Lessons Learnt from the Vernacular Architecture of Bedouins in Siwa Oasis, Egypt

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Abstract -

In the last few decades, climatic changes have become very important issue to investigate when dealing with sustainable structures. This paper presents the challenges made by the Bedouin residence of Siwa oasis in Egypt through the case study of three vernacular buildings, in order to identify the best practice and the most appropriate systems for climatic responsive low-carbon buildings. This paper investigates thermal insulation, best utilisation of building with the local materials, passive cooling techniques, natural sun lighting, all with the concept of best utilization of the available resources. The paper is also provides lessons learnt from the environmentally friendly case study buildings in Siwa for education, training and employment of people in rural areas with enriched environments, thus, the outcome of the paper will be used to achieve a surplus for investment and innovation.

Keywords -

Vernacular Architecture; Neo-vernacular Architecture; Sustainable Architecture; Environmental social enterprises; Siwa oasis; Egypt

1 Introduction

In the shadows of evolution of buildings' design strategies, philosophies and techniques, the world is facing environment crises and huge energy demands. Thus, emerging carbon and greenhouse gas emissions. In this notion of environmental pollution, climate has been linked directly to the ''vernacular responses'' where materials, resources and production is becoming the world's foremost source for research in the area [1]. Over the past few decades, there has been a greater demand in the field of architecture to achieve design strategies for comfortable living conditions in this challenging area, building on traditions and knowledge obtained from research into sustaining the natural environment. The majority of relevant research is focusing on the natural environment and its relationship with cultural heritage; where we found projects aiming to apply developed approaches of vernacular technologies for preserving cultural vernacular traditions. Some research exists on regionalization of vernacular architecture based on climate and cultural heritage aiming for energy saving, e.g.: [2]. However, limited data is available on the paradigm of the transformation of vernacular architecture from one generation to another with the transmission of technology. Nevertheless, by looking at the rich environments of Matmata in Tunisia, various lessons could be learnt from the ancient technique adopted of digging their houses in the caves as a mean by which they limit direct exposure to the harsh sun radiations [3]. Not only a remarkable beautiful traditional architecture have been emerged, but also such techniques comply successfully with the thermal comfort standards used worldwide now a days like ASHRAE-55 (The American Society of Heating, Refrigerating and Air-conditioning Engineers) [4] or ISO-7730 [5]. Likewise, many lessons could be learnt from the challenges met by Rajput Village in India where we can see the best utilisation of the landscape and agriculture for facing the prevailing monsoon rains, sudden flooding, rapid erosion and extremes of temperature and tropical storms [6]. From the same perspective, a recent example of neo-vernacular architecture has emerged from the wise use of technology in achieving the attractive luxuries vernacular Gouna resort in Hurghada, Egypt [7]. For this reason, this study is particularly interested in providing a review on three case study buildings in Siwa oasis in Egypt have made a major contribution to the sustainable architecture. Three case study buildings will be discussed for taking some lessons to be learnt from how the Siwan local people managed to incorporate their social enterprise dimension with the local architectural practices.

2 Siwa Oasis

Firstly, Siwa oasis is considered to be one of the ancient oases since pharaohs' days, called the oasis "mercy islands" as they represented the resting place for travelling tribes in the desert. The ancient Egyptian name of Siwa was "Sekht-am" which means the palm land. Siwa is located in Egypt's remote western desert, about 60 feet below the sea level. The total area of Siwa is 1088 kilo meters and it contains more than 300 fresh water streams and springs, populated by eleven traditional tribes totalling 20,000 people [8]. Siwa oasis has a dry hot summer reaching 39°C and cool winter reaching 5°C [9]. Siwa is popular for its palm and olive trees due to its location and the presence of hundreds of fresh water streams and springs, thus considered to be an agricultural oasis. It is one of the few Egyptian oasis communities that have managed to retain most of its traditional characteristics. Shali' the ancient salt-mud brick 'kershef' fortified dwellings was built in the 13th century. Dwellings were built side-by-side along steep, narrow and winding dirt roads, yet largely abandoned and left to collapse. Recently, heavy unusual rains damaged the dwellings, leading the population to abandon Shali searching for more space, dismantling any building materials and fixtures they could rescue to erect new. At the same time, the newly developed initiatives did not adequately consider the impact on the environment. Land was rapidly purchased by outside investors, the social fabric of the region started to change and traditional methods of sustainable use of resources were no longer practiced [8].

