

## **Sustainable Features of Vernacular Architecture** **A Case Study of Climatic Controls in Hot Arid Climate**

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**Key words:** Sustainability- Vernacular architecture - Nubian traditional architecture

### **Abstract**

From the end of the last century, energy constraint and global warming became the biggest challenges confronting the planet. The building sector is one of the major energy consumers in the world. In hot climates, most 20th century buildings are dependent on air-conditioning systems and electricity, reliant on fossil fuels and increasingly unable to adapt to a warming climate.

In contrast to modern buildings, we find vernacular architecture in these regions is more adaptable to the environment according to principles evolved over many generations, These principles include: layout orientation, distance between buildings, building orientation & form, climatic elements such as porches, wind catchers, central courtyard, and so on.

When sustainable design features of vernacular architecture are under scrutiny, we realize how traditional buildings and settlements in hot- arid regions were designed in harmony with the local cultural, topographical and climatic conditions and how their design and construction could be integrate in today's design practices.

In vernacular architecture, not only the climatic problems were resolved, but also the aesthetics, physical and social functions of the dwelling were considered. this is why we find so different designs across hot arid climates regions.

This paper aims to explore and evaluate the architectural design elements that can be adopted from the vernacular architecture in hot arid climate. In addition to, It will concentrate on Great examples of well-thought vernacular architecture are located in Egypt(Nubia), where prevail a hot -arid and desert climate zone.

### **Introduction:**

there are various ideas concerned with sustainability achievements that occurred in different fields. One of these ideas was sustainable architecture which seeks to minimize the negative environmental impact of buildings by enhancing efficiency and moderation in the use of materials, energy, and development space.

If we go back to the vernacular architecture in hot arid climate, we will find many examples that achieved sustainability with traditional tools and tried to realize a friendship with the natural environment. So, we will spot the light on The Nubian community as an example in these regions , with its superior heritage, special traditions and habits and its vernacular architecture is a discriminative community that needs to be conserved. .

The research aims to understand sustainability from environmental and cultural perspectives and analyses the traditional house as an example of achievement of these perspectives. In order to realize this aim, the research starts with discussion of the idea of sustainability and aspects of sustainability. And then the study focuses on Nubian village and Nubian house.

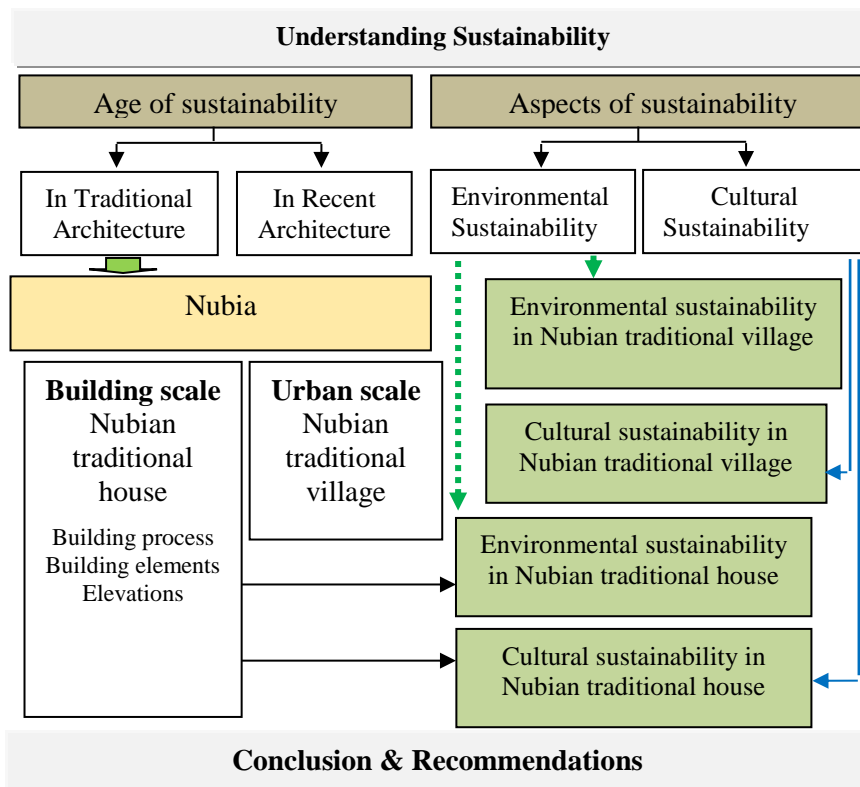


Figure 1: Methodology of the research

### 1 Sustainability as a traditional idea:

Towards the end of the twentieth century the word sustainable (and sustainability) entered into the consciousness of architects and became an essential concern in the discourse of architecture (Bennetts, 2004). The idea of sustainability is to ensure that our actions and decisions today do not inhibit the opportunities of future generations. This idea can be achieved in traditional architecture which is distinctive by its historical, cultural, social and environmental features. The traditional architecture has many faces of achieving sustainability starting from planning scale reaching to building scale. So, the word Sustainability is recent, but the idea is traditional.

