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Comparative Analysis of the Desert and Green Vernacular Architecture in the Oases of Egypt

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Keywords

vernacular architecture ;green building ;traditional and historical desert architecture ;Oases studies .

Abstract

Desert vernacular architecture has always been the nucleus of green architecture and sustainable buildings. This paper presents a focus on the vernacular architecture in the oases of the western desert of Egypt as a distinctive traditional architecture. The main aim of this paper is to finding out the principles of "green architecture" through a comparative analysis of both the historical and nowadays desert architecture in the western desert of Egypt. In order to represent the importance of the possibility of combining between green and desert architecture. Through an energy survey and a comparative analysis of both the historical and recent desert architecture and the analysis of the different traditional housing unit. Then comes the studies of the local ways of construction in the western desert of Egypt. The objective of this paper is established to stimulate environmentally appropriate practices in western desert architectural design and construction through the process of the impact of materials, openings and construction system to get better recommendation of a recent construction for a green sustainable desert unit in the oases of Egypt.

The aim of this paper is to study the comparison between the historical tradition architecture and the contemporary examples of the western desert in the last decade especially in the main five oases in western desert of Egypt: Siwa Oasis, Bahariya Oasis, Farafra Oasis, Kharga oasis, and Dakhla Oasis, the comparison will be between three different chosen oases. These studies of western desert architecture are analyzed through different elements such as the materials of the buildings, the pattern, the facades and the construction systems, also the different environmental treatments. Finally, obtaining the best results and recommendations of sustainable and vernacular architecture that helps to get the best energy efficiency construction system of new green residential houses at the oasis of the western desert of Egypt due to the expected expansion of the governance of Egypt in the sustainable and development projects.

1. Introduction

Traditional vernacular Egyptian architecture has changed a lot during different time periods especially at the oases, but architectural design respects nature in all durations. Green Architecture demonstrate a perspective understanding of environment-friendly architecture under all circumstances, and contains some universal consent (G.Burcu, 2015).The Green Building practice expands and complements the classical building design concerns of economy , utility, durability, and comfort (Niesewand, 2014 Mud House Design Competition) . So there is a deep

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relation between traditional vernacular architecture and the sustainble green architecture.

The purpose of this paper is to evaluate the effect of climatic factors on construction and local desert architecture in hot and arid regions with special focus on the historical vernacular and contemporary principales in the five main oases of western desert of Egypt. At the end of this paper, an example presenting that the architectural design of the building is one of the factors that affect the thermal comfort within. The architectural Elements play a great role in influencing the thermal comfort of the building (Elwefati, 2007), so this approach proposes a new perspective for looking at the future of the traditional and contemporary desert vernacular through conservation by modeling and simultion.The methodology developed provides a way to use vernacular values in contemporary and future houses and to ensure the continuation of the natural desert vernacular architecture of the oases and their expansions in the desert.

1.1. The Passive Strategies of "Vernacular Architecture"

Passive design is about taking advantage of natural energy flows to maintain thermal comfort. It is about using the appropriate building orientation, building materials also use environmental design principles and urbanism.(Hasim Altan, Mona Hajibandeh, Kheira Anissa Tabet Aoul and Akash Deep, 2016).Selecting passive strategies in vernacular architecture across different periods through decades especially based on the climate characteristics in the hot arid zones(figure1)depending on:

- Choosing a good orientation.
- Promoting natural ventilation and self- shade in summer and transitional season.
- Choosing a building envelope material of high heat capacity and low heat transfer coefficient.(Ying Wanga, Xiaofeng Lia*, Yuelang Gana , 2016)

