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New ventilation strategies for desert Houses in Oasis region in Egypt

Dina Shata
MSc student, Al Azhar University, Egypt, dinashata@hotmail.com

Abstract:
Housing is one of the human rights; people seek for the convenient place to live since the old ages. The new valley city in Egypt has a very unique architecture heritage that has been made by the habitants themselves. Those houses still remains until now as a witness of the human adaptation with the environment, therefore it's so important to get use of this heritage and reuse them in the present houses, get the main architecture design principles, and implement it.
Nowadays the new houses built there are an example of random architecture has no relation with environment.
The paper will present new sustainable ventilation techniques for desert climate .Methodology is to make an analyses and comparative analysis study between the old houses and the current ones which aims to present a suggested solution for the house elements. These solutions lead to reach the house sustainability in a desert environment.

Keywords: Desert climate, House design, Ventilation

1. Introduction

Until now, wind has played a great role in architecture in hot areas. Air movement makes humans feel cooler and more comfortable under a hot environment Thus; natural ventilation serves as the most effective passive design strategy for the hot arid regions (Table 1).

Considered the only vernacular architecture in Oasis, the traditional Oasis house (figure1) was designed by taking the full advantage of the prevailing wind. However, more urbanized and dense conditions in today's big cities like Cairo discourage the use of natural ventilation even in the most basic residential structure. Therefore, most designers replace this natural system with an air conditioning system needs additional to outside, thus warming up the environment (Figure2).

Table 1 the upper / lower limit temperature of the comfort zone during the summer season in Kharga Oasis.

Months	Jan	Feb	Mar	Apr	May	Jun.	Jul.	Aug	Sep.	Oct.	Nov	Dec.
Max. Temp.	22.0	27.0	29.6	35.7	39.6	40.2	39.8	38.7	36.5	35.4	28.1	23.8
Min. Temp.	5.2	9.1	12.5	17.9	22.1	24.8	4.7	24.5	23.3	20.5	14.5	7.4
Avg. Temp.	13.9	18.1	21.1	26.8	30.9	32.5	32.3	31.6	29.9	28	21.3	15.6

Figure 1 The Old city Shali, Siwa Oasis

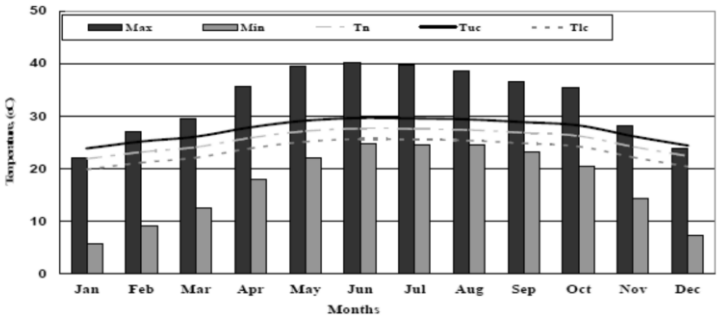

Figure 2 the monthly mean maximum / minimum of the outdoor air temperature, the neutrality temperature and the upper/lower limit temperature of comfort in Kharga Oasis.

2. Research goal:

This research explores the possibility of making a natural ventilation by re-function house design elements whereby adapts with Oasis climate conditions in the present time.

2.1 Traditional Oasis House

Since ancient times, Egyptian people have settled along the Nile River (Fig.3) (Hemdan, 1993). While the desert land was empty until the people discovered the oasis and the underground water which was the main reason for settling around it.

The Oasis considered within the region of The New Valley, located 800 km SSE of Cairo, 250 km W of Luxor and 475 km SW of Assuit, and its villages of Al Qasr and Balat (Ali, 2009)(Figure 4).

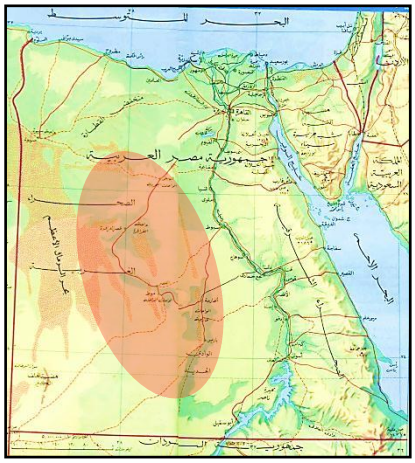

Figure 3 Egypt's map and the location of the new valley region

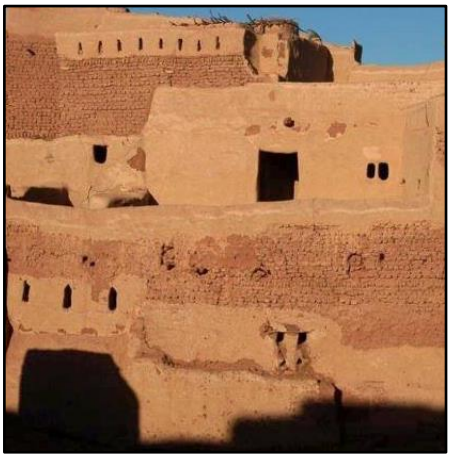

Figure 4 Hoses of Balat Village

Traditional Oasis Houses has a very unique architecture which deals with the hot arid climate and a lot of strategies were applied on the architecture design elements; it shows in:

-Material:

The previous settlements are characterised by a compact structure of mud-walled alleyways narrow separating houses with elaborately-carved wooden support beams and contains a wealth of vernacular architectural examples that eloquently represent ingenious methods and techniques to cope the hot arid environment prevailing in the recon.

