

Interior Architecture of Desert Climate

Case Study of Gadames city - Libyan Desert

Author: **Mr. Hadi Ali Shateh** BA, MA
Nasser University, Libya

Chief Editor: **Professor Salim Al-Hassani**
Editor: **Rabah Saoud** BA, MPhil, PhD
Production: **Ahmed Salem** BSc

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INTERIOR ARCHITECTURE OF DESERT CLIMATE

CASE STUDY OF GADAMES CITY - LIBYAN DESERT

ABSTRACT

The desert environment is often regarded as a primitive wasteland occasionally occupied by tents of the passing nomads. Yet, the Arab desert saw the birth and establishment of one of the great civilisations the world has ever seen. The Islamic civilisation, with its huge achievements, started in desert Arabia, the vestige of which is still scattered in various regions in the form of a number of thriving cities and ruins of others. With their distinctive character, these cities display a sophisticated design and building technology. They were specifically developed to meet the harsh climatic conditions of this type of environment and to translate the socio-cultural structures of the desert societies. The present paper examines the design principles of the interior of desert houses in the city of Gadames (Libya). The paper argues for the great congruence between the characteristics of the physical fabric of Gadames houses and its environmental conditions. Such a feature should provide lessons for solving the inadequacies of contemporary housing in Libya and the Arab World in general.

1. INTRODUCTION

The subject of design of the housing interior space in hot areas has been the subject of many studies before. The aim here is to study the nature of the interior space introduced in desert climate conditions, and analyse the principles applied in their design to achieve thermal comfort for residents. It is clear that natural circumstances of the desert present a great challenge to designers to finding appropriate ingredients to accommodate these circumstances in the characters of the built form, the open space as well as in the nature of material of construction used. In internal aspects, designers faced similar constraints in finding adequate spatial arrangement, décor, furniture and so on.

From the present study of Gadames, it appears that Arab designers have raised to this challenge and succeeded in developing a number of design tools to sustain the climatic and physical conditions of the desert. Acquiring his skills from his observation and experience with such environment, the Arab designer successfully adapted elements such as height, material of construction, wall thickness, lighting, furniture and décor to local climate conditions. These solutions, found explicitly in Gadames, provide contemporary designers of similar environments with valuable lessons for coping with harsh climate conditions.

2. LOCATION AND CLIMATE

Gadames is a Libyan desert city located on 35.08° north and 9.30° east with typical desert climate consisting mainly of hot and dry season. Temperatures reach an average of 48°C.

3. DESIGN OF HOUSING UNIT

3.1 The idea of design

The design typology developed in Gadames conforms largely to the environmental conditions. Such measures were produced on three main levels of design parameters. The city level involves the form of buildings, height, and material of construction, all of which reflected the local conditions. The level of ventilation and lighting systems of the city plan includes the ways the streets are designed, ventilated and lighted. The third level of this conscious design is the internal spatial organisation of buildings, which is the subject of this brief. Below is an illustrative example of a typical housing unit plan in Gadames in which we will examine various aspects introduced to cope with the temperatures of the desert climate (figure 1).

3.2 The House entrance

Entrances of the houses of old Gadames city generally open to the streets which are mostly vaulted to protect against the burning sun (figure 2). Residents took advantage of this and extended the upper floors of their dwellings towards these vaults. Figure 1 below illustrates a horizontal section of the ground floor of the house, identifying its main components. The walls are made thick to externally absorb the heat and internally to be used as wall cupboards for the storage of shoes, clothes and other items (figure 3).

- The entrance usually connects with a long hall leading to the main staircase of the upper floor (figure 4). This hall forms part of the female territory often highly decorated reflecting the good taste of the household, and the artistic talent of its female members.
- The entrance hall is usually painted white and equipped with a number of mirrors to reflect light and keep the area bright.

3.3. The First floor

As illustrated in figure 5, this area consists of the living space of the household. In its centre, there is the main living room that is divided into two sections. The first is reserved for family use while the second is mainly for the use of guests. Around this central space, the rest of rooms are arranged according to their use. They include the boys room, the girls room and the storage room (see figure 5).

