
Waste Management	Construction waste management	•	•	•	•	
	Waste treatment	•	•	•	•	( law n° 2001-19 article 1-40)
	Recycling facilities	•	•	•	•	(law n° 2001-19 article 41-45)
	Operational waste	•			•	(law n° 2003-10

						article 69)
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• **The comparison of material & pollution categories in selected assessment tools.**

Indicators of Material & Pollution		BREEAM	LEED	HQE	PRS	The Algerian context
Material	Material with low environmental impact	•	•	•	•	
	Re-use of structural frame materials	•	•	•	•	
	Use of non-renewable – virgin materials	•	•	•	•	
	Use of non-structural materials	•	•	•	•	
	Building fabric component (insulation)	•	•	•	•	
	Use of finishing materials	•			•	
	Responsible source of materials	•			•	
	Material efficiency over its life cycle (LCA)	•	•	•	•	
	Responsible Sourcing	•				
	Region Materials		•	•	•	
	Materials Cost				•	
Pollution	Night light & Noise pollution	•	•	•	•	(law n° 2003-10 article 2)
	Refrigerant GWP – building services	•	•	•	•	
	Preventing refrigerant leaks	•			•	
	Watercourse pollution	•	•	•	•	(law n° 2003-10 article 3)
	NOx emissions from heating source	•				(law n° 2003-10 article 45,46)
	CO2 emissions	•	•	•	•	
	Fire risk	•	•	•	•	
	Natural disaster	•	•	•	•	
	Heat island effect		•			

• **The comparison of Building Management & Innovation categories in selected assessment tools**

Indicators of Management & Innovation	BREEAM	LEED	HQE	PRS	The Algerian
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						context
Building Management	Commissioning	•	•	•	•	
	Building occupants guide	•	•		•	
	Building whole life plan	•				
	Construction site impacts	•		•	•	
	Consultation	•				
	Considerate constructors	•				
	Tool accredited professional	•	•		•	
	Security	•		•		
	Maintenance management	•		•	•	
Innovation	Exemplary performance	•	•		•	
	Innovation in design	•	•	•	•	
	Innovative Strategies & Technologies	•		•	•	
	Innovating Practice and support innovative culture				•	

## Annexe –4-

### **BREEAM Standards:**

BREEAM comprises six technical standards that apply to different stages of a building's lifecycle, depending on its location and type. These include.

**-BREEAM In-Use:** Focuses on the sustainability performance of existing buildings during operation.

**-BREEAM Refurbishment and fit-Out:** Guides the sustainable refurbishment and interior fit-out of existing buildings.

**-BREEAM Communities:** Assesses the sustainability of large-scale developments such as master plans, urban extensions, and mixed-use communities.

**-BREEAM New Construction:** The most widely used standard, it focuses on the design and construction of new domestic and non-domestic buildings.

**-Home Quality Mark:** Specifically targets the sustainability and performance of new homes in the UK.

**-BREEAM Infrastructure:** Evaluates the sustainability of infrastructure and civil engineering projects, including roads, bridges, and transport systems.

### **- Each BREEAM standard has different certification schemes:**

- **For non-residential buildings:**

- BREEAM Offices
- BREEAM Retail
- BREEAM Industrial (factories and warehouses)
- BREEAM Educational (schools)
- BREEAM Healthcare (medical facilities)
- BREEAM Courts
- BREEAM Prisons
- BREEAM Other Buildings (for buildings outside standard categories, such as laboratories, hotels, leisure complexes, etc.)

- **For residential buildings:**

- BREEAM Eco Homes (for refurbishment in England and new builds in Wales and Scotland)
- BREEAM Eco Homes XB (a tool used by housing associations, etc.)
- The Code for Sustainable Homes (applies to new single-family homes and apartments in England)
- BREEAM Multi-Residential (for student accommodations, sheltered housing, youth hostels, etc.)
- BREEAM Domestic Refurbishment (for refurbishment of existing buildings)

- **International schemes:**

The BREEAM International scheme has been developed for buildings outside the UK and includes the following versions:

- BREEAM Gulf (for all building types in the Persian Gulf region)
- BREEAM Europe (for selected European countries; applies to office and retail buildings)
- BREEAM Communities (for urban planning and large-scale development)
- BREEAM International Bespoke (any building type)
- BREEAM In-Use (for existing buildings in various regions)

## **Annexe –5-**

### **LEED Standards:**

Currently, LEED includes ten different rating systems tailored to various building types:

- LEED – NC (New Construction and Major Renovations)
- LEED – EB: O&M (Existing Buildings: Operational and Maintenance)
- LEED – CI (Commercial Interiors)
- LEED – CS (Core and Shell)
- LEED – H (Homes)
- LEED for Schools
- LEED – ND (Neighborhood Development)
- LEED Volume Certification
- LEED – Retail: NC and CI (Retail: New Construction and Commercial Interiors)
- LEED for Healthcare

Several countries around the world have adopted and adapted the LEED certification system to suit their specific conditions and needs. Some of these countries include:

- India (LEED India)
- Italy (LEED Italy)
- Canada (LEED Canada)

# Annexe –6- LEED Scorecards :



## LEED v4 for Operations & Maintenance: Existing Buildings Project Checklist

Project Name:  
Date:

Y ? N

0	0	0	<b>Location and Transportation</b>	<b>15</b>
Green	Yellow	Orange	Credit Alternative Transportation	15

0	0	0	<b>Sustainable Sites</b>	<b>10</b>
Y			Prereq Site Management Policy	Required
Green	Yellow	Orange	Credit Site Development-Protect or Restore Habitat	2
Green	Yellow	Orange	Credit Rainwater Management	3
Green	Yellow	Orange	Credit Heat Island Reduction	2
Green	Yellow	Orange	Credit Light Pollution Reduction	1
Green	Yellow	Orange	Credit Site Management	1
Green	Yellow	Orange	Credit Site Improvement Plan	1

0	0	0	<b>Water Efficiency</b>	<b>12</b>
Y			Prereq Indoor Water Use Reduction	Required
Y			Prereq Building-Level Water Metering	Required
Green	Yellow	Orange	Credit Outdoor Water Use Reduction	2
Green	Yellow	Orange	Credit Indoor Water Use Reduction	5
Green	Yellow	Orange	Credit Cooling Tower Water Use	3
Green	Yellow	Orange	Credit Water Metering	2

0	0	0	<b>Energy and Atmosphere</b>	<b>38</b>
Y			Prereq Energy Efficiency Best Management Practices	Required
Y			Prereq Minimum Energy Performance	Required
Y			Prereq Building-Level Energy Metering	Required
Y			Prereq Fundamental Refrigerant Management	Required
Green	Yellow	Orange	Credit Existing Building Commissioning— Analysis	2
Green	Yellow	Orange	Credit Existing Building Commissioning—Implementation	2
Green	Yellow	Orange	Credit Ongoing Commissioning	3
Green	Yellow	Orange	Credit Optimize Energy Performance	20
Green	Yellow	Orange	Credit Advanced Energy Metering	2
Green	Yellow	Orange	Credit Demand Response	3
Green	Yellow	Orange	Credit Renewable Energy and Carbon Offsets	5
Green	Yellow	Orange	Credit Enhanced Refrigerant Management	1

0	0	0	<b>Materials and Resources</b>	<b>8</b>
Y			Prereq Ongoing Purchasing and Waste Policy	Required
Y			Prereq Facility Maintenance and Renovations Policy	Required
Green	Yellow	Orange	Credit Purchasing- Ongoing	1
Green	Yellow	Orange	Credit Purchasing- Lamps	1
Green	Yellow	Orange	Credit Purchasing- Facility Maintenance and Renovation	2
Green	Yellow	Orange	Credit Solid Waste Management- Ongoing	2
Green	Yellow	Orange	Credit Solid Waste Management- Facility Maintenance and Renovation	2

0	0	0	<b>Indoor Environmental Quality</b>	<b>17</b>
Y			Prereq Minimum Indoor Air Quality Performance	Required
Y			Prereq Environmental Tobacco Smoke Control	Required
Y			Prereq Green Cleaning Policy	Required
Green	Yellow	Orange	Credit Indoor Air Quality Management Program	2
Green	Yellow	Orange	Credit Enhanced Indoor Air Quality Strategies	2
Green	Yellow	Orange	Credit Thermal Comfort	1
Green	Yellow	Orange	Credit Interior Lighting	2
Green	Yellow	Orange	Credit Daylight and Quality Views	4
Green	Yellow	Orange	Credit Green Cleaning- Custodial Effectiveness Assessment	1
Green	Yellow	Orange	Credit Green Cleaning- Products and Materials	1
Green	Yellow	Orange	Credit Green Cleaning- Equipment	1
Green	Yellow	Orange	Credit Integrated Pest Management	2
Green	Yellow	Orange	Credit Occupant Comfort Survey	1

0	0	0	<b>Innovation</b>	<b>6</b>
Green	Yellow	Orange	Credit Innovation	5
Green	Yellow	Orange	Credit LEED Accredited Professional	1

0	0	0	<b>Regional Priority</b>	<b>4</b>
Green	Yellow	Orange	Credit Regional Priority: Specific Credit	1
Green	Yellow	Orange	Credit Regional Priority: Specific Credit	1
Green	Yellow	Orange	Credit Regional Priority: Specific Credit	1
Green	Yellow	Orange	Credit Regional Priority: Specific Credit	1

0	0	0	<b>TOTALS</b>	<b>Possible Points: 110</b>
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Certified: 40-49 points, Silver: 50-59 points, Gold: 60-79 points, Platinum: 80+ points



# LEED v4 for BD+C: New Construction and Major Renovation

## Project Checklist

Project Name:

Date:



Credit Integrative Process 1

0	0	0	Location and Transportation	16
Green	Yellow	Orange	Credit LEED for Neighborhood Development Location	16
Green	Yellow	Orange	Credit Sensitive Land Protection	1
Green	Yellow	Orange	Credit High Priority Site	2
Green	Yellow	Orange	Credit Surrounding Density and Diverse Uses	5
Green	Yellow	Orange	Credit Access to Quality Transit	5
Green	Yellow	Orange	Credit Bicycle Facilities	1
Green	Yellow	Orange	Credit Reduced Parking Footprint	1
Green	Yellow	Orange	Credit Green Vehicles	1

0	0	0	Sustainable Sites	10
Green	Yellow	Orange	Prereq Construction Activity Pollution Prevention	Required
Green	Yellow	Orange	Credit Site Assessment	1
Green	Yellow	Orange	Credit Site Development - Protect or Restore Habitat	2
Green	Yellow	Orange	Credit Open Space	1
Green	Yellow	Orange	Credit Rainwater Management	3
Green	Yellow	Orange	Credit Heat Island Reduction	2
Green	Yellow	Orange	Credit Light Pollution Reduction	1

0	0	0	Water Efficiency	11
Green	Yellow	Orange	Prereq Outdoor Water Use Reduction	Required
Green	Yellow	Orange	Prereq Indoor Water Use Reduction	Required
Green	Yellow	Orange	Prereq Building-Level Water Metering	Required
Green	Yellow	Orange	Credit Outdoor Water Use Reduction	2
Green	Yellow	Orange	Credit Indoor Water Use Reduction	6
Green	Yellow	Orange	Credit Cooling Tower Water Use	2
Green	Yellow	Orange	Credit Water Metering	1

0	0	0	Energy and Atmosphere	33
Green	Yellow	Orange	Prereq Fundamental Commissioning and Verification	Required
Green	Yellow	Orange	Prereq Minimum Energy Performance	Required
Green	Yellow	Orange	Prereq Building-Level Energy Metering	Required
Green	Yellow	Orange	Prereq Fundamental Refrigerant Management	Required
Green	Yellow	Orange	Credit Enhanced Commissioning	6
Green	Yellow	Orange	Credit Optimize Energy Performance	18
Green	Yellow	Orange	Credit Advanced Energy Metering	1
Green	Yellow	Orange	Credit Demand Response	2
Green	Yellow	Orange	Credit Renewable Energy Production	3
Green	Yellow	Orange	Credit Enhanced Refrigerant Management	1
Green	Yellow	Orange	Credit Green Power and Carbon Offsets	2

0	0	0	Materials and Resources	13
Green	Yellow	Orange	Prereq Storage and Collection of Recyclables	Required
Green	Yellow	Orange	Prereq Construction and Demolition Waste Management Planning	Required
Green	Yellow	Orange	Credit Building Life-Cycle Impact Reduction	5
Green	Yellow	Orange	Credit Building Product Disclosure and Optimization - Environmental Product Declarations	2
Green	Yellow	Orange	Credit Building Product Disclosure and Optimization - Sourcing of Raw Materials	2
Green	Yellow	Orange	Credit Building Product Disclosure and Optimization - Material Ingredients	2
Green	Yellow	Orange	Credit Construction and Demolition Waste Management	2

0	0	0	Indoor Environmental Quality	16
Green	Yellow	Orange	Prereq Minimum Indoor Air Quality Performance	Required
Green	Yellow	Orange	Prereq Environmental Tobacco Smoke Control	Required
Green	Yellow	Orange	Credit Enhanced Indoor Air Quality Strategies	2
Green	Yellow	Orange	Credit Low-Emitting Materials	3
Green	Yellow	Orange	Credit Construction Indoor Air Quality Management Plan	1
Green	Yellow	Orange	Credit Indoor Air Quality Assessment	2
Green	Yellow	Orange	Credit Thermal Comfort	1
Green	Yellow	Orange	Credit Interior Lighting	2
Green	Yellow	Orange	Credit Daylight	3
Green	Yellow	Orange	Credit Quality Views	1
Green	Yellow	Orange	Credit Acoustic Performance	1

0	0	0	Innovation	6
Green	Yellow	Orange	Credit Innovation	5
Green	Yellow	Orange	Credit LEED Accredited Professional	1

0	0	0	Regional Priority	4
Green	Yellow	Orange	Credit Regional Priority: Specific Credit	1
Green	Yellow	Orange	Credit Regional Priority: Specific Credit	1
Green	Yellow	Orange	Credit Regional Priority: Specific Credit	1
Green	Yellow	Orange	Credit Regional Priority: Specific Credit	1

0	0	0	TOTALS	Possible Points: 110
Certified: 40 to 49 points, Silver: 50 to 59 points, Gold: 60 to 79 points, Platinum: 80 to 110				

# Annexe –7-

## BREEAM Scorecards:

breeam		Indicative Overall BREEAM Score		BREEAM Rating Benchmarks				
		0.00%		PASS	≥30%			
				GOOD	≥45%			
				VERY GOOD	≥55%			
				EXCELLENT	≥70%			
				OUTSTANDING*	≥85%			

Ref	Title	Offices Criteria	Number of BREEAM credits available	Total predicted BREEAM credits achieved	Minimum BREEAM Standards					Notes
					Pass	Good	Very Good	Excellent	Outstanding	
Achieved?					NO	NO	NO	NO	NO	
					Minimum required credits by BREEAM issue and rating					
<b>Management</b>										
Man 1	Commissioning	<p>One credit where evidence provided demonstrates that an appropriate project team member has been appointed to monitor commissioning on behalf of the client to ensure commissioning will be carried out in line with current best practice.</p> <p>Two credits where, in addition to the above, evidence provided demonstrates that regular commissioning will be carried out during the first year of occupation, post construction (or post fit out).</p>	2		1	1	1	1	2	
Man 2	Considerate Constructors	<p>One credit where evidence provided demonstrates that there is a commitment to comply with best practice site management principles.</p> <p>Two credits where evidence provided demonstrates that there is a commitment to go beyond best practice site management principles.</p>	2		-	-	-	1	2	
Man 3	Construction Site Impacts	<p>One credit where evidence provided demonstrates that 2 or more of items a-g (listed below) are achieved.</p> <p>Two credits where evidence provided demonstrates that 4 or more of items a-g (listed below) are achieved.</p> <p>Three credits where evidence provided demonstrates that 6 or more of items a-g are achieved.</p> <p>a. Monitor, report and set targets for CO2 or energy arising from site activities                      b. Monitor, report and set targets for CO2 or energy arising from transport to and from site                      c. Monitor, report and set targets for water consumption arising from site activities                      d. Implement best practice policies in respect of air (dust) pollution arising from the site                      e. Implement best practice policies in respect of water (ground and surface) pollution occurring on the site                      f. Main contractor has an environmental materials policy, used for sourcing of construction materials to be utilised on site                      g. Main contractor operates an Environmental Management System.</p> <p>One additional credit where evidence provided demonstrates that at least 80% of site water is responsibly sourced and 100% is legally sourced.</p>	4		-	-	-	-	-	
Man 4	Building user guide	One credit where evidence provided demonstrates the provision of a simple guide that covers information relevant to the health, occupants and non-technical building manager on the operation and environmental performance of the building.	1		-	-	-	1	1	
Man 5	Security	One credit where evidence provided demonstrates that an Architectural Liaison Officer (ALO) or Crime Prevention Design Advisor (COPA) from the local police force has been consulted at the design stage and their recommendations incorporated into the design of the building and its parking facilities (if relevant).	1		-	-	-	-	-	
Indicative Management (weighted) Section Score			0.00%							

