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# The role of Traditional Architecture Techniques in the formulation of Sustainable Architectural Form in the Natural Reserves in Egypt

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**ABSTRACT:** This research is based on shedding light on the techniques of traditional architecture in natural reserves and their relationship to sustainable architectural formation in order to preserve the internal and local environment suitable for the convenience of building users, as well as to achieve compatibility of the formation with environmental conditions. God Almighty has appointed man on earth to build it, granted him intelligence and strength, subjugated all creatures to him, and provided him with the means of living to fulfill this message.

And Allah says: "We have made that which is on the earth adornment for it that We may test them which of them is best in deed" [verse 7 of Surat Al-Kahf].

Therefore, it was necessary to put forward a theoretical framework in three chapters, the most important theories that explain the relationship between the characteristics of the natural and built environment in natural reserves in Egypt, where the focus was on building restrictions in natural reserves at the forefront of the topic. Then he dealt with the role of architectural formation in achieving sustainability by knowing the principles of sustainable architectural formation through compatibility of requirements and criteria for achieving sustainability with the characteristics of sustainable architectural formation in natural reserves. Then, at the end of the theories, he dealt with the formulation of sustainable architectural formation using traditional architecture techniques, with knowledge of traditional architecture in terms of concept, characteristics, techniques, and standards. In the fourth chapter, the analysis of international and Arab experiences in natural reserves and the reasons for choosing these experiences were dealt with. The experiments were analyzed and evaluated in the light of the proposed methodology, with deriving the criteria that must be met in order to reach the role of traditional architecture techniques in serving the marketable architectural formation of "sustainability". Thus, in the fifth chapter, the case study was applied and evaluated in the light of the proposed methodology, while extracting the criteria that must be met in order to reach the role of traditional architecture techniques in formulating sustainable architectural formation in nature reserves in Egypt.

**KEYWORDS:** Building restrictions in nature reserves, the natural and built environment, sustainable architectural formation, traditional architecture techniques

## I. INTRODUCTION

The research is directed towards studying the impact of sustainable architectural formation on traditional architecture techniques in natural reserves, and in order to achieve this research, it was necessary to put forward a theoretical framework on traditional architecture and its plastic techniques so that we could delve into the merit of studying formation in discussing the results to determine the best environmental treatments and the best in traditional techniques. An applied study has been done on natural reserves in Egypt, which was done by studying models at the local and international levels, whether inside or outside Egypt.

## II. RELATED WORK

Two main axes form together the research problem of this study, namely:

The first axis: the scarcity of research and scientific theses that dealt with traditional architecture techniques in nature reserves without delving into sustainable architectural formation, given the importance of formation in discussing the results to determine the best environmental treatments and the best in traditional techniques.

The second axis: the deterioration of traditional architecture and the failure to use appropriate architecture techniques to develop traditional architecture and limit the use of inappropriate techniques. Traditional architecture throughout the world provides useful examples of sustainable solutions to building problems.

Since nature reserves are one of the important means to maintain the ecological balance, preserve the environment and prevent the depletion and deterioration of natural resources in a way that guarantees the survival and preservation of biological diversity necessary for the continuation of life.

Any form of design works to reduce the destructive effects of the environment through its integration and integration with living processes. The sustainable architectural formation reinforces the emphasis on preserving the biodiversity of the planet.

Thus, the research problem confirms the deterioration of some buildings that negatively affect biodiversity in nature reserves. Illustration of some dilapidated buildings with Fig. 1.

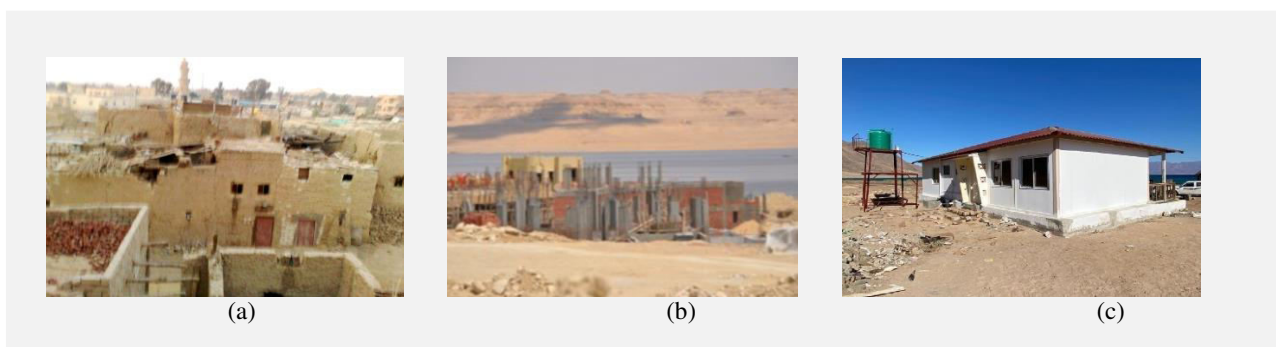


Fig. 1. Illustration of some dilapidated buildings (a) The deterioration of some traditional buildings due to the lack of awareness and the migration of the population to them - Siwa Reserve in Matrouh Governorate (b) Establishing tourism projects that are not compatible with the environment, but rather destructive, on the shores of the lake - Lake Qarun Reserve in Fayoum Governorate (c) Establishing a service building that is not compatible with the environment - Abu Galum Reserve, South Sinai Governorate.

## III. METHODOLOGY

The research is based on relying on the integrated approach that combines the theoretical framework with the practical reality, as this approach helps in the applied study (methodology - evaluation tool), as it allows the study of the factors and variables affecting it, and thus the research depends on four axes:

### 1. The first axis: the inductive (deductive) approach

It includes the theoretical study that pertains to the field of study on the characteristics of the natural and built environment in natural reserves, and extracts construction requirements and standards in buildings in natural reserves. As well as the role of architectural formation in achieving sustainability, in addition to identifying the formulation of sustainable architectural formation using traditional architecture techniques that are applied to sustainable architectural formation that must be available in any architecture and its relationship to the surrounding environment.

### 2. The second axis: the analytical approach

Concluding the role of traditional architecture techniques in formulating sustainable architectural formation in natural reserves through studying and analyzing international and Arab experiences that are famous for their absorption of high potentials and the compatibility of formation with environmental conditions. And a comparative analytical study between the cases of the global and Arab studies to reach the application of the efficiency of traditional techniques to improve the sustainable architectural formation of natural reserves.

### 3. The third axis: the applied approach

It includes studying the application of lessons learned from international and Arab experiences that would achieve and apply traditional architecture techniques in natural reserves in Egypt from the perspective of the compatibility of sustainable architectural formation with the conditions of the local environment.

### 4. The fourth axis: the deductive method

In this part, a comprehensive presentation of the research study that took place during the chapters of this research is presented and the results (conclusion) that have been reached are presented and discussed, and then some recommendations

are made and the most important directions for future research in the field of research and directions for its development are determined.

## 1. Characteristics of the natural and built environment in natural reserves

### 1.1. Natural reserves in concept and importance

The concept of natural reserves in its current legal form is relatively recent, although it has been known since ancient times, but with other concepts and names, and in its current concept it came into existence in 1970 through the Man and the Biosphere Program (MAP) as the map shows in Fig. 2. as well as in the first conference On the human environment of the United Nations, held in Stockholm in 1972, when the conferees approved a recommendation stipulating the need to establish a global network of nature reserves.

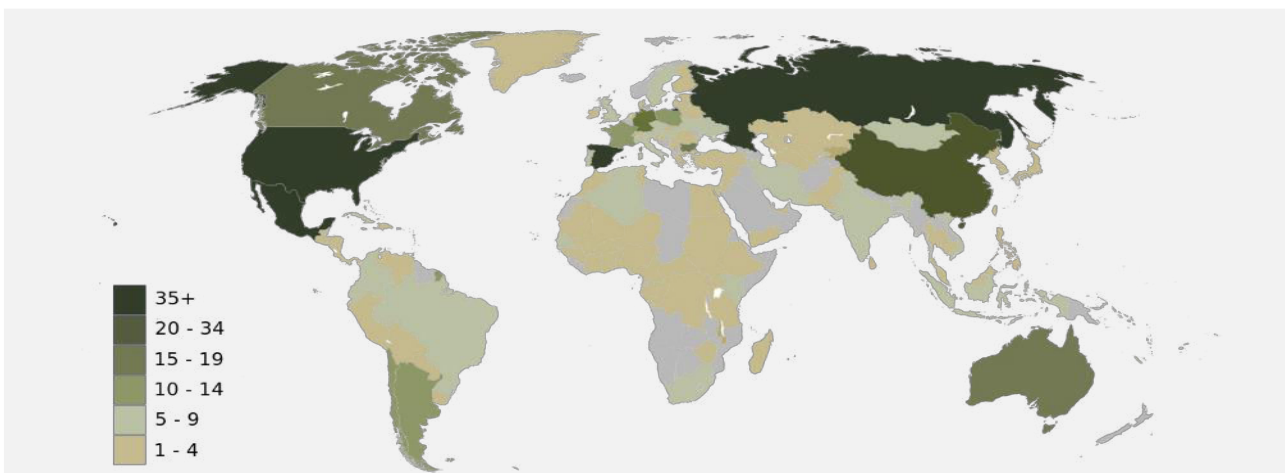


Fig. 2. A map showing the number of human and biosphere reserves in each country

The importance of these natural reserves lies in what they achieve in preserving living natural resources and maintaining the health of environmental processes in the ecosystem, conducting research, education, training and environmental media, as well as tourism and trying to make profits from visits and deepening human awareness of the agricultural, desert, marine and coastal environments, fresh water and their ecosystems, and providing forms Entertainment and tourism so that visitors and tourists can enjoy these natural resources.