### 2 Aspects of Sustainability in traditional architecture:

The aim of Sustainability is to save natural resources for coming generations, So sustainable architecture seeks to minimize the negative environmental impact of buildings by enhancing

efficiency and moderation in the use of materials, energy, and development space. On the other hand, cultural resources aren't less important than natural ones for coming generations that they form the characteristics of society. Therefore sustainable architecture has to seek also to minimize the negative cultural impact of buildings by enhancing the character and identity of place during design process.

Therefore traditional architecture with its superior character and environmental awareness can be a good example of achieving both aspects environmental and cultural sustainability.

### 3 Nubian traditional village and urban Sustainability:

Around 5,000 years ago, a rich and powerful nation called the kingdom of Kush (also referred to as ancient Nubia) was a center of culture and military might in Africa (Bulliet R., et al , 2009). Ancient Nubia had a wealth of natural resources such as gold, ivory, copper, frankincense and ebony, but they also produced and traded a variety of goods such as pottery. It is thought that this Nubian kingdom was established even before the Egyptian monarchies began to reign along the Nile.

Nubian village is a distinguished example of traditional Egyptian villages, it has a unique character which formed by its intimate correlation with Nile and Topography. West Aswan and West Soheil are examples of Nubian traditional villages.

#### 3.1 Urban characteristics of Nubian traditional village:

##### 3.1.1 Mergence into nature:

The village is formed according to topography of sight; even inside the Nubian house may found different levels which not found in most of other Egyptian traditional villages.

##### 3.1.2 Intimate conjunction with Nile:

Most of Nubian traditional villages are located in the Nile shore. So the orientation of buildings and paths related to the Nile.

##### 3.1.3 Urban tissue:

Nubian village is characterized by its Compact urban tissue and roads in Nubian settlements are not straight and always follow the natural shape of the site. The size of the road can be so narrow that only can be passed by two pedestrians. During hot days, the people like to sit outside in front of their houses. The streets are narrowed to allow the maximum shade and shadow Fig.2.

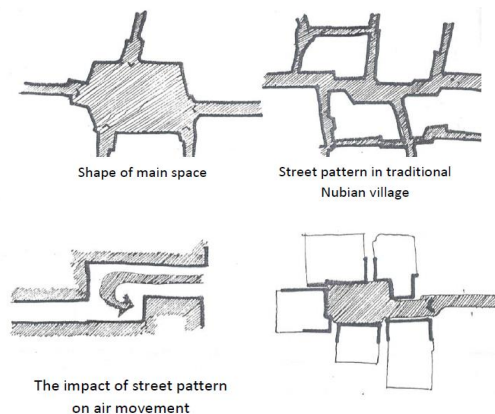


Figure 2 Example of Nubian traditional village pattern of streets and spaces

#### 3.2 Environmental sustainability in Nubian traditional village:

There are many elements in Nubian traditional village which reflect how Nubians take the environment into consideration such as:

##### 3.2.1 Harmony with nature:

That can be illustrated in buildings arrangement in consistency with topography Figure 3.

##### 3.2.2 Street pattern:

Streets in Nubian settlements are not straight and always follow topography of the site that prevent



Figure 3: Nubian village merges into topography and looking at the Nile

hot air and dust from movement inside the settlement. Streets are narrowed to allow maximum shade and shadow

### 3.3 Cultural sustainability in Nubian traditional village:

Nubian customs and traditions thousands of years old, making them combine to become rituals that reflect on every component of the society.

#### 3.3.1 Value of the Nile:

Since ancient Nubian civilization, the revere of the Nile has been a part of Nubian tradition and it has been related to many myths which are still alive in Nubians sentiment. Therefore, the Nile has been a vital factor in planning of Nubian traditional village. It influences building orientation that most buildings main elevations and entrances are looking at the Nile. Road network is composed of roads parallel to the Nile and roads perpendicular on it.

#### 3.3.2 Hospitality and Generosity:

Nubians are distinguished by their hospitality. They establish a building in the center of the village to guest visitors from other neighbor villages. This building is the communal guesthouse called Al Madiafa.