Hea 1	Daylighting	The credit where evidence provided demonstrates that at least 80% of floor area in each occupied space is adequately daylighted.	1																	
Hea 2	View Out	The credit where evidence provided demonstrates that at relevant building areas have an adequate view out.	1																	
Hea 3	Glare Control	The credit where evidence provided demonstrates that an occupant-controlled shading system (e.g. internal or external blinds) is fitted in relevant building areas.	1																	
Hea 4	High frequency lighting	The credit where evidence provided demonstrates that high frequency ballasts are installed on all fluorescent and compact fluorescent lamps.	1						1	1	1	1	1							
Hea 5	Internal and external lighting levels	The credit where evidence provided demonstrates that all internal and external lighting, where relevant, is specified in accordance with the appropriate maintained illuminance levels (in lux) recommended by CIBSE.	1																	
Hea 6	Lighting zones & controls	The credit where evidence provided demonstrates that, in all relevant building areas, lighting is appropriately zoned and occupant controllable.	1																	
Hea 7	Potential for natural ventilation	The credit where evidence provided demonstrates that fresh air is capable of being delivered to the occupied spaces of the building via a natural ventilation strategy, and there is sufficient user-control of the supply of fresh air.	1																	
Hea 8	Indoor air quality	The credit where air intakes serving occupied areas avoid major sources of external pollution and recirculation of extract air.	1																	
Hea 9	Volatile Organic Compounds	The credit where evidence provided demonstrates that the emissions of VOCs and other substances from key internal finishes and fittings comply with best practice levels.	1																	
Hea 10	Thermal comfort	The credit where evidence provided demonstrates that thermal comfort levels in occupied spaces of the building are assessed at the design stage to evaluate appropriate servicing options, ensuring appropriate thermal comfort levels are achieved.	1																	
Hea 11	Thermal zoning	The credit where evidence provided demonstrates that local occupant control is available for temperature adjustment in each occupied space to reflect differing user demands.	1																	
Hea 12	Microbial contamination	The credit where evidence provided demonstrates that the risk of waterborne and airborne legionella contamination has been minimised.	1						1	1	1	1	1							
Hea 13	Acoustic Performance	The credit where evidence provided demonstrates that the building achieves appropriate indoor ambient noise levels in offices areas.  In addition, for fully fitted buildings only: Appropriate airborne sound insulation levels are achieved between acoustically sensitive spaces and occupied spaces, sufficient to ensure adequate privacy.	1																	
Indicative Health & Wellbeing (weighted) Section Score			0.00%																	

Energy											
One 1	Reduction of CO2 Emissions	Up to fifteen credits where evidence provided demonstrates an improvement in the energy efficiency of the building's fabric and services and therefore achieves lower building operational annual CO2 emissions.	15			-	-	-	6	10	
One 2	Sub-metering of Substantial Energy Uses	One credit where evidence provided demonstrates the provision of direct sub-metering of energy uses within the building.	1			-	-	1	1	1	
One 3	Sub-metering of High Energy Load Areas and Tenancy	One credit where evidence provided demonstrates sub-metering of energy consumption by tenancy/building function area is installed within the building.	1			-	-	-	-	-	
One 4	External Lighting	One credit where energy-efficient external lighting is specified and all light fittings are controlled for the presence of daylight.	1			-	-	-	-	-	
One 5	Low zero carbon technologies	One credit where evidence provided demonstrates that a feasibility study considering local (on-site and/or near site) low or zero carbon (LZC) technologies has been carried out and the results implemented.  Two credits where evidence provided demonstrates that the first credit has been achieved and there is a 15% reduction in the building's CO2 emissions as a result of the installation of a feasible local LZC technology.  Three credits where evidence provided demonstrates that the first credit has been achieved and there is a 15% reduction in the building's CO2 emissions as a result of the installation of a feasible local LZC technology.  Or alternatively:  A maximum of one credit where evidence provided demonstrates that a contract with an energy supplier is in place to provide sufficient electricity used within the assessed building/development to meet the above criteria from a 100% renewable energy source. (Note: a standard Green Tariff will not comply)	3			-	-	-	1	1	
One 8	Lifts	Up to two credits are available where evidence provided demonstrates the installation of energy-efficient lifts.	2			-	-	-	-	-	
One 9	Escalators & travelling walkways	One credit where evidence provided demonstrates that escalators reduce unnecessary operation when there is no passenger demand.	1			-	-	-	-	-	
Indicative Energy (weighted) Section Score			0.00%								

**Transport**

Tta 1	Provision of public transport	Up to three credits are awarded on a sliding scale based on the assessed building's accessibility to the public transport network.	3			-	-	-	-	-	
Tta 2	Proximity to amenities	One credit where evidence provided demonstrates that the building is located within 500m of accessible local amenities appropriate to the building type and its users.	1			-	-	-	-	-	
Tta 3	Cyclist Facilities	One credit where evidence provided demonstrates that covered, secure and well-lit cycle storage facilities are provided for all building users. Two credits where, in addition to the above, adequate changing facilities are provided for staff use.	2			-	-	-	-	-	
Tta 4	Pedestrian and cycle safety	One credit where evidence provided demonstrates that the site layout has been designed in accordance with best practice to ensure safe and adequate pedestrian and cycle access.	1			-	-	-	-	-	
Tta 5	Travel plan	One credit where evidence is provided to demonstrate that a travel plan has been developed and tailored to the specific needs of the building users.	1			-	-	-	-	-	
Tta 6	Minimum car parking capacity	One credit where evidence provided demonstrates no more than one parking space is provided for every three building users. Two credits where evidence provided demonstrates no more than one parking space is provided for every four building users.	2			-	-	-	-	-	

Indicative Transport (weighted) Section Score **0.00%**

**Water**

Wat 1	Water Consumption	Up to three credits where evidence provided demonstrates that the specification includes taps, urinals, WCs and showers that consume less potable water in use than standard specifications for the same type of fittings.	3			-	1	1	1	2	
Wat 2	Water meter	One credit where evidence provided demonstrates that a water meter with a pulsed output will be installed on the mains supply to each building/unit.	1			-	1	1	1	1	
Wat 3	Major leak detection	One credit where evidence provided demonstrates that a leak detection system is specified or installed on the building's water supply.	1			-	-	-	-	-	
Wat 4	Sanitary supply shut-off	One credit where evidence provided demonstrates that proximity detection shut-off is provided to the water supply to all toilet areas.	1			-	-	-	-	-	

Indicative Water (weighted) Section Score **0.00%**

**Materials**

Mat 1	Materials Specification (major building elements)	Up to four credits are available, determined by the Green Guide to Specification ratings for the major building elements.	4																	
Mat 2	Hard landscaping and boundary protection	One credit where evidence provided demonstrates that at least 80% of the combined area of external hard landscaping and boundary protection specifications achieve an A or A+ rating, as defined by the Green Guide to Specification.	1																	
Mat 3	Re-use of building façade	One credit is awarded where evidence provided demonstrates that at least 50% of the total façade (by area) is reused and at least 80% of the reused façade (by mass) comprises in-situ reused materials.	1																	
Mat 4	Re-use of building structure	One credit is awarded where evidence provided demonstrates that a design reuses at least 80% of an existing primary structure and for part refurbishment and part new build, the volume of the reused structure comprises at least 50% of the final structure's volume.	1																	
Mat 5	Responsible sourcing of materials	Up to 3 credits are available where evidence provided demonstrates that 80% of the assessed materials in the following building elements are responsibly sourced: a. Structural Frame b. Ground floor c. Upper floors (including separating floors) d. Roof e. External walls f. Internal walls g. Foundations/substructure h. Staircase  Additionally 100% of any timber must be legally sourced.	3																	
Mat 6	Insulation	One credit where evidence provided demonstrates that thermal insulation products used in the building have a low embodied impact relative to their thermal properties, determined by the Green Guide to Specification ratings.  One credit where evidence provided demonstrates that thermal insulation products used in the building have been responsibly sourced.	2																	
Mat 7	Designing For Robustness	One credit where protection is given to vulnerable parts of the building such as areas exposed to high pedestrian traffic, vehicular and trolley movements.	1																	

Indicative Materials (weighted) Section Score **0.00%**

**Waste**

Wt1	Construction Site Waste Management	Up to three credits are available where evidence provided demonstrates that the amount of non-hazardous construction waste (not 100t or tonnes 100m2) generated on site by the development is the same as or better than good or best practice levels.  One credit where evidence provided demonstrates that a significant majority of non-hazardous construction waste generated by the development will be diverted from landfill and reused or recycled.	4																	
Wt2	Recycled aggregates	One credit where evidence provided demonstrates the significant use of recycled or secondary aggregates in high-grade building aggregate uses.	1																	
Wt3	Recyclable waste storage	One credit where a central, dedicated space is provided for the storage of the building's recyclable waste streams.	1																	
Wt6	Floor Finishes	One credit where carpets and other floor finishes are specified by the future occupant or, in tenanted areas of speculative buildings, where carpets or floor finishes are installed in a limited show area only.	1																	

Indicative Waste (weighted) Section Score **0.00%**

**Land Use & Ecology**

LE1	Re-use of land	One credit where evidence provided demonstrates that the majority of the footprint of the proposed development falls within the boundary of previously developed land.	1				-	-	-	-	-
LE2	Contaminated land	One credit is awarded where evidence provided demonstrates that the land used for the new development has, prior to development, been defined as contaminated and where adequate remedial steps have been taken to decontaminate the site prior to construction.	1				-	-	-	-	-
LE3	Ecological value of site AND Protection of ecological features	One credit is awarded where evidence provided demonstrates that the construction zone is defined as land of low ecological value and all existing features of ecological value will be fully protected from damage during site preparation and construction works.	1				-	-	-	-	-
LE4	Mitigating Ecological Impact	One credit where evidence provided demonstrates that the change in the site's existing ecological value, as a result of development, is minimal. Two credits where evidence provided demonstrates that there is no negative change to the site's existing ecological value as a result of development.	2				-	-	1	1	1
LE5	Enhancing Site Ecology	One credit where the design team (or client) has appointed a suitably qualified ecologist to advise and report an enhancing and protecting the ecological value of the site; and implemented the professional's recommendations for general enhancement and protection of site ecology. Two credits where, in addition to the above, there is a positive increase in the ecological value of the site of up to (but not including) 6 species. Three credits where, in addition to the above, evidence is provided to demonstrate a positive increase in the ecological value of the site of 6 species or greater.	3				-	-	-	-	-
LE6	Long term impact on biodiversity	One credit where the client has committed to achieving the mandatory requirements listed below and at least two of the additional requirements. Two credits where the client has committed to achieving the mandatory requirements listed below and at least four of the additional requirements.	2				-	-	-	-	-

Indicative Land Use & Ecology (weighted) Section Score **0.00%**

**Pollution**

Pol 1	Refrigerant GWP - Building services	One credit where evidence provided demonstrates the use of refrigerants with a global warming potential (GWP) of less than 5 or where there are no refrigerants specified for use in building services.	1				-	-	-	-	-
Pol 2	Preventing refrigerant leaks	One credit where evidence provided demonstrates that refrigerant leaks can be detected or where there are no refrigerants specified for the development. One credit where evidence provided demonstrates that the provision of automatic refrigerant pump down is made to a heat exchanger (or dedicated storage tanks) with isolation valves. Or where there are no refrigerants specified for the development.	2				-	-	-	-	-
Pol 4	NOx emissions from heating source	One credit where evidence provided demonstrates that the maximum dry NOx emissions from delivered space heating energy are ≤100 mg/kWh (at 0% excess O2). Two credits where evidence provided demonstrates that the maximum dry NOx emissions from delivered space heating energy are ≤70 mg/kWh (at 0% excess O2). Three credits where evidence provided demonstrates that the maximum dry NOx emissions from delivered space heating energy are ≤40 mg/kWh (at 0% excess O2).	3				-	-	-	-	-

Pol 5	Floodrisk	<p>Two credits where evidence provided demonstrates that the assessed development is located in a zone defined as having a low annual probability of flooding.</p> <p>One credit where evidence provided demonstrates that the assessed development is located in a zone defined as having a medium or high annual probability of flooding AND the ground level of the building, car parking and access is above the design flood level for the site's location.</p> <p>One further credit where evidence provided demonstrates that surface water run-off abatement measures are specified to minimise the risk of localised flooding, resulting from a loss of flood storage on site due to development.</p>	3			-	-	-	-	-	
Pol 6	Minimising watercourse pollution	One credit where evidence provided demonstrates that effective on site treatment such as Sustainable Drainage Systems (SuDs) or oil separators have been specified in areas that are or could be a source of watercourse pollution.	1			-	-	-	-	-	
Pol 7	Reduction of Night Time Light Pollution	One credit where evidence provided demonstrates that the external lighting design is in compliance with the guidance in the Institution of Lighting Engineers (ILE) Guidance notes for the reduction of obtrusive light, 2005.	1			-	-	-	-	-	
Pol 8	Noise Attenuation	One credit where evidence provided demonstrates that new sources of noise from the development do not give rise to the likelihood of complaints from existing noise-sensitive premises and amenity or wildlife areas that are within the locality of the site.	1			-	-	-	-	-	
<b>Indicative Pollution (weighted) Section Score</b>			<b>0.00%</b>								

**Innovation - Exemplary Level Criteria**

<p>Innovation: Man 2: Considerate Constructors</p>	<p>Where post construction, a Considerate Constructors Scheme certificate can be provided demonstrating that the site achieved CCS Code of Considerate Practice with a score of at least 30. OR Where post construction, the site has complied in full with the alternative, independently assessed scheme, and the alternative scheme addresses all the mandatory and optional items in Checklist A2.</p>	<p>1</p>			
<p>Innovation: Hse 1: Daylighting</p>	<p>At least 60% of the floor area (for the building spaces/room identified above in the standard requirements) has an average daylight factor of 2% in multi-storey buildings and 4% in single-storey buildings.</p>	<p>1</p>			
<p>Innovation: Ene 1: Reduction of CO2 emissions</p>	<p>One additional innovation credit can be awarded where evidence provided demonstrates the building is designed to be a carbon neutral building as defined by the NCM (i.e. in terms of building services energy demand), as follows: a. A new building achieves a CO2 index less than 0 on the benchmark scale. b. A refurbished building achieves a CO2 index equal to or less than 0 on the benchmark scale.  Two additional innovation credits can be awarded where evidence provided demonstrates the building is designed to be a True zero carbon building (in terms of building services and operational energy demand).</p>	<p>2</p>			
<p>Innovation: Ene 5: Low or Zero Carbon Technologies</p>	<p>A local L2C energy technology has been installed in line with the recommendations of a compliant feasibility study and this method of supply results in a 20% reduction in the building's CO2 emissions.</p>	<p>1</p>			
<p>Innovation: Wat 2: Water Meter</p>	<p>Where sub meters are fitted to allow individual water-consuming plant or building areas to be monitored such as cooling towers, car washes, catering areas, etc. If the building does not have any major water consuming plant this exemplar credit is not available.  Each sub meter has a pulsed output to enable connection to a Building Management System (BMS) for the monitoring of water consumption.  In addition to the above, for sites with multiple departments e.g. large health centres or acute hospitals, separate pulsed sub meters are fitted on the supply to the following areas where present: a. Staff and public areas b. Clinical areas and wards c. Lifting areas: On the water supply to each tenant unit d. Laundries e. Main production kitchen f. Hydrotherapy pools g. Laboratories h. CSSD/HSCU, pathology, pharmacy, mortuary and any other major process water user.</p>	<p>1</p>			