Nature reserves are classified into different categories, and many countries have adopted the International Union for Conservation of Nature (IUCN) classification system, which has classified protected areas according to their intended purpose into seven categories. The fig.3. shows the classification of nature reserves according to the International Union for Conservation of Nature.

The Egyptian state enacted laws and legislations according to which nature reserves were established in Egypt, perhaps the first of which was Law No. 102 of 1983, according to which a large number of nature reserves were established in Egypt, and so far they have reached 30 nature reserves.

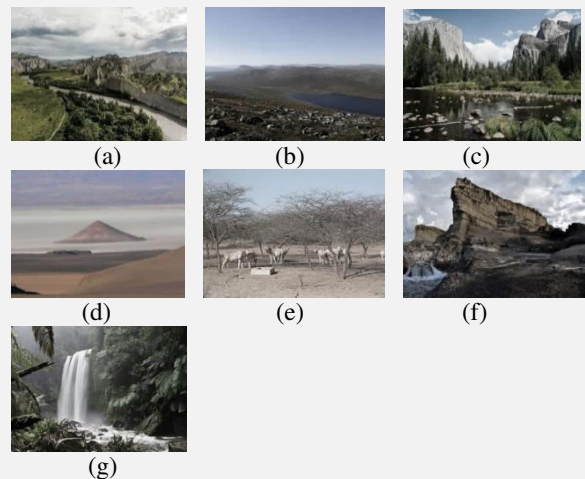


Fig. 3. the classification of nature reserves according to IUCN (a)Strict Nature Reserve (b)Wilderness Area (c)National Park (d) Natural Monument or Feature (e)Habitat/Species Management Area (f)Protected Landscape/Seascape (g) Protected area with sustainable use of natural resources.

### 1.2. Characteristics of the natural environment in nature reserves in Egypt

The Egyptian environment has many potentials and ingredients that, through its optimal utilization, can make Egypt at the forefront of tourism countries in the field of eco-tourism, due to the diversity and spread of these potentials and

ingredients at the level of the Republic. Below we address geographical characteristics, geological and morphological characteristics, climatic characteristics, ecological characteristics (plants and wildlife), natural resources and importance, scarcity and environmental sensitivity.

**1- Geographical characteristics**

Egypt is located in the northeastern corner of the continent of Africa, and it has an Asian extension, as the Sinai Peninsula is located within the continent of Asia, as it is a transcontinental country. The geographical location has a great influence in giving the environment some of its characteristics, and the characteristics of nature reserves differ in their geographical environment. Fig.4.

**2- Geological characteristics**

Geology includes everything related to the earth, including its phenomena, layers, properties, and phenomena related to it, such as earthquakes, volcanoes, the path of valleys, and everything related to surface water and the water cycle in nature. Fig.5.

**3- Climatic characteristics**

The climate in Egypt in general is a desert climate, which is hot in the summer and mild in the winter. The prevailing winds are coming from the Mediterranean side.

**4- Ecological characteristics**

The ecological (natural) environment includes several elements: climate, land, living biological creatures, and the natural components of the land. Fig. 6.

**5- Natural resources**

Egypt abounds with unique and diverse natural resources, whether on its coasts or deserts, or between its mountains and valleys, with mild weather throughout the year.

**6- Importance, scarcity and environmental sensitivity**

Includes Natural features and geological features: The region has distinct geology and landscapes of high aesthetic value. Examples of natural reserves in Egypt, as shown in Figure No. (7), are the Wadi El-Gemal Reserve. The most important natural elements to be preserved are addressed due to their importance and scarcity.

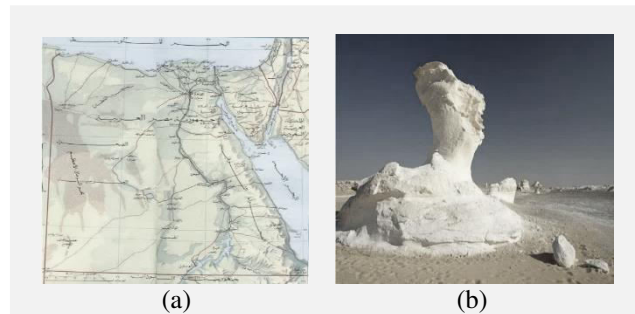


Fig. 4. (a) Egypt's geographical borders  
Fig. 5. (b) White Desert Reserve

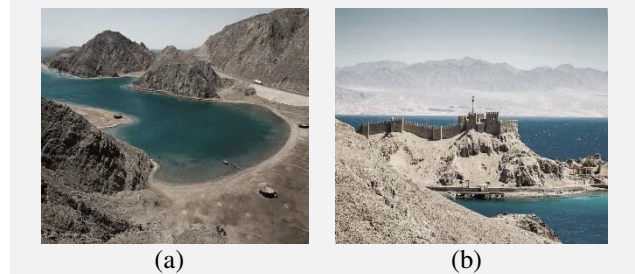


Fig. 6. (a), (b) Taba Reserve, South Sinai Governorate.

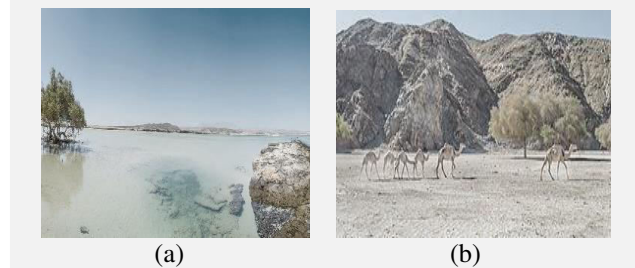


Fig. 6. (a), (b) Mount Hamata: one of the highest mountains in the eastern desert, which hosts a wide variety of plants and wildlife. The region also has several islands of international importance for breeding birds and sea turtles.

**1.3. Characteristics of the built environment in natural reserves in Egypt**

The research presents building restrictions in natural reserves at the forefront of the topic to know the international and local laws and regulations governing construction in natural reserves. It then presents the characteristics of the environment built in natural reserves in order to achieve the compatibility of the building with the environment, and includes four types of buildings built in natural reserves: residential, hotel buildings, tourist buildings, educational buildings, and museum buildings.

### 1.3.1. Building restrictions in nature reserves

The identification of building restrictions in natural reserves necessarily requires exposure to the identification of laws and regulations regulating construction in them, as international and local law regulates the categories of natural reserves and the use allocated to them, and the system of protection, use, designation and management of the mentioned areas. Details of these international and local laws and regulations are shown in Table.1.

