UNIVERSITY OF NOVI SAD
FACULTY OF TECHNICAL SCIENCES

Department of Architecture and Urbanism

A Study of Single Family Housing in Libya

Doctoral Thesis

by

Abdrahman Faraj Ali Shahran

Mentor :

Darko Reba, PhD, associate professor

Novi Sad,2018

УНИВЕРЗИТЕТ У НОВОМ САДУ ● **ФАКУЛТЕТ ТЕХНИЧКИХ НАУКА**
21000 НОВИ САД, Трг Доситеја Обрадовића 6

КЉУЧНА ДОКУМЕНТАЦИЈСКА ИНФОРМАЦИЈА

Редни број, **РБР**:	
Идентификациони број, **ИБР**:	
Тип документације, **ТД**:	монографска публикација
Тип записа, **ТЗ**:	Реч штампани документ
Врста рада, **ВР**:	Докторска теза
Аутор, **АУ**:	Мр абдрахман Фарај Али Схахран
Ментор, **МН**:	Др Дарко Реба,Ванредни професор
Наслов рада, **НР**:	Студија Сингле Фамили становања у Либији
Језик публикације,**ЈП**:	енглески језик
Језик извода,**ЈИ**:	енглески језик
Земља публиковања,**ЗП**:	Република Србија
Уже географско подручје,**УГП**:	Војводине, Нови Сад
Година, **ГО**:	2018
Издавач, **ИЗ**:	Аутора Репринт
Место и адреса, **МА**:	Факултет техничких наука, Трг Доситеја Обрадовића 6, 21000 Нови Сад, Србија
Физички опис рада, **ФО**: (поглавља/страна/ цитата/табела/слика/графика/прилога)	9/146/56/1/151/0/0
Научна област, **НО**:	Архитектура
Научна дисциплина, **НД**:	Архитектура
Предметна одредница/Кључне речи, **ПО**:	поднебље, материјали, традиционалне куће, двориште, савремени куће, архитектура, један породично становање
УДК	
Чува се, **ЧУ**:	Библиотека Факултета техничких наука, Трг Доситеја Обрадовића 6, Нови Сад
Важна напомена, **ВН:**	
Извод, **ИЗ**:	Циљ студије је да анализира различите типове традиционалних и савремених кућа у три различита географска подручја у Либији - оне на приморју (Триполи), у планинској области (Гхариан), и у пустињском терену (Гадамес) - у смислу прилагодљивости изграђених структура културним, друштвеним и климатским условима, као и да се испита како се користе традиционални елементи породичног становања у дизајнерским решењима савремених објеката. Студијом су обухваћени и анализирани различити утицаји који делују на породичне куће почев од планирања, градње, структуре објеката, коиршћење грађевински материјала, унутрашње уређење, отворе, конструкцију и коришћење крова... Спроведено је истраживање на терену кућа из Либије и примера из иностранства, сликани су и исцртани објекти који су укључени у анализу, и разговарало се са корисницима кућа ради јаснијег сагледавања услова које пружају.
Датум прихватања теме, **ДП**:	
Датум одбране, **ДО**:	
Чланови комисије,**КО**: Председник:	Др Јелена Атанацковић – Јеличић, редовни професор
Члан:	Др Милица Костреш, ванредни професор
Члан:	Др Милена Крклъеш, ванредни професор
Члан:	Др Душан Гордић, редовни професор
Члан, ментор:	Др Дарко Реба,Ванредни професор

Потпис ментора

Образац **Q2.НА.04-05** – И, редовни дање 1

UNIVERSITY OF NOVI SAD ● **FACULTY OF TECHNICAL SCIENCES**
21000 NOVI SAD, Trg Dositeja Obradovića 6

