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### Ecologes in Desert Regions: An Approach to Compatibility and Sustainability

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#### Abstract:

Natural environment is considered one of the most important pillars of touristic development in Egypt, whether in coastal regions, such as the North Coast, the Red Sea coast and Aqaba gulf, or in desert regions and oases. For enhancing sustainable touristic development, it is imperative to realize the optimal benefit from touristic resources, while preserving the rights of future generations to enjoy, but not to detriment, attraction spots.

However, desert tourism suffers challenges represented in harsh climate conditions that require planning and design methods suitable to the nature of these regions and different from those used in coastal regions. Balancing local environmental inputs with innovative urban design is required to boost tourist complexes' sustainability in the desert, hence preserving the spirit and identity of the place. This study offers a methodological framework for designing ecolodges in the Egyptian desert regions, while focusing attention on Siwa Oasis as an applied model. The methodology involves analyzing environmental and architectural characteristics of desert regions and reviewing environmental standards impactful on designing tourist facilities. Moreover, it also presents an analytical examination of Adrere Amellal Ecolodge as one of the models of ecolodges existing in Siwa to evaluate the extent of its compatibility with sustainability standards. The study reaches a set of design standards supporting the sustainability of tourist facilities in desert regions, while affirming the importance of respecting the environmental and cultural specificity of these regions. These standards contribute to achieving balance between development and conservation of environmental resources, leading to an enhanced tourism sustainability in Egyptian desert regions.

**Keywords:** sustainability, sustainable design, ecolodges, Siwa

## 1. Introduction:

During the last two decades, Egypt has significantly focused on touristic development to bolster the society's economic and social returns. The natural environment is deemed one of the most important supportive resources of such development. However, the lack of synchronicity between the economic and developmental benefits and the accumulation of negative environmental effects led to the emergence of remarkable environmental problems. In the absence of an integrated methodology for sustainable touristic development and continuous environmental evaluation tools, touristic activities have become a direct source of hazards that affect human life and the environment (Smith, 2005).

In desert regions, these challenges are exacerbated due to the harsh climate conditions involving high temperatures across the year and the effect of sand dunes creeping, which threaten development projects (Jones, 2010). These desert environments require development methods different from those used in coastal regions. Hence, the environmental approach is the most appropriate framework for developing desert complexes, from the choice of suitable development patterns to setting planning and design strategies compatible with local characteristics (Brown, 2015).

This paper focuses on the study of environmental characteristics of desert touristic regions, with Siwa Oasis chosen as an applied model. A theoretical analysis of environmental standards that impact urbanism in desert regions is presented in this study, in addition to a practical evaluation of one of the ecolodges in Siwa. The study seeks to offer a framework that balances local environmental inputs with the newly introduced infrastructure to ensure

compatibility that reflects the spirit of the place and the specificity of the region (Taylor, 2018).

## **2 Research Problem**

Desert tourism faces significant challenges due to the severe climatic conditions, demanding specialized planning and design strategies distinct from those employed in coastal areas. Achieving a harmonious balance between indigenous environmental considerations and pioneering urban design is paramount to fostering the sustainable development of desert tourism destinations, ensuring the preservation of their unique spirit and cultural identity.

The absence of clear design standards to support the sustainability of tourist facilities in desert areas in Egypt poses a significant challenge, especially given the growing interest in sustainable tourism and environmental conservation.

## **3 Research Hypothesis**

Does incorporating local architecture contribute to the success of environmental design principles in desert resorts?

## **4 Research Aim**

The research aims to develop a framework that harmonizes local environmental elements with modern infrastructure, ensuring a design that respects the region's unique identity and preserves its sense of place.

## **5 Research Methodology**

This paper examines the environmental characteristics of desert tourist areas, using Siwa Oasis as a case study. It includes a theoretical analysis of

environmental standards influencing urban development in desert regions, along with a practical assessment of an ecolodge in Siwa.