### 1.3.2. Characteristics of the built environment in nature reserves

Nature reserves vary greatly in nature and characteristics, and the buildings in nature reserves are characterized by a unique natural identity and character that evolved from the amalgamation of influences such as natural desert terrain, climate, and geography, along with cultural, social, religious, and historical factors. All these factors affect the way of life there and add distinction to the patterns and forms of construction as well. There is harmony and harmony between buildings and nature due to the use of local natural resources as building materials. As the famous Egyptian architect Hassan Fathi used to say: The building lives in the land to which it belongs. (Dabaieh, M., 2011)

Table.1.: Permitted construction requirements in nature reserves

Local laws and regulations governing construction	International laws and regulations governing construction	construction restrictions Standards and requirements
<p>The activities related to the nature reserve area have three management laws:</p> <p><b>A- Management within the natural reserve area</b></p> <p>The administrative authority to be determined by a decision of the Prime Minister is entrusted with implementing the provisions of this law and the decisions implementing it, with the aim of preserving and protecting reserves.</p> <p><b>b- The administration for carrying out activities in the natural reserve area</b></p> <p>In the Arab Republic of Egypt, environmental laws and legislation, in particular Law No. 102 of 1983 in the matter of natural reserves and Law No. 4 of 1994 as amended by Law No. 9 of 2009 in the matter of environmental protection stipulate Prime Minister's Decree No. 264 of 1994 and amended by Decree No. 2728 For the year 2015 regarding the conditions, rules and procedures for practicing activities in the areas of natural reserves.</p> <p><b>C- Administration outside the natural reserve area</b></p> <p>The natural resources are invaluable and are the basis for national development and tourist attractions in Egypt. And that the one who caused any damage to it bears the cost of restoring its efficiency and the value of the environmental damage it caused, in addition to the penalties stipulated in environmental laws.</p>	<p>The activities related to the nature reserve area have three management laws:</p> <p><b>A- Management within the natural reserve area</b></p> <p>Temporary stipulations to maintain the status quo where a protection area has been identified but designation takes time when nature reserves are divided into use areas.</p> <p><b>b- The administration for carrying out activities in the natural reserve area</b></p> <p>Requirements applied by the tourism-related administration that allow activities in nature reserves.</p> <p><b>C- Administration outside the natural reserve area</b></p> <p>Requirements applied outside nature reserves to prevent or reduce negative impacts due to outside activities that may be harmful therefore activities in nature reserves are prohibited.</p>	<p><b>environmental management laws</b></p>
<p>The role of reserves management in providing tourism objectives and facilities must be developed in close coordination with the region and the National Tourism Authority. The Tourism Board may sometimes provide financial assistance for the development of tourism facilities in nature reserves.</p>	<p>According to the National Park Tourism Management Act, strategic elements will be integrated into the management plan. The main purpose of a management plan is simply to describe how tourism and related services will be managed and organized.</p>	<p><b>Tourism management laws</b></p>
<p>Biodiversity of natural origin lies in the promotion of sustainable development. Egypt's future depends on the sustainable management of its natural, physical and human assets. The most serious challenges facing Egypt are poverty eradication, food security, provision of fresh water, soil conservation, and human health, all of which</p>	<p>Preserving biodiversity is the primary goal of IUCN-designated protected areas. Other types of protected areas, such as historical parks, monuments, sacred sites, tribal reserves, etc., which have no content relating to the conservation of nature or natural resources in any of their manifestations, while of paramount</p>	<p><b>Laws for the Convention on Biological Diversity (CBD)</b></p>

Understanding the characteristics of the built environment is the first step towards achieving an integrated natural design. It entails understanding the ecological activities of nature, the ecosystem and its actions and reactions that will be associated with building designs (Jideofor Anselm, A., 2006). Thus, it includes four types of buildings built in natural reserves: residential hotel buildings, tourist buildings, educational buildings, and museum buildings, which are studied in detail in the tables for the four buildings at the global and regional levels to extract the most important design characteristics of the environment built in natural reserves and assess the extent to which they meet the structural requirements. one of the tables, table.2.

By monitoring and evaluating previous examples of buildings and their design characteristics of the built environment, the results showed the extent to which projects achieve building standards and requirements, by comparing examples of buildings. Museum buildings by 96% in the laws related to activities and 100% for each of the laws related to tourism management and the laws of the Convention on Biological Diversity, and hotel residential buildings projects by 91% in the laws related to activities and 100% in the laws related to tourism management and 96% in the laws related to the Convention of Biological Diversity Biological diversity, and the lowest value in tourist buildings projects by 83% for each of the laws related to activities and the laws of the Convention on Biological Diversity, and by 91% in the laws related to tourism management, as shown in Fig.7.

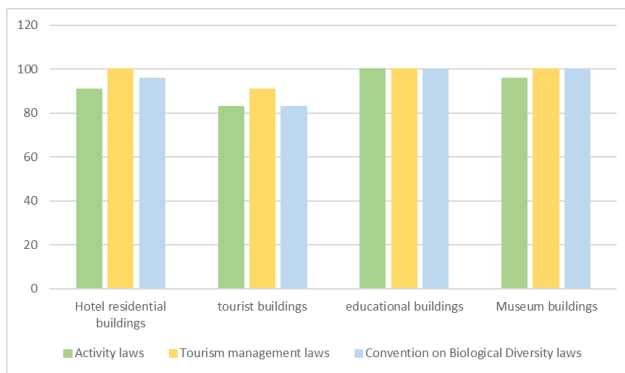
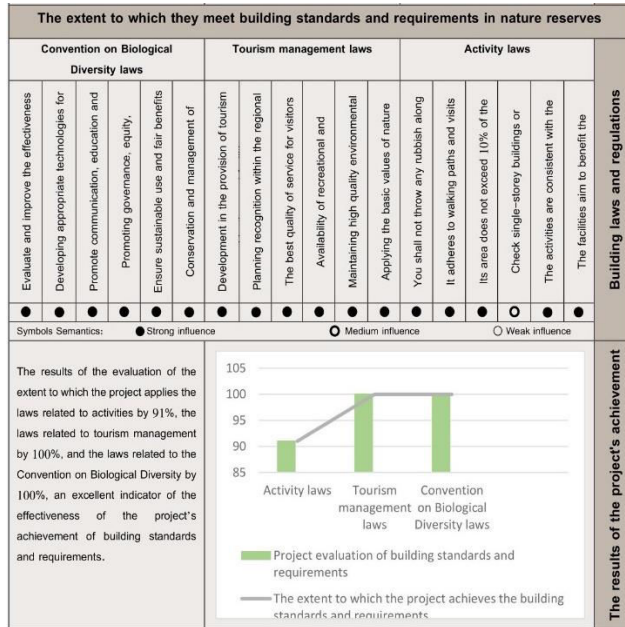


Fig. 7. The extent to which building projects are evaluated for building standards and requirements

Table.2: Adrere Amellal Resorts Project

Description of the Adrere Amellal Resorts project	
<p>The project is located in the Siwa Reserve in Matrouh Governorate, Egypt. The figure shows a map of the boundaries of the protected area and its relationship to the project site.</p> <p>Adrere Amellal Resorts The Authentic Ecologie A unique and exclusive location, each of the 40 hand-built rooms is unique, combining distinction and originality. The ground buildings blend naturally with the landscape. All of the furniture and crafts pay homage to nature and the talented local craftsmanship. With no electricity, the rooms are softly lit by dozens of candles and a starry desert sky. The Siwa Reserve is one of the areas rich in distinct tourism potentials, including antiquities tourism – medical tourism – safari tourism – and desert tourism, due to the region's distinguished archaeological sites.</p>	<p><b>Components of the project</b></p> <p>The figure shows the master plan for money-generating resorts, consisting of a group of buildings distributed on the surface of the land as follows:</p> <ul style="list-style-type: none"> <li>□ The reception building, which consists of the reception, a flat for administration rooms, a library and a multi-purpose hall.</li> <li>□ The restaurant building and its annexes.</li> <li>□ The bar building consists of a group of covered and exposed surfaces.</li> <li>□ The hotel room buildings for the project, consisting of 40 rooms distributed over a group of gatherings, namely Qasr Al-Mishmesh, Dar Jaafar, Al-Sukkariyeh, Shali Ghadi, in addition to the garden attached to it and the sanitary bathroom.</li> </ul>
<p><b>1- Ceilings and claddings:</b> The ceilings are made from palm kernels, which are produced from the palm gardens. They are cut, prepared, and treated with salt to prevent infection with mites, which leads to damage to the ceilings. They are covered with clay mortar, in addition to olive tree leaves, which act as an insulator. Masrani stone and sandstone were used in cladding some of the internal walls, and these stones are considered local building materials.</p>	<p><b>2- The walls and openings:</b> The walls were built with more rock salt, mud (karshel) and straw. The salt and mud are taken from the nearby lake and the two components are mixed with straw with the skill and the openings took the northern (marine) direction, corresponding to openings in the southern direction in order to achieve continuous ventilation. The low openings are designed to bring air into the human standard of living, in addition to the upper openings, which help the exit of hot air. These openings are closed in winter with palm leaves.</p>
<p><b>4- Dining rooms:</b> Depending on the prevailing wind and mood, dinner is served here in a different section of the house, the courtyard or the cave room each evening. At night, the only source of light is the many candles and lanterns and the desert sky.</p>	<p><b>3- The buildings and their relationship to the protected area:</b> The eco-lodge is very sensitive to its environment and does not provide electricity, air conditioning or WiFi, but rather preserves the natural beauty of the surrounding area. It offers a stunning view of the magnificent White Mountain, overlooking the vast Lake Gari, and the sand dunes of the Great Sand Sea. According to the nature of the site, the buildings conform to the natural surroundings, as they are complex masses and are supported by environmentally friendly local materials. It is built into the ground like a metal maze to get lost better among the heavenly vaults and waves of sand dunes.</p>
<p><b>5- Bedrooms:</b> As in the local houses, the room, covered with argillous salt, is pierced by small windows with wooden shutters. Egyptian cotton sheets on a platform in palm blossoms, locally woven Berber rugs.</p>	<p><b>6- The garden and the swimming pool:</b> Adrar Amallal resorts are committed to using original ingredients. All fruits and vegetables come from their own gardens, with loving care and no pesticides, meat and poultry from local farmers and all breads and cakes are home baked. The swimming pool is shaded by a large palm grove and flows from a natural spring.</p>

