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Nubian Vernacular Architecture Technique to Enhance Eco-Tourism in Egypt

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Abstract
The purpose of the research is to investigate and analysis how Nubian building technology could be useful for redesign tourism resorts in Egypt. The paper discusses how to achieve sustainable development in tourism resorts in Egypt by strategies environmental sciences and natural resources, which presented by Nubian vernacular style where the culture of society has customs and traditions which withstood for the hundred years' test and was fundamentally suitable for the climate and local economy and social conditions such as the bases of ideological and religious depends on the self-limited resources. The research aims to extract the most important of those values and techniques in the construction to be the main principles and determinants in the design of tourist resorts in Egypt, especially the Red Sea and the arid areas , it can be configured architectural identity belong to the local environment in Egypt is characterized as sustainability of increasing the passive cooling system in residential buildings and in turn, thermal comfort, least energy consumption and achieve the sustainable development.

Keywords: nubian houses, vernacular architecture, conservation, natural resources, sustainable development, environmental sciences

INTRODUCTION

Preserving the Egyptian architectural identity thoroughbreds of private old Nubian vernacular architecture and the content of the beauty, culture and traditions and linked closely to the natural environment building materials harsh climate is warm and struggling passive design. Tries this paper through the work of a comparative analysis between the two buildings in the same area in west *Seheil* in Aswan, one of them holds all the former qualities mentioned values, culture and belonging the identity of Nubian cultural architectural distinct (Clay Brick walls) by vaulted or domes covered, and the other building contemporary Nubian architecture, (built up by fire brick material and reinforced concrete roofing), trying to convergence of the inherent shape and some design elements and colors, but lack the hot dry climate resistance that region, which requires climatic processors and use energy-consuming cooling devices which affect a change in the architectural identity Nubian thoroughbreds .

OBJECTIVE OF THE STUDY

The aim of this paper is to revive to design solutions that were provided by old vernacular Nubian Architecture. So as to achieve energy efficiency in building and preserve natural resources through natural ventilation and thermal efficiency of materials and techniques.

HYPOTHESIS

The old vernacular Nubian Architecture built by raw brick, much better than new Nubian Architecture using fire brick, vaulting or reinforced concrete roofs. The paper studies the effect of thermo-physical properties of the building materials on saving energy, regarding (walls/ roof) as the main construction element having an important role in the thermal performance of buildings and in saving energy.

STATEMENT OF THE PROBLEM

In Egypt the basic materials for construction in various regions is reinforced concrete and fire bricks which increase the heat gain of the building causing environmental problems. In addition to the loss of architectural identity of old vernacular Nubian Architecture.

THE TOOLS

Through a field study of the site and conduct discussions and surveys of the views of residents and measuring the ability of mud buildings and concrete to adapt to the surrounding environment using devices (Hobo Data Loggers), HOBO U12Temp/RH/Light/Ext (Onset computer, 2015). The use of mathematical models and simulation tools is often presented as the most credible approach to model the comportment of a

building and predict the heating consumption, in a global vision of sustainability.

Different field measurements and theoretical studies were carried out to investigate the thermal performance of the traditional houses under the effect of local external climatic conditions of Aswan region, Egypt. Theoretical and experimental study was carried out to investigate the thermal performance of some traditional building built there.

Another study shows that using Nubian sandstone in wall alone is not favorable and didn't valid thermal comfort due to the high storage, high thermal mass and thermal conductivity of it, also shows that domes or vault built from fire brick mortar cement and reinforced concrete beams. Without using material with special thermal characteristics is not the solution. (Khalil, Mervat, 2012).

The thermal performance of exposed composed roofs in very hot dry desert region in (Toshky) region, Egypt was carried out and investigate that; the construction roof systems (insulated concrete, double, planted and un-insulated concrete roofs) valid an indoor air temperature thermal damping of about 96%, 90%, 89%, and 76% respectively, the green roof gives the lower indoor air temperature, due to the evaporation process. The thermal performance of building envelope in very hot dry desert region in Egypt (Toshka Region) was carried out and investigate that; the indoor air temperature of hollow clay brick and light sand block are nearest to the upper limit of thermal comfort. (Khalil, Mervat, 2012).