KEY WORDS DOCUMENTATION

Accession number, **ANO**:	
Identification number, **INO**:	
Document type, **DT**:	Monographic publication
Type of record, **TR**:	Word printed document
Contents code, **CC**:	Doctoral Thesis
Author, **AU**:	Mr Abdrahman Faraj Ali Shahran
Mentor, **MN**:	PhD Darko Reba, Assoc. Professor.
Title, **TI**:	A Study of Single Family Housing in Libya
Language of text, **LT**:	English
Language of abstract, **LA**:	English
Country of publication, **CP**:	Republic of Serbia
Locality of publication, **LP**:	Vojvodina , Novi Sad
Publication year, **PY**:	2018
Publisher, **PB**:	Author's reprint
Publication place, **PP**:	Faculty of Technical Sciences, Trg Dositeja Obradovica 6, 21000 Novi Sad, Serbia
Physical description, **PD**: (chapters/pages/ref./tables/pictures/graph	9/146/56/1/151/0/0
Scientific field, **SF**:	Architecture
Scientific discipline, **SD:**	Architecture
Subject/Key words, **S/KW**:	climate, materials, traditional houses, courtyard, contemporary houses, architectural, single family housing
UC	
Holding data, **HD**:	Library of Faculty of Technical Sciences, Trg Dositeja Obradovića 6, Novi Sad
Note, **N**:	
Abstract, **AB:**	The aim of this study is to analyze different types of traditional and contemporary homes in three different geographical areas in Libya – the coastal region (Tripoli), the mountainous region (Gharyan), and the desert region (Ghadames) – in terms of the suitability of cultural, social and climatic conditions, as well as to investigate how to take advantage of the traditional elements of single family housing in contemporary design solutions. The study includes the analyses on the impact of construction, planning guidance for building, construction materials, structure, distribution of internal arrangements and their function, roof, and openings, followed by conducting a field survey of the houses from home and abroad, and finally, taking pictures of houses and interviewing the residents of those homes.
Accepted by the Scientific Board on, **ASB**:	
Defended on, **DE**:	
Defended Board, **DB**: President:	PhD Jelena Atanackovic – Jelicic, Full Professor
Member:	PhD Milica Kostres, Associate Professor
Member:	PhD Milena Krkljes, Associate Professor
Member:	PhD Dusan Gordic, Full Professor
Member, Mentor:	PhD Darko Reba, Associate Professor.

Menthor's sign

TABLE OF CONTENTS

ACKNOWLEDGEMENTS

Thanks to Allah for His kindness giving me good health and full strength to finish this thesis. In time of difficulties, I believe He is always there to help and give me an internal encouragement. I would like to express my deepest gratitude to my mentor, Assoc. Prof. Dr Darko Reba, for his great sympathy, patience, supervision and suggestions throughout the preparation of this thesis. I would like to thank all the professors, assistants and my colleagues at the Department of Architecture and Urban Planning, Faculty of Technical Sciences, University of Novi Sad, for their assistance in completing my study. I am also very grateful to a nice group of kind people in Libya who helped me in providing the needed information and conducting the field study. Furthermore, I would like to take this opportunity to thank Professor Omar S. Omar and Dr Abdulkader Ahmad Ben Amer, for their encouragement and helpful advice every time. I wish to acknowledge my greatest debt to my family, my father, mother, brothers, sisters, and in particular my wife and my daughter Lamar. They never stopped encouraging me to finish this thesis and they suffered most because of my academic interests.

ABSTRACT

Over the course of the last few decades, most developing countries, including Libya, have experienced a rapid economic growth and the associated increase in population. This growth has led to a substantial increase in the implementation of contemporary single family housing and urbanization in the form of new districts, mainly influenced by western models, although the use of some traditional forms has been continued in hybrid designs. Traditional housing gains its name from its close relationship between the functional needs of the occupants, the culture, the climate, and other aspects of the living environment.

The aim of this study is to analyze different types of traditional and contemporary homes in three different geographical areas in Libya – the coastal region (Tripoli), the mountainous region (Gharyan), and the desert region (Ghadames) – in terms of the suitability of cultural, social and climatic conditions, as well as to investigate how to take advantage of the traditional elements of single family housing in contemporary design solutions. The study includes the analyses on the impact of construction, planning guidance for building, construction materials, structure, distribution of internal arrangements and their function, roof, and openings, followed by conducting a field survey of the houses from home and abroad, and finally, taking pictures of houses and interviewing the residents of those homes. Some advantages and disadvantages of both traditional and contemporary houses have been established. It has been concluded that the required level of thermal comfort found in traditional houses in all cities is better than in contemporary houses; the resort population in the cities with the exploitation of traditional houses in most extreme climatic conditions actually abandoned them and moved to contemporary houses; and, while building, there is a reason for the use of local building materials for contemporary houses.

