

# Cultural Identity of Desert Architecture: Exploring Strategies for Integrating Traditional and Modern

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**Abstract.** Predictions for desertification on a global scale, under an unusually variable climate, ecological vulnerability, and further expansion of human activities have become important in helping people build sustainable, green buildings in sensitive areas and exploring the possibility of better habitats in desert areas. The main objective of this study is to explore the possibilities of different types of desert architecture to provide sustainable habitats by combining desert traditional architecture, with modern architecture and human activities, to provide an alternative perspective on habitats on a global scale, and to predict their future evolution. Desert traditional architecture has always been a product of sustainable and green building, but the influence of globalization has made the people in the desert areas gradually lose their traditions and move towards industrialized construction and the use of materials, people are looking for modern living facilities to meet the needs that are not met by the traditional dwellings. In order to avoid the loss of traditional tangible and intangible architectural knowledge, this study focuses on how contemporary desert architecture can be adapted to meet the needs of modern lifestyles while still retaining the beneficial aspects of traditional techniques. Using examples of desert architecture from different periods in several countries, the study explores the differences and commonalities and summarizes the possibilities for sustainable development of traditional architecture in desert areas. In addition, the new architecture is categorized into three directions. The three directions of architectural design explore different possibilities for future desert architecture.

**Keywords:** Desert architecture; traditional protection; building development; suitability of desert; human settlements.

## 1. Introduction

Of the global land area of 162 million square kilometers, about one-third (48 million square kilometers) is arid and semi-arid desert areas, which are expanding at a rate of 60,000 square kilometers per year. Deserts have a dry climate and precipitation is scarce, with annual precipitation below 250 millimeters, and in some cases less than 10 millimeters (e.g., the Taklamakan Desert in Xinjiang, China), although occasional heavy rainfall does occur. Evaporation in desert areas is high and far exceeds local precipitation. Deserts often have clear, cloudless skies and strong winds, up to hurricane force [1].

The desert area is gradually expanding, but human beings have difficulty utilizing this type of land, so the potential for development is huge if can solve the problem of rational use of desert land, and have the possibility of building new, green, sustainable desert cities can effectively solve the current ecological imbalance of the earth, the problem of serious uneven distribution of population. Therefore, this paper takes the many possibilities of desert architecture as the starting point, explores the history and culture of desert architecture, and digs out the integration strategy between traditional desert architecture and modern architecture.

This paper analyzes and compares ancient and modern cases. For example, the Shali Castle in Egypt's Siwa Oasis was built in the 13th century and was constructed from a material called "kerchief" formed from the salt rock and soil of the local Salt Lake, and the building was gradually disintegrated due to the washing of rainwater [2]. The wind buckets and the layout of the windows in the Iranian building show the many environmental, green, and sustainable advantages of traditional desert architecture, which can be used as a basis for the future development of desert architecture, avoiding the consumption of energy in the form of high power. Modern architecture has a clearer and more

diversified division of functions to meet people's multiple needs, which is lacking in traditional architecture. Based on the long-lasting culture and characteristics of traditional architecture and the function and construction means of modern architecture, this paper believes that there are three integration possibilities, one is the continuation, the continuation of the traditional form of architectural appearance, or the extraction of local culture. The second is to complement, on the original site, with a new architectural language to fill the site, forming a strong visual contrast, both the continuation of the traditional architectural pattern, but also strengthening the artistic characteristics. The third point is the abstract expression of traditional culture, extracting one or a few cultural points and enlarging them as the cornerstone of creation to create a completely modern architecture. The industrialized and modernized architectural style is the unstoppable development step of any region in the face of the world. Giving skyscrapers local cultural elements as well as standing in the world requires a cultural identity.

This paper uses various case studies to further promote the green use and healthy development of today's desert lands, to explore more possibilities for human survival, to improve the living standards of the local people, to increase income, and most importantly, to make the desert civilization better and more open to the world [3,4].

## 2. Characteristics and Cases of Desert Architecture

### 2.1. Characteristics of Traditional Desert Architecture

#### 2.1.1. The Architecture of the Siwa Oasis in Egypt

The Egyptian oasis of Siwa is located on the edge of the Great Sand Sea, only 300 kilometers from the Mediterranean Sea and Marsa Matrouh in the southwest and about 70 kilometers from the Libyan border in the east. The Siwa is on average 18 meters below sea level and has always had excess groundwater.