Although these rooms are a level higher than the living room, they overlook it and are accessed from it through a set of staircases (figure 6). Such arrangements keep children always in sight and allow the head of the household (usually the mother or eldest sister) to control the space effectively.

Housing units of the city adopted this typical layout and subsequently appears as if they have one common scale and one common plan. They even display the same type of hand made furniture and décor, which give the city a strong identity feature. Different rooms are subdivided according to their use. The height of their ceiling varies reaching its highest point in the central living room, thus giving it a feeling of spaciousness.

3.3.1. Design restriction parameters

Because of the mediocre size of the land plot of the house, staircases were included inside the living room, eliminating void spaces. Furthermore, the case itself was converted into a storage space in the form of shelves and wall cupboards for keeping items of daily use needing immediate access such as tea pots, cutlery, plates, cushions and so on. Such arrangement also accentuates the centrality and functional predominance of the living room.

Houses are dense and attached to each other like honeycomb cells, reflecting the strong solidarity between the households, and allowing greater social interaction between them. In the meantime, private space is well protected from public domains in streets and public open spaces. Further demarcation of this private space is achieved by extending the height of the walls of the house at least one level higher than the immediate street (figure 7). In this case, one can conclude that housing design in Gadames have perfected the functionality of the private space and protected it well from public domains, translating, in this framework, the socio-cultural beliefs and values of the Muslim community and its desert traditions. Ben Sweas reflected on this issue suggesting that " the architectural theory, in this example, is based on the relationships between buildings and their users, a feature which considers the socio-cultural dimensions of the community".

3.4. Roof floor

The roof floor consists mainly of the kitchen and fuel storage room (figure 8). This unusual location of the kitchen is determined by the following factors:

- a. The first is the discharge of extra heat and smoke caused by cooking.
- b. It works as a safety precaution against accidental fire. In the event of fire, residents can be led out safely and the fire may be easily contained if it starts from the open roof terrace.
- c. By adding this floor, the insulation of the living floors below from the cold nights of the desert is achieved.
- d. The roof terrace is often used as a female territory for household work as well as interacting with neighbours (figure 9). The location of the kitchen in this floor enables easy access to it.

4. BUILDING METHOD AND MATERIALS

A key feature of desert buildings is they are densely attached to each other, a character that was determined by a number of environmental and socio-cultural reasons. With such density, buildings can withstand both the heat and the cold of the desert climate. The scheme reduces drastically the penetration of burning sunrays and consequently maintained adequate temperatures in streets, courtyards and houses (figure 10).

As for the material of construction, buildings were made from a composition of local materials such as clay, limestone, gypsum and palm wood. All of which are cheaply collected and have a high isolating ability of temperatures.

5. ADEQUATE DESIGN FOR DESERT CONDITIONS

Gadames city represents one of the best preserved building system providing best solutions to thermal issues of the desert climate. The city achieved a perfectly integrated design scheme that employed adequate instruments in shaping the character of the built form and its street system, to secure the highest possible comfort of residents. Figure 11, for example, gives a comparative summary of temperatures between the internal and external spaces in Gadames.

6. INTERIOR LIGHTING SYSTEM

In desert environment the lighting issue is approached differently to other environments. In the northern hemisphere, for example, buildings are designed to receive maximum amount of sunrays. The Desert requires different approach because of the strength and brightness of the sunrays that do not only raise temperatures inside but also affect the vision as well. Gadames provides a unique design scheme addressing this issue. In addition to the reduction of spaces open directly to the sky, the street system was designed in a manner to avoid direct contact with the sunrays. This was achieved by inclining the vertical street line at an angle forcing an angular entry of the rays which weakens their brightness and reduces the heat in the street. Figure 12 shows that the only time the sun enters directly the street is at 11:00am and 4:00pm, times when the rays are weak and their brightness is soft.

In houses, windows are absent and light enters in through small aperture (louver), which does not exceed the 1m², opened in the roof of the central living space and through the two floors. As this is the only source of light for the whole house, residents decorated their internal walls with reflective elements such as the white colour and mirrors, which are placed in the right locations to receive the sun coming from the aperture and project to other places. This method indeed provided good lighting without risking more heat. Figure 13 shows how the projected light in the main living room is distributed through the mirrors around the house.