The introduction of new building materials imported from abroad for contemporary housing without regard to the surrounding environment for those dwellings has made the thermal comfort industrially available through air conditioning, which resulted in the rise in the cost of energy. At the same time, traditional houses still retain the social and Islamic cultural features relying on privacy, and especially on the seclusion from

the street, neighbors and visitors related to the house. Privacy remains one of the most pervasive entities of the Arab Muslim family, although the contemporary Arab Muslim family is not as traditional as it used to be.

Author's preliminary findings suggest that privacy plays a pivotal behavioral role in influencing the design of the home environments and it remains one of the most persistent entities of these community-based cultural environments.

Consequently, this study should constitute a certain foundation for the comprehensive research into the concept of contemporary residential architecture, which would not disregard modern advances in materials and technology, but rather maintain the cultural continuity and identity of the place, meeting the aspiration of Muslim communities in this century at the same time. The method of juxtaposing old and new housing has proved helpful in conveying the main message. It has been illustrative and highly effective for the presentation of the main problems and the assessment of the quality of contemporary housing, often criticized for the residents' adjustment to environmental and social conditions. The method was helpful in convincing the decision-makers and the residents about the need to reach back to tradition when developing a new housing concept.

1. INTRODUCTION

1.1. Argument

In the oil-rich countries, many housing projects encourage the use of expensive imported materials, such as steel and cement, while discouraging the use of local ones. For this reason, such countries have become dependent on the import of building materials and infrastructure components. Additionally, such buildings are not suitable for the climatic conditions of the region(Nahla,2007). Libya, like most developing countries, has experienced rapid growth in the construction sector during the last thirty years. Unfortunately, this growth was only in favor of "modern" construction, which gave rise to large numbers of uniform-type reinforced concrete structures being built all over the country, with practically no regard for the conditions prevailing in their vicinity, climatic and otherwise(Nahla,2007). This resulted in not only uncomfortable and energy-consuming buildings, but also, according to the author's firm conviction, in the severance of ties with the historical past and culture of local people.

This study has been undertaken to investigate some of the significant factors underlying the apparent success of the construction patterns dominating in Libya. The main advantage of the traditional styles is their friendliness to their environment by using local building materials and by their design, which not only respects, but also takes advantage of the governing climatic conditions in the area (Nahla,2007).

1.2. Hypotheses of the study

This study will explore one of the problems of modern architecture of single family houses in recent times, where the advanced industrial technology has been directly introduced into the developing countries like Libya without taking into consideration conditions such as climatic, socio-cultural or economic factors.

The working hypothesis is based on the study and the analysis of different types of single family houses in Libya in order to establish relations and connections between traditional systems and contemporary elements, through the investigation and

evaluation of different systems and elements. The difference between the systems in terms of advantages and drawbacks will be addressed, as well as the approaches to develop traditional materials in modern construction and explore the possibility to propose a substitute for new materials that has physical and chemical properties suitable for climatically and geographically appropriate construction technologies for all regions in Libya. Moreover, the thesis will deal with the usage of new technology in the construction through the usage of traditional materials, in order to resist sun's rays falling during the day, especially in warm and hot spots in most seasons of the year.

Other hypothesis is the organization of the interior spaces of the house by taking into consideration some of the defects in the contemporary designs and offering solutions that embody the best features of traditional and contemporary forms through the separation of males and females in order to provide more privacy for the residents of the house.

One of the hypotheses is that the function and the role of the courtyard are changed from traditional to contemporary. The courtyard is an important component, and the contemporary home design can benefit from it. Certain functions in traditional houses are completely different in contemporary ones, and very often traditional houses are altered to fulfill modern demands for sanitation and health. Therefore, such facilities (kitchens and bathrooms) have to be designed in order to meet the requirements of a contemporary family to achieve sustainable development in the future.

Another hypothesis is that various natural effects have an important impact on the design of single family housing in Libya, such as the thermal comfort of home. This is considered be to one of the existing problems in the contemporary home and has to be overcome through certain suggestions, such as wall thickness. The use of trees and light colors on the walls are to provide shade in outer walls in order to reflect a large amount of sunlight falling on homes. The integration of traditional architectural features such as bay (terrace) into the contemporary housing, and the reduction of the excessive usage of finishing materials can provide simple beautiful house views in Libya.

One of the hypotheses also addresses the procedure of searching new concepts for housing, taking into consideration the common criticism of new housing. It seems a

good solution to return to the roots through the access to tradition, though without abandoning the means of potential technological contemporary comfort. Therefore, future solutions have to be concentrated on this problem while retaining the local architecture of each region in the design.