Innovation: Materials Specification	<p>One exemplary BREEAM credit can be awarded as follows:</p> <p>a. Where assessing four or more applicable building elements, the building achieves at least two points additional to the total points required to achieve maximum credits under the standard BREEAM requirements.</p> <p>b. Where assessing fewer than four applicable building elements, the building achieves at least one point additional to the total points required to achieve maximum credits under the standard BREEAM requirements.</p>	1		
Innovation: Responsible Sourcing of Materials	Where, in addition to the standard BREEAM requirements, 95% of the applicable materials, comprised within the applicable building elements, have been responsibly sourced.	1		
Innovation: Wet 1 Construction Site Waste Management	<p>Where non-hazardous construction waste generated by the building's development meets or exceeds the resource efficiency benchmark required to achieve three credits (as outlined in the guidance).</p> <p>Where at least 96% by weight (90% by volume) of non-hazardous construction waste and 93% of demolition waste by weight (85% by volume) (if applicable) generated by the build has been diverted from landfill and either:</p> <p>a. Reused on site (in-situ or for new applications)</p> <p>b. Reused on other sites</p> <p>c. Salvaged/reclaimed for reuse</p> <p>d. Returned to the supplier via a 'take-back' scheme</p> <p>e. Recovered from site by an approved waste management contractor and recycled.</p> <p>Where all key waste groups are identified for diversion from landfill at pre-construction stage SWMP.</p>	1		
<b>Innovation - BREEAM Accredited Professional</b>				
Innovation: BREEAM Accredited Professional	Up to two credits are available for the comprehensive use of a BREEAM Accredited Professional (AP) throughout project work stages.	2		
<b>Indicative Innovation (weighted) Section Score</b>		<b>0.00%</b>		

## Annexe –8-

### PRD Scorecards

Pearl Building Rating System									
<b>Project Details</b>									
Project Name	Office Building								
Project ID	1								
Building Use	Office								
Pearl Rating Stage	Design								
Pearl QP Name	Ahmed Effat Mokhtar Abdelalam Mosa								
Pearl QP Number	1								
Date	7/4/ 1905								
					Report a Template Bug : <a href="mailto:PBS_scorecard@supc.gov.ae">PBS_scorecard@supc.gov.ae</a>				
<b>Credit Points Summary</b>									
Credit Reference	Credit Title	Credit Points Available	Design			Construction			Comments
			Yes	Maybe	No	Yes	Maybe	No	
<b>IDP</b>	<b>Integrated Development Process</b>								
IDP-R1	Integrated Development Strategy	Required	No			No required submission			
IDP-R2	Tenant Fit-Out Design & Construction Guide	Required	No			No required submission			
IDP-R3	Basic Commissioning	Required	No			No required submission			
IDP-1	Life Cycle Costing	4			0				
IDP-2	Guest Worker Accommodation	2			0				
IDP-3	Construction Environmental Management	2			0				
IDP-4	Building Envelope Verification	1			0				
IDP-5	Re-Commissioning	2			0				
IDP-6	Sustainability Communication	2			0				
<b>TOTAL</b>		<b>13</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	
<b>NS</b>	<b>Natural Systems</b>								
NS-R1	Natural Systems Assessment	Required	Yes			No required submission			
NS-R2	Natural Systems Protection	Required	Yes			No required submission			
NS-R3	Natural Systems Design & Management Strategy	Required	Yes			No required submission			
NS-1	Reuse of Land	2			0				
NS-2	Remediation of Contaminated Land	2			0				
NS-3	Ecological Enhancement	2			0				
NS-4	Habitat Creation & Restoration	6			0				
<b>TOTAL</b>		<b>12</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	
<b>LBo</b>	<b>Livable Buildings : Outdoors</b>								
LBo-R1	Plan 2030	Required	Yes			No required submission			
LBo-R2	Urban Systems Assessment	Required	Yes			No required submission			
LBo-R3	Outdoor Thermal Comfort Strategy	Required	Yes			No required submission			
LBo-1	Improved Outdoor Thermal Comfort	2							
LBo-2	Pearl Rated Communities	1			0				
LBo-3	Accessible Community Facilities	1							
LBo-4	Active Urban Environments	1			0				
LBo-5	Private Outdoor Space	n/a							
LBo-6	Public Transport	3							

LBo-7	Bicycle Facilities	2			0				
LBo-8	Preferred Car Parking Spaces	1			0				
LBo-9	Travel Plan	1			0				
LBo-10	Light Pollution Reduction	1			0				
<b>SUB-TOTAL</b>		<b>13</b>	<b>0</b>						

<b>LBI</b>	<b>Livable Buildings : Indoors</b>								
LBI-R1	Healthy Ventilation Delivery	Required	No						
LBI-R2	Smoking Control	Required	Yes						
LBI-R3	Legionella Prevention	Required	No						
LBI-1	Ventilation Quality	3			0				
LBI-2.1	Materials Emissions : Adhesives & Sealants	1			0				
LBI-2.2	Materials Emissions : Paints & Coatings	1			0				
LBI-2.3	Materials Emissions: Carpet & Hard Flooring	1			0				
LBI-2.4	Materials Emissions : Ceiling Systems	1			0				
LBI-2.5	Materials Emissions : Formaldehyde Reduction	2			0				
LBI-3	Construction Indoor Air Quality Management	2			0				
LBI-4	Car Park Air Quality Management	1			0				
LBI-5.1	Thermal Comfort & Controls: Thermal Zoning	1			0				
LBI-5.2	Thermal Comfort & Controls: Occupant Control	2			0				
LBI-5.3	Thermal Comfort & Controls: Thermal Comfort Modding	2			0				
LBI-6	High Frequency Lighting	1			0				
LBI-7	Daylight & Glare	2			0				
LBI-8	Views	1			0				
LBI-9	Indoor Noise Pollution	1			0				
LBI-10	Safe & Secure Environment	1			0				
<b>SUB-TOTAL</b>		<b>23</b>	<b>0</b>						

<b>PW</b>	<b>Precious Water</b>								
PW-R1	Minimum Interior Water Use Reduction	Required	No						
PW-R2	Exterior Water Monitoring	Required	Yes						
PW-1	Improved Interior Water Use Reduction	15			0				
PW-2.1	Exterior Water Use Reduction: Landscaping	8			0				
PW-2.2	Exterior Water Use Reduction: Heat Rejection	8			0				
PW-2.3	Exterior Water Use Reduction: Water Features	4			0				
PW-3	Water Monitoring & Leak Detection	4			0				
PW-4	Stormwater Management	4			0				
<b>TOTAL</b>		<b>43</b>	<b>0</b>						

<b>RE</b>	<b>Resourceful Energy</b>								
RE-R1	Minimum Energy Performance	Required	No						
RE-R2	Energy Monitoring & Reporting	Required	No						
RE-R3	Ozone Impacts of Refrigerants & Fire Suppression Systems	Required	No						
RE-1	Improved Energy Performance	15			0				
RE-2	Cool Building Strategies	6			0				
RE-3	Energy Efficient Appliances	3			0				
RE-4	Vertical Transportation	3			0				
RE-5	Peak Load Reduction	4			0				
RE-6	Renewable Energy	9			0				

RE-7	Global Warming Impacts of Refrigerants & Fire Suppression Systems	4			0				
<b>TOTAL</b>		<b>44</b>	<b>0</b>						

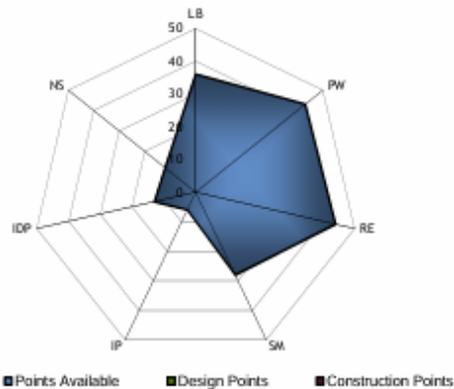
<b>SM</b>	<b>Stewarding Materials</b>								
SM-R1	Hazardous Materials Elimination	Required	No						
SM-R2	Basic Construction Waste Management	Required	No						
SM-R3	Basic Operational Waste Management	Required	No						
SM-1	Non-Polluting Materials	3			0				
SM-2	Design for Materials Reduction	1			0				
SM-3	Design for Flexibility & Adaptability	1			0				
SM-4	Design for Disassembly	1			0				
SM-5	Modular Flooring Systems	1			0				
SM-6	Design for Durability	1			0				
SM-7	Building Reuse	2			0				
SM-8	Material Reuse	1			0				
SM-9	Regional Materials	2			0				
SM-10	Recycled Materials	6			0				
SM-11	Rapidly Renewable Materials	1			0				
SM-12	Reused or Certified Timber	2			0				
SM-13	Improved Construction Waste Management	2			0				
SM-14	Improved Operational Waste Management	2			0				
SM-15	Organic Waste Management	2			0				
<b>TOTAL</b>		<b>28</b>	<b>0</b>						

<b>IP</b>	<b>Innovating Practice</b>								
IP-1	Innovative Cultural & Regional Practices	3			0				
IP-2	Innovating Practice	3			0				
<b>TOTAL</b>		<b>6</b>	<b>0</b>						

## Pearl Building Rating System

Project Summary	
Project Name	Office Building
Project ID	1/1/1900
Building Use	Office
Pearl Rating Stage	Design
Pearl QP Name	Ahmed Effat Mokhtar Abdelsalam Mosa
Pearl QP Number	1/1/1900
Date	7/4/1905

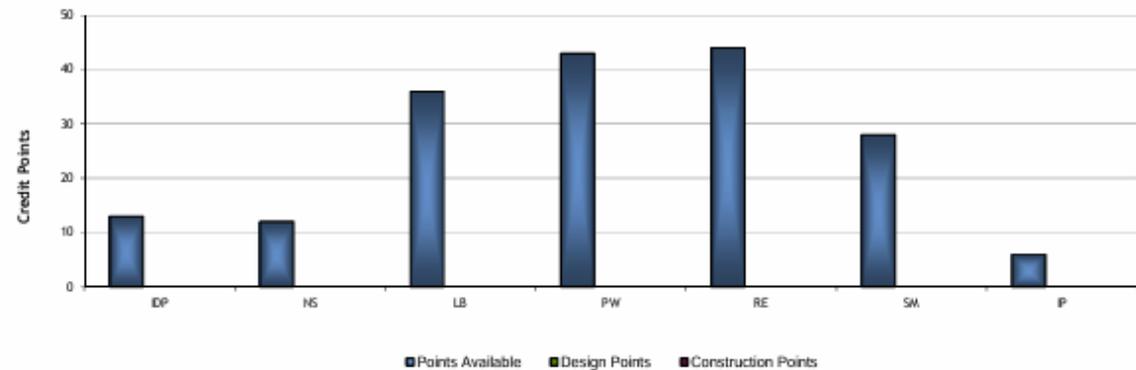
Pearl Rating Levels	
Total Credit Points	Pearl Rating
Required credits only	1
60	2
85	3
115	4
140	5



Credit Section	Credit Points Available	Design Credit Points	Construction Credit Points
IDP - Integrated Development Process	13	0	0
NS - Natural Systems	12	0	0
LB - Livable Buildings	36	0	0
PW - Precious Water	43	0	0
RE - Resourceful Energy	44	0	0
SM - Stewarding Materials	28	0	0
IP - Innovating Practice	6	0	0

<b>Total</b>	<b>0</b>	<b>0</b>
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<b>Design Pearl Rating</b>	<b>Unrated</b>
<b>Construction Pearl Rating</b>	<b>Unrated</b>



## Annexe –9-

### The 14 HQE Targets and Their Requirements (in French)

Cibles	Sous-cibles	Exigences minimales
<b>ECOCONSTRUCTION</b>		
<b>Cible 1</b> Relation harmonieuse du bâtiment avec son environnement immédiat	<ul style="list-style-type: none"> <li>- utilisation des opportunités offertes par le voisinage et le site</li> <li>- gestion des avantages et inconvénients de la parcelle</li> <li>- organisation de la parcelle pour créer un cadre de vie agréable</li> <li>- réduction des risques de nuisances entre le bâtiment, son voisinage et son site</li> </ul>	<ul style="list-style-type: none"> <li>* traiter l'insertion du bâtiment dans son environnement, en réalisant une étude préalable au projet, une étude d'organisation de la parcelle, une étude de traitement des espaces extérieurs et intermédiaires. En cas de friches industrielles, analyser le niveau de pollution et dépolluer si nécessaire</li> <li>* respecter un niveau maximal de pression acoustique de 50 dB(A) des bruits émis par des équipements ou des pratiques extérieures, en réalisant éventuellement un traitement acoustique</li> <li>* repérer les sources de bruits extérieurs et créer un isolement acoustique satisfaisant</li> </ul>
<b>Cible 2</b> Choix intégré des procédés et produits de construction	<ul style="list-style-type: none"> <li>- adaptabilité et durabilité des bâtiments</li> <li>- choix des procédés de construction</li> <li>- choix des produits de construction</li> </ul>	<ul style="list-style-type: none"> <li>* utiliser des procédés et des produits économes en matière et en énergie</li> <li>* étudier les possibilités de recyclage des déchets d'adaptation et de démolition des bâtiments • tenir compte des règles d'utilisation et de qualification des produits de bâtiment, notamment en choisissant des produits sans risques pour l'environnement</li> </ul>
<b>Cible 3</b> Chantiers à faibles nuisances	<ul style="list-style-type: none"> <li>- gestion différenciée des déchets de chantier</li> <li>- réduction des bruits de chantier</li> <li>- réduction des pollutions sur la parcelle et dans le voisinage</li> <li>- maîtrise des autres nuisances de chantier</li> </ul>	<ul style="list-style-type: none"> <li>* intégrer en amont les mesures permettant la maîtrise des déchets de chantier et la réduction des nuisances (bruit, poussières, boue...)</li> <li>* réduire la consommation d'énergie et la pollution de l'air par les chantiers</li> <li>* réduire la consommation d'eau et la pollution de l'eau et des sols durant les chantiers</li> </ul>
<b>ÉCOGESTION</b>		
<b>Cible 4</b> Gestion de l'énergie	<ul style="list-style-type: none"> <li>- renforcement du recours aux énergies renouvelables</li> <li>- renforcement de l'efficacité des équipements consommant de l'énergie</li> <li>- utilisation de générateurs à combustion propres lorsqu'on a recours à ce type d'appareil</li> </ul>	<ul style="list-style-type: none"> <li>* renforcer l'efficacité énergétique des projets</li> <li>* choisir des chaudières « propres » labellisées à faible émission de CO<sub>2</sub>, CO et NO.</li> </ul>
<b>Cible 5</b> Gestion de l'eau	<ul style="list-style-type: none"> <li>- gestion de l'eau potable</li> <li>- recours à des eaux non potables (récupération des eaux de pluie)</li> <li>- assurance de l'assainissement des eaux usées</li> <li>- gestion des eaux pluviales sur la parcelle</li> </ul>	<ul style="list-style-type: none"> <li>* rechercher des systèmes qui limitent la consommation d'eau potable: équipements performants, surveillance des réseaux pour diminuer les fuites</li> <li>* envisager une collecte des eaux pluviales pour l'alimentation des WC, le nettoyage, l'arrosage, etc.</li> </ul>
<b>Cible 6</b> Gestion des déchets d'activités	<ul style="list-style-type: none"> <li>- conception de locaux à poubelles adaptés au tri sélectif et à la valorisation des déchets</li> </ul>	<ul style="list-style-type: none"> <li>* prendre en compte les collectes sélectives locales</li> <li>* configurer les cuisines et les locaux techniques en prévoyant le tri sélectif</li> <li>* concevoir le transit entre les lieux de stockage et de ramassage</li> <li>* séparer le stockage des déchets ménagers de la circulation des personnes</li> </ul>
<b>Cible 7</b> Entretien et maintenance	<ul style="list-style-type: none"> <li>- optimisation des besoins de maintenance</li> <li>- mise en place de procédés efficaces de gestion technique et de maintenance</li> <li>- maîtrise des effets environnementaux des procédés</li> </ul>	