Yader (2001) observed that in order to best use the light that penetrates the living room without risking higher temperatures, the aperture should be made as small as possible. "The smaller the light aperture is made the lowest amount of rays penetrating inside. Meanwhile, the two level (floors) height of the living space keeps the heat in higher parts, trapped between the roof and the ceiling of the living room, making the latter cool and comfortable. The height also improves ventilation through the two apertures (of the first ground floor and first floor) which also lightens the ground floor" (Yader, 2001).

7. VENTILATION SYSTEM

The ventilation system of buildings of Gadames was scientifically designed based on the rule of hot air weighing less than cold air. The ventilation louvers were designed to function accordingly. The circulation of air is directed vertically through small holes to reduce the amount of hot air entering inside (figures 14a & b).

8. INTERIOR DESIGN SYSTEM FOR TREATING THE CLIMATE AND PSYCHOLOGY CASES

The desert climate of Gadames has conditioned the physical and psychological well being of its community. Apart from a few hours where male adults of the community spend either working in their oasis or entertain in local clubs (cafes), residents usually pass the largest proportion of their time inside their homes, away from the sun. As a consequence, they made considerable efforts making their homes heat proof and designed them in the best manner to secure the most comfortable living conditions. In Gadames, the field trip showed how residents developed a number of decorative tools, in addition to the planning tools discussed previously, to create the right pattern that keeps the interior of their homes lightened but cool and answers their socio-cultural and psychological needs.

The first of these measures is the choice of particular colour and geometrical patterns for the decoration of wall ends and furniture. The scheme's main function is to reduce the brightness of strong sunrays. It also creates a positive psychological atmosphere corresponding to local desert traditions.

The other tool employed involves the already mentioned use of mirrors in the living room. These are hanged in particular locations on walls to receive light from the louver and reflect it to the rest of the interior. This sometimes creates problems as the brightness of this reflective mirrors may cause some visual discomfort. Therefore, mirrors are usually framed with dark red colour patterns to soften the brightness of the incoming light and reduce the shining of the mirrors. Additionally, the particular choice of dark red colours was also successful as it helped create a comfortable calm atmosphere in the house.

The overwhelming decorative geometrical pattern applied in these buildings is the triangular shape. This is a long known tradition in the region of Gadames, as well as in most parts of the Sahara, which goes back to times before Islam.

The red colour, according to Yader (2001), is extracted from the seashells as well as from the oxide of the red mercury. In its raw form is called "Zinjabar". The use of the red colour is often made on white background, or combined with light yellow and dark blue and green colours. Such colours are widespread in hot climate environments. This colour scheme is used also in textile, pottery, linen, shoes, crafts and most of local products (figures 15a & b). The choice of green colour symbolises the greenery of the oasis, while the yellow refers to the yellow colour of morning dawn, a period favoured for its coolness and beauty. The blue colour, however, symbolises the colour of the sky, an expression of both limitlessness and calmness. The use of the yellow and blue provides an additional beauty and breaks the monotony of the red colour.

At night, the city is as beautiful as in daytime, especially in dry nights of the summer season. The use of copper plates of various sizes, hanged on the walls, to reflect the light of candles, not only is a useful technique to spread the light of the candles but also adds a beautiful charm to the city skyline at night. "Copper plates reflects the light from the mirrors, adding brightness and shine. They are regularly cleaned with clean sand to increase their dazzling reflections." (Yader, 2001).