So the main factors affecting on studying the thermal performance of building are; the outdoor climatic condition (outdoor air temperature, relative humidity and solar intensity).

Table 1 shows the climate data for Aswan, Egypt.

The highest record temperature was 51 °C (124 °F) on May 22, 1973 and the lowest record temperature was −2 °C (28 °F) on January 6, 1989.[22]

Climate data for Aswan, Egypt													
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Record high °C (°F)	33.3 (91.9)	39.0 (102.2)	44.0 (111.2)	45.3 (113.5)	48.4 (119.1)	49.5 (121.1)	48.8 (119.8)	48.3 (118.9)	46.7 (116.1)	44.8 (112.6)	39.3 (102.7)	35.4 (95.7)	49.5 (121.1)
Average high °C (°F)	22.9 (73.2)	25.2 (77.4)	29.5 (85.1)	34.9 (94.8)	38.9 (102)	41.4 (106.5)	41.1 (106)	40.9 (105.6)	39.2 (102.7)	35.9 (96.6)	29.1 (84.4)	24.3 (75.7)	33.6 (92.5)
Daily mean °C (°F)	15.3 (59.5)	17.5 (63.5)	21.8 (71.2)	27 (81)	31.4 (88.5)	33.5 (92.3)	33.6 (92.5)	33.2 (91.8)	32.0 (90)	27.7 (81.9)	21.5 (70.7)	16.9 (62.4)	25.9 (78.6)
Average low °C (°F)	8.7 (47.7)	10.2 (50.4)	13.8 (56.8)	18.9 (66)	23 (73)	25.2 (77.4)	26 (79)	25.8 (78.4)	24 (75)	20.6 (69.1)	15.0 (59)	10.5 (50.9)	18.5 (65.3)
Record low °C (°F)	1.6 (34.9)	1.0 (33.8)	4.6 (40.3)	7.5 (45.5)	13.6 (56.5)	16.4 (61.5)	20.2 (68.4)	19.8 (67.6)	15.8 (60.4)	11.8 (53.2)	6.5 (43.7)	3.2 (37.8)	1.0 (33.8)
Rainfall mm (inches)	0 (0)	0 (0)	0 (0)	0 (0)	0.1 (0.004)	0 (0)	0 (0)	0.7 (0.028)	0 (0)	0.6 (0.024)	0 (0)	0 (0)	1.4 (0.055)
Avg. rainy days (≥ 0.01 mm)	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.5	0.0	0.25	0.0	0.0	0.85
% humidity	40	32	24	19	17	16	18	21	22	27	36	42	26.2
Mean monthly sunshine hours	298.2	281.1	321.6	316.1	346.8	363.2	374.0	359.6	288.3	314.0	299.0	289.1	3,862.8

The upper / lower limit temperature of the comfort zone during the summer season in Aswan region. Source: World Meteorological Organization, EGY_Aswan. 624140_ETMY.ddy

Therefore, this paper to investigate of the thermal performance of buildings in old vernacular Nubian Architecture.

METHODOLOGY

In order to see how this concept of old Nubian Vernacular cooling system can influence Architectural practice, we have studied it through the different official texts, the three principles as proposed by:

1- The first principle how to integrating the economic, social, political and environmental dimension together to Preserving of the culture, customs , traditions and the architectural identity for Nubian Architecture .

2- Reduce consumer energy consumption the concerns over global warming and the reduction of high emissions of greenhouse gases has become a thrust for exploitation of passive strategies for indoor thermal comfort.

3- Preservation of the environment and the identity of Nubian Vernacular Architecture.

HISTORY OF NUBIANS

In Egypt the representatives of the first group are the (Kunuz) occupying the northern region of Nubia, while the (Fadigga) group who dwell in the southern region of Egyptian Nubia.(El-Hakim, Omar, 2008).The general features and factors in Nubian layout of the village (*Nagu*) in North *Kanuz* district west *Seheil* Island, see fig(1). The Dwellings extended along the Nile at irregular intervals in a staggered line more or less parallel to the river following the natural contours of the ground. The Orientation throughout Nubia, principal entrances to the houses faced the river, whether they were on the west banks of the Nile. On approaching the front of a dwelling, towards the main entrance and threshold, a person had his back to the river (Riad& Abdel Rasoul, 2007.