	de maintenance et des produits d'entretien	
<b>CONFORT</b>		
<b>Cible 8</b> Confort hygrothermique	<ul style="list-style-type: none"> <li>- permanence des conditions de confort hygro- thermique</li> <li>- homogénéité des ambiances hygrothermiques</li> <li>- zonage hygrothermique</li> </ul>	* assurer le confort thermique d'été
<b>Cible 9</b> Confort acoustique	<ul style="list-style-type: none"> <li>- correction acoustique</li> <li>- isolation acoustique</li> <li>- affaiblissement des bruits d'impact et d'équipements</li> <li>- zonage acoustique</li> </ul>	* réduire les niveaux de pression acoustique en protégeant les logements contre les bruits émis à l'intérieur et à l'extérieur
<b>Cible 10</b> Confort visuel	<ul style="list-style-type: none"> <li>- relation visuelle satisfaisante avec l'extérieur</li> <li>- éclairage naturel optimal en termes de confort et de dépenses énergétiques</li> <li>- éclairage artificiel satisfaisant en appoint de l'éclairage naturel</li> </ul>	<ul style="list-style-type: none"> <li>* réaliser une étude d'implantation et de dimensionnement des parois vitrées compatible avec l'exigence énergétique</li> <li>* respecter les exigences relatives à l'installation électrique</li> </ul>
<b>Cible 11</b> Confort olfactif	<ul style="list-style-type: none"> <li>- réduction des sources d'odeurs désagréables</li> <li>- ventilation permettant l'évacuation des odeurs désagréables</li> </ul>	
<b>SANTÉ</b>		
<b>Cible 12</b> Conditions sanitaires	<ul style="list-style-type: none"> <li>- création de conditions d'hygiène satisfaisantes</li> <li>- dispositions facilitant le nettoyage et l'évacuation des déchets d'activités</li> <li>- dispositions facilitant les soins de santé</li> <li>- dispositions en faveur des personnes à capacités physiques réduites</li> </ul>	<ul style="list-style-type: none"> <li>* choisir judicieusement l'emplacement et la forme des pièces techniques et les équiper correctement</li> <li>* faciliter l'entretien et le nettoyage</li> </ul>
<b>Cible 13</b> Qualité de l'air	<ul style="list-style-type: none"> <li>- gestion des risques de pollution par les produits de construction</li> <li>- gestion des risques de pollution par les équipements</li> <li>- gestion des risques de pollution par l'entretien ou la maintenance</li> <li>- gestion des risques de pollution par le radon</li> <li>- gestion des risques de pollution par l'air neuf</li> <li>- ventilation pour garantir la qualité de l'air</li> </ul>	<ul style="list-style-type: none"> <li>* choisir des générateurs à combustion dotés d'un système de sécurité normalisé</li> <li>* éviter les produits polluants utilisés dans la construction: formaldéhyde, solvants, pesticides...</li> <li>* analyser le risque d'émission de radon dans les régions sensibles et adapter la conception des bâtiments en conséquence</li> <li>* dimensionner correctement le renouvellement d'air et utiliser des systèmes de ventilation performants</li> <li>* vérifier l'absence d'amiante et de CFC dans certains isolants plastiques alvéolaires, ainsi que dans les équipements produisant du froid, les aérosols et solvants</li> </ul>
<b>Cible 14</b> Qualité de l'eau	<ul style="list-style-type: none"> <li>- protection du réseau de distribution collective d'eau potable</li> <li>- maintien de la qualité de l'eau potable dans les bâtiments</li> <li>- amélioration éventuelle de la qualité de l'eau potable</li> <li>- traitement éventuel des eaux non potables utilisées</li> <li>- gestion des risques liés aux réseaux d'eaux non potables</li> </ul>	<ul style="list-style-type: none"> <li>* ne pas utiliser de canalisations en plomb (interdites par le DTU 60-1)</li> <li>* maintenir une température de stockage de l'eau chaude à 60 °C et de distribution à 50 °C, pour minimiser les risques de légionellose</li> </ul>

## Annexe –10-

### Mahoney's tables

#### a- Temperature

	J	F	M	A	M	J	J	A	S	O	N	D	La+haute	TAM
Temp.Moy.Max	18	19	23	27	31	37	41	40	34	28	22	18	41	24.5
Temp.Moy.Min	8	8	11	15	19	25	29	28	24	17	12	8	8	33
E.D.T	10	11	12	12	12	12	12	12	10	11	10	10	La+basse	EAT

#### b- Humidity , rain and wind

	J	F	M	A	M	J	J	A	S	O	N	D	Total annuel pluie
Humidité Rel.Max	61	56	51	47	44	40	35	38	47	55	57	60	185.5
Humidité Rel.Min	60	51	46	42	36	31	26	31	42	50	55	59	
Humidité Rel.Moy	60.5	53.5	48.5	44.5	40	35.5	30.5	34.5	44.5	52.5	56	59.5	
Groupe(G.H)	3	3	2	2	2	2	2	2	2	3	3	3	
Pluie(mm)	15.9	17.5	24.7	22.6	5.7	23.6	00.0	3.7	10.4	16.3	44.8	0.3	
Vent Dominant	4.5	4.7	5	4	5.2	4.6	2.9	2.9	2.9	3.4	3.8	3.2	
Vent Secondaire													

G.H	
< 30%	1
30-50	2
50-70	3
>70	4

#### c- Comfort

	J	F	M	A	M	J	J	A	S	O	N	D
G.H	3	3	2	2	2	2	1	2	2	3	3	3

#### -Température:

Moy.Mens.Max	18	19	23	27	31	37	41	40	34	28	22	18
Confort Maxi	29	29	31	31	31	31	34	31	31	29	29	29
diurne Mini	23	23	23	23	23	23	26	23	23	23	23	23
Moy.Mens.Min	8	8	11	15	19	25	29	28	24	17	12	8
Confort Maxi	23	23	24	24	24	24	25	24	24	23	23	23
nocturne Mini	17	17	17	17	17	17	17	17	17	17	17	17

#### -Stress thermique:

Jour	f	f	/	/	/	c	c	c	c	/	f	f
Nuit	f	f	f	f	/	c	c	c	/	/	f	f

#### d- Indicators

	J	F	M	A	M	J	J	A	S	O	N	D
H1									X			
H2												
H3				x	x					X		
A1			x									
A2							X	X				
A3	x	x				x					X	X

## Architectural recommendations for Algeria (N.Ould Hnia)

### a- summer climate zones

According to the summer climatic zones which were defined by Ould Hnia, the wilaya of Biskra is located in zone E3 ( pre-Sahara tassili), this zone is characterized by a very hot and dry summer.

Recommandations	Les principes dans la période d'été
1.Orientation	Nord-sud ( est et ouest à proscrire).
2.Espacement entre les bâtiments	Plan compact en diminuant l'exposition des murs avec l'extérieur
3.Ventilation ou aération d'été	Ventilation nocturne
4.Ouvertures/fenêtres	Moyenne 25 à 40 %
5. Murs et planchers	Murs et planchers massifs. Forte inertie thermique multi journalière (hors période surchauffe) avec couleurs claires.
6.toiture	Massive. Forte inertie thermique multi journalière (hors période surchauffe) avec couleurs claires.
7.Isolation thermique	Toiture isolée
8.protection	Protection d'été. Occultation totale des ouvertures, ouvertures nord-sud
9.Espaces extérieurs	Emplacement pour le sommeil en plein air. Cuisine à l'extérieur
10. Végétation	Végétation ombrage murs et fenêtres.
11. Chauffage passif	/

### b- winter climate zones

According to the winter climatic zones, which were defined by Ould Hnia, the wilaya of Biskra is located in zone H3a, this zone is characterized by an altitude between 500-1000.

Recommandations	Les principes dans la période d'hiver
1.Orientation	Nord-sud souhaitée avec occupation Verticale des espaces.
2.Espacement entre les bâtiments	Plan compact en diminuant l'exposition des murs en contact avec l'extérieur
3.Ventilation ou aération d'été	/
4.Ouvertures/fenêtres	Sur surface totale ouvertures prévues,affecter pour captage soleil hiver surface vitrage sud égale à 0.15 par m <sup>2</sup> plancher.
5. Murs et planchers	Murs et planchers massif-inertie thermique journalière>8 heures compromis à prendre avec l'été.
6.toiture	Toiture massive et isolée.
7.Isolation thermique	Isolation thermique par toiture.
8.protection	D'hiver des vents de sable par plantation à feuilles persistantes qui poussent dans le sud .
9.Espaces extérieurs	/
10. Végétation	Végétation à feuilles persistantes pour vents dominants froids et surtout de sable.
11. Chauffage passif	Chauffage passif par stockage murs massifs inertie déphasage 8 à 12 heures ou vitrage sud.
12.Climatisation	/

## ANNEXE A.1 : CLASSIFICATION THERMIQUE DES COMMUNES D'ALGERIE EN PERIODE D'HIVER

### A1. PRELIMINAIRES

#### A1.1. Zone Climatique A

Localisation : Cette zone est délimitée par la mer au nord et les hautes plaines de l'intérieur au sud.

Caractéristiques :

- La température extérieure de base est de 3 °C.

#### A1.1. Zone Climatique A1

Localisation : elle comprend les régions de Bejaia, Skikda, Dellys, EL kala, Tenes et Beni saf

Caractéristiques :

- La température extérieure de base est de 7 °C.

#### A1.2 Zone Climatique B

Localisation : Elle regroupe les différentes régions du nord Tellien et les hautes plaines de l'intérieur.

Caractéristique :

- La température extérieure de base est de - 2 °C.

#### A1.3. Zone Climatique C

Localisation : elle comprend les différentes régions du nord Sahara et reliant la Saoura jusqu'à In-Amenas, Illizi et Bord Badji Mokhtar

Caractéristiques :

- la température extérieure de base est de 1°C.

#### A1.4. Zone Climatique D

Localisation :

Elle englobe les régions de Tanezrouft et une partie du nord Sahara et le Hoggar

Caractéristiques :

- La température extérieure de base est de 4 °C.



الجمهورية الجزائرية الديمقراطية الشعبية

وزارة التعليم العالي والبحث العلمي جامعة محمد خيضر - بسكرة -



جامعة محمد خيضر - بسكرة

## عنوان المشروع

تطوير نظام تقييم محلي للمباني المستدامة مصمم  
خصيصا ليتماشى مع المناخ، المواد والسياق الجزائري

صورة العلامة التجارية



الاسم التجاري

PALME

“Performance Assessment for  
Local and Multidimensional  
Environments”

## نموذج العمل التجاري

### بطاقة تعريفية

حول فريق الاشراف وفريق العمل

#### 1-فريق الاشراف

فريق الاشراف	
هندسة معمارية	الأستاذ المشرف بن فرحات محمد العدوي

#### 2-فريق العمل

الكلية	التخصص	فريق المشروع
الهندسة المعمارية والمدنية والري	هندسة معمارية	خوجة عبير

## نموذج العمل التجاري

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### فهرس المحتويات

- المحور الأول: تقديم المشروع
- المحور الثاني: الجوانب الابتكارية
- المحور الثالث: التحليل الاستراتيجي للسوق
- المحور الرابع: خطة الإنتاج والتنظيم
- المحور الخامس: الخطة المالية
- المحور السادس: النموذج الأولي التجريبي

## نموذج العمل التجاري

### المحور الأول: تقديم المشروع

بدأت فكرة المشروع من وعي عميق بجملة من التحديات المعقدة التي تواجهها الجزائر في مجال تقييم المشاريع المعمارية والعمرائية من منظور بيئي وهندسي، في وقت باتت فيه الاستدامة عنصراً مركزياً في السياسات الدولية والوطنية، فعلى الرغم من انتشار أنظمة تقييم عالمية مثل LEED (القيادة في الطاقة والتصميم البيئي)، BREEAM (المنهج البريطاني لتقييم الاستدامة البيئية)، أو HQE (الجودة البيئية العالية)، إلا أن تطبيقها داخل السياق الجزائري غالباً ما يكون إما جزئياً، أو غير فعال، أو حتى غير ممكن عملياً، نتيجة لعدة عراقيل هيكلية وسياقية.

من بين أبرز هذه العراقيل، يبرز الاختلاف الجذري في الخصائص المناخية بين الجزائر وسياقات الدول التي طورت هذه الأنظمة، حيث تعاني الجزائر من تباين حاد في المناخ بين المناطق الساحلية الرطبة والمعتدلة، والمناطق الداخلية الجافة، والصحراوية القاحلة، ما يجعل تبني معايير موحدة غير واقعي أو غير فعال بيئياً، يُضاف إلى ذلك الضعف النسبي في توافر المواد المحلية التي تستوفي الشروط التقنية والبيئية المطلوبة في هذه الأنظمة، مما يؤدي إلى اعتماد مكلف على مواد مستوردة، وهو أمر لا يتماشى مع مبادئ الاستدامة ذاتها ولا مع القدرات الاقتصادية للمشاريع المحلية.

كما يُلاحظ وجود فراغ تشريعي وتنظيمي واضح في ما يخص دمج المعايير البيئية في مسار التصميم والبناء، إذ تقتصر الجزائر حتى الآن إلى إطار قانوني ملزم أو محرك يُعزز اعتماد المعايير البيئية في قطاع البناء، وهو ما يترك المجال واسعاً لتفسيرات متفاوتة وتأويلات فردية في التطبيق. هذه الوضعية تتفاقم بسبب ضعف التكوين الأكاديمي والمهني في مجالات الاستدامة والتقييم البيئي، حيث لا تحظى مفاهيم مثل الكفاءة الطاقوية، أو المحاكاة البيئية، أو التحليل الدوري للأداء البيئي للمبنى بالمكانة التي تستحقها ضمن تكوينات المهندسين والمقاولين، ما يؤدي إلى ضعف القدرة التقنية لمكاتب الدراسات على تبني ممارسات تصميم بيئي فعالة.

ومن جهة أخرى، فإن اعتماد أنظمة تقييم عالمية دون تكييفها مع الخصوصيات المحلية يؤدي إلى إدخال مفاهيم وألويات لا تتسجم مع الواقع الجزائري، مما يُضعف من فعالية هذه الأنظمة ومصادقيتها عند التطبيق. كما أن غياب نظام تقييم محلي يأخذ بعين الاعتبار السياق المناخي، والاقتصادي، والتشريعي في الجزائر، يُسهم في تهميش البعد البيئي أو اختزاله في حلول سطحية وغير معمقة. إن تراكم هذه التحديات على المستويات التقنية، والمناخية، والأكاديمية، والتشريعية، ولّد حاجة ملحة إلى نظام تقييم وطني، مرن وواقعي، يُمكن الفاعلين في القطاع من قياس وتحسين الأداء البيئي للمباني بشكل فعال ومستدام.

مجال نشاطنا يتمثل في التطبيقات الحديثة " تطوير نظام تقييم محلي للمباني المستدامة مصمم خصيصا ليتماشى مع المناخ، المواد والسياق الجزائري

### 1- فكرة المشروع الحل المقترح

سيساعد هذا التطبيق الرقمي المهندسين المعماريين ومكاتب الدراسات على تقييم الأداء البيئي للمباني بطريقة دقيقة وفعالة، من خلال نظام تقييم مكيف مع الخصوصيات المناخية، والمواد المحلية، والمعايير التنظيمية في الجزائر، يعمل التطبيق على تحليل عدة معطيات تشمل المناخ المحلي، نوعية المواد المستعملة، كفاءة العزل الحراري، استهلاك الطاقة، وتوفر الشروط البيئية المستدامة، كما يس0.

تعمل نماذج محاكاة شبيهة بتلك المستعملة في EnergiePlus لتحليل الأداء الطاقوي، ويستفيد من آليات BIM لتكامل التصميم والتقييم في بيئة رقمية موحدة.