1.3. Objectives and goals of the research

Addressing the problem of housing in Libya demands for a broad study. The investigation of the differences between old and new forms of housing construction in different Libyan zones, from the perspective of the prevailing microclimate, is an important element of a great number of studies concerned with the comparison between old and new housing(Abdulkader,2007). Depending on the purpose, the goal and the conditions related to the issue of poor adjustment of modern housing to the existing environment, various aspects of the topic are studied with a view to continue the housing construction in Libya in the way that would make it possible to maintain the continuity and the cultural identity of the region (Abdulkader,2007). The following objectives have been addressed:

1. Analysis of different types of single family housing in Libya to establish connections between traditional and contemporary elements and systems;

2. Evaluation of structures, systems and elements of single family housing in different geographical regions in Libya and the comparison of traditional and contemporary systems;

3. Investigation on the manner the traditional elements of single family housing are transformed in contemporary design solutions;

4. Determination of the impact of different natural influences on the design of single family housing in Libya;

5. Understanding users' preferences towards the residential architecture in Libya;

6. Process of seeking new concepts of housing, taking into account common criticism of new housing and proving that a good solution implies returning to the roots by reaching to traditions, though without denying contemporary technological potential and modern amenities.

1.4. Defining the subject of investigation / analysis

The subjects of the investigation are seven single family houses in Libya: two houses (one traditional and the other modern) are analyzed in each of the three different climatic/geographical regions of Libya.The regions include the coastal zone (Tripoli), the mountainous zone(Gharyan), and the desert zone (Ghadames).

We will analyze houses according to the type of house, location, year of construction, total area, structural system, construction materials, internal functional arrangements, exterior and interior elements. We will also be interested in the courtyard, men salon, living rooms, kitchen, bathroom, roofs, openings, and privacy of houses.

The houses were all visited during August 2014 and plans were drawn at that time. Informal interviews were carried by the researcher with the house owners and with construction workers, certain engineers, architects and civilians in the old cities(Tripoli , Ghadames), as well as with few experts on architecture in Libya. Many questions were asked about the particular features of houses in order to understand users' preferences regarding residential architecture in Libya.

1.5. Research methodology

Research methodology includes a review of the general background of Libya, the detailed study of both the contemporary and the traditional houses in North Africa, especially in Libya, and the identification of their components. Some housing found in Tunisia and Syria will be examined to assess relevance outside Libya.

The study was based on the following: the field visit of three old single family houses and three contemporary single family houses, and the analysis of location of houses, year of construction, total house area, temperature, building materials, structural systems, the internal arrangements or functions (the entrance, corridor, bedrooms, living rooms in contemporary single family housing, courtyard in traditional single family housing, men salon, kitchen, bathrooms, roof and openings), as well as informal interviews with the authorities and inhabitants.

The methodology of this study focuses on the comparison made in each of the three Libyan cities according to certain criteria regarding traditional and contemporary houses as evaluation criteria elements of Libyan houses.

Seven houses were selected for a detailed survey; two houses (one contemporary and the other traditional) were studied in each of the three climatic regions in Libya, (Nahla,2007). coastal (Tripoli), mountainous (Gharyan) and desert (Ghadames) regions, as shown in Figure 1.1, with one possible example of a future single family house in Libya.

The study included visits to each house in three regions. The starting point was Gharyan, a city 90 km southwest of Tripoli, where we spent a day during August 2014, while the visit to Ghadames took three days later in August 2014, followed by the trip to Tripoli during August the same year. There were some difficulties in selecting the appropriate traditional houses, due to a lack of documentation for most of them, especially in Gharyan(Nahla,2007). The lack of safety in some abandoned houses, which were nearly demolished and infested with insects and reptiles, and the lack of cooperation on the part of some local authorities were other difficulties (Nahla,2007).

Figure 1.1: Three climatic regions in Libya, coastal (Tripoli), mountainous (Gharyan) and desert (Ghadames) regions.

1.5.1. Field survey

Architectural drawings of the contemporary houses were obtained from the owners and those for the traditional ones were obtained from the rehabilitation authorities of the old city of Tripoli and Ghadames(Nahla,2007). However, as there was no documentation available for the troglodytes in Gharyan, it was surveyed and the drawings were prepared by the author(Nahla,2007). All photographs were also taken by the author. Details of these houses are provided in Chapter nine.