Figure 1: Seheil Island in west Aswan (Source: Researcher, 2015)

Nubian vernacular architecture continued to be ignored by the rest of the world until 1963, when the region was to be flooded for the third time. (The first was after the British built the original dam, known as the *khazan* Aswan in 1898. The second time the dam was elevated in 1933, and the third time was the construction of the High Dam itself in 1964).

Then, they rebuilt all their villages on their own, with their own precarious means, giving them a chance to show the world potentialities of man when he is given the chance (Hssan Fathy). (El-Hakim, Omar,2008). In Fig(2) shown some Architectural drawing for Nubian houses built after 1964.

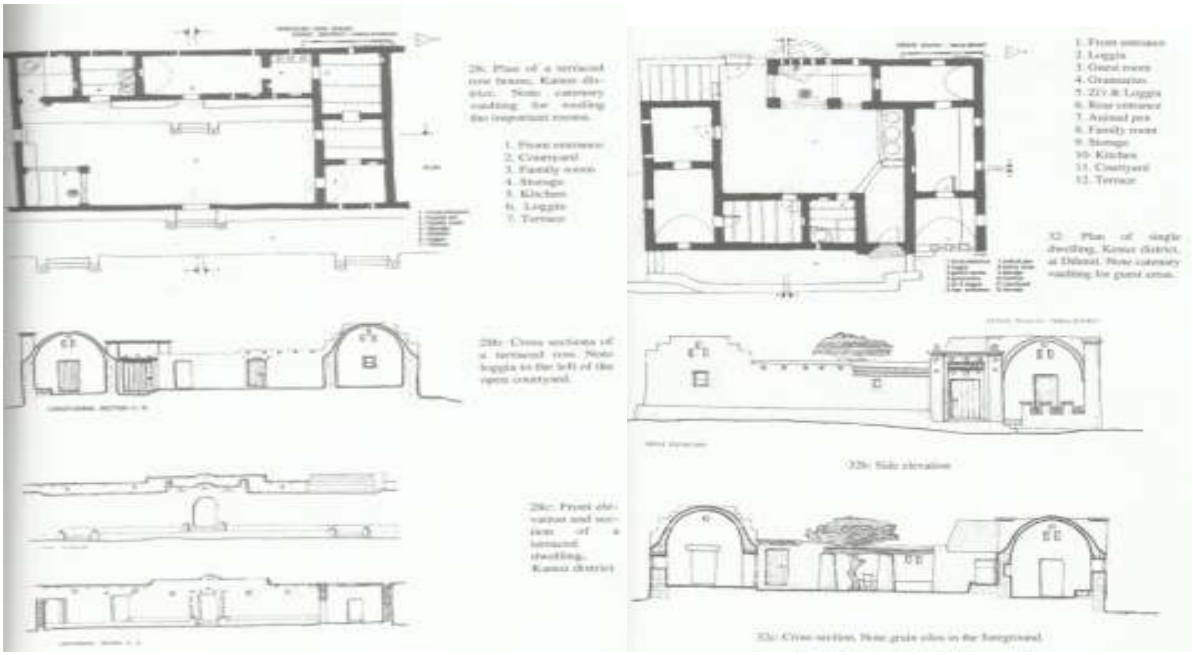

Figure 2: Old Nubian Vernacular houses. Source: El-Hakim, Omar, 2008

TRADITIONAL NUBIAN HOUSING COMPONENTS CONTEMPORARY

Most of the houses were built in the form of a rectangle with an area roughly from 200 to 1000 m 2, it depends on the site and topography, most of houses in west *Seheil* attached and smaller than houses in west Aswan

and the status of occupancy it's consists of the following:

1. The main entrance has formations that distinguish it from the rest of the house, in most cases leads to an open courtyard mediates the house, if the house area is relatively small becomes the majority of the yard shaded, and there are a small side entrance used especially for women and opens the inner courtyard directly (Elhabashi,Alaa, 2014)
2. Mandara is the guest room, located next to the main entrance and opens the inner courtyard right inside the house (Elhabashi,Alaa, 2014)
3. The Courtyard of the house opens on all rooms of the house and carpeted floor with sand for sitting.
4. Bed Rooms located in the sea side of the house and opens its doors to the main courtyard and opened her small ventilation window down the vault attract the air from inside the courtyard into the rooms.
5. Kitchen: There is next to the rooms and mostly consists of two rooms the roof covered by domes hanging up in the middle Tray (Meshlaa) serves as the refrigerator and on the reservation. , in outside the conventional oven Nubian who call (Duka), plus balconies which is about (Silos) built of mud, height about 40 cm builds upon (walls) to store the grain, dates and rest all food stuff. See fig (3).

Figure3: Old Nubian house renewed used to host tourists in west Aswan
Source: Researcher, 2015.

Topped (Aladrawi) full length of the interface with heights ranging and topped with cornices and triangle voids, and appeared on both sides of the entrance Photos mural is believed to be to protect the building from intruders, and most of the interfaces deaf only entrance door openings. All the walls of the house interior and exterior has been painted blanks Jerry white, but whites yellow exterior color Ocean bottom walls of the facade of the building is nearly the color of the earth's natural color, as I use blue and green for some Parts of the interior walls and windows, and there are interesting wall drawings that express their habit and beliefs, which were represented in Feel inside and outside houses, such as palm trees, birds and crocodiles. See fig 4.

Figure4: Front entrance Nubian house in *Seheil* Island & west Aswan, Source: Researcher, 2015.

CASE STUDY

Through a field study of the island of *Soheil* village (west *Soheil*) and village (west of Aswan). Has been selected one of the traditional homes of the study and analysis, and the house is owned and inhabited by Haj / Ahmed Hassan and his family, and is located in one of the island *Soheil* ancient Nubian villages that is located south of the city of Aswan, and still retain the character and identity. That was built on the old Nubian style and using traditional building materials, home was built before displacement suffered by Nubians, and the owner of the house management and activation of tourism trips, as the island has become a popular destination for tourists to get to know the rest of the social, cultural and artistic heritage. And neighbored by other dwelling for the same owner and the same direction and is divided into two parts, one on the old style and the other half newly built red brick and concrete ceiling.

Was selected the East Room overlooking the Nile for both two houses carry the same direction and size and different job, one with mud and other brick and concrete roof of the two houses, so as to make a comparison between them to measure temperature, humidity and carbon dioxide, and the severity of Luminosity. This paper explore the effects of indoor thermal conditions in a tradition Nubian house residence found in the hot regions in Aswan (west Seheil) & (west Aswan) in Egypt. The design theme is centred towards an explanation of architectural concepts and principles of the traditional and Vernacular Nubian house as a source of deriving passive design strategies. Field investigation reveals a significant correlation between wall temperature and indoor air temperature. Airflow behaviours are sufficient to modify indoor thermal conditions to achieve comfortable environments. Furthermore the experiments will be on two types of houses.

The experiment Comparison between two different types of houses Nubian clay house with raw brick vaulting & Nubian fire brick and reinforced concrete roof slab semi attached each other see fig (5). All of them have the same characters and function configurations and Nubian features.

(A) FIRE BRICK HOUSE (B) CLAY HOUSE

Figure 5: Comparison between two different types of houses Nubian. Source: Researcher, 2015.