سيقدم النظام توصيات تفصيلية قابلة للتطبيق ميدانياً وبهذا، يساهم المشروع في دعم ممارسات البناء المستدام، تعزيز كفاءة الطاقة، تقليل المخاطر البيئية، وتحقيق راحة المستخدمين دون الحاجة لاعتماد أنظمة تقييم مستوردة مكلفة أو غير ملائمة، كما يمكن هذا النظام الجهات الفاعلة من اتخاذ قرارات تصميم مبنية على بيانات دقيقة ومحلية، ما يرفع من جودة المشاريع المعمارية ويمنحها شرعية بيئية في السوق الجزائرية.

### 2. تعريف المشروع

العنصر	الشرح
طبيعة المشروع	تطوير نظام تقييم محلي للمباني المستدامة مصمم خصيصا ليتماشى مع المناخ، المواد والسياق الجزائري
اسم المشروع	PALME "Performance Assessment for Local and Multidimensional Environments"
مجال نشاطنا	تطبيقات حديثة
موقع المشروع	ولاية بسكرة
النطاق	وطني
الفئة المستهدفة	-مكاتب الدراسات الهندسية والمعمارية (خاصة وعامة)، شركات البناء والمقاولات العقارية، مديريات الصحة و مديريات التربية، الخواص كاصحاب الفنادق و المركبات السياحية .

## نموذج العمل التجاري

عدد العمال	07
تسمية النشاط	نظام تقييم محلي مصمم خصيصاً ليتماشى مع المناخ، المواد والسياق الجزائري
مضمون النشاط	تطوير نظام تقييم، صياغة المؤشرات والمعايير المناسبة للسياق الجزائري، اعداد منصة رقمية، تجربة واختبار النظام على المشاريع
الشكل للمؤسسة	شخص معنوي SARL
تكلفة شراء الأرضية	00 دينار جزائري

### 3. القيم المقترحة

- تحسين الأداء البيئي للمباني: يساعد التطبيق على تعزيز جودة التصاميم المعمارية من خلال دمج معايير الاستدامة البيئية، مما يرفع من كفاءة استهلاك الطاقة ويحسن جودة الهواء والإضاءة داخل المباني.
- تكامل مع خصوصيات السياق الجزائري: يأخذ النظام بعين الاعتبار المناخ المتنوع في الجزائر وكذلك المواد المحلية المتوفرة (كالطين، الحجر، الطوب الأحمر...)، مما يضمن نتائج واقعية وقابلة للتطبيق.
- حلول قابلة للتخصيص: يُمكن المستخدمين من تعديل معايير التقييم بحسب نوع المشروع والموقع الجغرافي، مما يجعل الأداة مرنة وفعالة في مختلف سيناريوهات البناء داخل البلاد.
- واجهة استخدام بسيطة وعملية و بثلاث لغات: صُمم التطبيق بواجهة سهلة الاستخدام تُساعد المهندسين والمصممين على إدخال البيانات وتحليلها بسرعة، مع فهم واضح للنتائج والتوصيات البيئية.
- ربط ذكي بين التصميم والتقييم: عبر تكامل مبادئ الـ BIM (نمذجة معلومات البناء)، يتيح النظام تقييم المشروع بشكل متزامن مع مراحل التصميم، مما يُعزز اتخاذ القرارات البيئية في الوقت المناسب.
- تقليل التكاليف والاعتماد على حلول محلية: يقدم التطبيق توصيات مبنية على الموارد المحلية، مما يقلل من الحاجة إلى مواد أو تقنيات مستوردة ومكلفة، ويُسهّم في بناء مشاريع بيئية منخفضة الكلفة.
- امتثال للمعايير الوطنية والدولية: يُساعد المستخدمين على ضمان توافق مشاريعهم مع متطلبات القوانين الجزائرية، وفي الوقت ذاته يفتح الباب أمام مطابقة معايير عالمية مثل LEED أو HQE.
- تحليل شامل ومتعدد الأبعاد: يُجري التطبيق تقييماً متكاملاً يشمل الطاقة، العزل، التهوية، الإضاءة، واستهلاك المياه، مما يوفر رؤية بيئية متكاملة للمبنى ويعزز من جودة الحياة داخله.

## نموذج العمل التجاري

- تشجيع الابتكار المعماري المستدام: يفتح المجال أمام المعماريين لاختبار حلول تصميم جديدة ومستدامة، مستندين إلى معايير تقييم علمية مكيّفة محلياً.

### 4. فريق العمل

الطلبة	التخصص	الدورات التكوينية
خوجة عيبر	هندسة معمارية	- تربص ميداني على مستوى مكتب الدراسات. - تربص ميداني على مستوى مديرية الترقية والتسيير العقاري بسكرة. - دورات تكوينية حول برامج المحاكاة ثلاثية الأبعاد. - دورات تكوينية على مستوى حاضنة الاعمال بسكرة حول تطبيقات المالية و المحاسبة و حول الجوانب القانونية لانشاء الشركات....

### 5. أهداف المشروع

#### 1. أهداف قريبة المدى

- تطوير تطبيق رقمي محلي للتقييم البيئي: تصميم تطبيق ذكي متكامل وسهل الاستخدام، يمكن المهندسين والمصممين من تقييم مشاريعهم المعمارية وفق معايير بيئية مكيّفة مع الواقع الجزائري.
- تحسين فعالية النظام وتقييم أدائه: اختبار وظائف النظام على مشاريع ، وضبط المؤشرات والمعايير لضمان دقة التقييم وملاءمته للمناخ والمواد المحلية.
- الترويج وبناء الوعي: نشر ثقافة التقييم البيئي المحلي بين مكاتب الدراسات والمقاولين من خلال ورشات عمل وعروض تطبيقية.

## نموذج العمل التجاري

- بناء شراكات استراتيجية: إقامة شراكات مع هيئات حكومية، جامعات، مكاتب دراسات ومراكز البحث لتعزيز تبني النظام ودعمه في الأطر المهنية والعلمية.

### 2. أهداف متوسطة المدى

- إدماج تقنيات متقدمة وتحليل طاقتي ديناميكي: تطوير نماذج تقييم متقدمة تعتمد على التكامل مع أدوات مثل BIM وEnergiePlus، من أجل تحليل شامل للأداء الطاقتي والبيئي للمباني.
- التأثير الإيجابي في المجال العمراني: الإسهام في إنشاء مشاريع أكثر استدامة في الجزائر من خلال تشجيع الممارسين على تبني ممارسات تصميم بيئي واقعي وقابل للبناء.
- تطوير محتوى تكويني وتعليمي: إعداد دليل استخدام وتكوين متخصص لفائدة الجامعات ومكاتب الدراسات لتكوين جيل جديد من المهنيين ملمين بثقافة التصميم البيئي المحلي.
- التوسع التجريبي: اعتماد التطبيق بشكل تدريجي في مشاريع نموذجية في مختلف المناطق الجغرافية (الشمال، الهضاب، الجنوب).

### 3. أهداف بعيدة المدى

- تحقيق مرجعية وطنية في التقييم البيئي: ترسيخ التطبيق كنظام تقييم بيئي معتمد على المستوى الوطني، ليصبح مرجعاً رسمياً في السياسات العمرانية والبنائية الجزائرية.
- الوصول إلى استقلالية تقنية ومالية مستدامة: بناء نموذج فعال للتطبيق يضمن استمراريته وتوسّعه، عبر خدمات تقييم مدفوعة وخطط اشتراك مكيفة لمكاتب الدراسات.
- الريادة التكنولوجية في المنطقة المغربية: تطوير النظام ليصبح منصة إقليمية تنافسية في شمال إفريقيا، تجمع بين الامتثال الدولي والخصوصيات المحلية، وتخدم دولاً ذات سياق بيئي مشابه.
- المساهمة في تحقيق الأهداف المناخية الوطنية: دعم الجزائر في التزاماتها الدولية في مجال الحد من الانبعاثات، عبر تحسين أداء الأبنية من حيث الاستهلاك الطاقتي والانبعاثات الكربونية.

## المحور الثاني: الجوانب الابتكارية

### 1. طبيعة الابتكار: ابتكارات تكنولوجية

### 2. مجالات ابتكارية:

- تكييف المعايير العالمية للسياق المحلي: يُعد المشروع أول نظام تقييم بيئي في الجزائر يُكيّف معايير عالمية مثل LEED وBREEAM وHQE، مع الخصوصيات المناخية، المادية، والاجتماعية للمجال الجزائري، مما يجعله نظاماً مرجعياً محلياً بامتياز.

## نموذج العمل التجاري

- إستعمال أدوات المحاكاة الطاقوية والمناخية: يستعمل النظام محاكاة ديناميكية للأداء الطاقوي (مثل EnergiePlus) لتقدير استهلاك الطاقة وانبعاثات الكربون، مع مراعاة مواد البناء المحلية وخصائص المواقع الجغرافية المختلفة داخل الجزائر.
- سهولة الاستخدام: تصميم واجهة مستخدم بسيطة وبديهية تسهل على المستخدمين التعامل مع التطبيق وتحقيق أقصى استفادة منه.
- نظام تقييم تدريجي وقابل للتخصيص: يتيح النظام تقيماً مرناً عبر مستويات مختلفة، بدءاً من مشاريع صغيرة إلى مشاريع كبيرة، مع إمكانية تخصيص مؤشرات التقييم حسب نوع المشروع.
- ربط بين الأبعاد البيئية، الاقتصادية والاجتماعية: لا يقتصر التقييم على البعد البيئي فقط، بل يأخذ في الحسبان مؤشرات ترتبط بالتكلفة، وإمكانية التنفيذ، وأثر المشروع على المستخدمين، وهو ما يعزز مفهوم الاستدامة الشاملة.
- التحديث المستمر وفق البحث العلمي المحلي: يتم تطوير النظام تدريجياً بناءً على نتائج البحوث الجامعية والدراسات المناخية المحلية، مما يجعله نظاماً ديناميكياً متجذراً في الواقع المعرفي والعلمي الجزائري.

## المحور الثالث: التحليل الاستراتيجي للسوق

### 1. تحليل PESTEL

العوامل السياسية	العوامل الاقتصادية	العوامل الاجتماعية	العوامل التكنولوجية	العوامل البيئية	العوامل القانونية
الدعم الحكومي للاستدامة: تزايد الاهتمام الحكومي الجزائري بمسائل التحول الطاقوي والتزاماتها بالاتفاقيات الدولية المتعلقة بالمناخ ( اتفاقية باريس اجندة 2030 لسياسات الوطنية للبناء وجود رغبة رسمية لتحديث قوانين التهيئة والتعمير، مما يفتح المجال لامكانية اعتماد أنظمة تقييم بيئي ضمن منظومة	تكلفة الطاقات التقليدية المرتفعة ارتفاع ميزانية الكهرباء والماء يحفز على الاعتماد على أنظمة البناء ذات الكفاءة الطاقوية. حوافز ضريبية، إعانات الحاجة لرفع الأداء الطاقوي للمباني بتكلفة منخفضة نسبياً. محدودية الميزانيات المخصصة للبناء الأخضر تبرز الحاجة إلى تطوير حلول تقييم محلية منخفضة الكلفة، تكون أكثر ملاءمة	ارتفاع الوعي البيئي تدريجياً خاصة لدى فئة المهندسين الشباب وطلبة العمارة الذين يبحثون عن حلول مسؤولة بيئياً . النمو السكاني والتحضر السريع يفرضان طلباً المساكن والمنشآت بكميات ضخمة، مما يُبرز أهمية دمج التقييم البيئي في عمليات البناء والتخطيط العمراني لضمان تنمية مستدامة. ضعف ممارسات	تزايد استخدام البرمجيات المعمارية في الجزائر (AutoCAD، Revit). ما يسهل دمج التطبيق في بيئة العمل الرقمي للمهندسين. انتشار الإنترنت يسمح بتوسيع استعمال التطبيق حتى خارج المدن الكبرى. تطور الذكاء الاصطناعي وأدوات المحاكاة يمكن ان يدعم تطوير نظام تقييم ذكي سريع ودقيق.	تأثيرات التغير المناخي المرصودة في الجزائر بدرجات حرارة مرتفعة وجفاف متكرر، ما يجعل من الضروري التوجه نحو بناء مستدام. التنوع البيئي الكبير من الساحل الى الصحراء: يفرض اعتماد نظام تقييم يأخذ بعين الاعتبار الخصوصية المناخية والجغرافية. الضغوط الدولية	فراغ قانوني في مجال تقييم الاستدامة: غياب معايير تقييم بيئية يفتح المجال أمام المبادرات الخاصة. إمكانية اعتماد النظام من طرف الحكومة مستقبلاً: إذا أثبتت فعاليته علمياً يمكن تدريجياً أن يُعتمد رسمياً في المشاريع. احتمال الحاجة الى اعتماد رسمي مما يتطلب التنسيق مع هيئات مثل وزارة السكن و العمران لتأطير

## نموذج العمل التجاري

قانوني رسمي	على البلدان النامية لتقليل البصمة الكربونية ما يفتح فرصاً للمشاريع المحلية التي تساهم في هذا الوجه	الاستدامة الحالية يجعل من التكوين في تطبيق أدوات التقييم البيئي أداة تربوية فعالة، تسهم في توجيه المهندسين نحو تبني ممارسات أكثر احتراماً للبيئة، وتعزيز من وعيهم بدورهم في تحقيق التنمية المستدامة.	السياق الاقتصادي مقارنة بالأنظمة العالمية المكلفة. فرص التمويل عبر شراكات دولية : إمكانية جذب دعم مالي من برامج تُعنى بالتنمية المستدامة أو التعاون الأوروبي، مثل GIZ، و UNDP، وهي جهات تركز على تعزيز الاستدامة وبناء القدرات المحلية، مما يعزز فرص تنفيذ مشاريع بيئية على أرض الواقع.	تصاريح البناء . منح تمويلية متاحة لنشر حلول تقنية مبتكرة في قطاع البناء والتخطيط الحضري.
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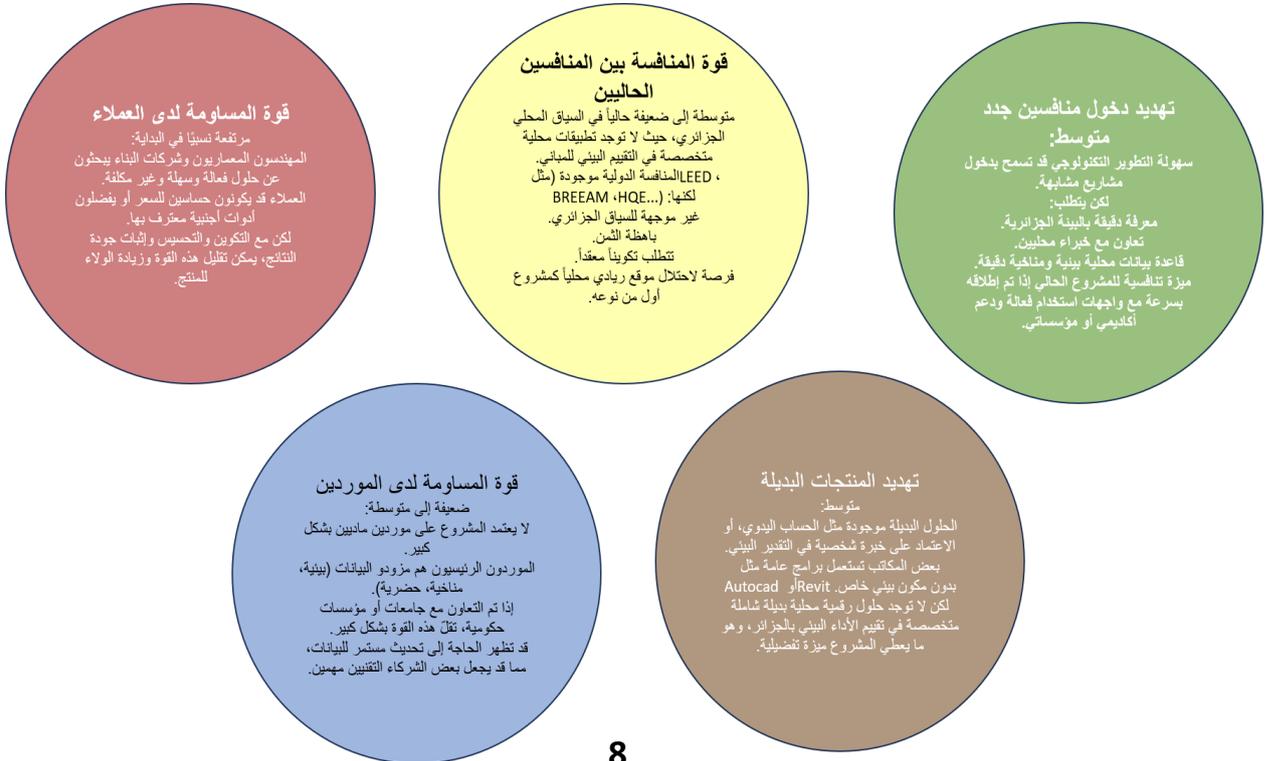
## 2. تحليل S.W.O.T