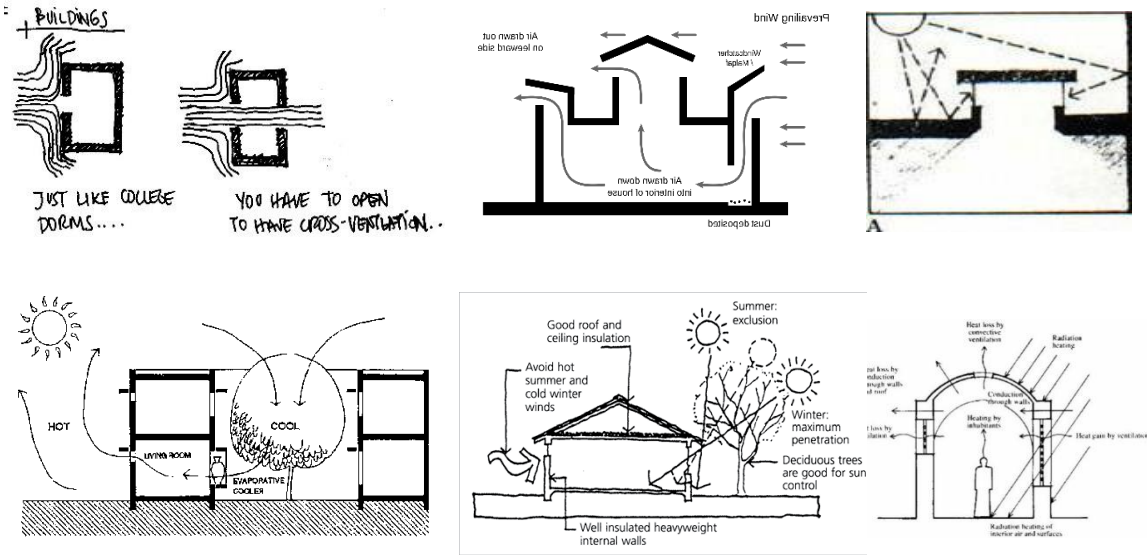

Figure 1 different diagrams show the passive strtegies based on the climate characteristics in the hot arid zones

1.2. The Green Design Strategies of "Vernacular Architecture"

Green architecture, or green design, is an approach to building that minimizes bad effects on human health and the environment. The "green" architect or designer attempts to maintain air, water, and earth by choosing eco-friendly building materials and construction practices (Roy Madhumita, 2008).

The following points summarize key principles, strategies and technologies of architecture which are associated with the five major elements of Green building design which are: Sustainable Site Design; Water Conservation and Quality; Energy and Environment; Indoor Environmental Quality; and Conservation of Materials and Resources(figure2). These points support the use of the USGBC ,LEED ,Green Building Rating System,and also focuses on sustainable principles and strategies rather than specific solutions or technologies, which are often site specific and will vary from project to project. (Amany Ragheb, Hisham El-Shimyb, Ghada Raghebb, 2015).

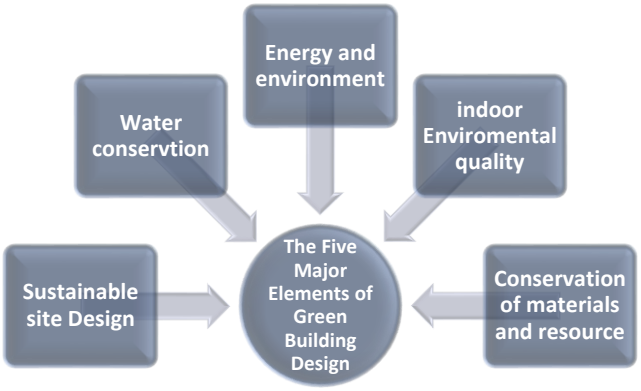

Figure 2 The five major elements of green building design

2. The Environmental Characteristics of the Western Desert of Egypt:

The republic of Egypt is one of the important countries with almost arid and semi-arid lands that got a high energy potentials in the world. Egypt covers very arid regions situated between the Sahara and Arabian deserts.(Moniem, 2009.).Egypt has lots of interesting Characteristics such as:

1. Egypt is situated in the north-eastern corner of Africa continent between latitudes 21^{O} and 31^{O} North and longitudes 25^{O} and 35^{O} East.
2. With a total area of 1 001 450 km^2; the country stretches 1 105 km from north to south and up to 1 129 km from east to west.
3. It is bordered in the north by the Mediterranean Sea, in the east by the Gaza Strip, Israel and the Red Sea, in the south by Sudan and in the west by Libya. (Dr. Mohamed A. El-Nahrawy, 2011)As shows figure 3. Egypt has many oases in its werstern desert and each oasis has its valuable historical architecture.