As a natural response to adapt to the harsh conditions of Siwa's arid desert environment, dwellings are generally characterised by being compact in shape for minimizing the amount of building surface exposed to the direct radiation of the sun and the alleys in between are narrow and often covered and shaded streets to avoid the heat of the sun and extreme brightness and provide ventilation shaft. According to interviews with the Siwans regarding their traditional architectural vocabularies used, another natural technique was used for cooling the air during the hot summer is the use of vegetation beside the openings and hence improving cooling the air before passing through the windows. Moreover, wind towers and atriums were used inside the houses. Also the windows were oriented opposite to each other's for creating cross ventilation. With regards to the construction technique with Kershef blocks, salt from the salt rich soli was dehydrated via leaving it in a direct sun exposure. Then 'Tlakht' is used as the filling material which is again fermented wet mud from the salty soil left for one week or two to dry.

Figure 1. Building with Kershef blocks row by row, one builder on top of the building, receiving the wet Tlakht from another builder after the layout of each block.

Buildings normally don't exceed 5 meters high. Thickness of walls is normally 50cm starting from the first row in the ground reaching 30 cm thick in the last row. Currently, Kershef building technique is abundant owing to the high moisture content in the soil, so it determined insulation before the workers immense in the building. Nevertheless, during the construction phase, the builders had to build layer by layer after making sure that the sand Kershef blocks get dried. Hence, recently Siwans have started to replace their traditional Kershef buildings with typical white blocks and cement as a mean by they save time.

3 Case study buildings

3.1 House of a Siwan: Haj Ali

The house of Haj Ali (Figure 2), occupying around 350m^2/ floor and 10 meters height. The building has been selected as it is one of the typical Siwans' Kershef built houses which are in a good condition up to date.

Figure 2. External view of Haj Ali's house

The building has two storeys connected by a central staircase also serving as a ventilation shaft, and a backyard sitting area for men 'khos' (Figure 3), a guest room 'almarbouaa' for visitors who visit the family on more frequent basis located close to the main entrance with a separate door from outside to insure privacy for the family member. The external walls are painted for emitting the solar radiations.

Inside the house, a small entrance lobby welcomes the visitors; family members pass through this area to access their private area upstairs. Storage room is located in the area between the entrance lobby and the kitchen, followed by the family living area so that there is no need for workers or outsiders to penetrate the house (Figure 4).

Figure 3. The backyard sitting area for men 'khos'

Interestingly enough, the stair case tower is used as lighting pipe where mirrors have been installed on the walls to reflect the sun light inside the house as shown on the diagram below (Figure 5), beside acting as a cooling tower as well.

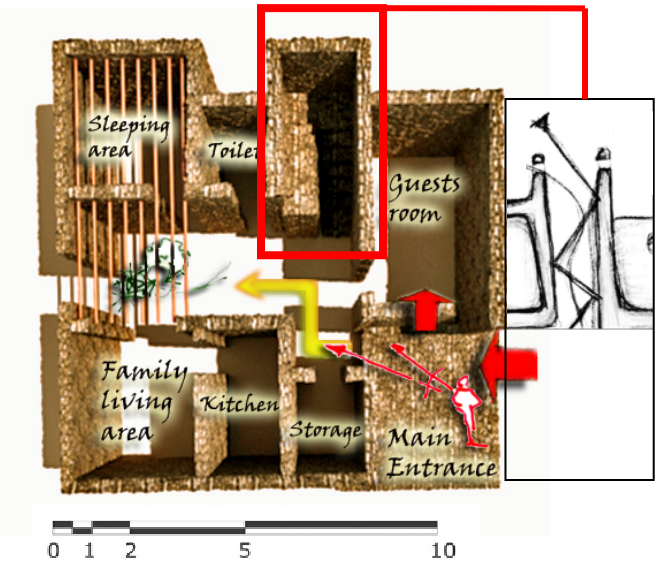

Figure 4. Left: Ground floor plan of Haj Ali house comprises of: L-shape entrance, 1 guest room, 2 storage, family living area, open roof sleeping area, toilet and a stair case leading up stairs to the bedrooms
Figure 5. Right: the stair case acting as a lighting pipe