نقاط الضعف	نقاط القوة
<ul style="list-style-type: none"> <li>- غياب الاعتراف الرسمي من الهيئات الحكومية: مما قد يحد من تبنيه بشكل واسع في المشاريع العمومية والخاصة.</li> <li>- نقص ثقافة التقييم البيئي لدى بعض المهنيين: ما يتطلب جهوداً إضافية في التكوين والتحسيس.</li> <li>- محدودية الموارد البشرية والتقنية في المراحل الأولى: ما قد يؤثر على سرعة تطوير وتحديث النظام.</li> <li>- تحديات الصيانة والتحديث المستمر: للحفاظ على دقة وفعالية النظام أمام تغيرات المعايير والمناخ.</li> </ul>	<ul style="list-style-type: none"> <li>- ابتكار محلي موجه خصيصاً للسياق الجزائري: يراعي الخصائص المناخية، الجغرافية، والمعمارية الخاصة بالجزائر.</li> <li>- سهولة الاستخدام وسرعة التقييم: واجهة مبسطة و بثلاث لغات تمكّن المماريين من الحصول على نتائج دقيقة.</li> <li>- تكلفة منخفضة مقارنة بالبرمجيات الأجنبية: يُعدّ بديلاً اقتصادياً للأنظمة العالمية التي تكون غالباً باهظة الثمن ومعقدة.</li> <li>- قابلية التكيف مع مختلف البيئات: يمكن تكيفه مع المشاريع السكنية، التعليمية، الإدارية.</li> <li>- توافقه مع التوجهات البيئية العالمية: يعزز صورة المستخدم (مهندس أو مؤسسة) كشريك في التنمية المستدامة.</li> </ul>

## نموذج العمل التجاري

التحديات	الفرص
<ul style="list-style-type: none"> <li>- المنافسة مع البرمجيات العالمية الكبيرة: مثل LEED, BREEAM، التي قد تُستخدم في مشاريع دولية أو تمويل أجنبي.</li> <li>- المقاومة من الفاعلين التقليديين في قطاع البناء: بسبب مقاومة التغيير والاعتماد على الأساليب القديمة.</li> <li>- عدم استقرار السياسات البيئية: تغيير التوجهات الحكومية قد يؤثر على دعم أو تسهيل المشروع.</li> <li>- مشاكل البنية التحتية الرقمية في بعض المناطق: مما قد يحد من استعمال التطبيق خارج المدن الكبرى.</li> </ul>	<ul style="list-style-type: none"> <li>- التحول الرقمي في قطاع البناء: يدفع نحو تبني حلول ذكية وفعالة في التقييم والتخطيط.</li> <li>- البرامج الحكومية والدولية الداعمة للبيئة: إمكانية الحصول على تمويل أو دعم من مشاريع تنموية أو بيئية.</li> <li>- توسع قطاع البناء الأخضر في الجزائر وشمال إفريقيا: يمكن أن يُستخدم النظام كأداة تقييم إقليمية.</li> <li>- إمكانية دمجها مع برمجيات أخرى (مثل BIM): ما يجعله أكثر تكاملاً مع أدوات التخطيط الحديثة.</li> <li>- الشراكات مع الجامعات والمدارس المعمارية: لنشر ثقافة الاستدامة عبر التعليم والتكوين</li> </ul>

### 3. تحليل PORTER



4. المزيج التسويقي

الاحتياجات التي يلبيها	خصائص ومميزات المنتج أو الخدمة	المنتج أو الخدمة
<ul style="list-style-type: none"> <li>- حاجة مكاتب الدراسات والمهندسين لتقييم بيئي دقيق يتماشى مع المعايير الوطنية والدولية.</li> <li>- الحاجة إلى أدوات محلية بديلة عن البرمجيات المستوردة المكلفة والمعقدة.</li> <li>- دعم القرار الهندسي والبيئي بمعلومات مبنية على الواقع المحلي.</li> <li>- مواكبة متطلبات التمويل البيئي والتخطيط الحضري المستدام.</li> <li>- المساهمة في تحقيق أهداف الجزائر المناخية وتقليل البصمة الكربونية</li> </ul>	<ul style="list-style-type: none"> <li>- تقييم بيئي شامل يأخذ بعين الاعتبار الخصائص المناخية والمادية الجزائرية.</li> <li>- يعمل بتكامل مع أدوات BIM ويستعمل محاكيات شبيهة بـ EnergiePlus.</li> <li>- واجهة استخدام ثنائية سهلة وواضحة و ب ثلاث لغات</li> <li>- مدعوم بقاعدة بيانات محلية محدثة.</li> <li>- قابل للتخصيص حسب موقع المشروع</li> </ul>	<ul style="list-style-type: none"> <li>- تطبيق رقمي محلي لتقييم الأداء البيئي في المباني</li> </ul>

5. السعر :يعتمد المشروع على استراتيجية تسعير مرنة ومتعددة المستويات ( Tiered Pricing

Strategy)، تضمن تلبية احتياجات مختلف فئات المستخدمين (مكاتب دراسات، مهندسين مستقلين، مؤسسات جامعية)، مع ضمان دخل مستدام وقابل للنمو.

## نموذج العمل التجاري

### 1. الرسوم المباشرة مقابل التقييم (Pay-per-Assessment):

- يتم فرض رسوم ثابتة على كل عملية تقييم تُجرى عبر التطبيق.
- السعر يتفاوت حسب حجم المشروع أو نوعه (سكاني، تجاري، مؤسساتي).

### 2. رسوم اعتماد للمكاتب المهنية (Accreditation Fees):

- اشتراك سنوي أو نصف سنوي للمكاتب الراغبة في استخدام النظام بشكل دائم.
- يُمنح المكتب اعتمادًا رسميًا كمستخدم معتمد للنظام.
- يشمل الاعتماد:
  - وصولًا غير محدود أو موسع للنظام.
  - دعم فني مخصص.
  - ذكر المكتب ضمن لائحة المستخدمين المعتمدين على الموقع الرسمي.

### 3. خدمات إضافية مدفوعة (خدمات مرافقة):

#### أ. التكوين والتدريب (Formation):

- دورات حضورية أو عبر الإنترنت حول استخدام النظام، ومفاهيم التقييم البيئي.
- شهادات مشاركة معتمدة.

#### ب. الاستشارات الفنية (Consulting):

- دعم خاص لمشاريع معقدة، أو طلب تحليل بيئي متقدم.
- تقديم حلول تصميم بيئي واقعية مخصصة للموقع.

### 6. الترويج

التكلفة	التفاصيل	وسيلة الترويج
مجاني	تنظيم ورشات حضورية في الجامعات، مكاتب الدراسات، أو عبر الإنترنت لشرح كيفية استخدام النظام، ورفع الوعي حول أهمية التقييم البيئي في السياق الجزائري. تشمل عروض تجريبية، تطبيقات مباشرة، وأسئلة/أجوبة	ورشات العمل التكوينية (Workshops)
مجاني	إنشاء صفحات رسمية على فيسبوك، لينكدان، وإنستغرام لنشر محتوى تفاعلي: فيديوهات تعليمية، شهادات مستخدمين، أخبار التطوير، مقالات قصيرة حول الاستدامة	الترويج عبر وسائل التواصل الاجتماعي (Social Media Marketing)

## نموذج العمل التجاري

الموقع الإلكتروني الرسمي للتطبيق	لموقع الإلكتروني الرسمي للتطبيق يُعتبر الموقع الإلكتروني واجهة أساسية للترويج للنظام، حيث يتم تصميمه بشكل احترافي ليُقدّم معلومات شاملة وواضحة عن النظام التقييمي، بما في ذلك تفاصيل الخدمات المقدمة، الأسعار، الأسئلة الشائعة (FAQ). بالإضافة إلى نسخة تجريبية محدودة: يُقدّم الموقع تجربة تقييم مبسطة تشمل عدداً محدوداً من المعايير، لتعريف المستخدم بآلية عمل النظام. وتحفيزه على الاشتراك في التقييم الكامل. كما يمكن دمج الموقع بمدونة تعليمية تشرح مفاهيم الاستدامة وتقييم المباني، ومنصة مخصصة للتسجيل في الدورات التدريبية وورش العمل المتعلقة بالنظام، مما يساهم في رفع الوعي وبناء مجتمع مهني مهتم بالاستدامة.	مجاني
المشاركة في المعارض والفعاليات المتخصصة	حضور المعارض الوطنية (مثل الصالون الوطني للبناء أو التهيئة) لتقديم عروض حية للتطبيق وعرض فوائده أمام المهندسين والمستثمرين	تكلفة المشاركة في المعرض
الشراكات مع الجامعات والمعاهد	عقد اتفاقيات مع مدارس الهندسة والعمارة لتقديم التطبيق ضمن وحدات التكوين، أو كأداة بحث للطلبة	مجاني

### 7. التوزيع

سيتم اعتماد المنصة الإلكترونية الرسمية كقناة التوزيع الأساسية، حيث تُوفّر واجهة رقمية شاملة تسمح للمستخدمين بتقديم طلبات التقييم، تحميل التقارير، والاستفادة من التكوينات والخدمات المرافقة بكل سهولة وفعالية.

تُوفّر المنصة الرقمية وصولاً مباشراً وسريعاً للنظام، ولكن فقط للمستخدمين المشتركين في الخدمة، مما يوفّر تجربة مرنة و سهلة دون الحاجة إلى تنقل أو إجراءات معقدة.

سيتم إنشاء شبكة وطنية من مكاتب الدراسات المعتمدة، عبر اعتماد تدريجي لمكاتب محلية في مختلف ولايات الجزائر، وذلك بعد خضوعهم لتكوين متخصص على استخدام النظام.

## نموذج العمل التجاري

هذه المكاتب تتولى إجراء التقييمات الميدانية عند الحاجة، مما يضمن تغطية جغرافية متكاملة وموثوقة في التطبيق العملي للنظام. يهدف النظام إلى لامركزية خدمات التقييم البيئي، من خلال تمكين المهندسين المحليين المعتمدين من تنفيذ عمليات التقييم تحت إشراف وتوحيد منهجي من قبل المنصة المركزية. كما يشمل التوزيع بعداً أكاديمياً، حيث يتم إدماج النظام تدريجياً في المؤسسات الجامعية والمعاهد التكنولوجية، عبر توفير تكوينات تطبيقية، مما يُمهّد لنشر ثقافة التقييم البيئي المستدام لدى الجيل الجديد من المهندسين.

### 8. عرض القطاع السوقى

#### أ. السوق المستهدف (Marché Cible)

السوق الأساسي الذي يوجّه له النظام يتمثل في:

- مكاتب الدراسات المعمارية والعمرانية التي تبحث عن حلول تقييم بيئي محلية وفعالة.
- شركات البناء والمقاولات الراغبة في تحسين مطابقتها لمشاريعها للمعايير البيئية.
- المهندسون المعماريون والمدنيون الباحثون عن أدوات ذكية وموثوقة لدعم قراراتهم التصميمية.
- الخواص كاصحاب الفنادق و المركبات السياحية.
- مديريات الصحة و التربية.

#### ب. السوق المحتمل (Marché Potentiel)

يمتد السوق المحتمل إلى:

- الهيئات الحكومية (وزارة السكن، وزارة البيئة، الدوائر التقنية في البلديات) التي يمكن أن تعتمد النظام ضمن سياساتها
- الجامعات ومدارس الهندسة والعمارة التي يمكن أن تعتمد التطبيق كأداة تعليمية داخل وحدات التكوين الأكاديمي.
- المؤسسات العمومية الكبرى (مثل دواوين الترقية والتسيير العقاري - OPGI، شركات الدولة العمرانية)، والتي تحتاج إلى أدوات تقييم في المشاريع السكنية والاجتماعية.
- المنظمات الدولية المانحة التي تمّول مشاريع تنمية مستدامة في الجزائر (GIZ، UNDP، البنك الدولي...)، حيث تُشترط معايير تقييم بيئية واضحة.
- السوق المغربي والإفريقي في مراحل متقدمة، حيث تشترك عدة دول في ظروف مناخية وعمرانية مشابهة للجزائر.

## نموذج العمل التجاري

### ج. السوق المتخصص (Marché de Niche)

- يمثل السوق المتخصص شريحة صغيرة لكنها استراتيجية:
- مكاتب الدراسات التي تريد ان تعتمد على مبادئ العمارة المستدامة.
- المهندسون الاستشاريون في مجال الطاقة والبيئة.
- مشاريع الإسكان النمطي في المناطق الصحراوية أو المعزولة التي تحتاج إلى حلول بيئية دقيقة حسب المناخ والموقع.
- المستثمرون العقاريون الذين يسعون للحصول على شهادات جودة بيئية لمشاريعهم من أجل جاذبية تسويقية أو مطابقة للتمويل الأخضر.

### 9. تحليل الزبائن

الفئة المستهدفة	الحاجات الأساسية	الخصائص السلوكية	العوائق المحتملة	الدوافع الأساسية للشراء
مكاتب الدراسات الهندسية والمعمارية	أدوات تقييم بيئي بسيطة، مرنة، ومطابقة للسياق الجزائري	ميل للتطبيقات السهلة، العمل ضمن جداول زمنية ضيقة	ضعف التكوين في التقييم البيئي - تخوف من استخدام نظام جديد	مطابقة القوانين، تحسين صورة المكتب، جذب المستثمرين
شركات البناء والمقاولات	تقارير تقييم تساعد في نيل الموافقات القانونية ورفع القيمة السوقية للمشاريع	تركيز على الجوانب التقنية والتنفيذ السريع	مقاومة الابتكار، تركيز على التكلفة	تقليل المخاطر القانونية والبيئية، تحسين التنافسية
المهندسون المعماريون المستقلون	وسيلة مرجعية تدعم تصميم بيئي مستدام	اهتمام بالاستدامة لدى المهندسين الشباب	محدودية الميزانية، نقص الأدوات المناسبة	دمج بعد بيئي في إثبات الكفاءة
الجامعات والمؤسسات الأكاديمية	وسيلة تربوية تطبيقية تُدرّب الطلبة على أدوات التقييم البيئي	رغبة في تحديث المناهج بأدوات رقمية واقعية	غياب التمويل أو الدعم التقني	إعداد طلبة ملمين بثقافة الاستدامة