This experiment to determine the ability of passive design for thermal comfort in both houses by using devices (Hobo Data Loggers), U12Temp/RH/Light/Ext. (Onset computer, 2015)

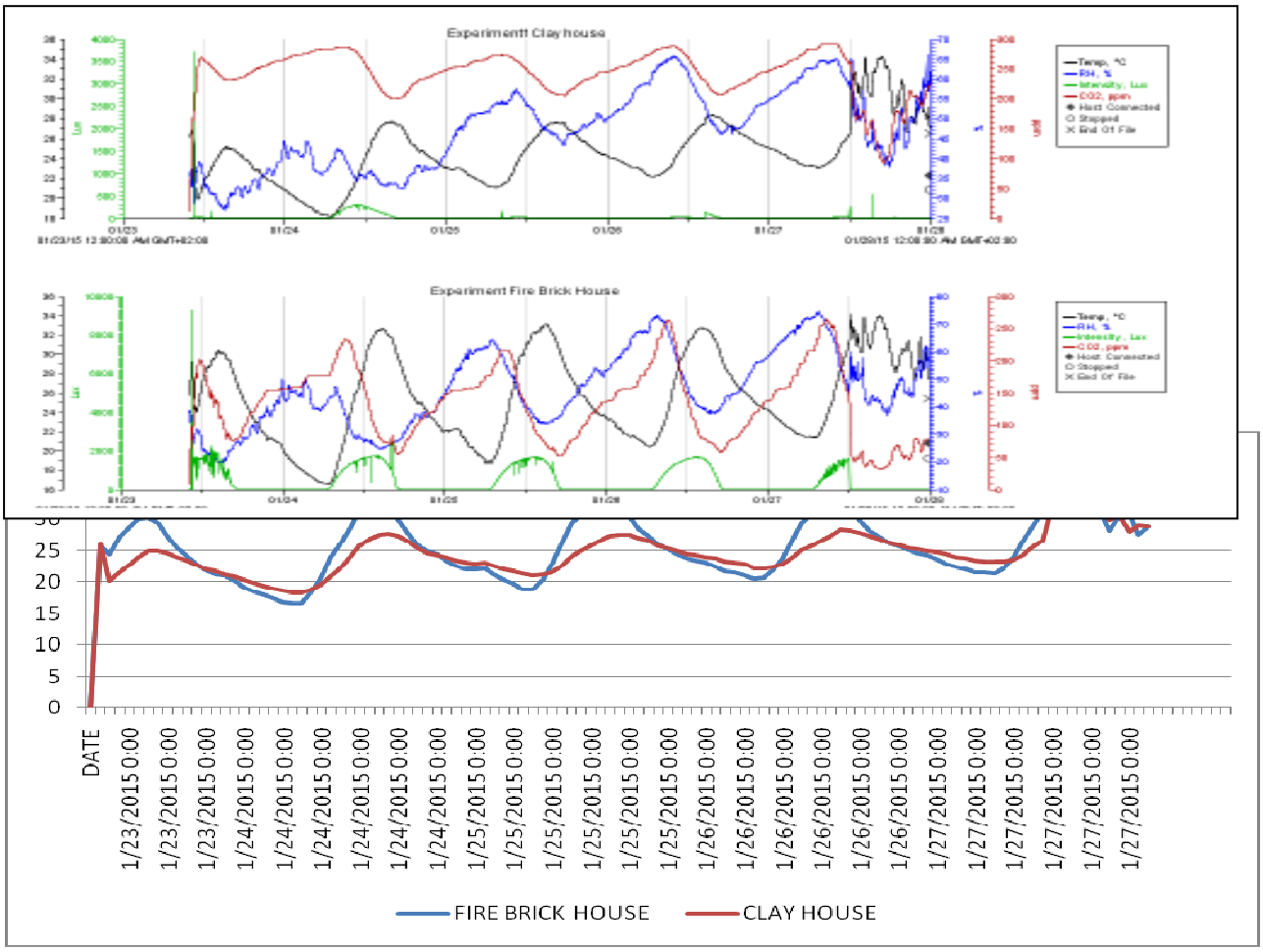

Table 3: Comparison of internal wall surface temperature for types A & B. Resource: (Hobo Data Loggers), U12Temp