## **6-Sustainable touristic development**

### **6-1-Defination**

Sustainable touristic development is a process that aims to exploit natural resources in a responsible manner that ensures their non-deterioration, while preserving the rights of future generations to benefit from such resources. To achieve this aim, a balance between three main axes must be realized. First, financial returns for owners of touristic projects must be guaranteed to support its sustainability and encourage investment in this sector. Second, the social dimension must be strengthened by involving the local community in the development process and benefiting from local competences and experiences to guarantee the realization of direct economic and social benefits. Third, conservation of the environment from pollution and deterioration must become a commitment, and the protection of its resources must be guaranteed. This approach requires a comprehensive evaluation of touristic regions to determine tourist attraction regions and set design and executive standards that ensure compatibility with environmental sustainability requirements. Hence, it contributes to realizing a balance between touristic activity and environmental protection (UNWTO, 2004; Hall, 2008).

### **6-2 Sustainable touristic development axes:**

The proposed efforts to clarify the relationship between the environment and sustainable touristic development are numerous. Several main axes are proposed for achieving this purpose. The first axis is represented in achieving natural balance of ecosystems in touristic natural regions. This

ensures the sustainability of natural resources and enhances tourist attraction without any adverse impact on the environment. The second axis is related to the presence of distinct human cadres responsible for effectively managing the touristic development process. Trained and expert cadres are deemed a key factor in guaranteeing the success of sustainable development. The third axis is represented in the necessary absence of a biological gap between natural processes of resources and human activities that are utilized in development. This can be realized by using environmentally compatible technology which ensures lack of any detriment to ecological balance. For sustainable touristic development to be realized, the government and the private sector must be active actors to ensure coordination and cooperation between the parties concerned (UNWTO, 2004; Hall, 2008).

### **6-3- Ecotourism**

Ecotourism is defined as “Travel and trips to discover remote regions scattered across the land for the purpose of spending vacations (World Tourism Organization, 2019).

Compatibility with nature is regarded one of the most important bases and methods to realize **sustainable touristic development**. Natural resources are deemed the main capital of touristic development projects. These resources are regarded the key factor for implementing developmental operations in this sector (Mowforth & Munt, 2009).

Ecotourism has become one of the most outstanding fields of tourism industry across the world. It contributes to environmental protection through boosting environmental awareness between countries and nations. Tourism also helps to augment the national income of countries through establishing sustainable touristic infrastructures that conserve the environment.

Consequently, many international agreements were signed, and international conferences tackling **sustainable development** in tourism were held, leading to the introduction of “green” environmental measurement tools (Ceballos-Lascuráin, 2001).

According to the data published by WTO, request for ecotourism and eco-friendly trips has witnessed a significant growth, as ecotourism has become one of the fastest growing sectors in the world tourism industry. Additionally, the share of natural attraction-based tourism is estimated by 10%-15% from the total spending of world tourism (UNWTO, 2020).

#### **6-4- Ecotourism in Siwa Oasis:**

In this section of the study, the most important fundamentals of touristic development in the Oasis, as well as the most important obstacles facing them will be examined. This examination will be conducted by analyzing one of the environmentally compatible ecolodges to reach an environmental approach of the standards governing sustainable touristic development in such regions.

#### **Development potentials:**

-Availability of fresh water sources from more than 200 artesian wells. Some of these wells possess merits of healing from many diseases and can be used in health tourism.

-Diversity of wildlife and plant life, especially in Serra, Al-Arj, and Bahrain regions, etc., based on which a network of touristic natural reserves and open desert gardens can be implemented.

-Uniqueness and diversity of visual and aesthetic values of natural land formations, including sand formations in the Great Sand Sea to the south of

the Oasis, as well as lakes, hills and rock plateaus spread across the depression and at the north edge.

-Famous archaeological sites that date back to Pharaonic and Roman ages, the most famous of which are the Amun Temple and the Coronation Temple.

-Outstanding social life of traditional Oasis villages denoting the local urban and social aspect.

### **Obstacles to Touristic Development**

-Mismanagement of water resources and its increased loss.

-Continuous deterioration of the traditional architectural and urban aspect of the Oasis villages, represented in the collapse of ancient traditional buildings and inhabitants' migration to it, in addition to the random sprawl of modern buildings in a manner that neither suites environmental indicators nor the specificity of the site.