9. RESULTS AND RECOMMENDATIONS

The main theme of this paper has been the particularity of the desert environment and its relationship with the design features of desert towns and cities. The case study of Gadames has illustrated the influence of environmental conditions on the character of the layout and the physical fabric of the city. This determinism has been demonstrated in the design of the housing interior where a great degree of congruence between residents needs and their environment was successfully achieved. The two main conclusions reached in this brief study are:

- (i) Architecture of the interior of desert housing should be inspired by local environment and traditions. Importing design ideas from other environments or cultures would be doomed to fail.
- (ii) With its unpolluted environment and abundance of energy resources (sun and petrol), the Sahara represents a viable potential for the Arab peoples to develop. This would require greater understanding of its importance and more respect of its hard conditions. Such an approach would necessitate more research to find the best ways to adapt urban design to local circumstances, in similar way Gadames did. This issue was repeatedly emphasised by the failure of design solutions completely foreign to the nature of the Arabian Sahara.

The example of Gadames raised a number of key elements. These are summarised below:

One of the most crucial aspect in the success of desert architecture is the incorporation of climate conditions in the design of the layout and the physical fabric of the desert city. Consideration of local natural conditions, such as topography, wind direction, temperatures, movement of sand, water resources and fertile land...etc, is pertinent in any settlement schemes.

The need to respect and preserve the identity of local desert life is decisive for both improving the character and function of desert urban environments. The use of local colours, construction material, density levels, height of buildings and spatial arrangement are all essential ingredients emphasising the identity and personality of the area.

The need to observe the functionality of the interior space is essential for achieving the satisfaction of residents. The space needs to be kept simple but well integrated. Any decor needs to reflect residents' taste rather than being imposed by the designer.

There is an urgent need to preserve local traditional building skills of the desert regions. This can be solved by setting up training institutions, which record and teach these techniques. This training need also to extend to finding ways of improving the design of buildings as well as domestic technology.

FIGURES TO FOLLOW...

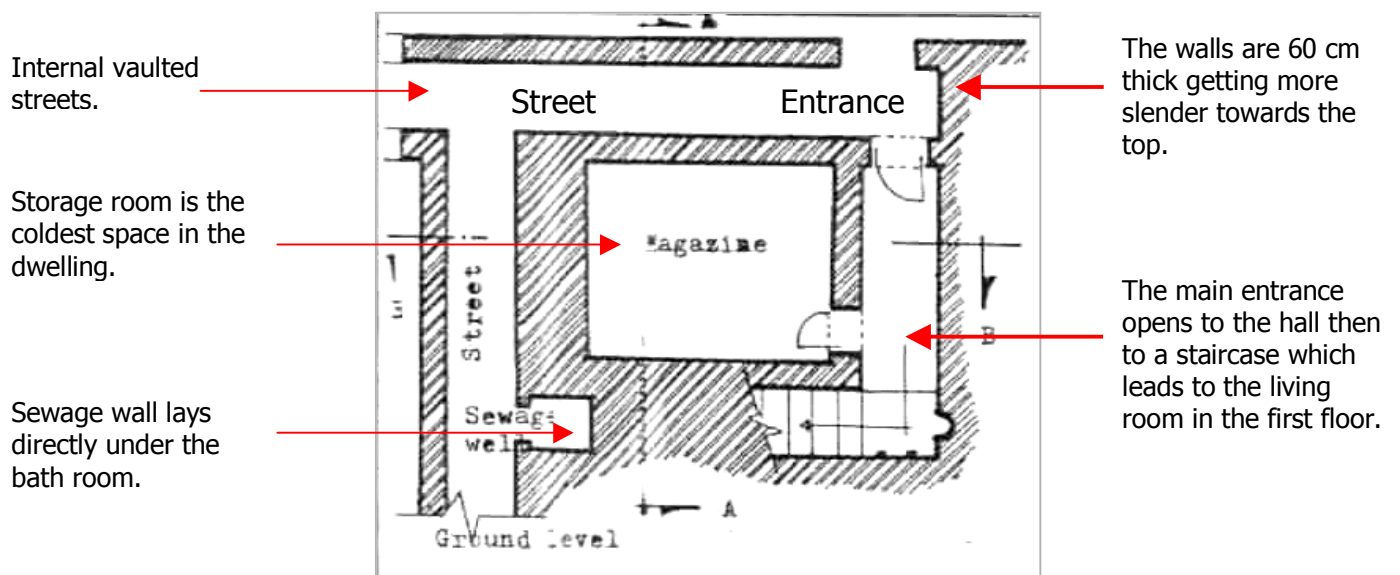


Figure (1) shows the plan of the ground floor and the entrance of the dwelling.