1.5.2. Informal interviews

Informal interviews were carried out individually by the author with the owners of traditional houses, with people who had earlier experienced living in both types of houses, with construction workers and visitors in the old city, and with some experts on local architecture in Libya(Nahla,2007). Many questions were asked about the particular features of the houses in order to understand users' preferences regarding residential architecture in the country.

1.6. Brief content of the thesis

The study is presented in nine chapters. First chapter comprises the argument, objectives and research methodology. It finishes with the disposition of the subject matter in the remaining chapters, while the bibliography is placed at the end of the thesis. Remaining chapters deal with the following:

2. Single family housing in this chapter is presented via some of the important single family houses worldwide.

3. The chapter contains literature review, and includes the investigation of traditional Islamic single family housing in Arab countries (climate, building materials, socio-cultural dynamics of privacy, courtyard privacy and climate function, neighbor relations, thermal comfort functions of the courtyard) and the characteristics of the courtyard housing in Islamic (Arab) culture.

4. This chapter includes a case study on a traditional house in architecture in Arab countries (Tunisia and Syria), and a contemporary Islamic single family house in Egypt.

5. The chapter provides information about Libya, such as total area of Libya, population in 2004, latitude and longitude, geographical boundaries, historical background of Libya, economic development, and climate in Libya regions.

6. The chapter addresses culture, society and religious influences on Libyan housing.

7. In this chapter, there are criteria elements of evaluation of Libyan houses, like urban situation, climate, socio-cultural factors, privacy, structural system, materials and construction methods, house façade, and internal functional arrangements.

8. This chapter comprises case studies with the results of analyzing traditional and contemporary single family houses in three regions in Libya.

9. Finally, this chapter concludes the thesis with conclusions and recommendations.

2. SINGLE FAMILY HOUSING

A house is a building that functions as a home for humans, ranging from simple dwellings such as rudimentary huts of nomadic tribes to complex structures composed of many contemporary technical and technological systems (https://en.wikipedia.org/wiki/House) (February 2015). The social unit of people living in a house is known as a household. Most commonly, a household is a family grouping of some kind, although households may also be other social groups or individuals.

Home in the general concept consists of a place designed by a human with the walls and a roof and floors to secure the protection of the family from heavy weather (winds, storms, heat, and cold) and the attack of animals in villages and forests, or even the attack from criminals and thieves in modern cities (https://en.wikipedia.org/wiki/House) (February 2015). Hence, it is an example of a basic shelter.

Housing model differs greatly from one country to another. The pattern of housing construction has changed over time. Patterns may be labeled according to the style of building, name of the country or the period of time it was built, or by simply bearing the names of architects who designed them.

Many houses have several large rooms with specialized functions and several very small rooms for other various purposes. These may include a living/eating area, a sleeping area, and (if suitable facilities and services exist) separate or combined washing and lavatory areas. Additionally, in modern times, a spa room, indoor pool, sport area, and so forth can be included. In traditional agriculture-oriented societies, domestic animals such as chickens or larger livestock (like cattle) often share a part of the house with human beings(https://en.wikipedia.org/wiki/House) (February 2015). Most conventional modern houses will at least contain a bedroom, a bathroom, the kitchen or cooking area, and a living room.

In the United States, modern house construction techniques include light-frame construction (in areas with access to the supplies of wood) and adobe or sometimes rammed-earth construction (in arid regions with scarce wood resources). Some areas use brick almost exclusively, and quarried stone has a long history of walling(House from Wikipedia) (February 2015). To some extent, aluminum and steel have replaced some traditional building materials. Increasingly popular alternative construction materials include insulating concrete forms (foam forms filled with concrete), structural insulated panels (foam panels faced with the oriented strand board or fiber cement), as well as light-gauge steel framing and heavy-gauge steel framing.

More generally, people often build houses with the nearest available material, and often tradition and/or culture govern construction materials; thus, whole towns, areas, counties or even states/countries may be built with one main type of material. For example, a large fraction of American houses use wood, while most British and many European houses utilize stone or brick(House from Wikipedia) (February 2015).

In continuation, we will present some of the most important single family houses:

- **Frank Lloyd Wright, Fallingwater house.**

-Location: Mill Run, Pennsylvania, America.