-Materials not suitable to the environment have been used in construction, and the Siwan human element has been disregarded in the development. Furthermore, ideas and principles upon which this society was established across ages have been discarded.

-Severe deficiency in infrastructure and materials required for the development process.

-Continuous destruction of wildlife in the Oasis due to overfishing, leading to the extinction of many animals.

-Development strategy and plans are lacking in the Ministry of Tourism for Siwa Oasis.

### **6-5-Current condition of touristic facilities in Siwa**

Touristic development in the study region depends on providing various levels of residence services to make the touristic product required for various tourism sectors available. For instance, Siwa Oasis has 7 ecolodges licensed from the Ministry of Tourism and Antiquities. These ecolodges comply with eco-friendly standards, such as the use of natural building materials and energy generation from solar sources. They also offer around 309 rooms that fulfil the needs of tourists seeking a unique and calm experience.

Shali Lodge and Adrere Amellal are two of the most distinct ecolodge models, where the environmental dimension has been taken into consideration in their design and construction. The Ecolodge Adrere Amellal was chosen by the Earth Summit Conference held in Johannesburg as one of the best world models in the ongoing environment and development projects. This ecolodge will be analyzed to reach standards for designing environmentally compatible touristic facilities in Siwa which realize the concept of ecotourism.

### **7-Desert Environment**

Desert is considered a unique geographical environment that features wide vacant lands mostly covered by sand. These regions constitute a harsh climate characterized by rain scarcity and high temperatures. Desert climate is defined as an arid climate, since the evaporation rate is higher than the precipitation rate, leading to a significant scarcity of water resources. In this environment, temperatures in the morning can reach very high levels, and sharply decrease at night. Additionally, deserts have unstable environmental conditions represented in dry winds and sandstorms, contributing to the harsh life in these regions.



Deserts are considered one of the most important ecosystems across the world, manifesting a remarkable adaptation ability via living organisms there, including plants and animals that have evolved to bear harsh environmental conditions (Wright, S.J., & Webster, M. 2020).

Nevertheless, despite these harsh conditions, there are many species whose life is confined to these desert environments. Hence, this environmental adaptation requires vast knowledge of how different climate factors affect biodiversity in deserts (Thomas, D.S. G. 2004).

### **Natural characteristics of Hot Dry Egyptian Deserts (Climate Characteristics)**

The climate of hot, dry Egyptian deserts is characterized by harsh climate conditions that significantly impact the environment and human activities. During the summer season, morning temperatures reach very elevated levels, scoring up to 54.5 °C, with a sharp decrease in temperatures during the winter season. Temperatures can drop at night from 5-10 °C. This huge discrepancy between temperatures in summer and winter is deemed one of the distinguishing features of this region and exhibits a vast thermal extent that reflects the harshness of the desert climate (Soliman, T.M., & El-Shazly, A.M. 2011).

Furthermore, this region suffers from high solar intensity, leading to elevated temperatures on horizontal surfaces and facades exposed to direct sunlight. This phenomenon contributes to raising temperatures in the region generally, posing huge challenges to life and activities in this environment (Ghoneim, E., 2009).

Winds are prevalent in this region, coming often from the North and Northwest, and are laden with fine dust and sand. Winds are regarded one of

the significant climate factors that affect the local environment, contributing to the reinforcement of drought in the region and the formation of sandstorms potentially devastating for facilities and infrastructures.

One of the most distinct climate characteristics in the Egyptian Desert is rain scarcity, where precipitation rates in most parts do not exceed very low values. This rain scarcity leads to a decrease in water resources, aggravating life difficulty in this region.

It is noteworthy that harsh climate conditions constitute a decisive factor in the design of utilities and facilities in desert regions, especially in Siwa Oasis. In this context, environmental treatment fundamentals emerge as a main element that guarantees buildings' adaptation to the harsh desert environment. This involves developing sustainable techniques in architectural design, such as using local materials and effective thermal insulation to achieve a balance between comfort, energy, and limited resources in such regions (Aldous, D., & Hassan, M. 2014).