On the upper floor, bedrooms are located with a central living area in which the family member gather, eat and discuss the family issues. Besides, the bedrooms are separated in to roofed rooms for sleeping in winter and non-roofed for sleeping in summer to replace the use of any mechanical modes for cooling during the hot summer. On a similar basis, another un-roofed kitchen is located on the upper floor in addirion to the one in the ground floor. The upper kitchen 'Tabent' is actually the one sued for cooking, equipped with a built-in Kershef cooker for minimising the use of electricity as well. The house was built first with 50 cm high concrete wall on the ground floor level, which is not costly to build for isolating the ground water from the Kershef blocks. Then they determined the areas of the room and afterwards they started building with the thick Kershef blocks until they reached the desired height. They repeated this for each single room. Following, they supported their walls with palm wood trunks connections on roofs to achieve straight endings of the building's walls, which was used as decorative element for interior design as well (Figures 6, 7).

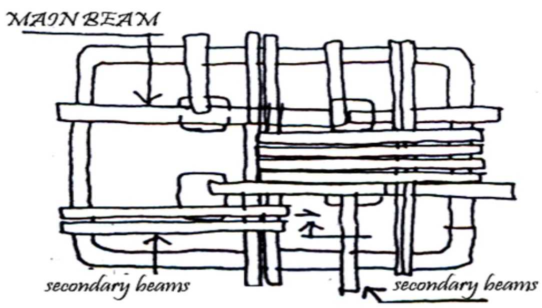

Figure 6. looking up view of the the palm trunks' roof with reference to the layout of the main and secondary beams (After Altawil H., 1989) [10].

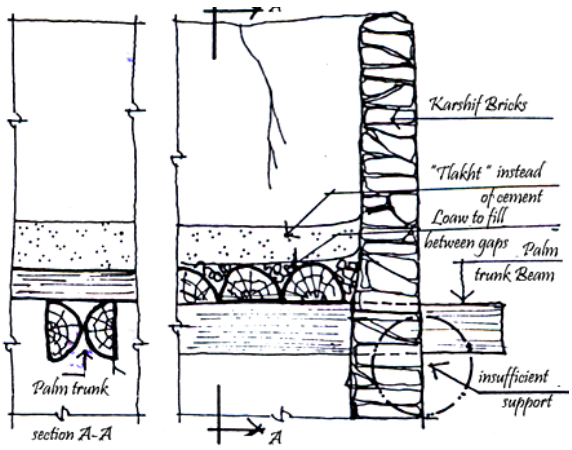

Figure 6. Section showing the palm tree trunks used for roof construction (After Altawil H., 1989) [10].

Figure 7. Interior view of the palm tree ceiling

As shown from this example, various low cost climatic responsive building techniques have been adopted inspired by the traditional Siwans' houses, summarised as follows:

1- Best utilisation of the local material for climatic responsive zero carbon emission building, while using the local material for building the cooker to minimise the electrical devices.
2- Using the stair case tower as an atrium for passive ventilation.
3- Creating an affordable lighting pipe for maximum the use of sunlight sheded on the house for long hours during the day.
4- Orienting the windows in a way to promote cross ventilation as a replacement for air conditioners.
5- Designing the main entrance in L-shape and locating the private rooms at the back of the house for conserving the local culture and traditions of keeping the privacy of the family and segregation between females and males.
6- Designing a beautiful yet robust palm tree trunk ceilings, matching with the layout of Kershef building and also as a material for climatic responsive zero carbon emission material.
7- Encouraging social interaction among the family members by providing central gathering areas.
8- Encouraging social interaction among the members of the society by providing outdoor sitting area for men 'khos'.