	DATE	HOUR	(A) FIRE BRICK HOUSE					(B) CLAY HOUSE			
			TEMP	RH	ILLUM	CO2		TEMP	RH	ILLUM	CO2
1	1/23/2015	3:00 PM	30.142	20.26	894.8	101		24.992	27.621	11.8	233
2	1/24/2015	6:00 AM	16.677	40.035	11.8	177		18.295	36.681	11.8	283
3	1/24/2015	3:00 PM	32.587	25.251	1,525.50	74		27.579	33.492	98.5	208
4	1/25/2015	7:00 AM	18.818	64.159	98.5	182		21.127	53.303	11.8	273
5	1/26/2015	3:00 PM	33.105	33.787	1,446.70	71		27.284	47.197	11.8	216
6	1/26/2015	6:00 AM	20.555	67.225	11.8	186		22.321	58.8	11.8	274
7	1/27/2015	2:00 PM	32.691	39.773	1,651.60	81		27.358	54.721	19.7	234
8	1/27/2015	7:00 AM	21.39	72.786	122.2	219		23.208	62.941	11.8	284

TEMP= Temperature RH= Relative Humidity ILLUM= Light Illuminate

Table 4: Comparison of internal wall surface temperature for types A & B. Resource: (Hobo Data Loggers), U12Temp

ANALYSIS AND MAIN RESULTS

Thermal Mass

The hourly wall surface temperature of the entrances, courtyard and internal walls (all internal walls in each zone were monitored and averaged for a mean value) were compared with external walls. Thus, the best thermal performance type house (A) and the worst thermal performance type house (B). The diurnal temperature range (DTR) is the difference between the daily maximum and minimum temperature. Through the table, through the table, we find an increase in temperatures (DTR), Specials in type (A) more than 50,and the time leg longest in time (B) which confirms the ability of the thermal insulation of clay house is much higher than buildings in fire brick.

Relative Index Evaluation

Modification of Indoor Air Temperature While almost uniform ambient conditions exist, the presence of different thermal conditions within the courtyard and interior zones would be the impact of different envelope configurations, which resulted diversity in airflow characteristics. Furthermore, is effective in modifying the thermal capacity of the high thermal mass building envelope, this is shown by Relative Humidity high in daily peak time of type (B) daily than (A), and vice versa for the night time lag peak time.

- Nubian clay house mud materials and raw brick vaulting which is based on the use of passive approaches in achieving maximum thermal comfort without the use of cooling or heating devices, which in turn consume energy Electric enormous.

CONCLUSIONS

Fire brick construction and Reinforced concrete are displayed spread all over Egypt, especially along the coast beach Resorts, which is supposed protected areas or compatible with the environment due to environmental studies that offer EIA which materials cannot be recycled as well as consume energy due to the weakness of their thermal insulation. Knowing that some of the resorts used architectural elements and some features of Nubian Architecture but still not eco-friendly due to the use of concrete and fire brick, such as El Gouna resort in Hurghada.

Construction of clay and silt has become a rare phenomenon of private construction in those areas due to the lack of availability of Nile silt, especially after the construction of the High Dam, the dam blocking the silt is not authorized to extract as well as protects the soles of the dam to prevent razing farmland. Note this type of the construction is environmentally compatible and the material can be recycled and has a high capacity for thermal insulation and achieve thermal comfort warm climate area.

Preservation those architectural and environmental heritage, as well as crafts, social and cultural from extinction, which represents the value of the Egyptian environment value.

There is no doubt that eco-tourism beach resorts must be eco- friendly buildings and building materials can be recycled, in addition to the tourists turn to our country to looking for the natural environment and the vernacular culture and architecture such as Gopher resort in Siwa in arid region in Egypt. See fig (6).

Figure 6: Photos for gopher resort in Siwa Egypt. Resource: www.siwashaliresort.com.

Recommend using these unique and good techniques, which express the identity of the place and of great ability to reduce the energy lost to design of rural and arid areas, which is in the role of development and particularly in these paper to design of tourist resorts which represent a small sector comparing with a large public housing sector such as that sector have an environmental value for tourism development in Egypt. It is a natural environment areas must be protected and preserved according to the environmental considerations, and is considered a strong attractive point for eco-tourism in Egypt, that may be a reason to revive and spread of this types of buildings in all Egypt in the future.

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