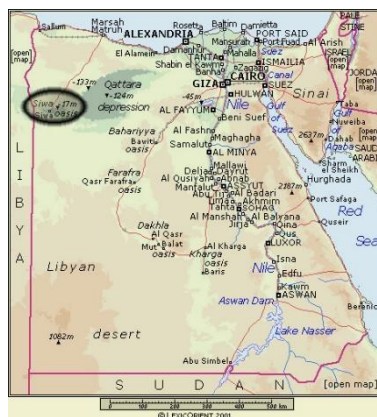


Figure (1) shows Siwa's location on Egypt's map.

## 8- Requirements and Fundamentals of Formation and Design in Desert Regions (Siwa Oasis):

Siwa Oasis lies in the Northwest of the Arab Republic of Egypt, 30 km from the southwest of Marsa Matrouh. The Oasis contains a depression that extends across 120 km from **Umm Al-Saghir** village in the East to Gaghboub Oasis in the west, 30 km from the Egyptian borders with Libya. The Oasis geographical location is at 25.5 latitude in the north and 29 longitude in the east. The depression spans an area of 77 km in length, with width ranging from 5-15 km. Being 18 m under the sea surface, this depression directly impacts the region's climate and life conditions there (Soliman & El-Shazly, 2011).

Siwa Oasis is made up of a group of aligned small oases, the most important of which are Siwa (Divided into Siwa East and Siwa West), Al-Al-Maraghi, Khamisa Abu Al-Shorouk, Kreishit, and Al-Zaytoin. These oases enjoy a unique desert environment and a long history spanning several centuries.

## **8-1-Development in the Planning of Siwa Oasis across historical stages**

### **Sidi Muslim Village Stage**

This is deemed the first stage in Siwa planning development, since this region was initially used as a primitive residential center where population activity was limitedly concentrated.

### **Old Town Stage (Shali):**

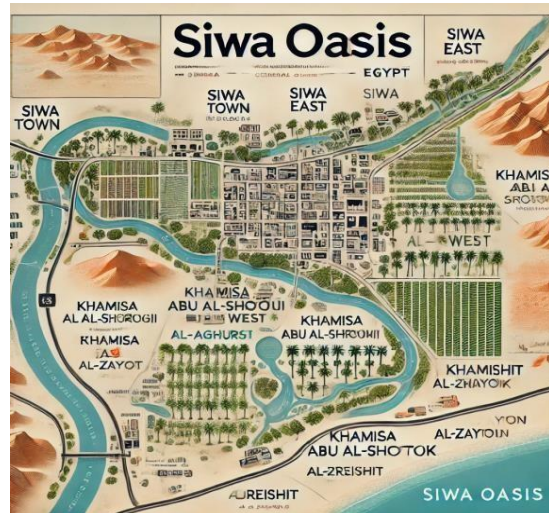
In this stage, urban planning evolved to take the form of a **traditional desert Arabian city**, where an integrated city was established to include **markets, mosques, and houses**, as well as commercial, social and political activities. The main advantage of this stage was **the defensive aspect of houses**, where **mudbrick** was used to provide thermal insulation and resist weather fluctuations (Nasser & Hegazy, 2012).

### **Descending from the mountain to the plains' stage:**

This stage witnessed changes in the city planning due to increased population density and urban expansion. This expansion moved construction from elevated regions on the mountains to low areas in the plains to provide bigger construction spaces.

### **Urban expansion stage (Current Siwa)**

In this stage, urbanism in Siwa was affected by multiple environmental, social and economic factors. Urbanism started to expand increasingly towards regions surrounding the Oasis. Moreover,



modern techniques in construction were exploited, while preserving the traditional aspect of the region. In this stage, Current Siwa manifests a blend of traditional architectural styles and modern buildings that are compatible with harsh environmental conditions (Aldous & Hassan, 2014).