All these combined techniques helped achieving a healthy, low-cost, thermally comfortable and well-designed house, externally and internally.

3.2 Shali Lodge and its extension Al Baben Shali

The second building proved a role example in a community sustainable designed project which helped in providing a better quality of life for the Siwans.

In an aim to achieve sustainable development in Siwa, Mounir Neamatalla (president of Environmental Quality International (EQI) in Egypt), decided to invest in projects for preserving Siwa's wealth of natural assets and cultural heritage which in turn could reduce poverty. Thus, Shali Lodge and its extension Al Baben Shali were constructed as the first eco-tourism lodges in Siwa. Shali lodge is situated few meters from the village in Siwa and built with the local Kershef. Interestingly, no electricity was used, unlike the other eco-lodges, which promoted the awareness of less energy consumption among the society. The building technique adopted relied mostly on best utilizing the available resources. For instance; both buildings were built with Kershef and the interior walls exposed to the sun were painted in light colors for emitting solar radiations (Figures 8, 9). Also, open air atrium between the rooms has been created for passive ventilation, where we can see wide opening arches are surrounding the atrium for enhancing the wind speed. Again, the windows were orient in an opposite direction for achieving cross ventilation for replacing air conditioners. In addition, different forms of palm trees' layout were designed for ceiling construction, inspired by the traditional Siwan technique adopted in the previous example (Figure 11).

Figure 8. An atrium in Shali lodge between the hotel rooms influencing wind movement via passive cooling and creating cross ventilation as well.

Figure 9. An open roof gathering area in Shali lodge, showing the Siwan bedwin spirit reflected on the interior façades design and integration of palm trees.

As seen on Figure 9, alcoves were grooved on the walls for storage or decorative purposes inspired by the old Siwan vocabularies. Most important, since the project determined construction using the local materials, Neamatalla had to establish a contracting company for kershef to carry out the building work where not many Siwans were skilled for the task. As a result, further demand in kershef building techniques occurred afterwards; creating more job opportunities for many Siwans. The number of workers who obtained training in building with kershef increased as well. Moreover, part of the project was dealing with proper management of Siwa's assets, which attributed to raising the awareness of the local people to the importance of protecting the non-renewable resources of the oasis. As a result, land reclamation was significantly limited by agriculturalists to become 25,000 acres after it was from 250,000 while also water depletion was prevented and agriculturalists started to grow organic pesticide-free crops.

Figure 11. A unique pattern of the wooden palm tree ceiling with a lamp made from salt, hung from the ceiling.

The unique wooden designs inspired by the traditional Siwan vocabularies are also applied in arches' designs (Figure 12).

Figure 12. Decorative arches using palm trees' trunks

Lighting lamps, furniture items using dehydrated sand. A unique pattern of the wooden palm tree ceiling with a lamp made from salt, hung from the ceiling.

Figure 13. A center piece table made from dehydrated salt blocks

Figure 14. Natural technique adopted for passive cooling and the design of narrow alleys with narrow windows from one side and wider ones from the other side for creating cross ventilation.

The project helped employment of over 45 Siwan which also helped them not only to earn wages but to gain the abilities and techniques of long-established building systems.

In addition to the best utilization of Kershef in buildings' design, both Shali and Albabin Shali lodges helped achieving the following:

1- Enhancing passive cooling via separating the building with narrow alleys for creating wind currents, besides cross ventilation replaced the use of air conditioners.
2- Promoted the awareness of less energy consumption among the society.
3- Workshops for the community to raise the awareness for climatic responsive architecture, as a result land reclamation was significantly limited for instance.
4- Encouraging local trades inspired by the traditional building techniques like constructing a Kershef factory, and palm tree roof construction for creating more job opportunities to the society.
5- Creating a new and unique practice of dehydrating the salt furniture and lighting units inspired by the best utilization of the natural environment.

3.3 Adrere Amellal eco-lodge

Another EQI sustainable driven project is the Adrere Amellal eco-lodge. It has been selected for the remarkable blend of the building with the surrounding natural environment and landscape.