**characteristics of the built environment**

**2. The role of architectural formation in achieving sustainability**

**2.1. Architectural formation in concept, foundations and underlying values**

The concept of architectural formation lies in the importance of composition through basic principles, which is like a book in a language that has its own vocabulary and rules. The oldest written text on architecture theory is De architectura, in which it says that a good architectural composition should satisfy the three basic principles of durability, utility (functionality) and pleasure (aesthetics). Now architects around the world prefer to believe that aesthetics in architecture do not have an independent existence and that it comes as a natural result to achieve the greatest amount of functional benefit as structural expression.

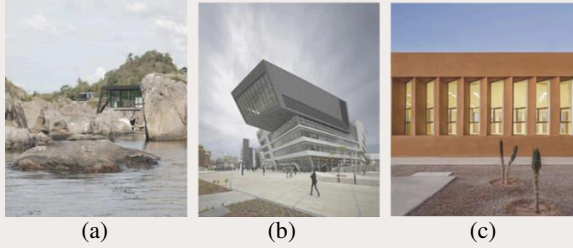

And they support the pursuit of architecture to achieve aesthetics and enjoyment for humans as long as it meets the requirements of functionality and achieves sustainability. Contemporary ideals require that the building be constructed in an environmentally friendly manner in terms of the production of the building materials used in it, its impact on the natural environment and the built environment, and its operation requirements from non-sustainable energy resources needed for heating and cooling such as lighting, waste water treatment and waste. Fig.8. An example of aesthetics in postmodern architecture, the island manzil building, where the building seeks to enhance the quality of the site and take advantage of areas that have no value in the original. So the building is placed on top of a rock formation embracing on different levels, and the overall design is more efficient, sustainable, healthy and aesthetically pleasing.



Fig. 8. House next to the island in Larvik, Norway

**2.1.1. Foundations of architectural formation**

A number of principles must be taken into account to organize the masses and spaces of the building, including shape, repetition, rhythm, proportion, scale, texture and color, which can be used to organize an architectural formation. Organization does not simply refer to formal regularity, but rather to a state in which each part of the whole is so precisely arranged in relation to the other parts and for its purpose that in the end it produces a harmonious order. Foundations of architectural formation are shown in Table.3.

Table.3: Foundations of architectural formation	
<p><b>1- Shape</b></p>  <p>(a) (b) (c)</p> <p>Fig.9. Foundations of Shape (a) <b>Regular form:</b> the example of the Laayoune School of Technology in Morocco, a group of breakers formed in a regular and sustainable iterative manner. (b) <b>Irregular shape:</b> the example of the library and learning center of the University of Economics Vienna, the formations are irregular in shape, and they are formed sustainably. (c) <b>The look is inspired by nature:</b> An example of a house inspired by nature in Norway. This glass-walled house has been specially restored and is linked to the rocky landscape of Larvik, Norway.</p>	<p><b>2- Repetition and rhythm</b></p>  <p>(a) (b) (c)</p> <p>Fig.10. Foundations of Repetition and rhythm (a) <b>Regular Rhythm:</b> An example of Canterbury Cathedral, the library is characterized by regular recurring bays of brick buttresses (b) <b>Flowing rhythm:</b> an example of a cultural center designed by the architect Zaha Hadid, where the rhythm of all the curves and flowing spaces in it (c) <b>Progressive Rhythm:</b> The Australian Opera House example, a sequence is created in which the elements change slightly each time they are repeated.</p>
<p><b>3- Ratio and Proportionality</b></p>	<p><b>4- Texture and color</b></p>



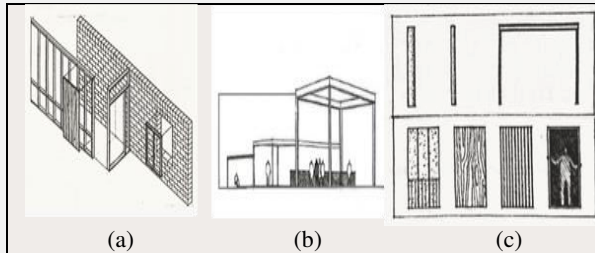


Fig.11. Foundations of Ratio and Proportionality (a) Example material ratios for iron and wood (b) Structural proportions example (c) An example of manufacturing ratios for materials with fixed proportions.



Example texture and color at home in Argentina. The "lower" house enjoys a more harmonious relationship with the surrounding topography and scenery, the meeting point of the house, the environment that seeks to focus its creation with the hill in color and texture. The materials used are low maintenance and respond to structural and project logic that balance their existence with their environment.

### 2.1.2. The values inherent in the architectural formation

The values of the architectural formation are the main reason for preserving it. However, most researchers agree that natural and climatic values are the most important reasons for preserving the architectural formation. Researchers Nigel Dunn, Derek Worthing, and Stephen Bond highlighted that the importance of preserving the architectural formation lies in the continuity of its function (social and structural values) and the culture it contains. Moreover, defining heritage assets according to natural and climatic values contributes to an "appreciation of relevant social and structural aspects". However, the values inherent in the architectural formation that must be analyzed in order to determine the importance of the architectural formation and the importance of preserving it can be classified into four categories: natural, climatic, social and structural. The values inherent in the architectural formation are shown in Table.4.

Table.4: Foundations of architectural formation

#### 1- Natural value



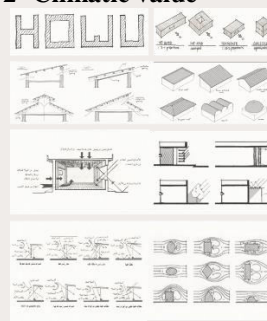
The built environment harmonizes with the natural surroundings in the village houses nestled in the landscape of Madagascar's central highlands and are the region's most humble expressions.

#### 3- Construction value



An example of aesthetic functional elements in the Architectural Heritage Center in Diriyah. The building envelope is constructed from a double facade inspired by the sand dunes as thick as the earthen masonry of the historic Diriyah buildings: a perforated outer layer that protects the building from sunlight and an inner curtain wall to preserve the surrounding landscape. The underlying strength of the architectural formation of this center lies in the sand dunes and the heritage environment, a more lively and expressive visual element.

#### 2- Climatic value



The formation is considered one of the important aspects that are affected by the climate of the prevailing conditions. It is better to know the climatic factors that affect this shape and how the architect chooses the appropriate solutions in a manner that is associated with human comfort inside the building. It is affected by several factors: the shape and direction of the building | Walls | openings.

#### 4- Social value



An example of a modern mashrabiya at the Institut du Monde Arabe in Paris. It drew inspiration from the traditional lattice work that has been used for centuries in the Middle East to protect from the sun and provide privacy, and also for its authenticity and enhancement in Arab architecture.

**2.2. Principles of sustainable architectural formation**

The formation of the architectural building is like the formation of writing, where the formation of the components tells the story of the formation of the building and determines its structure. Also, through the formation of the architectural facade, the architectural function of each of the functional formations of the building (Al-Rawashdeh) can be determined, and the formation can also be defined with sustainable foundations. In the following, the requirements and criteria for achieving sustainability are first addressed. Secondly, the characteristics of sustainable architectural formation in nature

**2.2.1. Requirements and criteria for achieving sustainability**



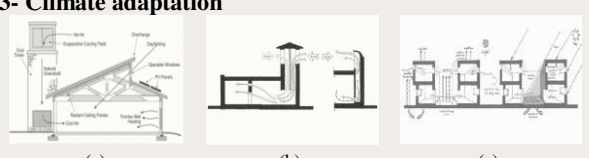

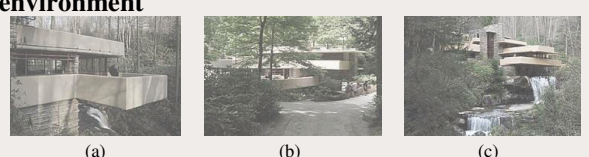
The architectural formation plays a major role in supporting the sustainability of the building, as it can contribute significantly to raising the efficiency of the environmental performance of architecture and urbanism, and it can also negatively affect them. Form directly on the costs of supplying services and infrastructure. There are organizations that support sustainability, as these organizations seek to organize projects to encourage the foundations and principles of sustainability, such as (American LEED), (British BREEAM), (Australian GREEN STAR) and (Japanese CASBEE), from which the most important requirements and standards have been drawn, which have been clarified In Table.5.