**Figure (2): Oasis Villages(Soliman, T.M., & El-Shazly, A.M. 2011)**

## **8-2- Characteristics of Urban Texture in Siwa Oasis**

### **General Characteristics of the Texture and its Orientation**

-Integrated planning patterns were employed to reduce urban texture exposure to external climate conditions. Integrated planning led to reducing lengths of routes and passages. Additionally, the broken lines of paths, composed of space sequences of different shapes, helped reduce wind movement within and provided shading.

-Comprehensive orientation of the urban texture effectively reduces the extent of hot dry climate, as it is perpendicular on the direction of the north and the northwest.



**Figure (3): Siwa General Layout**

#### **Distribution of road networks and urban spaces:**

- Hierarchy of road networks in Siwa is observed, where they are divided into:

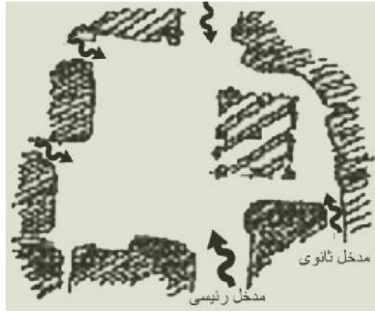
-Public roads represented in a road that link Siwa to the outside, in addition to a road connecting north Siwa to its south.

-Semi-public road, which is a road at the level of every division whether western or eastern, linking the division alleys to each other and to the public road.

-Semi-private roads, which are roads linking residential units. These roads are particularly covered with wicker and arcades to provide shading.

- Urban spaces in the Oasis are divided into three levels:

-Public spaces representing the market space which is directly linked to the public road connecting north Siwa to its south.



**Figure 4: Street shaded with wicker for protection from direct solar radiation**



**Figure (5): Market space in Siwa**



**Figure 6: Semi-public space in Siwa**

-Semi-public spaces exist at the level of each urban division (Eastern-Western), as it is considered the meeting place of family heads and Sheikhs.

-Semi-private spaces exist inside districts, representing most of the ancient Siwa spaces.

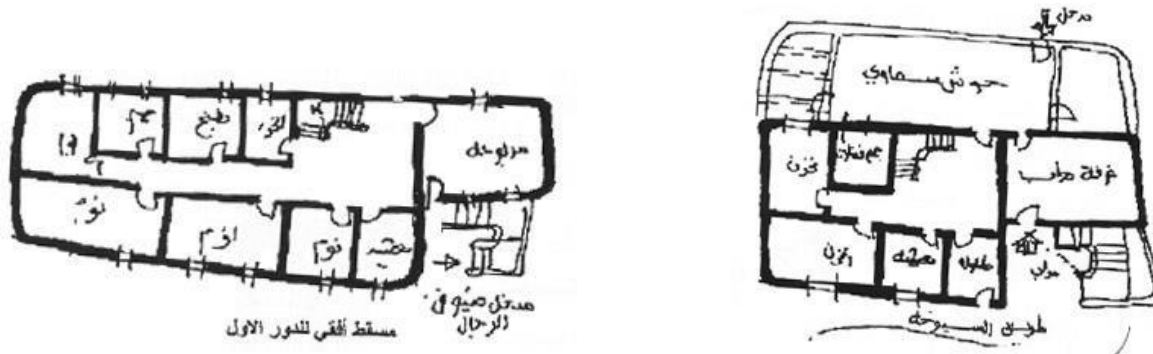
### **8-3-Fundamentals and Standards of Urban Design of Buildings in Siwa Oasis**

Buildings in Siwa are characterized by spontaneity, simplicity and depth in thought, whether in terms of construction style and materials, or design. The most important thought pillars in designing buildings are as follows:

#### **Architectural Formation of Horizontal Projection**

-The horizontal projection has a rectangular shape with 1:1.4 and 1:2 ratios, where interior yards and backyards can be seen, allowing for the practice of several activities within its scope. This provided more privacy and inward closure according to the prevailing customs and traditions, as exhibited in figure (7).