#### 3.3.3 Privacy:

Privacy is one of the distinguished features of Nubian character, So Nubians try to achieve privacy starting from urban scale, they build separate buildings which surrounded by four street from all directions to prevent attachment between building that provide more privacy.

### 4 Nubian house and sustainable architecture:

In the following part, the research will describe the old Nubian house from an environmental and cultural perspective. The study of the house will include several elements such as building process, house elements and elevations.

Nubian traditional house is considered as the most important feature of the Nubian society and stamps it from other Egyptian societies. These houses form open museums for the Nubian culture. The typical Nubian house is very spacious, with several large rooms that are able to accommodate the extended family members and guests. In the center of each home is an open courtyard Figure 4.

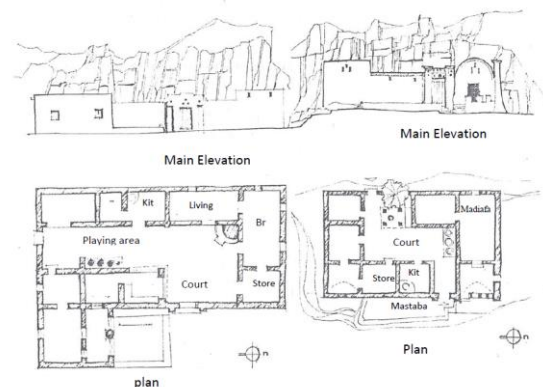


Figure 4 Examples of Nubian traditional houses

### 4.1 Architectural analysis of Nubian traditional house:

#### 4.1.1 Building process:

The house for Nubian isn't only a place to inhabit but also a place where he meets relatives and neighbors and where he celebrates with important events like marriage, birth and circumcision. Therefore the house for Nubian is considered as his own world (Jennings A. M., 1995). So building a Nubian house is considered as a valuable social event in the village. First step is taking a decision of building a house, secondly choosing the location of the new house which used to be close to family and relatives and finally building process takes place with its different stages (Bakhit M. A., 2000)

Building process starts with digging for foundations. foundations of Nubian traditional house usually have been built with stone. After finishing foundation stage, building walls stage starts with getting mud and sand, mixing and kneading components, cutting and forming mud bricks. These bricks are lift exposed under sun rays for two or three days. These sun dried mud bricks are used in building

walls and sometimes stone are used instead. After that, roofing stage comes. Roofing of traditional Nubian house varies between flat roofs, vaults and domes. Kind of roofing depends on function of space, vaults are used to cover some spaces like guest room "Madiafa" and domes sometimes appear upon entrance hall or kitchen.

#### 4.1.2 Important Elements of Nubian traditional house:

- **Entrance:**

The entrance is measured as an important space in the Nubian house that it provides privacy that, it acts as a transitional space between the inner and outer space. It may have been covered by a dome in case of squared space or by a vault in case of rectangular space and sometimes covered with a flat roof.

- **Madiafa (Guest Room):**

The other important element is **the Madiafa (Guest Room)** which is normally located near the main entrance served as a middle ground between the public and private spheres of the house. It has direct accessibility from the entrance lobby. It is the only space in the house, which has windows to outside.

- **Al Diwani:**

This element is considered one of the most important elements which reflect the relation between the house and Nubian customs and traditions.

Al Diwani is a small house attached to the main house. It consists of a major space is used as living space, dining space and at the same time sleeping space. In addition to services like bathroom, kitchen and "maziara" which is a space for water pottery, in addition to a small courtyard which found in the center of these elements. The function of "Al Diwani" is a residential place for house owner's daughter which newly married. She stays with her husband in this place "Al Diwani" for a period that may extend to two years, after that they move to their new house ( Fernea, 2005).

- **Services:**

**The kitchen "Dio Ka":** "Dio" means a faceplate is used to make Nubian bread and "Ka" means a room. The kitchen in traditional house consists of three zones: first for making bread, second for preparing food and external space which facing the kitchen is the third. The kitchen used to be in a squared space and looking at the court. Sometimes this space is covered by a dome (Hasabo N., 2007)

There are other services such as **store** which is used to store cereal and as **toilets** which used to be found in one of the corners of the court and usually covered with a flat roof.

- **The inner courtyard**

It lies in the center, where the people do all domestic activities. It usually has all the rooms around it, with one or two loggias, or roofed open areas (normally with vault). The position is organized in order to allow the best possible access to any breeze that came late in the evening. It was usually used as a private veranda for relaxation and conversation during hot season.