Figure 3 Figure is showing the oases in the western desert of Egypt and the Nile Valley and Delta and Egypt's borders

2.1.Desert Vernacular Architecture and Urban Compostion in Egypt

By studying the architectural composition and urban texture of hot and dry cities and villages in the western desert of Egypt, it is realizing that the climate factor plays a major role in the formation the texture of cities and architectural composition in these areas and climatic factors have always been an important material for the people living in these areas. These problems have guided people towards finding solutions over thousands of years which noticeably decrease annoying aspects of climate.

Most historic cities having spatial values are located in the hot and dry climate in the oases of the western desert of Egypt. The whole city or village looks :(figure 4)

- as a compact complex.
- The least surface is designed to be facing the sun.
- The pores are small.
- The direction of the castle in this climate has been towards the main alleys and included the summer parts of the houses.(Saeed Mahdeloei, Pooyan Gholami Saman, Mohammad Hossien Porkareh, 2Reza, 2011).

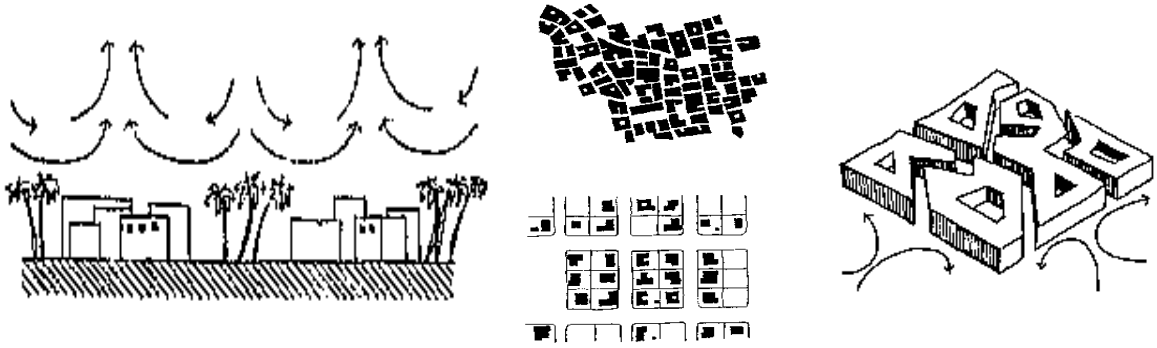

Figure **4** shows The main points of the settlements planning in the desert ; the orientation, the air movement, the form and the alleys.

Vernacular architecture in the oases is influenced by the sustainable principles of the environmental, economic and social studies. (Figure 5).