Source: Salem (1985, p.50)



Figure (2a) Vaulted streets and its branches.



Figure (3) View of the entrance hall showing side view of a typical main door of the dwelling and the storage wall units.

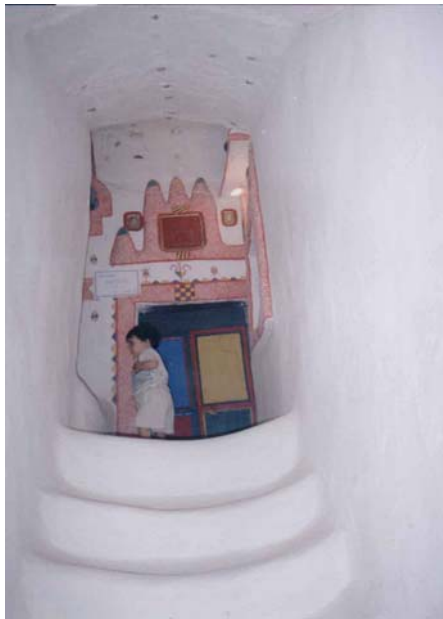


Figure (4) Main door seen from inside view leading to the staircase.

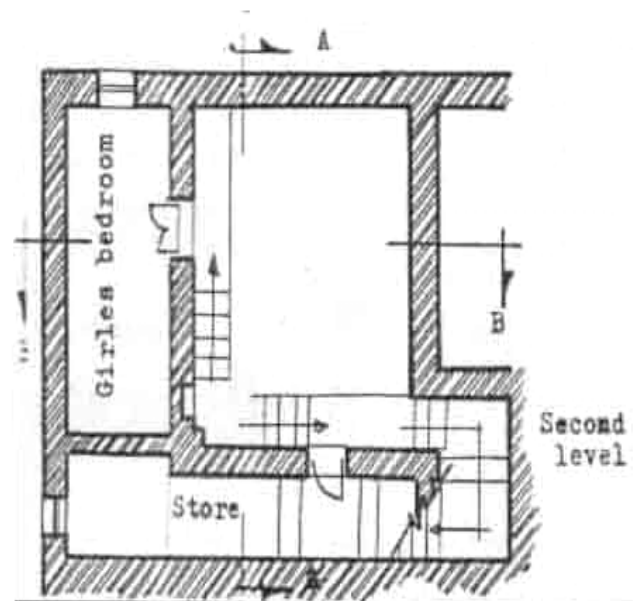


Figure (5) First floor plan showing different rooms and their use.
Source: Salem (1985, p.50)



Figure (6) View of first floor and its access taken from the central, also showing the under stairs storage space.



Figure (7) General view of Dwellings showing the general height and the absence of windows for protection from heat and enhance privacy.

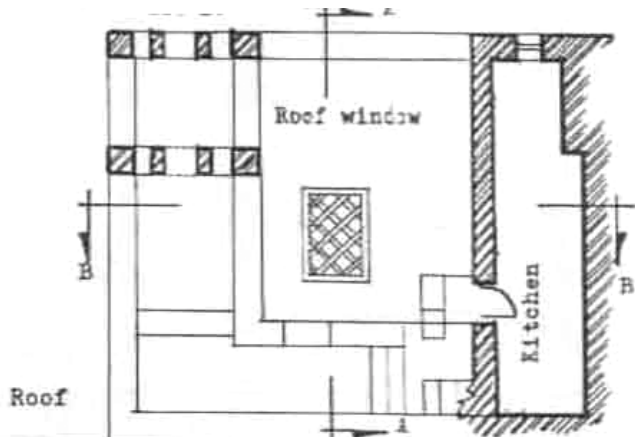


Figure (8) Plan of top floor containing the kitchen.
Source: Salem (1985, p.50)

Figure (9) General view of roof tops of dwellings marked by low walls and used as open terraces.