### 10. تحليل المنافسين

اسم النظام	البلد المنشأ	الموقع الإلكتروني	الخبرة	نقاط القوة	نقاط الضعف

## نموذج العمل التجاري

مكلف جدًا، معايير غير مكيفة مع المناخ الجزائري، تطبيقه معقد	نظام معترف به دوليًا، مؤشرات دقيقة، دعم عالمي	من أكثر أنظمة التقييم استخدامًا عالميًا منذ 1998، معتمد في آلاف المشاريع حول العالم	<a href="http://www.usgbc.org/LEED">www.usgbc.org/LEED</a>	الولايات المتحدة	LEED – Leadership in Energy and Environmental Design
مكلف جدًا، معايير غير مكيفة مع المناخ الجزائري، تطبيقه معقد	مرنة في المعايير، توجه أوروبي معتدل	أول نظام تقييم بيئي مستخدم في أكثر من 104 دولة	<a href="http://www.breeam.com">www.breeam.com</a>	المملكة المتحدة	BREEAM – Building Research Establishment Environmental Assessment Method
يحتاج إلى خبرة تقنية، وثائق فرنسية فقط، لا يعكس الواقع المناخي الجاف	متكامل، قريب من ثقافيًا ممكن تطبيقه في مشاريع ممولة فرنسيًا	نظام فرنسي يستخدم في عدة مشاريع (كالمستشفيات، المؤسسات)	<a href="http://www.behqe.com">www.behqe.com</a>	فرنسا	HQE – Haute Qualité Environnementale
واجهته محدودة، لا يأخذ بعين الاعتبار البيئة المعمارية المحلية	يوفر أدوات حسابية بسيطة يمكن للمصممين استخدامها بسهولة عبر الإنترنت . تكلفة منخفضة	نظام موجه لدول النامية ، يستخدم تقنيات بسيطة ومؤشرات توفير طاقي	<a href="http://www.edgebuildings.com">www.edgebuildings.com</a>	البنك الدولي / مؤسسة التمويل الدولية	EDGE – Excellence in Design for Greater Efficiencies
لا تتضمن نظام تقييم متكامل	قوية تقنيًا، تُستخدم في التحليل المتقدم	برامج متخصصة في المحاكاة الطاقوية	<a href="http://energyplus.net">energyplus.net</a> , <a href="http://designbuilder.co.uk">designbuilder.co.uk</a>	الولايات المتحدة	برامج تقييم فردية (مثل EnergyPlus, DesignBuilder)

### 11. استراتيجية التسويق

#### أ) استراتيجية الانطلاق:

- الإطلاق التجريبي (Version pilote): إطلاق نسخة تجريبية محدودة في ولايتين أو ثلاث (مثلاً: الجزائر العاصمة، بسكرة، وهران) بالتعاون مع مكاتب دراسات مختارة وجامعات محلية.
- التكوين الأولي: تنظيم ورشات تكوينية حضورية وافتراضية للمهندسين ومكاتب الدراسات حول كيفية استخدام النظام ومزاياه.
- الشراكات الأكاديمية: عقد اتفاقيات مع مؤسسات تعليمية (كليات الهندسة والعمارة) لتجريب النظام ضمن مشاريع الطلبة والتكوين الجامعي.
- حملة توعية رقمية مكثفة: عبر وسائل التواصل الاجتماعي، الموقع الإلكتروني، والإعلانات المستهدفة، لشرح مشكلة التقييم البيئي والحل المحلي الذي يوفره النظام.
- شهادات المستخدمين الأوائل: توثيق حالات استخدام حقيقية (études de cas) ونشرها لتعزيز مصداقية النظام.
- تخفيضات محفزة: منح تخفيضات أو استخدام مجاني لعدد معين من التقييمات لفترة محدودة لجذب الفاعلين المهنيين.
- الاتصال بالمؤسسات الحكومية: تقديم المشروع إلى وزارتي السكن والبيئة بهدف فتح نقاش حول إمكانية دمج مستقبله في دفاتر الشروط الوطنية.

#### ب) استراتيجية التوسع

- التوسع الجغرافي التدريجي: اعتماد مكاتب دراسات جديدة في ولايات إضافية بعد تكوينهم على النظام، وفق مخطط زمني مرحلي (شمال - هضاب - جنوب).
- إطلاق نسخة مطورة من التطبيق: تشمل تحسين التكامل مع برامج التصميم المعمارية، إضافة أدوات تحليل متقدم، ودمج الذكاء الاصطناعي لتسهيل التقييم وتقديم توصيات ذكية. كما سيتم توسيع نطاق التقييم ليشمل الأحياء والبنية التحتية العامة، مثل الطرق مما يساهم في تحسين الاستدامة على مستوى الأحياء والمدن.
- المشاركة في فعاليات وطنية ودولية: الترويج للنظام في الصالونات المتخصصة داخل الجزائر وخارجها لكسب اعتراف أوسع.

## نموذج العمل التجاري

- تطوير شراكات مع مؤسسات تمويل دولية: التعاون مع مؤسسات مثل GIZ أو UNDP لتمويل مشاريع بيئية تستخدم النظام.
- دمج النظام في برامج التكوين المهني الرسمية: التنسيق مع وزارتي التكوين المهني والتعليم العالي لإدراج النظام كأداة بيداغوجية رسمية.
- دراسة إمكانية التوسع الإقليمي: دراسة أسواق مغربية أو إفريقية لها خصائص مناخية وعمرانية مشابهة، خاصة في تونس، موريتانيا، والنيجر.

### المحور الرابع: خطة الإنتاج والتنظيم

#### 1. مخطط الإنتاج

#### 2. الموقع يقع في طريق سيدي عقبة بجانب جامعة محمد خيصر بسكرة



سبب اختيار الموقع بسبب قربه للجامعة و سهولة الوصول اليه  
الجانب المعماري للمشروع تقدر مساحة المشروع ب 70 متر مربع

#### 3. احتياجات المشروع

##### المعدات والألات

اسم العتاد	الكمية	السعر	السعر الإجمالي
حاسوب	07	200 000.00	1 400 000.00
شاشة عرض كبيرة	01	20 000.00	20 000.00
مكاتب	07	10 000.00	70 000.00
كراسي	14	7 000.00	98 000.00
خزائن	01	17 000.00	17 000.00
مودام لنترنيت	01	4 000.00	4 000.00

## نموذج العمل التجاري

المجموع	1609000.00 دج
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### 4. احتياجات الطاقة والكهرباء

الخدمات	احتياجات الثلاثي % الزيادة ب 1%	تكلفة السنة 1
الماء	200m	10 800.00
الكهرباء		60 000.00
انترنت وهاتف	غير محدود	30 000.00
صيانة	/	150 000.00
المجموع		250 800.00 دج

### 5. نظام الإنتاجي: خطوات الإنتاج

#### الخطوة 1: التحليل والدراسة القاعدية

- دراسة المعايير العالمية للتقييم البيئي (LEED, BREEAM, HQE...).
- مقارنة مفصلة و دقيقة لمعايير الأنظمة (LEED, BREEAM, HQE, PRS) و مدى ملائمتها للسياق الجزائري
- تحليل الواقع المناخي والمعماري الجزائري (البيئة، المواد، القوانين، الممارسات المحلية).
- جمع البيانات البيئية من مصادر وطنية (مكاتب الأرصاء، مراكز الطاقة...).
- الاستعانة بباحثين ومهندسين من مراكز بحث وطنية مثل CNREIP، CDER، APRUE لتكييف المؤشرات مع الخصوصيات المحلية
- إجراء استبيان للباحثين، الأساتذة، والمهندسين لتحديد معايير النظام الخاصة بالجزائر
- إعداد هيكل أولي للنظام التقييمي مكيف مع السياق الوطني.

#### الخطوة 2: التصميم الرقمي للنظام (البرمجة والتطوير)

- تطوير واجهة المستخدم
- برمجة وحدات التقييم البيئي (الطاقة، المواد، التهوية، الإضاءة، المياه...).
- دمج قاعدة البيانات المحلية داخل التطبيق.
- اختبار أولي داخلي للنظام وتعديل الأخطاء التقنية.

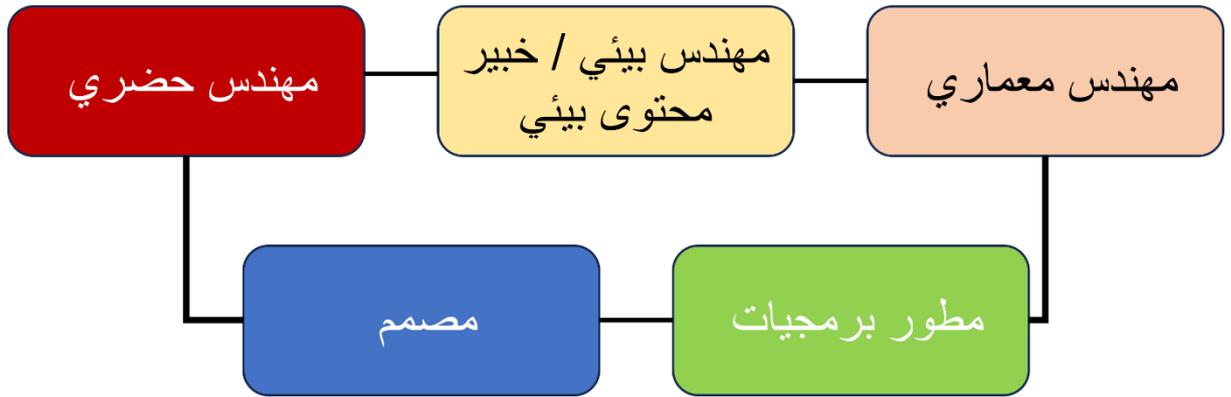
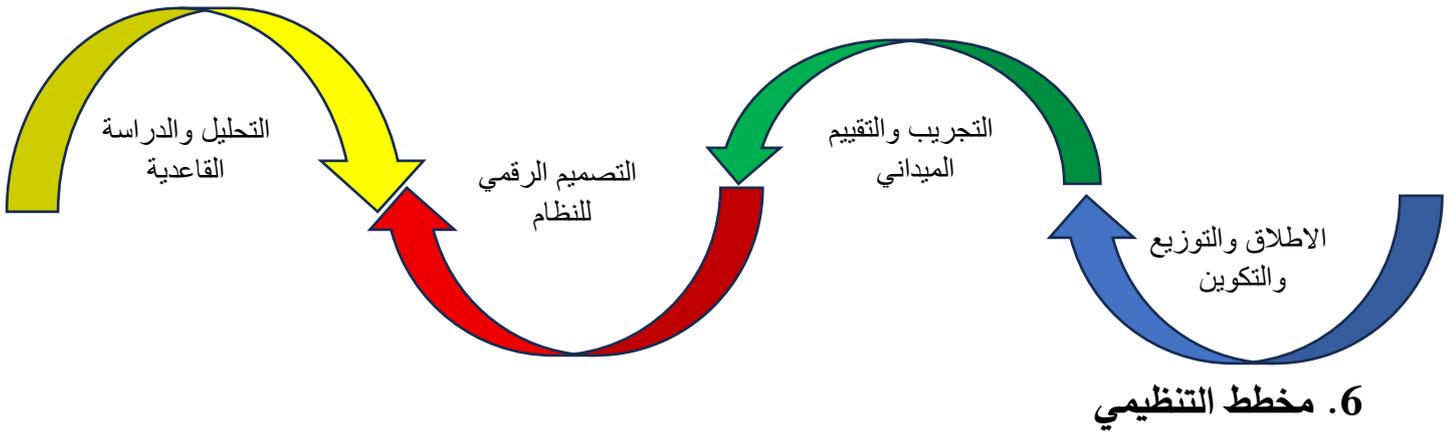
#### الخطوة 3: التجريب والتقييم الميداني

## نموذج العمل التجاري

- إشراك مهندسين ومكاتب دراسات محلية في تجربة النظام وتقديم ملاحظات.
- تحسين خوارزميات التقييم والتوصيات بناءً على النتائج.
- إعداد النسخة شبه النهائية الجاهزة للإطلاق.

### الخطوة 4: الإطلاق والتوزيع والتكوين

- نشر النظام عبر المنصة الإلكترونية الرسمية.
- تقديم خدمات الاعتماد والتكوين لمكاتب الدراسات في الولايات المختلفة.
- متابعة المستخدمين وتوفير الدعم الفني.
- تحديث مستمر للنظام حسب المعايير والمستجدات.



### 7. احتياجات اليد العاملة والأجور

الأجور	الوظيفة	التخصص	العدد	المنصب
30 000.00	مطابقة المعايير مع واقع التصميم، ضبط مؤشرات البناء الجزائري	ماستر هندسة معمارية	01	مهندس معماري

## نموذج العمل التجاري

30 000.00	وضع المعايير البيئية، تحليل البيانات، صياغة توصيات التقييم	هندسة بيئية / طاقات متجددة / عمران مستدام	02	مهندس بيئي
30 000.00	تقييم البيئة الخارجية المحيطة بالمشروع	ماستر تسيير تقنيات حضرية	01	مهندس حضري
40 000.00	تصميم وتطوير التطبيق، إدارة قاعدة البيانات، التحديثات، التكامل مع الأنظمة الأخرى	تطوير برمجيات / هندسة برمجيات / ذكاء اصطناعي	02	مطور برمجيات
20 000.00	تصميم التطبيق والموقع	ماستر اعلام الي	01	مصمم
220 000.00 دج	المجموع			

### 8. التموين

التجهيزات المكتبية و اللوازم تكون مرة واحدة

### 9. الشركاء

دوره في المشروع	الشريك
تمويل المشروع	البنوك
دعم علمي في تطوير المعايير، تجريب النظام داخل مشاريع طلبية الهندسة، توفير قواعد بيانات بحثية.	الجامعات الوطنية (مثل: جامعة باب الزوار، جامعة قسنطينة، جامعة بسكرة)
تقديم استشارات علمية، تحليل البيانات، التحقق من مدى دقة المؤشرات البيئية.	مخابر البحث في البيئة والبناء المستدام
إدماج النظام كأداة تكوين تطبيقي في المناهج الجامعية.	المدارس العليا للهندسة والعمارة (EPAU)

### المحور الخامس: الخطة المالية

## نموذج العمل التجاري

### 1. تكاليف المشروع واستهلاك الاستثمار

#### تكاليف استثمارية

التكلفة	الأصول
/	العقار
1 659 000.00	الألات والمعدات
/	رأس المال العامل
1 659 000.00 دج	المجموع

#### التكاليف التشغيلية

التكلفة	الأصول
220 000.00 دج	الأجور
30 000.00 دج	الهاتف والانترنت
70 800.00 دج	الكهرباء والماء
2 740 800 دج	المجموع

#### تقدير المبيعات

المجموع	ديسمبر	نوفمبر	أكتوبر	سبتمبر	أوت	جويلية	جوان	ماي	أفريل	مارس	فيفري	جانفي	/
1132560	174240	159720	145200	130680	116160	101640	87120	72600	58080	43560	29040	14520	2024(60%)
1321320	203280	186340	169400	152460	135520	118580	101640	84700	67760	50820	33880	16940	2025(70%)
1510080	232320	212960	193600	174240	154880	135520	116160	96800	77440	58080	38720	19360	2026(80%)
1698840	261360	239580	217800	196020	174240	152460	130680	108900	87120	65340	43560	21780	2027(90%)
1887600	290400	266200	242000	217800	193600	169400	145200	121000	96800	72600	48400	24200	2028(100%)
7550400	مجموع المبيعات ل5 سنوات												
1170312000 دج	سعر المبيعات ل5 سنوات												

### المحور السادس: النموذج الأولي التجريبي

بعد الدراسة النظرية والتحليلية لأنظمة التقييم العالمية

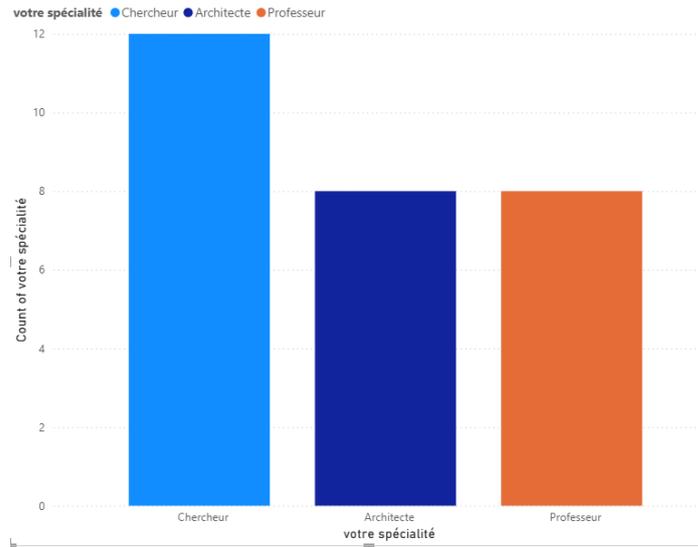
## نموذج العمل التجاري

تبين أن هذه الأنظمة لا تتلاءم كليًا مع الخصوصيات البيئية والاجتماعية والثقافية والاقتصادية في الجزائر. لذلك، كان من الضروري تطوير نظام محلي يتكيف مع هذه الخصوصيات

### منهجية إعداد النظام

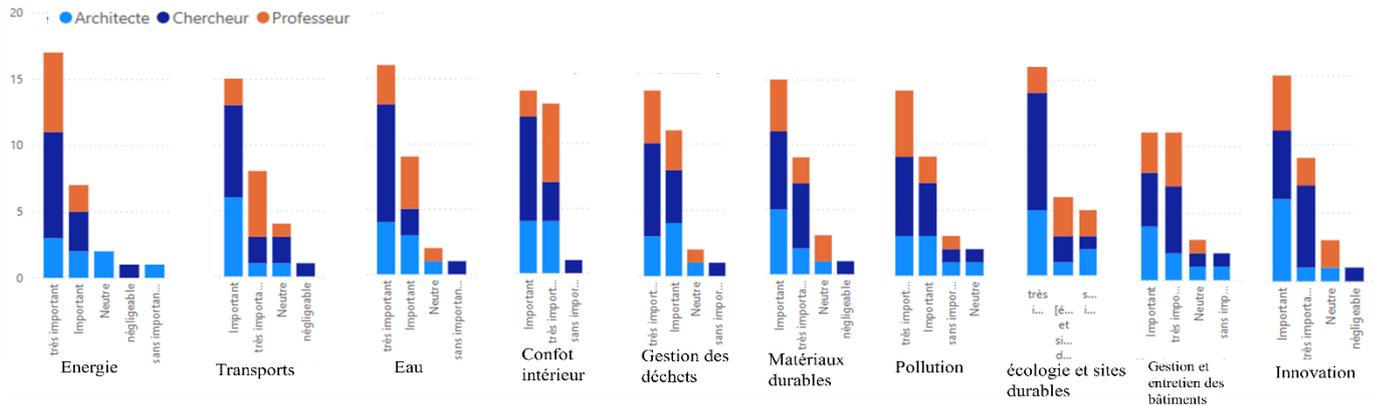
التحليل الشامل والمقارنة تم إجراء تحليل مفصل للأنظمة العالمية الأربعة (ملحق 3) من حيث محاور التقييم، المعايير، منهجية النقاط، والمرونة في التكيف مع السياقات المحلية. وقد بينت هذه المقارنة الفروقات والحدود التي تعيق تطبيق هذه الأنظمة في الجزائر.