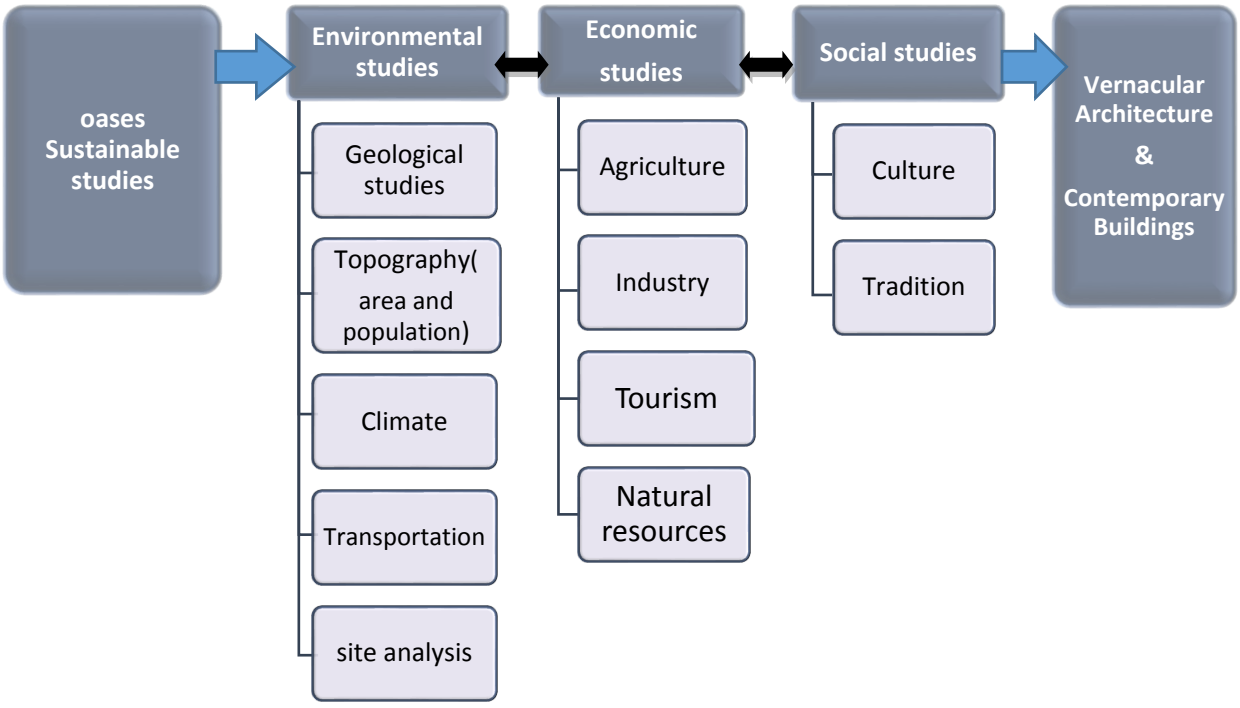

Figure 5:Diagram Of The Sustainable Oeses Studies and Architecture(by author)

2.2.The Effects of Climate Factors on Architecture in the Egyptian Desert

Since the ancient civilizations, energy has been employed in buildings to work with light, ventilation and thermal comfort. The need for shade in summer and sunshine in winter dominated the architecture of the past. (Chatterjee, 2007). The passive features of the western desert of Egypt have been studied in more details, in particular, the hot and dry arid region. The study identifies the passive features through the description in traditional vernacular architecture, in comparison with the contemporary architecture in the desert of Egypt.

Since in such climatic type of a hot arid desert with extreme high summer temperatures and dust storms, the houses have some features as:

- The natural lighting
- The air movement
- The insolation reflected lighting,
- The narrow shaded streets.

The degree of changing of heating in Courtyards and streets leads to ventilation, night ventilation minimized insolation with narrow street widths. The purpose of this article is to evaluate the effect of climatic factors on construction and local architecture in hot and arid regions with special focus on the oases of Egypt.

The building depth of the lighting air movement thermal capacity constricted of: a frontage on shaded street; the most lighting from courtyard; a ventilation through court and an evaporative cooling from well or water feature in courtyard; the thick stone walls; and mud roof and high thermal mass. The Building orientation of the grid pattern is diagonally to the east-west axis, the materials and thickness walls are important factors in the urban and architectural design in hot arid zones. Smooth curves and human scale proportions in mud brick structures. When hot air touches the humid and shaded mud brick walls and surfaces it cools down. The houses are built from:

- Stone with 0.45 m or more,
- The roof is thick vaulted,
- The bricks set or edge with strong lime plaster,
- Mud roof on timber beams Windows,
- In addition Wooden Shutters/Stone carved Jalis,
- The percentage of opening area is few opening towards street and open to courtyard.
- Historical Buildings in the oasis of Siwa are built from Karsheef.

Figure 6 shows the effect of climate on architecture in the desert vernacular towns of the oasis of the Western Desert of Egypt especially in Siwa oasis with shaded streets and alleys and the use of natural materials.