These architectures draw a unique architectural creations of outstanding value, which over the centuries,were accomplished to adapt the transformations insociey, secure ne eds, climatic conditions, and to interact with the environment, thanks to the simplicity of building processes, the techniques and the local materials employed such as earth and wood (hammad, 1995).

-Plan:

Houses are compact with an almost closed outer face. Plans width is about 5-6 m, except the upper one usually smaller, unless it extends over a street below (Filippi, September 2006). It was divided to two courts; one was the main for the Family rooms and main elements and the other for the service elements (Bath room-kitchen-storages-space for home bakery).

-Openings:

It was constructed in a little number to control the amount of direct sunlight entering the structure. They are small and infrequent, because indirect light is preferable to direct exposure, and protection of the sandy wind. Screening wooden and brick elements (Figure 5), a sort of **masharabiya**, reduce the direct amount of direct lighting entering buildings and hide private spaces from unwanted curiosity from the street or the neighbourhood. In the first floor; there is a small opining above the window to take out the hot air (Shata, 2013)(Figure 6 &7).

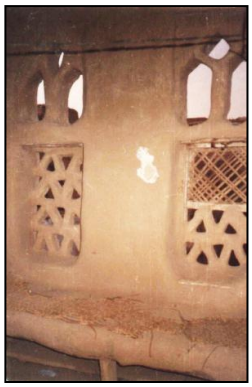

Figure 5 windows with screening brick window elements.

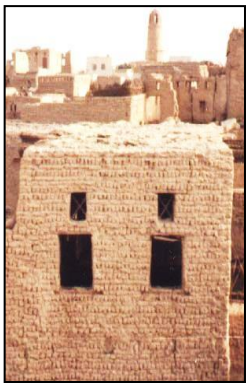

Figure 6 small openings above the windows.

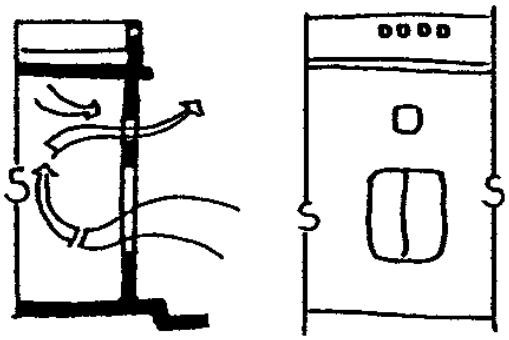

Figure 7 shows a sketch drawing for the air movement getting inside the room through the window & outside through the opening.

-The Courts:

This Element is one of the best solutions for the houses of the hot region (Figure 8). It affect positively on the weather inside the house; as its parts is shaded during the morning, which reduces the pressure on the rooms located on the elevation.

The courtyard system related to day and night conditions and thermal inversion phenomenon, where at night cold air is accumulated inside the courtyard so that the bottom of the courtyard is filled with cold air and the temperature has a high variation as we go up inside a court, when the sun rays hit the building envelope the air temperature increases than the one inside the court which makes a pressure difference. The cold air starts to move from the cold part to the hot part where the pressure is lower through the building. This movement makes the spaces naturally ventilated.

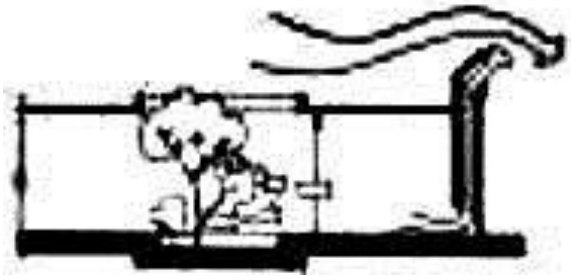

Figure 8 Natural air flow through the court

2.2 The present time house:

Lately, The Oasis Habitants started to have connections with the main cities and began to import some construction technology. The influence from the capital cities of architecture gradually changed the outlook of Oasis house from their traditional sand architecture (Fig9).