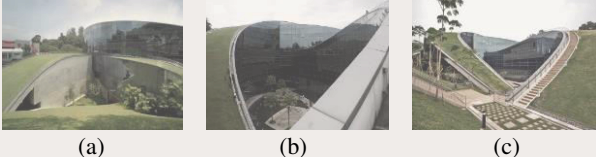
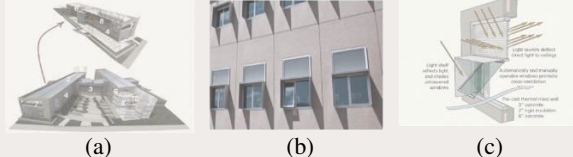
Table 5: Requirements and criteria that have been extracted from the systems supporting sustainability

CASBEE	GREEN STAR	BREEAM	LEED	Foundations and principles extracted from organizations supporting sustainability
✓	✓	✓	✓	Energy efficiency
✓	✓		✓	Resource efficiency
✓	✓		✓	Climate adaptation
		✓		formation related to the surrounding environment
	✓			Respect for users
	✓		✓	Innovative design

Some experts in the field of sustainability agreed on six main principles that represent the foundations and principles of sustainability, and should not be seen as a fixed list that must be applied by designers as a whole when designing buildings (Vale, B. & Vale, R., 1991). However, they are considered as indicators and directions that contain some ideas and solutions in order to make the most use of them, as it is noted that in practice it is often difficult to completely separate each principle from the other, there is no doubt that there is overlap and sometimes interdependence between these principles and each other, and six principles can be clarified As follows in table.6.

Table 6: Six principles of sustainability





<p><b>1- Energy efficiency</b></p>  <p>Fig.12. Principles of passive design.</p>  <p>(a) Right: Installing the wind turbines on site, Left: Installing them on the roof of the building. (b) Installing solar cells on these auxiliary structures to shade car parks (c) On-site installation of solar cells at the Los Angeles Postal Processing Center.</p>	<p><b>3- Climate adaptation</b></p>  <p>(a) (b) (c)</p> <p>Fig.15. Processor examples (a) Sectional example of a visitor center building in climate adaptation and design strategies (b) Right: the one-way grabber. Left: the two-way grabber, similar to the shakhshikha (c) The role of the inner courtyard as a cooler in the hot and dry summer months.</p>
<p><b>2- Resource efficiency</b></p>  <p>(a) (b) (c)</p> <p>Fig.14. Straws galore (a) Complete construction inside the building. (b) The method of finishing the walls (c) Straw baling method for walls.</p>	<p><b>4- formation related to the surrounding environment</b></p>  <p>(a) (b) (c)</p> <p>Fig.16. The Waterfall House by Byron, Pennsylvania, which was built on the rock at different levels with the waterfall and achieved the strong horizontal and vertical lines of the distinctive feature of the waterfall out of respect for the site, which led to the creativity of the formation's consistency with the natural surrounding environment (a) Strong horizontal and vertical lines (b) Trail to the entrance to the waterfall (c) The building overlapped the waterfall.</p>

<p><b>5- Respect for users</b></p>  <p>(a) (b) (c)</p> <p>Fig.17. An example of green roofs in the building of the College of Arts and Media Nanyang in Singapore, which was cultivated on the roof with the creation of a middle space between the three buildings to gather students and the teaching staff and create gathering places for students on the roof of the building, and the walls and columns were built of sustainable concrete material to resist earthquakes, which achieved the building Respect and human safety and environment (a) Concrete walls and columns (b) Creating a middle space (the courtyard) (c) College of Arts and Media Nanyang.</p>	<p><b>6- Innovative design</b></p>  <p>(a) (b) (c)</p> <p>Fig.18. An example of an innovative design principle, the RSF Research Support Center project in Golden, Colorado, which serves as a leading example of energy efficiency and innovative design (a) Innovative design strategies for the building, the interior design team developed a workspace layout to take full advantage of daylight and facilitate employee collaboration (b) Features of the facades and openings of the building (c) An innovative take on triple-glazed windows with drop-down awnings.</p>
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**2.2.2. Characteristics of sustainable architectural formation in nature reserves**

As mentioned in the previous chapter, buildings in nature reserves are characterized by a unique natural identity and character that evolved from the amalgamation of influences such as natural desert topography, climate, geography, and cultural factors, which influence the way of life there and add distinction to building styles and forms as well. There is harmony and harmony between buildings and nature due to the use of local natural resources as building materials. As architect Hassan Fathi used to say: “The building lives in the land it belongs to” (Dabaieh, M. 2011). For example, buildings can be fashioned into mountains, roofs are forests, and columns are trees, something akin to man-made "ecosystems," in service of the marketable architectural formation of "sustainability."

The following are some of the characteristics and features through which the sustainable architectural formation in nature reserves is distinguished from other patterns, and six characteristics can be clarified as follows in table.7.

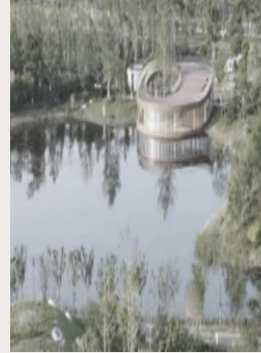
Table.7: Foundations of architectural formation	
<p><b>1- Compatibility with the surrounding environment</b></p>  <p>Sustainable architectural formation depends on the harmony of the building with the surrounding environment, climate, geography, and landscape. Architectural formation is not always about regular or irregular shapes. Designers can find inspiration from anywhere, especially nature. This specific type of inspiration is actually called biomimetic architecture. The shapes are so inspired by nature that what seems so simple in nature can actually translate into a better design solution by the designer. These design solutions are generally more efficient, sustainable, healthy and aesthetically pleasing.</p>	<p><b>2- Using local building materials</b></p>  <p>The sustainable architectural formation responded directly to locally available materials such as clay, stone, wood, and bamboo for construction, which were more energy efficient, cheap, readily available, and even less labor-intensive. The building materials used today are more synthetic, not sustainable, and difficult to reuse like concrete and steel. The construction industry consumes enormous energy and mainly contributes to global greenhouse gas emissions.</p>
<p><b>3- Compatible construction techniques</b></p>  <p>The sustainable architectural formation in building techniques still exists today and has proven to be more durable by merit. The use of local materials allowed for easy preparation, and the possibility to create the composite allowed for thermal efficiency, recycling, biodegradability, and sustainability. Building techniques were changed on the basis of trial and error and building materials were changed or added depending on the survival of the building. The building techniques were the result of those attempts to shape the best sustainable building.</p>	<p><b>4- Embodiment of local cultures (distinguished personality)</b></p>  <p>The values inherent in the architectural formation are the basic expression of the society's culture. It reflects the relationship with the region, and at the same time depicts the cultural diversity of the world, which can be seen in its shapes, colors, construction, and heritage characteristics. Also, the heritage of the architectural formation can be seen as the "essence of sustainability". Each community had its own architectural style, which showed its main character and culture and restored its sense of heritage, giving it a unique look. They are inseparable from the culture in which they were raised, resulting in their regional and economic aesthetics. The buildings were built according to their capabilities, needs, availability of materials, terrain and climate.</p>

**5- dominant visual character**



The visual character includes the architectural and urban character, and the architectural character is intended as the outcome of the external formation characteristics prevailing in the formation of building facades at the individual level, and it includes all of the building line, height, scale, proportions, formation, details, building materials, texture, colors, porosity, proportions of openings, and vertical and horizontal rhythms. As for the urban character, it is intended as the outcome of the external formation characteristics prevailing in the formation of groups of buildings, urban spaces, and the natural surroundings at the level of collegial relations among them.