Figure 6 The effects of climate factors on architectural composition(the pictures was taken by the author on a field survey)

3. Characteristics And Identity of The Oases of The Western Desert of Egypt

Oases and farmlands in windy regions can be protected by planting tree fences or grass belts. Small plots of trees may also be scattered inside oases to stabilize the area. (Walker, 1997).Oases has different characteristics than the whole desert in general because it is kinf of agricultural settlements in the middle of the desert.

Oases are inhabited by Bedouin Tribes for years. The Egyptian desert consists of seven important depressions arranged by their nearby to the Mediterranean Sea but the main five Egyptian oases in the western desert (Siwa, Baharia, Farafrah, Dakhla and Kharga), as in figure 7.

The historical settlements in these oasis are presenting the heritage perspective of vernacular architecture. These oases have geographically and topographically its main characteristics which effect, the composition of local community settlements (Atiya, F. S., & Jobbins, J. Dabaieh,M, 2003)

The Oasis in the desert of Egypt is a kind of geographic landscape suitable for plant growth and sustaining human life, supported by stable water resources in desert regions; and it is obviously different from desert landscape that's why it has special characteristics. For vernacular architecture design and its effect, the traditional interior design of oases settlements keep buildings cool along the day while at the evening it will be warm ; moreover, preserve these buildings very well against environmental impacts of desert such as wind, sand storms, humidity, insects, fire … etc. (Dabaieh, 2011, p. 54).

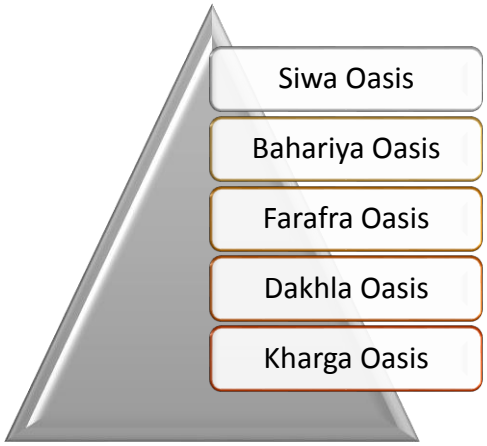

Figure 7 Diagram shows the five main oases in the western desert of Egypt (by author)

The figure 8 below studies the effects of climate factors on architectural composition of Egyptian Desert hot climate and evaluates the historic structure of the oasis and the environmental treatments.

Figure 8 The Characteristics Of The Architecture Of The Oasis Of Egypt (by author)

A comparison between three different oases and their vernacular architecture through construction materials, environmental treatments, plans and sections . This comparison shows the importance and the value of the historical and vernacular architecture and puts the spot on a future mix-design between the relation of historical and recent architecture in the western desert of Egypt.

3.1.Siwa Oasis:

Siwa is the most western Egyptian oases crossroads of the long trade routes crossing the desert ,it has represented throughout a very important place,from a commercial,cultural and historical viewpiont..The traditional urban model saw in the massive building in karsheef but nowadays therecent buildings looks different,in its dense

shape,composed of sections is supported one on the other and opened northwards,in the narrow and shady roads because of the mazallah(shady urban spaces that replace the squares),anxcellent attempt of adaptation to the climate context and usage of local materials,environmentally compatible.(figure 9)

Figure 9 Plan, Front View and Section of the survey of a house in Shali,Siwa Oasis(Oasi Di Siwa book)and a panoramic photo by the author

3.2.Baharia Oasis

The Bahariya Oasis is located in the central part of the Western Desert. Bahariya is the closest oasis to Cairo in kilometers, but the most distant oasis in time (figure 10) . The Nubian Sandstone Aquifer is the most important source of groundwater in the Western Desert, particularly in the Bahariya Oasis. (Himida, I.H . Holial, H.M., Shaaban, M.N, El-Fiky, A.A., Abd El-Latif, R.M.1, 2011).