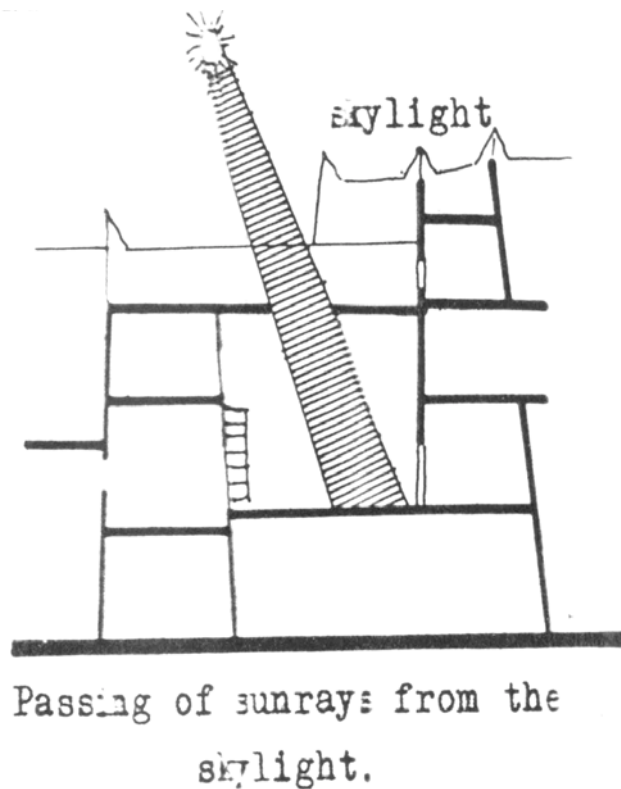


Figure (10) Avoiding vertical contact with sun rays is one of the key techniques introduced by local designers to reduce the heat inside the dwellings.

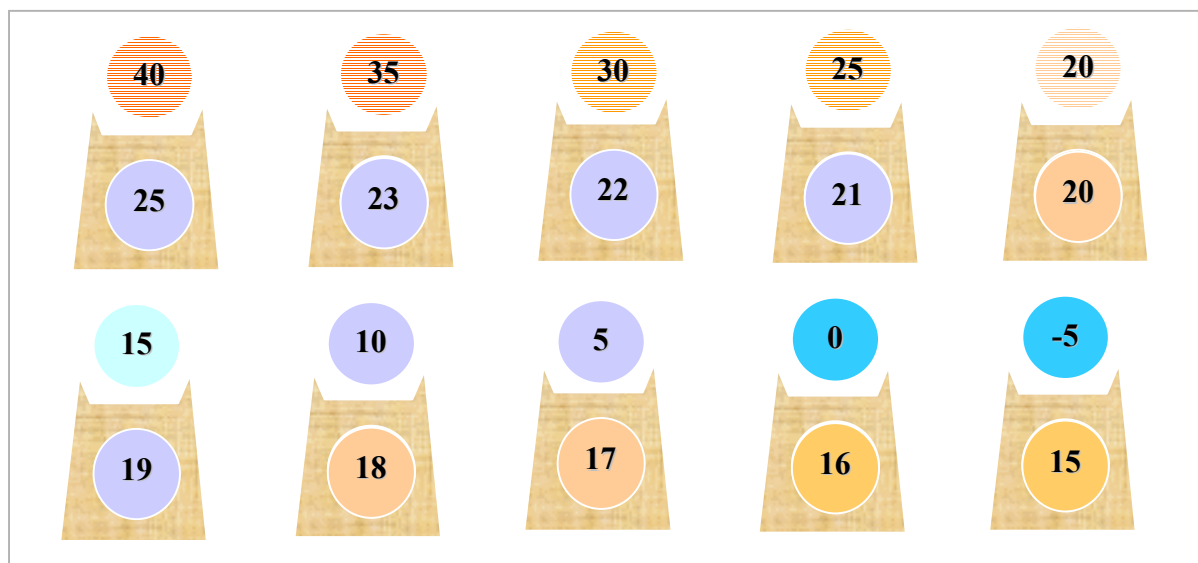
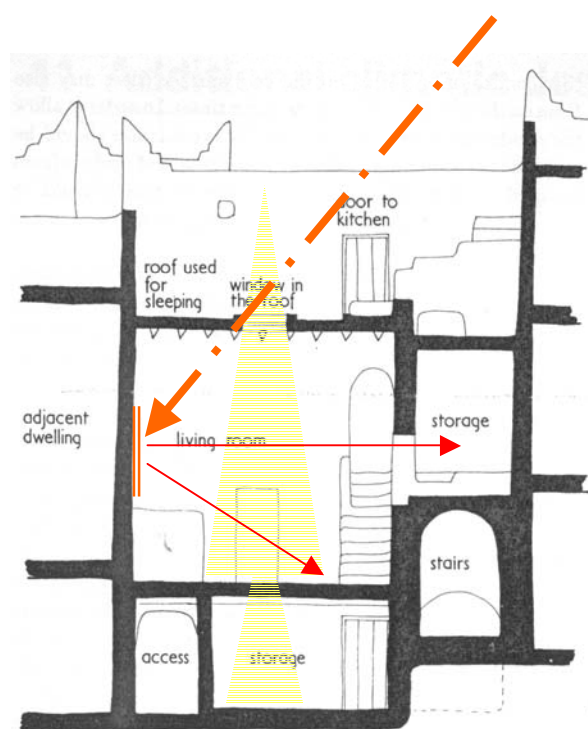