**6- The design reflects the climate**



The climate of a region plays an important role in building culture. For this reason, building physics is one of the few areas of building engineering that does not change when moving from one climate to another. The figure also shows the design strategies in four different climate zones with illustrations of the proposed buildings

**3. Formulation of sustainable architectural formation using traditional architecture techniques**

**3.1. Traditional architecture in concept and characteristics**

Construction probably began with simple forms of masonry used as shelter from wind, sun and rain. Gradually, as the desire for better shelter increased, suitable materials were identified and construction skills developed. Traditional architecture throughout the world is usually characterized by the appropriate use of readily available local materials and an experiential understanding of climate and site. These building forms evolved over generations, and since the requirements were relatively simple and change was usually very slow, design, building materials, and construction techniques evolved according to needs and available resources (Sayigh, A. (Ed.. 2019). In the following, the concept of traditional architecture is dealt with with its concepts and characteristics.

**3.1.1. Concept of traditional architecture**

The concept of sustainability was present in the way of living of traditional societies and their lifestyle because the surrounding environment was the source of their life, and therefore they did not use the term sustainability as an expression of their way of living and how to provide sources of livelihood and the way they build, but rather lived the concept and applied it spontaneously and automatically. Brian Edwards, one of the most important specialists in sustainability and green architecture, defines it. He emphasizes the foundations of sustainability in traditional architecture: that it was able to blend the dimensions of social sustainability with environmental requirements to form sustainable architecture compatible with the environment.

**3.1.2. characteristics of traditional architecture**

Traditional architecture is affected by a wide range of different factors of human behavior and the environment. The factors affecting traditional architecture differ from one region to another, but nevertheless they share many characteristics, which include the four most important characteristics of traditional architecture, as shown in Fig. 19. these characteristics Overlapping in some way, as studies have shown that climate, building techniques, and availability of resources are the most important characteristics that affect most traditional architecture in Arab models. However, in global models, climate, heritage, and culture are the most prevalent characteristics.

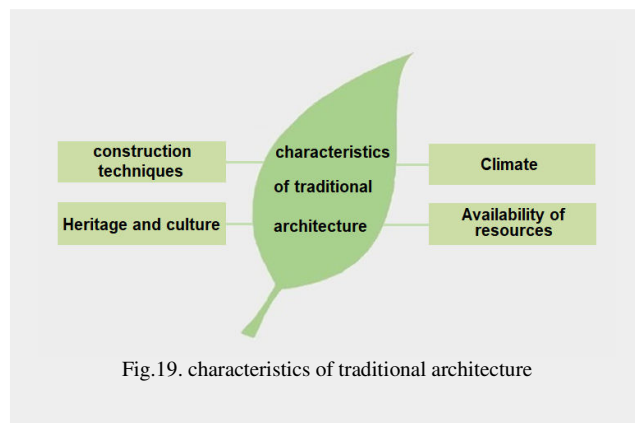


Fig.19. characteristics of traditional architecture



#### IV. EXPERIMENTAL RESULTS

#### 4. Analysis of experiments in the light of sustainable architectural formation in nature reserves

##### 4.1. Analytical study methodology

It reviews the components of the methodology used in analyzing experiences and begins with identifying the reasons for selecting global experiences. Through these reasons, the proposed methodology is formulated by defining, arranging and organizing basic data on the project according to a set of criteria that must be available when selecting international and Arab architectural projects to be analyzed and determining data analysis, followed by designing Tables used in data analysis to reach the results of trial analysis.

##### 4.1.1. Reasons for choosing international and Arab experiences

As previously analyzed international and Arab models in theories, examples and descriptions of four types of buildings existing in natural reserves, including hotel residential buildings, tourist buildings, educational buildings and museum buildings, which were distinguished in nature reserves by a unique natural identity and personality that developed from the amalgamation of influences such as natural desert terrain, climate and geography, and influenced There is a way of life, patterns and forms of construction and distinguish sustainable architectural formation in nature reserves from other patterns. In addition to analyzing international and Arab models of traditional architecture, it witnessed rich examples of traditional architecture distinguished in the development of forms and materials used with techniques, which depend on natural resources, especially the remains of wood and trees. Therefore, international and Arab experiences were selected in the following points:

1. Natural reserves were characterized by scarcity and environmental sensitivity, and they have natural features and geological features that the region contains distinct geology and landscapes of high aesthetic value. Therefore, it must be preserved and preserved, and the building requirements and standards must be fulfilled in order to be compatible and in harmony with it functionally and aesthetically.

2. The presence of shapes is so inspired by nature that what seems very simple in nature can actually translate into a better design solution by the designer. So these design solutions are generally more efficient, sustainable, healthy and aesthetically pleasing.

3. The importance of the characteristics of the global models of traditional architecture in taking into account the challenge and the history of heritage and culture, along with heritage elements that serve two functions, a structural function and an aesthetic function, where the structural function is in response to the climate, while the aesthetic function is represented in the culture of architectural models that were created in direct response to the needs and awareness of the importance of heritage and culture to the population local.

4. The importance of the characteristics of Arab models of traditional architecture in climate, building techniques and building materials, and the development of simple buildings from local materials in the surrounding area without relying on the transfer of materials from other regions.

Therefore, the focus is on global and Arab experiences in the analysis through these projects, in order:

- Visitor Center Project in Canada.
- Project of the Royal Academy for Nature Conservation in Jordan.
- Visitor Center Project in the United Arab Emirates.

##### 4.2. International and Arab experiences

International and Arab experiences are analyzed through three projects, namely the Visitor Center project in Canada, the Royal Academy for Nature Conservation project, and the Visitor Center project in the United Arab Emirates, through the proposed methodology as follows:

- General description of the project.
- Characteristics of the natural and built environment.
- Characteristics of sustainable architectural formation.
- Analyzing the role of traditional architecture techniques in achieving sustainable architectural formation.
- Conclusion.

The most important strategies for designing the project have been demonstrated in the criteria for achieving sustainable architectural formation using traditional architecture techniques in nature reserves, in the design of the table for project data with defining building standards and requirements in nature reserves, and defining criteria for achieving sustainable architectural formation using traditional architecture techniques, which can be clarified in Tables.9, 10 and 11, in order.









**4.3. The results of the analytical study of the experiments**

By analyzing the experiences of a selection of international and Arab models for projects to see the extent to which they meet the standards and construction requirements in natural reserves, as well as the extent to which they meet the criteria for achieving sustainable architectural formation using traditional architecture techniques through criteria for realizing the values inherent in architectural formation and the criteria for achieving sustainability. This is done through the tables used in the analysis of experiments, which are based on extracting the criteria that must be met in order to reach the role of traditional architecture techniques in formulating sustainable architectural formation in nature reserves, which can be explained as follows:

**4.3.1. Structural standards and requirements in natural reserves**

It is clear that international and Arab experiences adhere to building standards and requirements in nature reserves through the tables used, which achieve the most important laws related to activities, laws related to tourism management, and laws related to the Convention on Biological Diversity. Through previous monitoring and evaluation of international and Arab experiences and their design characteristics of the built environment, the results showed the extent to which projects achieve building standards and requirements, by comparing the experiences. Related to activities and laws related to tourism management and laws related to the Convention on Biological Diversity, then the educational buildings, which is the Royal Academy for Nature Conservation project, with a percentage of 91% in the laws related to activities and 100% for each of the laws related to tourism management and laws related to the Convention on Biological Diversity, as shown in Fig.20.

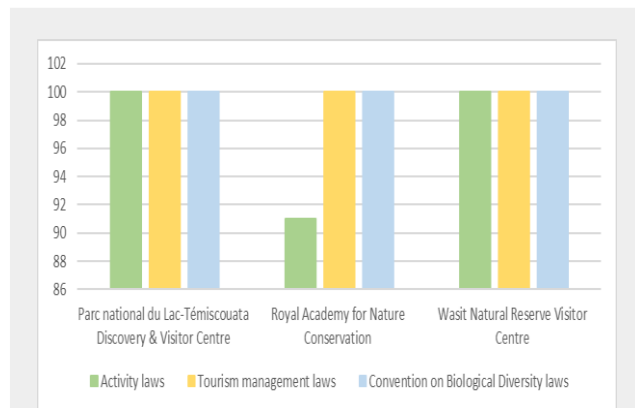


Fig.20. The extent to which building projects are evaluated for building standards and requirements

**4.3.2. Criteria for achieving sustainable architectural formation using traditional architecture techniques**

It is also clear that most of the international and Arab experiences achieve the standards of sustainable architectural formation using traditional architecture techniques by comparing the evaluation results of the experiments to find out the criteria for achieving the foundations and values inherent in the architectural formation, the characteristics of sustainable architectural formation, and the characteristics and techniques of traditional architecture through the tables used. The results can be stated as follows in Fig.21.