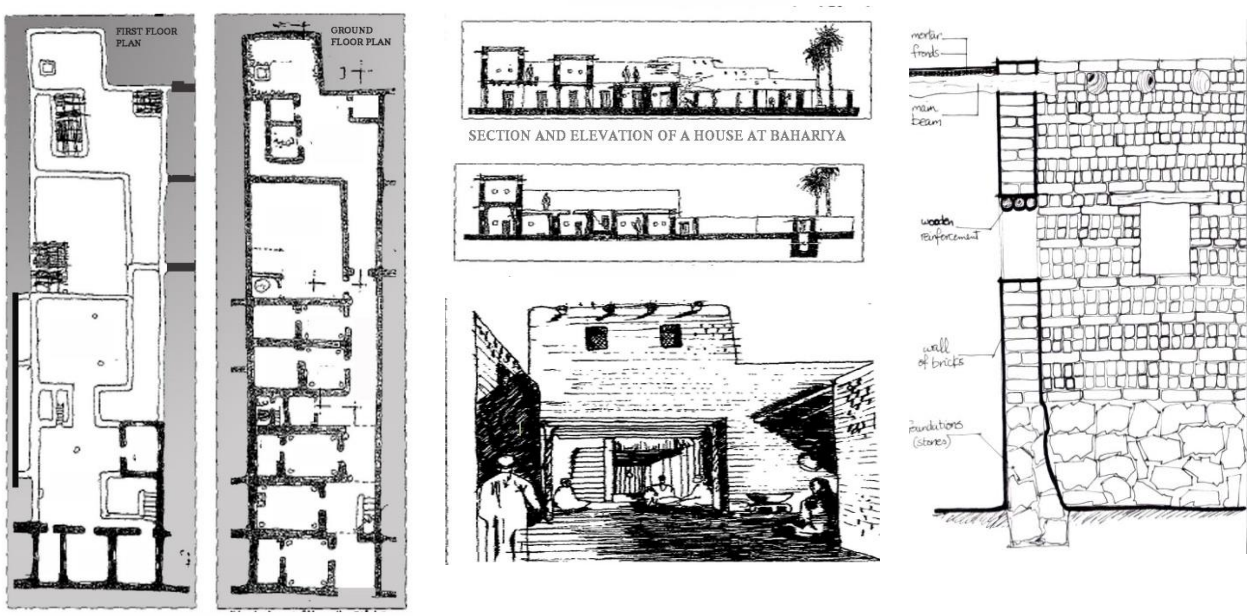

Figure 10 Typical plan ,section of a Bahariya house(Alam El Benaa) and a wall section (Oasi Di Bahareya-Archeourb)

The houses of Bahariya do not differ very much from the houses of the villages of the Nile Valleyat the edge of the cultivation Typically a traditional house of Bahariya is built of mud brick or stone walls(figure11), sand stone foundation and timber roof.(ElKerdany, D., S. Hawas, R. Kamel, F. Hassan, T. ElSerafi, A. Ghanem, and M. AbdelRaouf, 2011)

Figue 11 The houses of Bahariya Oasis.1-https://ar.wikipedia.org/ /File:Bahariya-oasis.jpg.2-walycenterjournal.wordpress.com.3-(The History of the Bahariya Oasis by Jimmy Dunn)

3.3.Dakhla Oasis:

Dakhla Oasis is located within the Western desert oases series and follow administratively the governorate of the new Valley. There are sixteen villages in Dakhla Oasis and Mut is still the capital. There is evidence to suggest that Dakhla has been inhabited since prehistory. The Dakhla Oasis training and Archaeological Conservation Project helps the people of Dakhla learn to honor and conserve their own heritage. (Vivian, 2000)