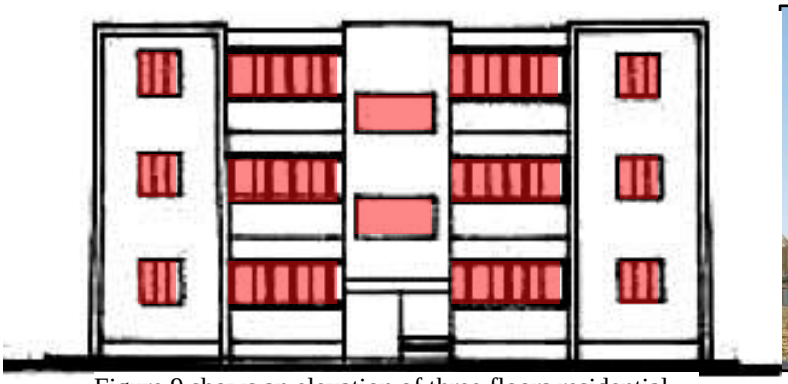

Figure 9 shows an elevation of three floors residential building with wide windows. The opening percentage is almost 50% of the elevation.

Figure 10 Residential buildings with terraces

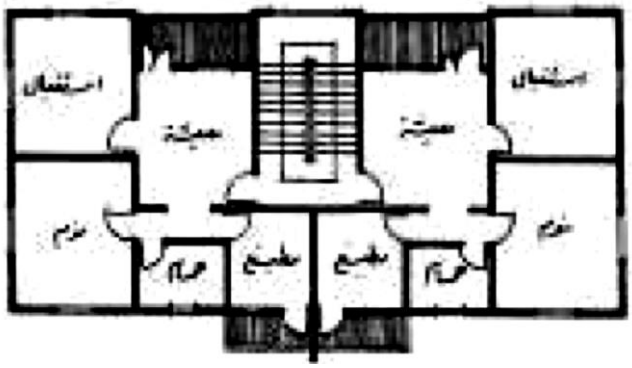

Figure 11 shows plane for the residential building above and it is opened to the outside.

-Materials:

People started to use the concrete instead of the local sand salted bricks. This change affected the internal temperature of the house. (Figure10).

-The plan:

The floor planes are opened to the outside which is not adapted with hot arid environment (Figure11).

-Openings:

The opening is about 50 % from the façade. According to the previous background about the Oasis climate; there is no need for such a wide windows or terraces.

2.3 Result :

The present houses aren't suitable for the Oasis environment, and there is a need for finding a solution and other natural ventilation strategies.

3 . Proposed ventilation strategies:

-Wind catcher:

It could be works as an intake and exhaust at the same time depending on wind speed. (Figure12).

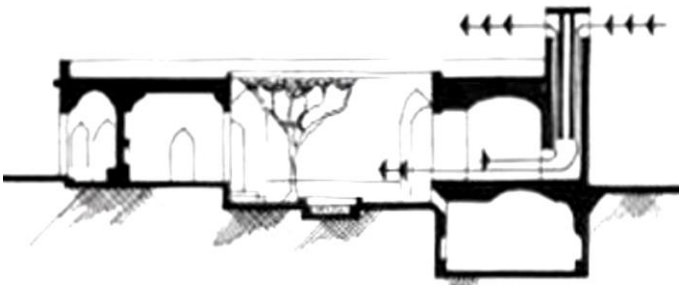

Figure 12 A drawing shows using the wind catcher and the air flow through it to the court

-Courtyard:

It allows the cold air to pass in to the internal space of the house (Figure 13).

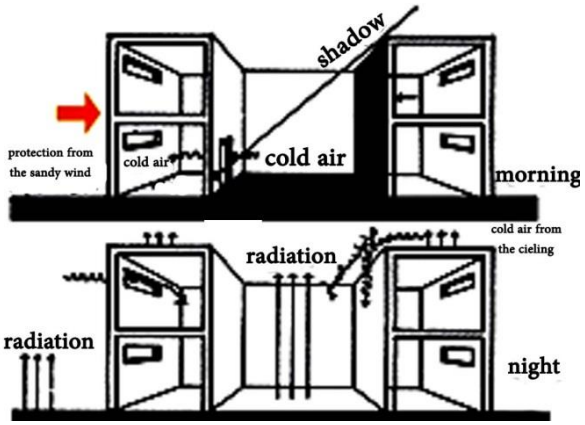

Figure 13 sketch drawing shows the court during morning & night.

-Openings:

The openings ratio should be less than 50% of the elevation area, and with small openings above the windows (Figure 14).

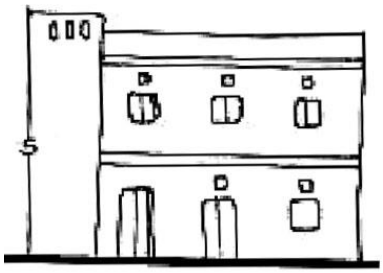

Figure 14 an elevation with openings of 30%from the total area.

-Plans:

The plans designed to be opened to the inside on the courtyard and separating the living elements from the service elements (Figure 15).

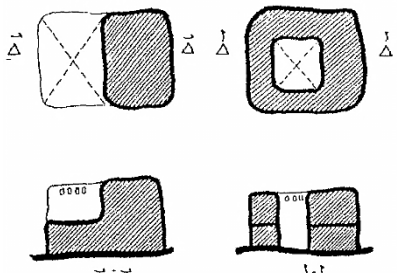

Figure 15 shows two types of houses one opened to a two level court, and the other to one upper level court.

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