Siwa has been inhabited since ancient times, Siwa has tombs and other remains from the late dynastic period, as well as a large number of monuments from the Graeco-Roman era. Over the centuries, the salinity of the ground and the size of the lake have increased with the development of agriculture and increased irrigation runoff. Today, the majority of the population resides in the town of Siwa, with a number of other villages scattered throughout the rest of the depression. The oasis is a unique environment with a mix of lush cultivated land, natural vegetation, and inhospitable desert landscapes. There are several salt lakes in Siwa, and Siwa also abounds with springs flowing with sweet sparkling water. Siwa is used as a case study to analyze the application of traditional desert architecture [3].

The residents of Siwa Oasis develop their eco-tourism industry with restraint and rationality, and everything is based on the protection of the forest resources. There is no massive felling of trees to build modern houses to attract tourists, and over the past thousands of years, the forests, the oasis, and the human beings have protected each other in this way and coexisted harmoniously. The Architecture of the Siwa Oasis in Egypt can be seen in Figure 1.



**Fig. 1.** Shali castle in the west desert in Siwa, Egypt.

The characteristics of Siwa architecture can be divided into the architectural heritage of Siwa Oasis, noble architecture, and urban architecture.

The architectural heritage of Siwa Oasis. Historical evidence suggests that the people of the siwa oasis began their lives, and corresponding architectural forms, at an early age. Early pharaonic tombs and the temples of Alexander the Great. As well as the fact that there is a considerable wealth of traditional housing here [3].

Aristocratic architectural features. The orientation of aristocratic buildings was purposely designed especially for the privileged, so the entrances and exits as well as the windows of most of the buildings face different directions, which are closely related to the stars and the sun in the sky (Reference Figure 2).



**Fig. 2.** Castle restoration imagery.

Characteristics of urban buildings. Compact shapes are designed to minimize exposure of building surfaces to the sun. Shadows and tunnels from the compact structure protect pedestrians and provide a comfortable environment. Favorable air circulation, and sand filtration (especially during sandstorms).

Features of religious architecture. Mostly stone masonry. Divided into an inner courtyard with a colonnade, a hall of columns, and a shrine. In front of the main entrance, there is an obelisk or a statue of Pharaoh. The front wall is carved with colorful light reliefs. The diameter of the columns in the Hall of the Great Columns is larger than the spacing between the columns, which enhances the atmosphere of the temple. Examples of architecture include the Temple of Amun (Reference Figure 3). The works of Egyptian artists had a practical purpose. They were not only an expression of inspiration and captured the imagination, but also conveyed the correct religious laws and connected the relationship between man and God [3].



**Fig. 3.** The Temple of Amun.

Building window characteristics. The number of windows opening onto the sidewalk is minimized to avoid adverse weather infiltration. Most of the windows face the protected central courtyard area, where climatic conditions are usually less severe and the interior environment is more favorable than the exterior of the building. In addition, the window openings are oriented in opposite directions to create cross ventilation. Another natural cooling technique used during the hot summer months is to grow plants next to the windows to cool the air before it passes through them (Reference Figure 4).



**Fig. 4.** Windows in traditional buildings.

The Siwa Oasis building is characterized by Karshif which is a special material Karshif material is used. This is an unusual material. It consists of sodium chloride salt crystals with impurities of clay and sand. These irregularly shaped lumps, taken from the salt crusts around the salt lakes were cut into smaller pieces and then masoned with mud. The mud is rich in salt extracted from two different types of clay - tafla or tiin. To improve the joints between the walls, wooden planks were also laid inside the walls. To improve the connection between the outside and the inside especially where the walls are wider [4]. The courtyard is a time-tested and valuable design pattern, located inside the house to protect against extreme heat and cold, as well as wind, sandstorms, and more. Inside, there are completely different room configurations, and the locals use different rooms depending on the season, using rooms with roofs in the winter and rooms without roofs in the summer, in lieu of mechanical refrigeration (Reference Figure 5).