Therefore, the focus is on these experiences in the applied study in the fifth chapter to achieve the objectives of the research in order to reach the role of traditional architecture techniques in serving the marketable architectural formation of "sustainability". Where the characteristics of sustainable architectural formation are among the most important foundations and principles for achieving sustainability, which dealt with the foundations of sustainable architectural formation through compatibility of the requirements and criteria for achieving sustainability with the characteristics of sustainable architectural formation in natural reserves.

Criteria for achieving sustainable architectural formation using traditional architecture techniques													
Characteristics of sustainable architectural formation						The foundations and values inherent in the architectural formation							
The design reflect the climate	dominant visual character	Heritage of old buildings (characteristics of permeability)	Compatibility with traditional techniques	Use of local building materials	Compatibility with the surrounding environment	Achieving values is to enhance aesthetic, sense of location, and the physical structure of the building	The physical structure of the building is compatible with the surrounding environment	Shaping the building according to the aesthetic climate	Attention to building aesthetics in color and texture	Follow the principles of ratio and proportion	Use of traditional architectural elements or a specific program	Adaptation to the complementary field of the project	
●	●	○	○	○	○	●	●	●	○	○	○	○	Climate
○	●	○	●	●	●	○	●	●	●	○	○	●	Availability of resources
●	○	●	●	●	●	●	●	●	●	○	○	○	Construction techniques
○	●	●	●	●	●	●	●	●	●	○	○	○	Heritage and culture
●	●	●	●	●	●	●	●	●	●	●	●	○	Former construction and formation techniques
●	●	○	○	○	○	●	●	●	○	○	○	○	Climate
○	○	○	●	●	●	○	●	●	○	○	○	○	Availability of resources
●	○	○	●	●	●	●	●	●	○	○	○	○	Construction techniques
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●	●	●	●	●	●	●	●	●	○	○	○	○	Stone construction and formation techniques
●	●	○	○	○	○	●	●	●	○	○	○	○	Climate
○	○	○	○	○	○	○	○	○	○	○	○	○	Availability of resources
○	○	○	○	○	○	○	○	○	○	○	○	○	Construction techniques
○	●	●	●	●	●	●	●	●	○	○	○	○	Heritage and culture
—	—	—	—	—	—	—	—	—	—	—	—	—	No using traditional techniques

Symbols Semantics: ● Strong influence ○ Medium influence ○ Weak influence

Fig.21. Criteria for achieving sustainable architectural formation using traditional architecture techniques

5. An applied study on natural reserves in Egypt

1.5. Application of the Remal al Rayan Resort project as a case study in Egypt

The project is analyzed through the proposed methodology as follows:

- General description of the project.
- Characteristics of the natural and built environment.
- Characteristics of sustainable architectural formation.
- Analyzing the role of traditional architecture techniques in achieving sustainable architectural formation.
- Conclusion.

The most important strategies for designing the project have been demonstrated in the criteria for achieving sustainable architectural formation using traditional architecture techniques in nature reserves, in the design of the table for project data with defining building standards and requirements in nature reserves, and defining criteria for achieving sustainable architectural formation using traditional architecture techniques, which can be clarified in Table .12.

General description of		Characteristics of the natural		Characteristics of the built environment		Characteristics of sustainable architectural formation		Characteristics and techniques of traditional							
	The project consists of one floor, and the project includes a restaurant, suites, and entertainment activities. As shown in the figure corresponding to the components of the project.		In 2017, a mountainous area was developed in Wadi El Rayan Reserve. It took three years to meet the strict regulations for an environmentally protected area. Therefore, Remal Al Rayan Resort was opened in March 2021 with a restaurant, three suites and four rooms. As shown in the corresponding figure is the map of the general location of the project.		<b>6. Importance, rarity and environmental sensitivity</b> The project is one of the most important desert areas in the Western Desert, which enjoys stunning and panoramic views of the white and black deserts, including rock formations, conical mountains, and the only waterfalls in Egypt.		<b>5. Natural resources</b> The area boasts water and natural resources including wind and solar energy, and forestry, which aims to optimize the use of treated wastewater, timber production, and sand dune stabilization.		<b>4. Ecological characteristics</b> An ecological environment in the project, which is characterized by biodiversity of rare plant and terrestrial organisms as well as marine fossils.		<b>3. Climatic characteristics</b> Climatic environment at the project site in relation to the reserve. A hot desert climate prevails, with warm winters and very hot and humid summers. Stable downdrafts and high clear clouds make for arid, hot conditions with intense sunshine.		<b>2. Geological characteristics</b> The geological and morphological environment of the project. It enjoys its integrated desert environment, including sand dunes, natural springs and lakes.		<b>1. Geographical characteristics</b> Location and geographical environment of the project in relation to the reserve. It is located on the banks of the lower Nile, which covers an area of 62 square kilometers. It is also located near Wadi El Rayan Falls, which is one of the largest waterfalls in Egypt.
<b>Description of the distinctive structural spaces</b>		<b>Description of the building systems of the project</b>		<b>Room Spaces</b> The wing spaces have been used with local materials that blend with the beauty of the Sahara desert. The buildings are inspired by the appearance of the desert and the sand dunes, using simple structures and circular shapes, reflecting the nature in which they are located in order to respect it.		<b>restaurant spaces</b> The design of the venue is a perfect example of having an architectural sensibility that respects its environment and blends elegantly into its environment in harmony with the surrounding desert dunes. There are various seating areas with a dining table inside.		<b>The concept of creating spaces</b> The structures were configured in the form of goodomes and innovative architectural tents in harmony and harmony with the surrounding desert environment as a symbol of the shapes of the sand dunes.		<b>Ceilings and floors:</b> The ceilings consisted of several voids, including wooden beams covered with cloth, wooden beams covered with palm leaves, and wooden beams covered with bamboo. As for the floors, the use of tiles varied.		<b>Columns and openings:</b> The columns are built with the technique of wood structure (plywood) and stone (limestone). As for the openings, wood (plywood) was used in the doors and windows.		<b>Walls and cladding:</b> The walls were built with the wooden structure technique, the stone technique, and the clay technique, based on the embodiment of sustainable architectural forms that are functionally and aesthetically in harmony with the natural environment. Marble has been clad in some of the external and internal walls.	
<b>6. The design reflects the climate</b> Orienting the project according to the direction of the sun and the movement of winds in relation to the hot desert climate in Wadi El Rayan Reserve.		<b>5. dominant visual character</b> The architectural style of Tuni Village is one of the most famous rural and traditional buildings in the south of Lake Qarun. The urban character is detailed in the analysis row later.		<b>4. Embodiment of local cultures (distinctive character)</b> The project site surrounding four distinct elements. Which is one of the most important desert areas in the Western Desert, which enjoys stunning and panoramic views.		<b>3. Compliant construction techniques</b> The building was designed using environmentally friendly materials, which resulted in integrating the local rich traditional culture and in harmony and compatibility with contemporary building materials to achieve sustainability and the combination of heritage and modernity.		<b>2. Use of local building materials</b> Local building materials used in the project. Which includes clay, stone, bamboo, and wood, and are renewable and resource-efficient materials.		<b>Compatibility with the surrounding environment</b> Contemporary local building materials were used and reliance on the form of innovative architectural goodomes and tents, leading to the integration of the project as part of the natural environment surrounding the reserve.					
<b>The natural surroundings of Remal el Rayan resort project</b>		<b>Principles of urban character in directing and forming blocks.</b>		<b>The effect of sun direction and wind movement on building orientation</b>		<b>A map to show the project site and its relationship to the urban character</b>		<b>The most important strategies for project design have been demonstrated in the criteria for achieving sustainable architectural formation using traditional architecture techniques in nature reserves, in designing the table for project data with defining building standards and requirements in nature reserves, and defining criteria for achieving sustainable architectural formation using traditional architecture techniques</b>							
<b>The extent to which the project meets the criteria for achieving sustainable architectural formation using traditional architecture techniques</b>		<b>The extent to which the project meets construction standards and requirements in natural reserves</b>		<b>Activity laws</b>		<b>Activity laws</b>		<b>Activity laws</b>							
<b>Characteristics of sustainable architectural formation</b>		<b>The foundations and values inherent in the architectural formation</b>		<b>Activity laws</b>		<b>Activity laws</b>		<b>Activity laws</b>							
<b>The design element</b>	<b>Formulation</b>	<b>Use of local materials</b>	<b>Use of local materials</b>	<b>Use of elements in an organized manner or a specific order</b>	<b>Use of elements in an organized manner or a specific order</b>	<b>Use of elements in an organized manner or a specific order</b>	<b>Use of elements in an organized manner or a specific order</b>	<b>Use of elements in an organized manner or a specific order</b>	<b>Use of elements in an organized manner or a specific order</b>						
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**5.2. The results of the case study analysis**

Through the application of the case study of the Rayyan Sands Resort project in knowing the extent to which it meets the standards and construction requirements in natural reserves, as well as the extent to which it meets the standards for achieving sustainable architectural formation using traditional architecture techniques through the criteria for achieving the foundations and values inherent in the architectural formation and the characteristics of sustainable architectural formation and the characteristics and techniques of traditional architecture used . This is done through the table summary of the case study, which is based on extracting the criteria that must be met in order to reach the role of traditional architecture techniques in formulating sustainable architectural formation in nature reserves, which can be explained as follows:

**5.2.1. Structural standards and requirements in natural reserves**

It is clear that the case study adheres to the building standards and requirements in the natural reserves through a summary of the table, which achieves the most important laws related to activities, laws related to tourism management, and laws related to the Convention on Biological Diversity. Through monitoring and previous evaluation of international and Arab experiments and their design characteristics of the built environment, the results showed the extent to which projects achieve building standards and requirements, by comparing the study case in the experiments. Of the laws related to activities and laws related to tourism management in order, as shown in Fig.22.