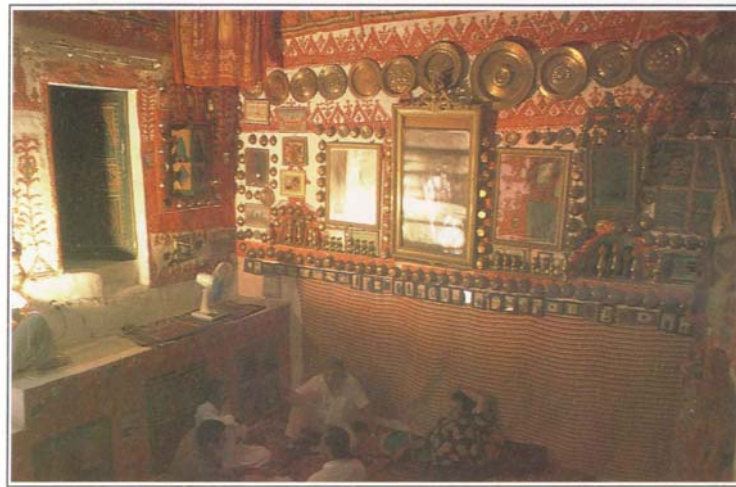
Figure (11) The difference between the inlet and out let temperatures in old houses.



Section of a typical dwelling in the oasis of Ghadames,
Libya

Figure (12) The penetration of the light into the dwelling.

Source: Salem (1985, p.13)



Ghadamis

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Figure (13) view of the living space (room) showing the distribution of copper plates and mirrors on walls of the room to reflect the incoming light.

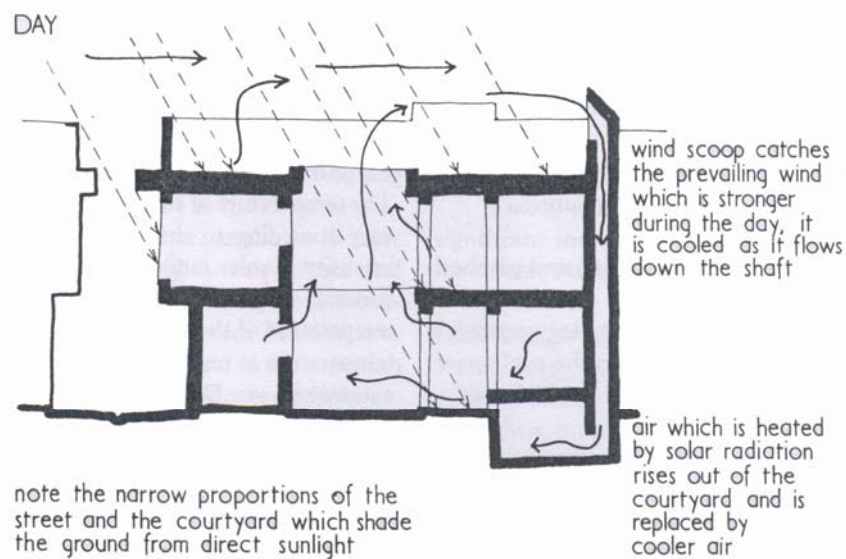


Figure 14 (a) The cooling system and the circulation of air in day light.