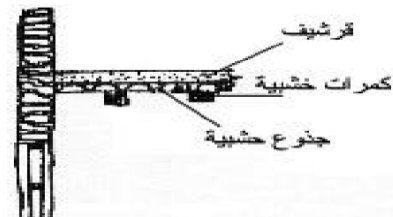
The nature of the economic activity based on cultivating palm and olive trees requires huge spaces in the house on the ground floor to store a huge part of the crop, sufficient for family consumption throughout the year. The upper floors are allocated to the living room and bedrooms as indicated by figure (7/A).



**Figure (7/A): Horizontal projection of the ground floor, showing a space for storage**

### *Ceilings*

-Ceilings are flat, whether simple or complex according to the space size. Simple ceilings are used in roofing spaces with specific dimensions. They are made of long palm tree trunks filled with fibers and covered by a 10 cm layer of hammered karshif without any protrusions in the buildings, as manifested in figure (8).



**Figure (8): Vertical Section of Simple Ceiling**

-Complex ceilings are used for roofing relatively vast spaces from 4-5 m. For such ceilings, a type of beams from half palm tree trunks is used. On top of such beams, palm tree trunks are aligned beside each other and then

covered with karshif, as shown in figure (9).

-Vertical parapets are used, forming deep shadows in the morning above the roof surface itself. This reduces the amount of heat acquired by the surface.

### *Walls*

-Load-bearing walls often take spontaneous curved shapes. They may also be built perpendicular on each other. These are thick walls up to 60-80 cm in thickness, with reduced thickness in upper floors reaching 30-40 cm of local construction materials. Karshif mixed with clay are materials that reduce thermal transmission, leading to insulation between the outer perimeter, spaces, and the inner perimeter



Figure (9): Vertical Section of Double Ceiling

-Walls coatings are smooth, reflecting sunlight. They have the same natural soil color.

### *Openings*

-Facades exhibit less openings with small surface reaching around 5% of the facade, designed in a rectangular shape and topped by beams of Swedish wood.

## **9- Analytical examination of Adrere Amellal as an Ecolodge Building Model**

### **9-1- Location:**

Adrere Amellal Ecolodge is surrounded by Gafar Mountain (The White Mountain) at Al-Maraqi Village, 18 km far from Siwa. Ancient Siwan houses



surrounding this mountain were fully restored with some architectural modifications. Furthermore, all architectural (lodge) elements were added, allowing for the lodge use at the highest hotel standards.

## **9-2- Ecolodge components**

-The ecolodge was divided into several regions, showcasing Siwa's distinct aspect.

1- Car Parking building in addition to a number of warehouses and (6) employee rooms.

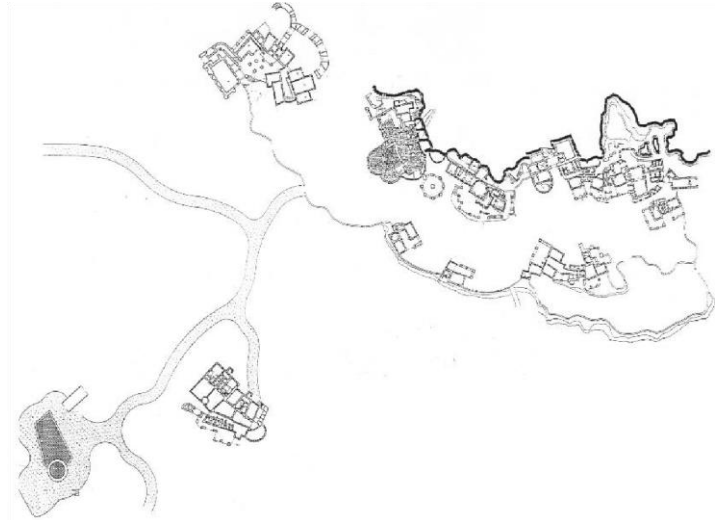
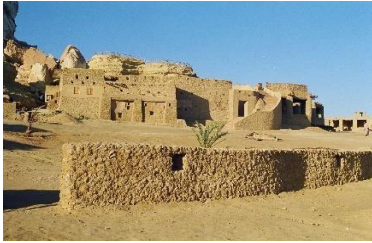
2- Reception building composed of reception hall, an area for management rooms, and a multi-purpose hall.