-Year of construction: 1936-1939

This is one of the most iconic pieces of architecture, and is now a registered historic landmark. The way the block-like house is constructed out of a waterfall inspires people, as shown in Figure 2.1.

Fallingwater house stands as one of Wright's greatest masterpieces, both for its dynamics and for its integration with the striking natural surroundings. Fallingwater house has been described as an architectural tour de force of Wright's organic philosophy(Tadao Ando, 1995). Wright's passion for Japanese architecture is strongly reflected in the design of the Fallingwater house, particularly in the importance of interpenetrating exterior and interior spaces and the strong emphasis placed on the harmony between man and nature("Fallingwater". The Columbia Encyclopedia. Columbia University Press). This organically designed private residence was intended to be a nature retreat for its owners (Tadao Ando, 1995).

The interior of the house depicting a sitting area with furnishing designed by Wright is shown in Figure 2.2.

Figure 2.1: The way the block-like house is constructed out of a waterfall is inspirational. (http://en.wikipedia.org/wiki/Fallingwater) (January 2015).

Figure 2.2: The interior of the Fallingwater house depicting a sitting area with furnishing designed by Wright. .(http://en.wikipedia.org/wiki/Fallingwater) (January 2015).

The fireplace hearth in the living room integrates boulders found on the site and on the living room floor it is left in place to demonstrably link the outside with the inside. The integration with the setting extends even to small details. For example, where glass meets stone walls, there is no metal frame; rather, the glass and its horizontal dividers run into a caulked recess in the stonework so that the stone walls appear uninterrupted by glazing(Tafel, Edgar,1979). From the cantilevered living room, a stairway leads directly down to the stream below, and in a connecting space which unites the main house with the guest and servant level, natural spring drips water inside, which is then channeled back out. Bedrooms are small, some with low ceilings to encourage people outward toward the open social areas, decks, and outdoor("Fallingwater". The Columbia Encyclopedia. Columbia University Press). The design incorporates broad expanses of windows and balconies which reach out into their surroundings. (Tafel, Edgar,1979). The staircase leading down from the living room to the stream is accessed via movable horizontal glass panes. In conformance with Wright's views, the main entry door is away from the falls. (http://en.wikipedia.org/wiki/Fallingwater) (January 2015).

- **Hassan Fathy, Mit Rehan house.**

-Location: The house is in the countryside on the Sakkara Road in Giza, Egypt.

-Year of construction: 1981

Two systems dominate architectural thinking: the climatically efficient houses of Mamluk and Ottoman Cairo, ingeniously shaded and ventilated by means of their two-storey halls, mashrabiyyas and courtyards; and the indigenous mud brick construction still to be found in rural areas. The latter consists of inclined arches and vaults, built without shuttering, domes on squinches built over square rooms in a continuing spiral, semi-domed alcoves and other related forms(The Aga Khan Trust for Culture. 1989). These fine old houses enriched the architect's imagination; however, they are to become models for later large-scale work. The ancient mud brick forms, in contrast, are still being produced by rural masons unchanged. Stimulated by what he had learned, Fathy had what was then a revolutionary idea. He perceived that a connection could be made between the continuing viability of mud brick construction and the desperate need of the Egypt's poor to be taught once again to build shelter for themselves (https://archnet.org/authorities/1/sites/2689) (February 2015) , as shown in Figures 2.3, 2.4, 2.5 and 2.6.

Figure 2.3: Exterior façade.
(http://archnet.org/) (February 2015).

Figure 2.4: Roof view.
(http://archnet.org/) (February 2015).

Figure 2.5: Southwest courtyard.
(http://archnet.org/) (February 2015).

Figure 2.6: Interior.
(http://archnet.org/) (February 2015).

Hassan Fathy devoted himself to housing the poor in developing nations and deserves to be studied by anyone involved in rural improvement. He worked to create an indigenous environment at minimal cost, and in doing that, to improve the economy and the standard of people living in rural areas(Steele, 1989). He utilized ancient

design methods and materials. He integrated knowledge of the rural Egyptian economic situation with a wide knowledge of ancient architectural and town design techniques(The Aga Khan Trust for Culture, 1989). He trained local inhabitants to make their own materials and build their own buildings. Climatic conditions, public health considerations, and ancient craft skills also affected his design decisions. Based on the structural massing of ancient buildings, Fathy incorporated dense brick walls and traditional courtyard forms to provide passive cooling (Steele, 1989).