Source: Evans (1980, p.106)

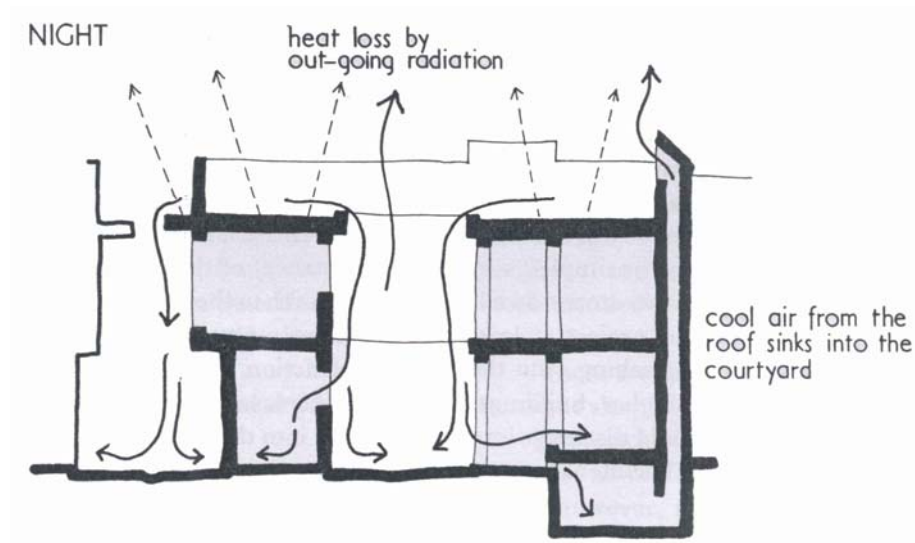


Figure 14 (b) The cooling system and circulation of air at night.

Source: Evans (1980, p.106)



Ghadamis

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Figure 15 (a) Distribution of red color around the mirrors.

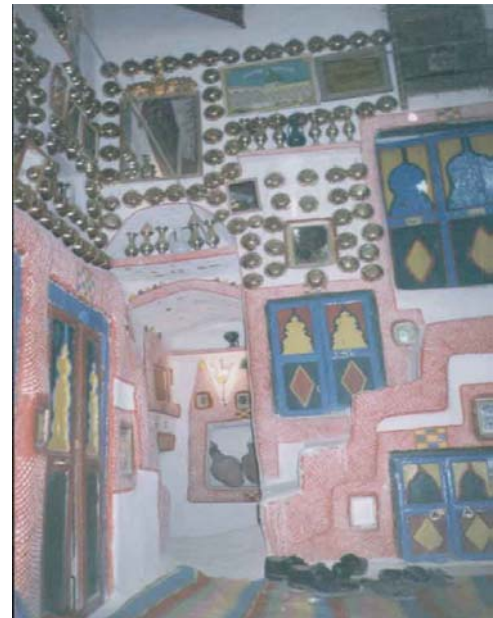


Figure 15 (b) The composition of red, yellow and blue colors in internal decor.

REFERENCES

Interview with Haj Abed-Alwahed Ahmed Yader. An Expert in old and vernacular buildings, Gadames-
[personal contact], 15.05.2001

Salem Ahmed 'City of Gadames General Plan', 1985, Libyan Jamahiriya

Evans, M. 'Housing, Climate and Comfort', Halsted Press: New York- 1980, p.106.

Bin-Sweas Abdul-jawwad, 'Developing Gadames Town' Al-Fatkeh University Libya, [undated and
unpublished]