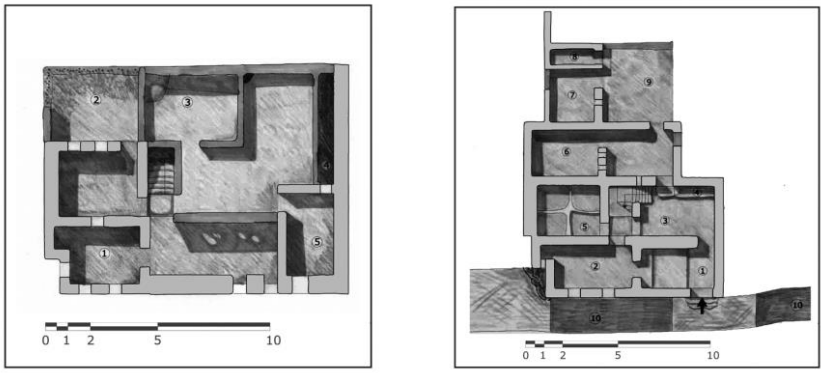

Figure 12 plans of Houses in Al Qasr,Dakhla oasis ((Francesca De Filippi, 2006))

The walls of houses in dakhla oasis in the historical area especially Mut are generally constructed using mud bricks, the main roof material is local wood, either from trees or palms.(figure 12) Reeds and palm ribs are used as secondary construction materials in roof construction. All the village in Dakla that were built during Mamluk and Turkish times had covered, narrow streets not only for coolness and protection from the sand laden winds but also so the horses and camels of invaders could not penetrate the city .Ornate carved door beams decorate the entrances to some of the old houses which are painted a medley of colors. The figure 13 shows an interaction between the human being and the surrounding cultural landscape within the patterns of socio-cultural behavior, Dakhla oasis (Dabaieh, 2011).

Figure 13 El Wadi El Gadid Governerate Dakhla oasis (Development Fund For Slums)

4. The Contemporary Architecrure of the Oases of Western Desert of Egypt

As a contemporary architecture two different directions in construction is taken in the Oesis of Siwa as an example the oesis of western desert of egypt . First Adrére Amellal: The Desert Ecolodge Sidi al-Ja'afar Siwa, Egypt. The lodge was built with 100 percent Siwan labor so that it would fit entirely into the architectural styles of the oasis.Adrere Amellal consists of a series of traditional Siwan kershef houses that have been restored and reconfigured into ten suites and 17 rooms, all of which offer genuine desert-style comfort. Kershef, a mixture of sun dried salt rock mixed with straw, is used for wall building , figure14.(Arab Republic of Egpyt , January 26th-27th, 2006)

In the other hand some habitants distroy the style of the oasis by building blocks with cement and reinforsed concrete and high rise buildings which deform the history of the oasis, figure15.

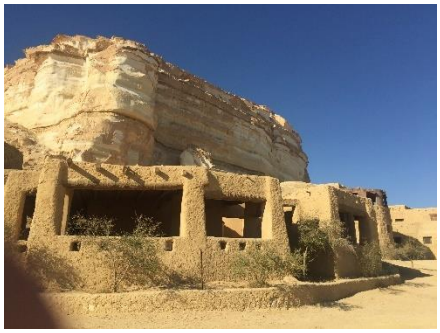

Figure 14 The lodge:Adrére Amellal(by author)

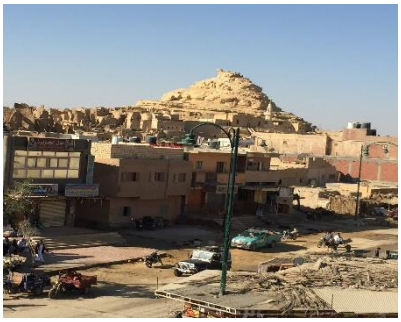

Figure 15 The new buildings by individuals (by author)

5. Conclusion

Oasis has the possibility for reviving the traditional architecture like the passive strategies of vernacular architecture and construction methods,and also has the possibility for reviving the traditional arts like wall paintings,but the absence of awareness for environmental construction methods, the local materials, and the habitants new buildings style are not compatible with oases style and historical value of the oasis of western desert of egypt, new houses with new material and forms affect negatively the oasis image, deterioration of living conditions or locals, labor problems among the youth for absence of enough economic activities, and Lack of essential matrials for day life and finaly a high cost of energy and electrecity problem of lighting and ventilation soThis paper shows the importance and the value of the historical and vernacular desert architecture in the western desert of Egypt and recommend a future mix between the new passive and active strategies in building sustainable houses.

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