**Fig. 5.** Interior room.

### 2.1.2. Iranian desert architecture

Falat-e-Marakazi (Central Iranian Plateau) this is the largest region of Iran, surrounded by mountains and rugged terrain, with a dry climate. The climate is dry. The two districts of Dasht-e-Kvir and Kavar-e-Lout make up 7% of Iran's area. The two districts of Dasht-e-Kvir and Kavar-e-Lout make up one-seventh of Iran's area and are located in the center of the country, which is completely barren. These two regions are completely barren and it rarely rains. The hot season is characterized by high temperatures, large differences between day and night temperatures, intense sunlight, and a relatively dry atmosphere. High temperatures during the hot season, large temperature differences between day and night, strong solar radiation, and a relatively dry atmosphere characterize the climate of salt deserts and deserts. Temperatures in different parts of these regions depend on geographic location, sea level height, and wind direction [5].

In terms of harmonizing architecture with regions, old settlement patterns, and cities were both residential and urban areas. Therefore, in terms of architectural harmonization with the region, old settlement patterns, and cities are both residential and aboriginal.

The urban fabric of these areas is compressed. The walls of the houses are merged or grouped together, and the boundaries between houses are unrecognizable. The compression and combination of buildings minimize the external area of each building [5].

The city space is completely enclosed. All public and private spaces are surrounded by high walls and have internal courtyards to minimize the effects of hot and sandy winds (Figure 6).





**Fig. 6.** Yazd urban texture.

Dome roofs are used to cover the roofs of mosques, reservoirs, and bazaars (shopping centers) and are another roof type for hot, dry areas. Apart from structural reasons, there are some thermo-physical reasons for dome roofs built in this region [6]. Due to the uneven surfaces of the domed and gabled roofs, the sunlight strikes the roof at different angles. As a result, part of the roof is always in the shade in the morning and afternoon. This effect on the intensity and angle of solar radiation helps to cool the roof (Figure 7).



**Fig. 7.** The dome's roof.

Windows are usually small in hot and dry areas and are located at the top of the wall near the sky panel. There are not so many Windows on the outer wall, but there are many Windows in the courtyard facing the inner wall. These Windows will promote ventilation. The wind catcher also helps ventilate the interior of the building (Figure 8).



**Fig. 8.** Hot-dry regions house windows.

People living in these areas have found through experience that the cold and unbearable heat of desert areas is due to the reflection of the land, which causes some substances to over-produce heat gas on the lower thin layer of land [7]. For this purpose, they built a high-air vent with up to eight wings for their own house, called the Badgir or wind catcher (Figure 9).



**Fig. 9.** Hot-dry regions house windows.

The commonly used materials for building large walls in hot and dry areas include mud slurry, mud brick, stone head, brick, ash slurry, stone ash, and wood (Figure 10).



**Fig. 10.** Material in desert architecture.

The thermophysical properties of these materials are the key factors in hot and dry areas. These materials have thermal resistance, high heat capacity, and absorb solar radiation through their outer surface. The micro view of the above material and a plurality of pores, during which the material is filled with air so that it becomes a material similar to the heat insulation material.

## 2.2. Examples of Modern Desert Architecture

### 2.2.1. The Region of Saudi Arabia

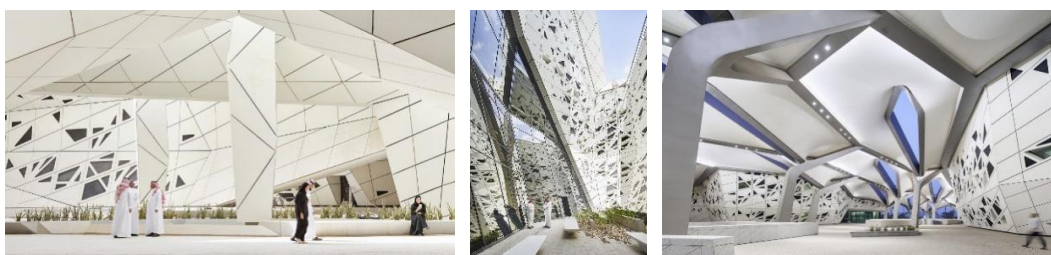
The design responds to the environmental conditions of the Riyadh Plateau, minimizes energy and resource consumption, and was recently awarded LEED Platinum certification by the US Green Building Council. The basic layout of the building is based on a cellular, semi-modular system in which the different buildings form a whole, connected to each other through public Spaces (Reference Figure 11). Hexagonal prisms shaped like honeybees form a cellular lattice system in a limited volume with a minimum of materials. This structure and organization principle defines the essence of KAPSARC: a crystalline structure emerging from the desert landscape that optimally responds to the environmental conditions and at the same time meets the functional requirements of the internal space. The honeycomb lattice gradually flattens towards the central axis, echoing the natural environment of the river bed extending to the west [8].