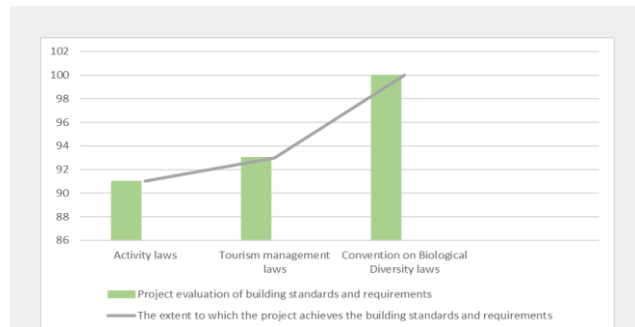


Fig.20. The extent to which the project evaluates the building standards and requirements

**5.2.2. Criteria for achieving sustainable architectural formation using traditional architecture techniques**

It is also clear that international and Arab experiences achieve the standards of sustainable architectural formation using traditional architecture techniques through the results of the evaluation of the case study to know the criteria for achieving the foundations and values inherent in the architectural formation, the characteristics of sustainable architectural formation, and the characteristics and techniques of traditional architecture through the tables used. The results can be stated as follows in Fig.23.

Criteria for achieving sustainable architectural formation using traditional architecture techniques													
Characteristics of sustainable architectural formation				The foundations and values inherent in the architectural formation									
The design reflects the climate	dominant visual character	Emulation of local culture (distinctive personality)	Compatible materials to landscape	Use of local building materials	Compatibility with the surrounding environment	Architectural values to be retained	The physical structure of the building according to its architectural form	Design the building according to the sustainable climatic conditions	The retention of the building form compatibility with the natural	Attention to building materials in accordance with the local	Follow the principle of state and	Integrate an integrated element	Adaptation of the complementary elements of the form
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○	●	○	●	●	●	●	●	●	●	○	○	●	●
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●	○	○	●	●	●	●	●	●	●	○	○	●	●
●	○	○	○	○	○	●	●	●	●	○	○	●	●

Legend: ● Strong influence, ○ Medium influence, ○ Weak influence

Vertical labels on the right: climate, Availability of resources, Construction techniques, Heritage and culture, Clay construction and formation techniques, Stone construction and formation techniques, Timber construction and formation techniques, Bamboo construction and formation techniques, Characteristics and techniques of traditional architecture and formation, Remot of Rayyan Resort Project

Fig.21. Criteria for achieving sustainable architectural formation using traditional architecture techniques

It is clear from the results of the statement that the case study focused on the techniques of clay, stone, wood and bamboo, which are more contemporary, more solid, durable and more environmentally friendly, in addition to being the future. It just needs to develop some elements of this evaluation, which achieved the research objectives down to the role of traditional architecture techniques in serving the marketable architectural formation of "sustainability". Where the characteristics of sustainable architectural formation are among the most important foundations and principles of achieving sustainability, which dealt with the foundations of sustainable architectural formation through compatibility of the requirements and criteria for achieving sustainability with the characteristics of sustainable architectural formation and the characteristics and techniques of traditional architecture in nature reserves.

## V. CONCLUSION AND RECOMMENDATIONS

- The study dealt with the characteristics of the natural and built environment in natural reserves, and reviewed natural reserves in terms of concept and importance, through these reserves it dealt with their concept, importance and classification according to the International Union for Conservation of Nature (IUCN) and according to the Environmental Affairs Agency in Egypt.
- The importance of studying the characteristics of the built environment in natural reserves in Egypt, as it dealt with building restrictions in natural reserves through international and local laws and regulations regulating construction in natural reserves. The characteristics of the built environment in the natural reserves were presented in order to achieve the compatibility of the building with the environment by analyzing four types of buildings built in the natural reserves.
- The value of architectural formation in the concept, foundations and inherent values. Thus, knowing the foundations of sustainable architectural formation through compatibility of the requirements and criteria for achieving sustainability with the characteristics of sustainable architectural formation in natural reserves.
- Provide an understanding of the formation of traditional architecture and the factors affecting its formation and existence. Due to the insufficient research on this subject, the method applied in this subject was based on the available research and reflections from the fieldwork study. The main objective that can be learned from exploring different traditional buildings is how the building blends with the natural surroundings using traditional techniques both on the external facade and through the internal techniques used. Finally, examining the forms and solutions of traditional architecture around the world can help solve the problems facing today's architecture. Lessons learned from these inspiring solutions must be implemented into current contemporary designs.
- Identifying traditional architecture in terms of concept and characteristics by addressing the concept of traditional architecture and its characteristics. Then the traditional architecture in techniques and standards by identifying the various traditional techniques in construction, and presenting the traditional techniques in construction that enabled builders to reach the building of traditional architecture with advanced ancient methods around the world with sustainable architectural formations, and thus the focus was on the most important materials used in the techniques: Clay, stone, wood, and bamboo in order, which are more contemporary, more solid, durable, and more environmentally friendly, in addition to being the future. Finally, the criteria for achieving sustainable architectural formation in nature reserves, which clarified the extent to which sustainable architectural formation was achieved by taking advantage of traditional architecture techniques.
- Focusing on analyzing international and Arab models in theories, examples and descriptions of four types of existing buildings in natural reserves, including hotel residential buildings, tourist buildings, educational buildings and museum buildings, which were distinguished in nature reserves by a unique natural identity and personality that developed from the amalgamation of influences such as natural desert terrain, climate and geography. There, it influenced the way of life, patterns and forms of construction, and the distinction of sustainable architectural formation in nature reserves from other patterns. In addition to analyzing international and Arab models of traditional architecture, it witnessed rich examples of traditional architecture distinguished in the development of forms and materials used with techniques, which depend on natural resources, especially the remains of wood and trees. Therefore, the international and Arab experiences were selected in the following points through these projects: the Visitor Center project in Canada, the Royal Academy for Nature Conservation project in Jordan, and the Visitor Center project in the United Arab Emirates, with extracting the criteria that must be met in order to reach the role of traditional architecture techniques in Formulation of sustainable architectural formation in nature reserves.

## VI. FUTURE RESEARCH

The research proposes a set of recommendations and future studies in this field and the research approach to the role of traditional architecture techniques in formulating sustainable architectural formation in nature reserves in Egypt. The following are some important instructions:

- Studying the conservation of natural reserves due to environmental scarcity and sensitivity, including the natural features and geological features that the region contains distinct geology and landscapes of high aesthetic value. Therefore, it must be preserved and preserved, and the building requirements and standards must be fulfilled in order to be compatible and in harmony with it functionally and aesthetically.
- Studying harmony and homogeneity between buildings and nature by using local natural resources as building materials, as architect Hassan Fathi used to say: "The building lives in the land to which it belongs." For example, buildings can be fashioned into mountains, roofs are forests, and columns are trees, something akin to man-made "ecosystems," in service of the marketable architectural formation of "sustainability."
- Studying traditional building techniques and their impact on the plastic elements in a strong way, and focusing on changing the features of architecture, as it provided a great deal of freedom and flexibility in the architectural formation. Moreover, traditional architecture can be considered sustainable because it respects economic, environmental and social factors. Therefore, we must fully study these sustainable plastic elements and increase architectural awareness towards them, in order to keep pace with the traditional architecture techniques that are compatible with them. Among the most important techniques of traditional architecture in construction and formation are: construction and formation techniques with clay, stone, wood and bamboo, which are more contemporary, more solid, durable and more environmentally friendly, in addition to being the future.

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