3- Restaurant building and its annex buildings

4- Mini-bar composed of a group of covered and uncovered areas.

5- Different buildings composing the project's lodge rooms made up of 32 rooms distributed across a set of complexes: Al-Meshmesh Castle, Dar Gaafar, Al-Sokaria, Shali Ghadi, and the spa building.

6- Swimming pool building and the garden attached to it, in addition to the spa building.



**Figure (10): Images showing Adrere Amellal Ecolodge**

**Figure (11): Horizontal Projection of the Ground Floor**

### **9-3- Analysis of the texture general properties**

-Integrated patterns were used in planning for protecting the ecolodge rooms from external climate conditions.

-The internal yard was used, and openings were oriented to it. This helped reduce solar radiation projecting on facades that overlook the yard. Additionally, the internal yard was used in the different tourist activities.

### **9-4- Fundamentals of designing the building external envelope:**

#### **A-Construction materials**

Construction materials available and appropriate for the environment in Siwa were used. These materials depend on a silt-building material called Karshif (Salt Blocks). These bricks are bonded with a type of loam which acts as mortar and is characterized by high thermal resistance leading to reduction of thermal transmission between the external and internal mediums.

## **B-Ceilings**

-Palm tree wood taken from palm gardens trunk wastes was used, cut, prepared, and treated with salt to prevent infection with weevils which cause ceiling damage. It is then covered with loam mortar to which olive leaves are added, acting as insulators.

-Domes built from Karshif are used to reduce the amount of solar radiation projecting onto the roofs.

-Internal space heights are increased, thus reducing the sense of heat inside the space.

## **C- Openings**

-Openings are oriented towards the north, and opposite to it are openings oriented towards the south for cross ventilation.

-Openings are designed to be on a low level to allow air to enter at the human level, with upper openings added to it that help hot air to exit. These openings are closed in the winter with palm fiber.

## **D-Cladding**

-Limestone and sandstone are used in cladding some internal walls. These stones are considered local construction materials.



**Figure (13): Images**



**Figure (14): Images showing general landscaping**



showing ratios between elements  
openings and solid parts in  
residence units

### **9-5-Fundamentals of designing general landscaping elements**

-Before initiating the design of general landscaping, a comprehensive examination was undertaken of all rare desert plants and trees, threatened by extinction in Egypt. Seedlings from all plants and palm trees were collected and cultivated at the site to become a natural museum of desert plants and trees.

-The garden annexed to the project was cultivated with all fruits and vegetables, spanning a 9-feddan area. This cultivation was organic without additives or chemical substances, and the garden feeds the hotel with all its needs.

-The natural spring existing in the site was used as a swimming pool after cladding with the natural stone existing in the region.

### **9-6- Techniques employed for realizing the concept of sustainable development**

-Olive timber was used for designing windows.

-Palm leaves were used for making furniture, including beds, chairs and tables. Moreover, manual fabric and local carpets were utilized, granting the place a local aspect.

-Involving local groups in the process of design and execution to benefit from their expertise.

-A new idea was designed and executed in a natural manner (to get rid of sewage, called “the wetland”). This idea depends on collecting all wastes in the sewage, then in a closed reservoir, and then in a wetland of no less than

20x40 m area. This wetland is divided into several rooms of gravel soil and pipes with holes leading to a garden of specific plant types: reed, lotus, papyrus.

## 10-RESULTS

While studying the **Adrere Amellal** Hotel, located in a transitional area within nature reserves, it becomes evident that the natural environment and its characteristics are the foremost considerations among the fundamental standards for designing the structural framework of tourism establishments.

On the other hand, the role of construction methods and the selection of appropriate building materials that align with the natural characteristics of the area cannot be overlooked. These elements are crucial in ensuring that the development harmonizes with the environment and supports sustainable practices.

Orientation must be carefully considered during the design of tourism establishments, as it significantly impacts thermal transfer between the exterior and interior, ventilation, and natural lighting. Proper orientation can reduce the reliance on mechanical systems to achieve thermal comfort within the spaces, promoting energy efficiency and sustainability.