اعداد الاستبيان تم تصميم استبيان موجه لثلاث فئات رئيسية: باحثين ، أساتذة جامعيين، ومهندسين . هدف الاستبيان هو تحديد أهم المعايير من وجهة نظر محلية، وتحديد أوزانها حسب الأولوي



### تحليل نتائج الاستبيان

المعالجة الإحصائية تم جمع وتحليل الأجوبة باستخدام أدوات تحليلية، وتم إنتاج رسوم بيانية توضح نسب وأهمية كل محور



## نموذج العمل التجاري

استخراج المعايير والأوزان انطلاقًا من نتائج الاستبيان، تم تحديد قائمة نهائية للمعايير موزعة حسب محاور رئيسية، مع تحديد الوزن النسبي لكل معيار. وتم تلخيص النتائج في جدول يوضح الأوزان المقترحة

Category	Point
Water (Reduction of overall water consumption)	22
Indoor Comfort (Improve the quality of the indoor environment such as air, light, sound...)	17
Energy (Improve the operational energy efficiency of the building)	22
Material efficiency	11
Ecology and Sustainable Sites (Reduce pollution, preserve biodiversity...)	8
Waste	8
Social impact	10
Innovation (Innovation in construction materials and intelligent systems)	5
	105

### النسخ المختلفة للنظام

النظام المقترح لا يقتصر على نسخة واحدة، بل هو قابل للتطوير على شكل عدة نسخ حسب طبيعة المشروع والموقع الجغرافي.

**النسخة الأولى (الأساسية):** تعتمد على نتائج الاستبيان والتحليل النظري و الوضع الحالي للقوانين و التشريعات و التكنولوجيا الجزائرية ، وهي نسخة شاملة ومتكاملة موجهة للمباني التعليمية و الإدارية و السكنية

**النسخة الثانية:** ستتوسع لتشمل أنواع مبانٍ أخرى مثل المباني مع تعديل في المعايير حسب طبيعة النشاط و حسب السياق الجزائري و ستشمل أيضا فئات أخرى كالأدارة و النقل و التوصيل .

**النسخة الثالثة:** ستكون مخصصة للحياة و البنية التحتية.

يراعى النظام الجزائري لتقييم استدامة المباني الظروف المناخية والاجتماعية والاقتصادية لكل منطقة ( قسم المركز الوطني للدراسات و الأبحاث التكاملة للبناء الجزائر ل5 مناطق (ملحق 11)

## نموذج العمل التجاري

وتم تصميمه بطريقة تُبقي أوزان المحاور ثابتة عبر جميع المناطق لضمان العدالة في التقييم، مع تكييف المتطلبات التقنية داخل كل معيار حسب خصوصيات كل منطقة.

مثلاً:

لضمان (U-value) في المناطق الحارة مثل الجنوب، يُطلب قيمة أقل لعامل انتقال الحرارة فعالية العزل الحراري

Wall: Zone1: 0.6 / Zone2:0.8 / Zone3:1.0 /Zone4:1.1/ Zone5: 1.2

Roof: Zone1: 0.4/ Zone2:0.5/ Zone3:1.6/ Zone4:1.7/ Zone5: 1.8

Wall: Zone1: 0.6.

في المناطق الرطبة مثل الشمال الساحلي، يُشترط توفير تهوية طبيعية بفعالية أعلى ( $\leq 0.35$  ACH) لمواجهة الرطوبة

عتبات تغطية التهوية حسب المنطقة

Zones 4–5 (South, hot/dry):  $\geq 75\%$

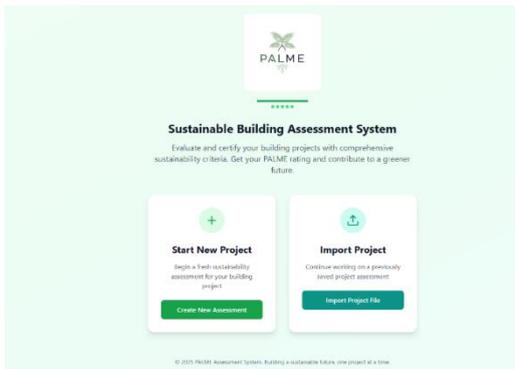
Zone 3 (High plateaus, semi-arid):  $\geq 60\%$

Zones 1–2 (North, humid):  $\geq 50\%$

و أيضاً تختلف حسب المواد فكل منطقة تتميز بمواد محلية

بهذا الأسلوب، يضمن النظام تكافؤ الفرص بين المشاريع، ويعكس واقع كل منطقة دون أن يُفضل أو يُهمل أيّاً منها.

عرض التطبيق



# نموذج العمل التجاري

**PALME Sustainable Building Assessment System**  
Sustainable Building Assessment System

Step 1 of 4  
50% Complete

### Project Information

Please provide information about your building project.

Project Name\*  Existing Buildings

Building Type\*  Location\*  Climate Zone\*  Zone 1

Project Status\*  Land Area (m<sup>2</sup>)\*  Built Area (m<sup>2</sup>)\*

Design Phase\*  Total Land Area\*  Total Built Area\*

Number of Floors\*  Building Height (meters)\*  Expected Number of Occupants\*

Use Type\*  Interior Building Height\*  Expected Completion Date\*

Full-time (24 hours/day)  Project Start Date\*

1 Stakeholder Information 2 Project Information 3 Sustainability Criteria 4 Project Review & Results

1. Previous 2. Next

**PALME Sustainable Building Assessment System**  
Sustainable Building Assessment System

Step 1 of 4  
25% Complete

### Stakeholder Information

Please provide information about the key stakeholders involved in the project.

Architect Name\*  Contractor Name\*

Client Architect Name\*  Client Contractor Name\*

Efficiency Engineer\*  Project Owner\*

Other Efficiency Engineer Name\*  Other Project Owner Name\*

Project Email\*  Email Address\*

Phone\*  Email@Company.com

1 Stakeholder Information 2 Project Information 3 Sustainability Criteria 4 Project Review & Results

1. Previous 2. Next

**PALME Sustainable Building Assessment System**  
Sustainable Building Assessment System

Step 1 of 4  
100% Complete

### Sustainability Criteria

Energy Efficiency

Other

Water Efficiency

Indoor Environmental Quality

Material Efficiency

Waste Management

Social Impact

Health & Well-being

Accessibility

Other

**PALME Sustainable Building Assessment System**  
Sustainable Building Assessment System

Step 1 of 4  
100% Complete

### Water Efficiency

Other

Water Efficiency

Water Conservation

Water Recycling

Water Reuse

Water Treatment

Water Distribution

Water Disposal

Water Quality

Water Quantity

Water Security

**PALME Sustainable Building Assessment System**  
Sustainable Building Assessment System

Step 1 of 4  
100% Complete

### Material Efficiency

Other

Material Efficiency

Material Conservation

Material Recycling

Material Reuse

Material Treatment

Material Distribution

Material Disposal

Material Quality

Material Quantity

Material Security

**PALME Sustainable Building Assessment System**  
Sustainable Building Assessment System

Step 1 of 4  
100% Complete

### Water Efficiency

Other

Water Efficiency

Water Conservation

Water Recycling

Water Reuse

Water Treatment

Water Distribution

Water Disposal

Water Quality

Water Quantity

Water Security

**PALME Sustainable Building Assessment System**  
Sustainable Building Assessment System

Step 1 of 4  
100% Complete

### Ecology and Sustainable Sites

Other

Ecology and Sustainable Sites

Ecological Conservation

Ecological Restoration

Ecological Enhancement

Ecological Protection

Ecological Management

Ecological Monitoring

Ecological Assessment

Ecological Reporting

Ecological Planning

**PALME Sustainable Building Assessment System**  
Sustainable Building Assessment System

Step 1 of 4  
100% Complete

### Indoor Climate

Other

Indoor Climate

Indoor Air Quality

Indoor Thermal Environment

Indoor Acoustic Environment

Indoor Lighting Environment

Indoor Airflow Environment

Indoor Humidity Environment

Indoor Air Pollution Environment

Indoor Air Temperature Environment

Indoor Air Velocity Environment

Indoor Air Concentration Environment

**PALME Sustainable Building Assessment System**  
Sustainable Building Assessment System

Step 1 of 4  
100% Complete

### Final Assessment Review

The final review conducted at the end of the assessment process.

**53**  
☆☆☆☆

**2 PALME**

The program is designed to be used by architects.

Project Overview

Project Name:

Project Location:

Project Status:

Project Start Date:

Project End Date:

Project Owner:

Project Manager:

Project Architect:

Project Contractor:

Project Engineer:

Project Designer:

Project Planner:

Project Operator:

Project Maintainer:

Project Inspector:

Project Auditor:

Project Verifier:

Project Approver:

Project Signatory:

Project Seal:

Project Stamp:

Project Signature:

Project Date:

Project Time:

Project Place:

Project Country:

Project City:

Project Street:

Project Zip:

Project Phone:

Project Email:

Project Website:

Project Social Media:

Project Other:

1 Stakeholder Information 2 Project Information 3 Sustainability Criteria 4 Project Review & Results

1. Previous 2. Next

Category	Score	Target
<b>WATER EFFICIENCY</b>	AWARDED 10 / 22	10/22
<b>ENERGY EFFICIENCY</b>	AWARDED 10 / 22	10/22
<b>WASTE MANAGEMENT</b>	AWARDED 5 / 8	5/8
<b>SOCIAL IMPACT</b>	AWARDED 3 / 10	3/10
<b>INDOOR ENVIRONMENTAL QUALITY</b>	AWARDED 11 / 17	11/17
<b>INDOOR ENVIRONMENTAL QUALITY</b>	AWARDED 11 / 17	11/17
<b>MATERIAL EFFICIENCY</b>	AWARDED 5 / 11	5/11

## نموذج العمل التجاري

<p><b>الشركات الرئيسية</b></p> <ul style="list-style-type: none"> <li>-مخابر البحث في البناء والبيئة المستدامة.</li> <li>-المدارس العليا للهندسة والعمارة.</li> <li>- الجامعات الجزائرية (باب الزوار، قسنطينة، بسكرة...).</li> </ul>	<p><b>الأنشطة الرئيسية</b></p> <ul style="list-style-type: none"> <li>-تقييم المباني بيئيًا</li> <li>-جمع وتحليل البيانات البيئية والطاقوية محليًا.</li> <li>-تكوين المهندسين والمكاتب عبر دورات ميدانية أو عن بُعد.</li> <li>إصدار تقارير التقييم.</li> </ul> <p><b>الموارد الرئيسية</b></p> <ul style="list-style-type: none"> <li>-الموارد البشرية: فريق تطوير النظام، خبراء تقييم، تقنيون</li> <li>-الموارد الفكرية: قاعدة البيانات، النظام بحد ذاته، المحتوى العلمي</li> <li>-الموارد المادية: مقر، حواسيب، سيرفرات</li> <li>-الموارد المالية: تمويل ذاتي أو تمويل من برامج دعم المؤسسات الناشئة</li> </ul>	<p><b>القيم المقترحة</b></p> <ul style="list-style-type: none"> <li>-أول نظام تقييم بيئي مكيف مع السياق الجزائري (مناخ، مواد، تشريعات).</li> <li>- يقلل التعقيد في فهم المعايير العالمية (مثل LEED وBREEAM).</li> <li>-دعم التصميم البيئي وممارسات العمارة المستدامة.</li> <li>-مرونة في التقييم حسب نوع المشروع والموقع.</li> <li>-واجهة سهلة الاستخدام و بثلاثة لغات</li> <li>تحليل بيئي شامل .</li> </ul>	<p><b>العلاقات مع العملاء</b></p> <ul style="list-style-type: none"> <li>-دعم فني عبر المنصة لتحسين بأهمية النظام.</li> <li>-إرسال تقارير لكل مشروع.</li> <li>-دليل استخدام + تكوينات مستمرة مدمجة في التطبيق.</li> <li>-منصة تواصل مع المستخدمين عبر الشبكات الاجتماعية والموقع الرسمي.</li> </ul> <p><b>القنوات</b></p> <ul style="list-style-type: none"> <li>المنصة الإلكترونية الرسمية (واجهة استخدام + بوابة تقييم).</li> <li>مكاتب دراسات محلية معتمدة موزعة عبر الولايات.</li> <li>الجامعات كشريك في النشر التكويني والتجريبي.</li> <li>ورشات حضورية + محتوى فيديو تفاعلي.</li> <li>مشاركات في معارض وصالونات مهنية</li> </ul>	<p><b>شرائح العملاء</b></p> <ul style="list-style-type: none"> <li>-مكاتب الدراسات الهندسية والمعمارية (خاصة وعامة).</li> <li>-شركات البناء والمقاولات العقارية.</li> <li>-مديريات الصحة و مديريات التربية</li> <li>-الخواص كاصحاب الفنادق و المركبات السياحية</li> </ul>
<p><b>هيكل التكاليف</b></p> <ul style="list-style-type: none"> <li>أجور الفريق الأساسي (مهندس معماري، بيئي، مطور، إداري...).</li> <li>-تكاليف تطوير النظام (برمجة، تصميم، استضافة).</li> <li>-معدات (حاسوب، خادم، شاشة، طابعة...).</li> <li>-مصاريف التدريب، ورشات العمل، التنقلات.</li> <li>-نفقات تسويقية (موقع، منصات، إعلانات...).</li> <li>-اشتراكات خدمات الإنترنت والطاقة</li> </ul>		<p><b>المصادر والإيرادات</b></p> <ul style="list-style-type: none"> <li>-رسوم مباشرة مقابل كل تقييم.(Pay-per-Assessment)</li> <li>-منح اعتماد تجاري وتراخيص سنوية لمكاتب الدراسات.(franchise)</li> <li>-خدمات استشارية مدفوعة.(Consulting)</li> <li>-دورات تكوينية و تدريبية .(Formation)</li> <li>-رخص تعليمية موجهة للجامعات والمؤسسات .</li> <li>-إمكانية تمويل مشاريع من طرف جهات مانحة.</li> </ul>		