- **Elevations**

Elevations are the most distinguished feature in the Nubian city that they reflect the proficiency and cleverness of Nubians in expressing their culture. **Entrances:** There are always two entrance gates: one in the main elevation for men and visitors and the second one for women and as usual found in the side elevation. Main Entrance Doors are usually made from wood. **Windows** are decreased in external walls. They usually found in guestroom elevation and sometimes covered with grills. **Ventilation openings** are one or two small openings in the upper part of the room wall. They used to be found for ventilation and moving air from the court to the inner place. They usually found in North and south direction. **Perforated units** regularly extends along the sky line of the building elevation. The unit which is square or triangle usually collected to form a triangular form.

**Color of elevation:** walls mostly are white and openings are green or blue. **Painting & Decoration:** Lack of windows in the elevation of the Nubian house provides more area of solid walls which always are colorfully painted with geometric patterns. Most of the paintings and decorations on the homes have religious connotations. The colorful designs are a distinctive and admired feature of Nubian culture. **Mastaba** used to be found in front of the elevation of every Nubian house. Its function is to host foreigners in especially at summer nights or as a dining place. It could be built of clay or stone and painted with the same color.

#### 4.2 Environmental sustainability in Nubian house:

**4.2.1 Using sun dried mud bricks in building process:** Using sun dried mud bricks in building process is suitable for hot arid areas that experiment has proved that mud brick is most appropriate for achieving thermal comfort and mud-brick wall has a high thermal resistance comparing with other building materials.

**4.2.2 Ventilation:** There is a group of factors that contributes in providing good ventilation in the Nubian traditional house:

**The existence of interior courtyard** performs an important function as a modifier of climate in hot arid areas. It allows outdoor activities with protection from the wind, dust and sun. Interior courtyards serve both as light-wells and as air-wells into which the cool, dense air sinks at night .

**Lack of windows in elevation** increases the area of solid walls which help decrease thermal transfer from outer space to inner space.

**Using light colors in painting** external walls to reflect sun rays and reduce absorbance of heat.

**Upper openings** help good ventilation that they provide access for hot air which rises up and out through upper openings.

#### 4.3 Cultural sustainability in Nubian traditional house:

Nubian society has its own traditions, habits and customs which influence its product. This product might be a building. Nubian house is a good example of Nubian culture embodiment. These points illustrate some of traditions of Nubians and its influence.

##### 4.3.1 Blessing of the Nile:

- Orientation of the main entrance looking at the Nile
- Drawing group of triangles in refracted lines in the lower part of the elevation symbolizes the River Nile.

##### 4.3.2 Hospitality can be shown in:

- Projection of the main entrance and decoration surrounding it.
- Existence of Madiafa (guest room) and assuring it externally by widening its windows and decoration of its sky line.
- Presence of Mastaba which considered as an external place for sitting with neighbors or visitors.

**4.3.3 Privacy:** Privacy is essential in Nubian house. So Nubians reduced exterior windows and Lift openings in elevation to provide privacy (Fernea R. A., 2005). In addition to presence of side entrance which is separated from guest entrance and this side entrance is called secret door. Nubians used to build a screen wall beside guest entrance to prevent guests from seeing the inner spaces of the house. They also used to build a wall to segregate between Al Dewani and rest of house.

**4.3.4 Religiousness:** Quran verses or religious statements appeared on some houses elevations, and sometimes pilgrimage drawings which considered as a way for rejoicing of Hajj, and considered a

mean for the declaration that the house owner had performed this duty. In addition to using triangle in wall decoration symbolizes the link between the earth and the sky .

**5 Conclusion:**

From previous analysis which illustrates the achievement of sustainability in Nubian traditional village and house with its environmental and cultural aspects, the research concludes that Nubian traditional architecture needs conservation. And the following table demonstrates the relation between main points of both aspects of sustainability and study elements of Nubian traditional house.

Nubia		Sustainability														
		Environmental				Cultural										
		Thermal resistance	Ventilation	Heat absorption	Nile of the	Ybressny	Hospitalit	Privacy	ess	Religiousn	and magic	from jealousy	Tear occasions	Consideration of	Showing power	Peace and safety
Building process																
Building elements	Entrance															
	Madiafa															
	Al Diwani															
	Services															
	Inner Court															
Elevation	Opening	Entrance door														
		Windows														
		Ventilation openings														
		Perforated units														
	Color of elevation															
	Painting & Decoration															
	Mastaba															

Table 1. research conclusion : matrix between main points of both aspects of sustainability and study elements of Nubian traditional house

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