Using building materials sourced from the local environment, particularly those with high thermal capacity, helps minimize thermal transfer from the outside to the inside. Additionally, these materials should be sustainable and environmentally friendly, considering the energy consumed in their production, as well as their potential for recycling and reuse in the event of the building's demolition. This approach ensures both energy efficiency and environmental responsibility.

T

he environmental and spatial capacity of the designated area for tourist buildings must be carefully considered to avoid negatively impacting the surrounding natural environment. This is essential to align with the principles of sustainable tourism development, ensuring that construction and operations do not harm the ecological balance or degrade the natural landscape. The suitability of infrastructure (electricity, water, and sanitation) to the hotel's capacity must be ensured, with a focus on implementing water rationing technologies and effective waste management systems. This includes recycling waste, separating and sorting it, and transporting it to safe locations that minimize environmental impact. Owners of tourism buildings must also be fully aware of the environmental consequences of constructing and operating these facilities near nature reserves.

In terms of social and economic sustainability, it is crucial to involve local community members from the planning, design, and implementation stages. Additionally, their participation in the workforce should be encouraged, whether by showcasing local arts and culture as part of the entertainment offerings or by providing traditional cuisine to tourists. This approach not only supports the local economy but also preserves and promotes the region's cultural heritage.

## **11-Recommendations**

The study presents several recommendations for planners and designers undertaking the desert touristic development process. These recommendations target interaction and compatibility with nature. They can be classified as follows:

1

### **1-1 Planning recommendations**

-The necessity of granting more attention to the desert environment and providing the requirements for human comfort, whether physiological or psychological. The study specifically recommends the improvement of the environmental performance of touristic urbanism in desert regions. This is considered one of the most important axes for sustainable touristic development in Egypt.

-The necessity of setting urban policies for desert tourist complexes, which suit the special nature of each region in terms of shape and essence.

-Full compatibility with the site's ecological characteristics and employment of its elements to realize the maximum benefit from these characteristics in formulating the most optimal urban texture.

-Ensuring that desert touristic project sites are provided and supplied with infrastructure networks for touristic development process functioning.

### **11-2- Architectural and design recommendations**

-Care for urbanism formation fundamentals and standards, and designing tourist facilities in terms of the following:

- Use of local construction materials from renewable resources and preventing the use of materials that require intensive energy and that are environmentally hazardous.
- Ventilation inside the spaces of residence units by normal methods via openings ratios and measurements, as well as air inlet and outlet places to realize thermal comfort for the space user.

- P  
rotection from direct solar radiation projecting on the external building envelope is imperative by using different architectural treatments.
- Orienting buildings to ensure a distinct sight.
- Using local materials for finishing and furnishing spaces of residence units, granting a unique appearance to tourist facilities.
- Involving local labor who possess remarkable local heritage, as well as significant local design and executive expertise.
- The study recommends the necessity of merging heritage methods to manage desert touristic regions and eco-friendly technology. The aim is that design solutions will stem from the natural medium of the place and intersect with the ideological cultural and social background.

### **11-3- Recommendations for general landscaping elements**

-Using plants and crops that are compatible with the desert natural and local environment (guaranteeing life sustainability of these plants and contributing to the rationalization of irrigation, maintenance and follow-up costs).

-Encouraging the use of local and natural materials in designing elements and components of landscaping by local inhabitants.

### **11-4-Construction recommendations**

-Identifying the most appropriate site construction methods, taking into account the natural, environmental, economic, and cultural aspects.

-Choosing construction methods that do not pollute the natural environment.

### **11-5-Technical recommendations**

-Using clean methods and means for generating energy in touristic projects, such as solar energy and wind energy, etc.



- Reusing sewage water after treatment for irrigation and soil fertilization works
- Following the re-sorting and recycling principle in managing wastes
- Commitment to the principle of closed cycles in the vital processes forming the different activities inside tourist facilities.
- Necessity of establishing ecolodges which realize the concepts of sustainable touristic development.

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