The house is situated in the countryside on the Sakkara Road in Giza, Egypt. The construction was once again overseen by the client rather than the architect, more specifically by Mahmood Fahmy, who saw to its timely completion. In the interim, Fahmy was also able to cooperate with the architect in solving several special problems. One of the most fascinating among them was finding a natural way of sealing the Fayum limestone that was used, by coating it with boiled oil from the plant, so that the soft yellow color of the stone would not change (http:// www. yamay.com.ar/images/Hassan_Fathy.pdf) (February 2015). The house in its built form is quite different from the final documents, with the first floor added over one entire portion during the course of construction, due to the client's wish for more space. Most recently, further changes have been made, which have significantly altered the character of a delightful south facing terrace and taktaboosh, as well as the interior quality of a number of rooms.(http://archnet.org/) (February 2015).

- **Mies van der Rohe, Farnsworth house.**

-Location: Chicago, USA.

-Year of construction: 1945-1951

Although the term glass house has become ubiquitous in describing a type of modernist building, the idea was pioneered by Mies van der Rohe. The Farnsworth House was designed and constructed by Ludwig Mies van der Rohe in the period 1945-51. It is a one-room weekend retreat in a once-rural setting, located 55 miles (89 km) southwest of Chicago's downtown on a 60-acre (24 ha) estate site, adjoining the Fox River, south of the city of Plano, Illinois (Farnsworth House,2007). The steel and glass house was commissioned by Dr Edith Farnsworth, a prominent Chicago nephrologist, as a place where she could engage in her hobbies: playing the violin, translating poetry, and enjoying nature. Mies created a 1,500-square-foot (140 m^2)

house that is widely recognized as an iconic masterpiece of International Style of architecture. The home was designated as a National Historic Landmark in 2006, after joining the National Register of Historic Places in 2004 (Farnsworth House,2007). The house is currently owned and operated as a house museum by the historic preservation group, National Trust for Historic Preservation. It achieved Mies' concept of a strong relationship between the house and nature.

The single-story house consists of eight I-shaped steel columns that support the roof and floor frameworks, and therefore are both structural and expressive, as shown in Figure 2.7. In between these columns, there are floor-to-ceiling windows around the entire house, as shown in Figure 2.8, opening up the rooms to the woods around it. The windows are what provides the beauty of Mies' idea of tying the residence with its tranquil surroundings(http://en.wikipedia.org/wiki/Farnsworth_House) (February 2015). His idea for shading and privacy was conceived through the many trees located on the private site. Mies explained this concept in an interview about the glass pavilion stating, "Nature, too, shall live its own life. We must beware not to disrupt it with the color of our houses and interior fittings. Yet we should attempt to bring nature, houses, and human beings together into a higher unity." (http://en.wikipedia.org/wiki/Farnsworth_House) (February 2015).

Figure 2.7: Exterior façade. (http://en.wikipedia.org/wiki/Farnsworth_House) (February 2015).

Figure 2.8: Interior view, living room, the Farnsworth House. (http://en.wikipedia.org/wiki/Farnsworth_House) (February 2015).

Mies intended for the house to be as light as possible on the ground, and so he raised the house 5 feet 3 inches off the ground, allowing only the steel columns to meet the ground and the landscape to extend past the residence, as shown in Figure 2.9. In order to accomplish this, the mullions of the windows also provide structural support for the floor slab. The ground floor of the Farnsworth House is thereby elevated, and

wide steps slowly transcend almost effortlessly off the ground, as if they are floating up to the entrance. Aside from walls in the center of the house enclosing bathrooms, the floor plan is completely open exploiting true minimalism (Zimmerman, 2006).

Figure 2.9: The house 5 feet 3 inches off the ground.

(http://en.wikipedia.org/wiki/Farnsworth_House) (February 2015).

- **Frank Gehry's House in California.**

-Location: Santa Monica, California, USA.

-Year of construction: 1977-1978

Before Frank Gehry acquired international prestige as the architect of the Guggenheim Museum in Bilbao, he designed his own house in Santa Monica (1977 – 78). The story started when his wife, Berta, bought a small pink bungalow in a bourgeois neighborhood. Gehry decided to redesign what he considered "a dumb little house with charm", by building around it and trying "to make it more important" (http://storiesofhouses.blogspot.com /2006/02/frank-gehrys-house-in california.html) (March,2015).