Amellal eco-lodge is considered one of the main touristic eco-lodges in siwa. It is located in a unique place surrounded by sculpted limestone, 75 acres of palm and olive trees, salt rocks and clay, aimed to best use the available local building materials available in the surrounding environment. The hotel is at the edge of the lake Siwa in the western desert. The building has 39 environmentally friendly rooms, the rooms are designed with a style of comfort and respect to the environment at the same time. Windows were designed to be very small in size and imbedded in the very thick Kershef walls. Similar to the previous buildings discussed, climatic responsive materials used and passive cooling and cross ventilation were achieved for better climatic conditions.

Figure 15. Adrere Amellal eco-lodge blended within the mountain and within the surrounding landscape

The building was built at the foot of the mountain in order to build on non-arable ground and to appropriately coat the arrangement in a manner that merges the mountain with the building. The building is characterised with its furniture, made with the local materials of sand blocks, various Kershef patterns, unique sky light roof made of palm tree trunks blended with sand blocks, and furniture carved from palm tree trunks. The floors are built with stone. In bathrooms, both walls and floors are built with stone (Figure 17).

 

Figure 16. Left: The small windows imbedded in the thick walls.

Figure 17. Right: Bathrooms built with stones on walls and floors

Figure 18. Sky light roof made of palm tree trunks blended with sand blocks

Figure 19. An example of the dehydrated Kershef textures which added beauty to the interior design in addition to acting as good insulators

According to a report by Hatem T. (2007), the EQI projects enabled the local people to create economic opportunities for themselves while restoring the physical environment, promoting gender equity, marketing local products to the international market, and helping position Siwa on the global stage [11]. Also, it has been reported by a Siwan that the EQI projects has respected Siwa's culture, norms, and nature. Moreover, it used modern technology to enhance the past; referring to not using electricity which was done intentionally to make travelers experience night time and day time to allow them to go back to the natural rhythm of life, and feel harmony with nature. A better quality of life was provided to the people, including: simple, clean, good food, and fusion of state of being, that makes Siwa a unique enterprise. Furthermore, according to Abou Adel, marketing coordinator of the Siwa Initiative, Siwa was one of the poorest communities in Egypt where over 90 percent of its people were involved in agriculture, and the rest in tourism. Not until the EQI eco-lodges encouraged the local people to be engaged in other activities related to tourism, like Kershef construction, palm trees' roof construction, sand furniture and products, the Siwans. At the same time, Siwan women were given opportunities to gain employment, a prospect that was previously unheard of in the male-dominated society [12].

A primary lesson that could be learnt from this example is the remarkable blend of the building with the natural environment using the traditional vocabularies, not only on the exterior façades, but also through the interior vocabularies used.

4 Lessons learnt

According the case studies illustrated, it could be concluded that the local material in Siwa is cheap, naturally available in large quantities in the surroundings, durable, when applied correctly, having good thermal mass capacity for insulation and having beautiful surfaces as a finishing materials. Most important, the building technique adopting the local materials is more climatic responsive and adds the uniqueness of design and traditional spirit versus other techniques for a more sustained environment. Thus, owing to Siwa's rich natural environment and the use of vernacular architecture in transforming Siwa's traditional building techniques, the following lessons could be learnt from the previous examples:

1- Using the local availabilities in the building site yield the most appropriate building isolative properties for achieving thermal comfort
2- Using technology in adopting vernacular architecture vocabularies helps achieving climatic responsive innovations in the building construction filed.
3- Explaining to the local people the actions that benefit the earth compared to what may be damaging to the environment enhances climatic responsive building techniques, best utilization of the local available materials, and the creation of low-cost zero carbon building techniques.
4- Engaging the community in environment awareness programs promotes a better quality of living from all aspects of life.
5- Transforming the sustainable development project scope in the low income communities in to a business model would significantly enhance the economic status of the poor.
6- Limiting the use of air conditioning to be replaced by natural ventilation methods achieves cheaper and a more energy-saving conventional alternative for climate control.

Overall, one can say that these lessons could be taken for a comprehensive sustainable development model that can inspire other communities around the world and would significantly increase positive impacts on the poor.

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