**Fig. 11.** KAPSARC campus five key buildings.

This research center is undoubtedly a forward-looking institution, and KAPSARC's architecture is also future-oriented: its structure allows for expansion and functional adaptation without altering the exterior features. The modular design has given rise to an overarching organizational, spatial, and structural strategy. The hexahedral "cells" have greater connectivity than rectangular blocks with only four sides, and KAPSARC's five buildings have different dimensions and organizational principles in order to better adapt to the needs of the user. Each building contains a functional structure that can be adapted to the needs of use and work. By extending the honeycomb lattice, the crystals can be easily stacked to accommodate the future expansion of the research center.

The unique form of the building also provides relief from the intense light and heat of the Riyadh highlands. The campus building wraps around a large communal courtyard, shaded by an elaborate forest of steel columns supporting a series of canopies. The buildings are oriented to the north and west, with a solid shell that protects them from the intense sunlight to the south, while drawing the prevailing winds from the north into the courtyard (Reference Figure 12).



**Fig. 12.** The buildings of the campus surround a large public courtyard.

In addition to a strong protective shell against extreme weather, the building has a porous interior. Special hexagonal 'cells' are systematically placed in each building and left open to form a series of covered courtyards that bring soft, controlled natural light into the interior. The crystalline structure of the building is increased in height on the south, west and east sides to protect the interior spaces from direct sunlight. The interior courtyards face north and northwest, bringing indirect sunlight to the spaces below. "Wind catchers" are installed inside the roof on the south side of each courtyard to catch the prevailing winds from the north, thus lowering the temperature of the courtyard [8].

The work is an inheritance and innovation of traditional desert architecture, reflected in the following points:

The windows have small openings to the outside and large openings to the inner courtyard.

The building blocks are closely connected to reduce wind and dust infringement and increase the correlation between functional blocks.

Wind-catching vents to promote wind circulation.

Satisfy the volume requirements of modern multifunctional buildings and enrich the multifunctional space of the building.

### 2.2.2. The Dubai region

Dabbagh Architects led by Principal Architect and Founder, Sumaya Dabbagh, completes the Mosque of the Late Mohamed Abdulkhaliq Gargash (Dubai, UAE), a contemporary place of worship that is quietly masterful in its use of form, materiality, and controlled natural light to evoke a sense of calm and spiritual connection and transition the worshipper from outer material world to inner sense of being (Reference Figure 13). The mosque is one of the first in the UAE to be designed by a female architect.



**Fig. 13.** External view of the building.

Dabbagh Architects endeavoured to eliminate the use of numerous volumes and simplify the conventional Islamic architectural style by reducing complexity to reveal its core. As part of the design refining process, the primary building volume was divided into two sections - the prayer block, housing separate spaces for men and women, and the service block, comprising ablution amenities and areas for the Imam, who leads the prayers, and the Moazen, who summons the prayers.

To regulate sunlight, three techniques are employed in the design. Firstly, the perforated dome enhances the connection to heaven by vertical means. Secondly, beams of light enter through narrow side openings to create a sense of divine light. Thirdly, the light directed towards the prayer halls worshippers indirectly create a focal point behind the Mihrab arch. A series of small apertures in the facade, following the decorative pattern of the interior, generate play of light and shadow. This is also a key component in traditional desert architecture - variations in light and shadow articulate the concept of eternity (solar change) in religious architecture.

### 2.2.3. The Old City of Tel Aviv

Facing the endless waves of the sea that break right at the entrance to the Old City, townhouses, adorned with impressive and traditional stone cladding, stand tall (Reference Figure 14). Within one of these historic buildings lies an apartment that has been transformed into a meticulously designed, one-of-a-kind house by architects Raz Melamed and Omar Danan [9].



**Fig. 14.** Urban environment.

During the redesign of the house, the interior was characterized by an interplay between traditional and modern elements. The original construction of the house was entirely covered with Kurkar stone, which is an ancient and traditional stone in Israel that adorned its walls and arches. However, during the renovation, selected parts of the stone were plastered to achieve a contemporary and clean look. This contrasted with the roughness of the remaining surfaces, and a balance was achieved between the smoothness of the plaster and the roughness of the stone [9]. The white plaster imitates the sensation of the sea, which, in its boundlessness, induces an atmosphere of complete tranquillity. Hence, the architecture is an extension of the sea, and vice versa. They coexist in a harmonious symbiosis, interdependent as if they were a single entity, devoid of any dichotomy between constructed and natural (Reference Figure 15).





Fig. 15. Detailed view.

### 2.2.4. Modern desert architecture

Dubai is undergoing an urban transformation and hopes to transform it into a livable city for all seasons through a series of urban construction projects. As arrive in the city by plane or car at night can feel this behemoth of a city evolving, connecting the city, its inhabitants, and the culture of the region. The 300-meter-high Wasl Tower is designed to do just that (Reference Figure 16). A vertically twisting tower, it rotates in all directions of the city, and a series of public spaces are integrated into it.



Fig. 16. Detailed view.

The project is based on Dubai's urban transformation and wants to present it in the most modern way possible. The core concept was to create a building that meets the needs of a modern city, realizing the concepts of form, engineering, and sustainability [9, 10]. In addition, intelligent operating systems, communication, and security systems are perfectly integrated into the structure. Clean and fresh materials, different levels of light, and sound insulation are used throughout the design of the building, which will be the tallest ceramic facade in the world. After much negotiation, basic materials were chosen for the main body of the building, such as low-tech glossy ceramic tiles for the facade (Reference Figure 17). The project uses parametric design and the latest technological engineering to realize the overall architectural appearance and employs a wide range of sustainable construction means. The facade's delicate scales perfectly cover the building's exterior seams, which not only provide the building with the necessary shade but also reflect some of the daylight back into the interior of the building [10].

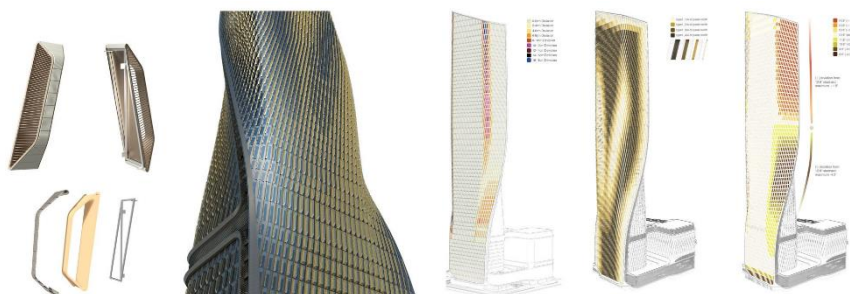


Fig. 17. Facade optimization.

### 3. Conclusion

With the advancement of science and technology and the further expansion of the human population, the problem of human survival is becoming more and more significant. Economic and cultural policies and climatic factors have led to imbalances in population distribution and regional development. At present, the desert climate problems and the question of whether human beings can survive and develop here, through a variety of scientific and technological as well as humanistic policies to help solve, and improve the desert countries, cities, and other regions to better and faster integration into the world stage, will be a multi-win strategy.

In terms of the examples of architecture in this paper, the desert architecture development strategy can be divided into three directions, namely, three degrees of preservation of the original architectural language, one is to retain more of the original language of the building, the modern architectural language less or less obvious into it, the second is to put the two architectural language together, forming a contrast, with a special art, the aesthetics of time. The third is to distill the traditional architectural language, perhaps artistic symbols, perhaps architectural features, and give it to modern architecture.

No matter which form of desert architecture, to a certain extent, the future development of the desert city, as well as human living space provides one more possibility. In order to better meet the multiple developments of ecology, economy, and humanity, it becomes an important target direction to maximize the protection of traditional cultural heritage, which will be passed down from generation to generation to summarize the experience of survival, the use of modern science and technology and the advantages of the close exchange of civilizations, to give play to the traditional low-carbon building of the possibilities of the present, look to the future, and give play to more creativity.

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