The house in Santa Monica, just west of Los Angeles, has been a landmark for 15 years. It introduced the architectural vocabulary in 1978, a precise balance of fragment and whole, raw and refined, new and old, inspiring a generation of designers. It helped establish Los Angeles as America's most vibrant city for architectural innovation. And it widened the scope of Gehry's own practice from a

regional to a global sphere. Thus, the main goal of the project was to meet the challenge of growth, both his own as well as his family's, while remaining sympathetic to what was already there. As Gehry put it, "The job was to let the house change without stepping outside its own vernacular". The basic layout of the house remained much the same. The entrance, kitchen and dining area still occupied the narrow, U-shaped strip of space between the old pink house and the industrial-strength walls that Gehry wrapped around it in 1978. The kitchen's large, distinctive window and skylight remained intact within their tumbling wooden frames.

However, surfaces throughout the house went from raw to cooked. Ceilings were fitted with neat wooden battens, covering up formerly exposed beams. The crude asphalt that once lined the kitchen floor was replaced with square asphalt pavers. In place of plain plywood there occurred varnished Douglas fir. Those smooth surfaces brightened the rooms, and now there is air-conditioning as well.

Gehry actually kept the existing house almost completely intact, though not in a conventional manner. The Dutch colonial home was left intact and the new house was built around it. Holes were made, the walls were stripped, torn down and put up, and the old quiet house became a loud shriek of contemporary style among the neighboring mansions – literally. Neighbors hated it, but that did not change the fact that the house was a statement of art entwined with architecture, as shown in Figure 2.10.

Figure 2.10: Exterior façade of the Frank Gehry's House.
(http://www.archdaily.com/67321/gehry-residence-frank-gehry/) (February 2015).

Gehry's design is wrapped around three sides of the old house on the ground floor, extending the house towards the street and leaving the exterior of the existing home almost untouched. The interior went through a considerable amount of changes on both of its two levels. In some places it is stripped to reveal the framing, exposing the joists and wood studs. It has been repaired according to the addition, showing both old and new elements. This is especially evident when walking through the rooms of the house and passing by both new doors placed by Gehry and older ones originally in the house(www.archdaily.com/67321/gehry-residence-frank-gehry/)(February 2015).

On the second floor, the boys' old room became a study room for Mrs. Gehry. The master bedroom now features a built-in, glass-topped table that doubles as a skylight for the living room below. Thick glass also replaced the chain-link floor in an area leading from the bedroom to a balcony, being wrapped around the side of the house. A steep stair, more like a ship's ladder, ascends from the bedroom to a garret-lookout Gehry set aside for reading. Here, plywood bookshelves and walls of exposed wooden slats recall the building's pre-renovation roughness, though the slats now frame small windows that open and close by discreet electric motors(www.archdaily.com /67321 /gehry-residence-frank-gehry/)(February 2015).

The landscaping around the house is also more formally ordered. An ancient, towering cactus still commands the backyard, though the new paving that surrounds it replaced the pulverized concrete that once gave the yard the appearance of a vacant city lot. A lap pool, lined with apple green tile, now stretches along the width of the yard. On the far side of the pool, the pink-shingled garage has been enlarged by a metal façade. Remodeled for guest quarters, the garage has been requisitioned by the boys as a recreation room.

In front of the house, the landscape designer Nancy Power has arranged a sumptuous oasis of desert flora around a bubbling fountain: water tumbles into a basin from stainless-steel faucets, the kind you remember from chemistry class. Overhead, nasturtiums begin to soften the cantilevered chain-link screens into bucolic trellises. However, the real "landscaping" of this house is the fractured panorama of multiple perspectives that unfolds as you look out its windows. As you ascend through the house, your angle of vision pivots downward, directed by openings that frame sky, then treetops, then the motley Santa Monica cityscape in a low-flying bird's-eye view, (Muschamp, 1993). The entrance is barely discernible amidst the jutting angles of the

exterior, which Gehry created from wood, glass, aluminum, and chain-link fencing. The apex of the old house peeks out from within this mix of materials, giving the impression that the house is consistently under construction, (http://www. Archdaily .com/67321/gehry-residence-frank-gehry/)(February 2015). In 1991, due to the Gehry family's growth, which involved two boys, the house had to be expanded. Even though Gehry tried to maintain the same style of the house, allowing the original design to determine that of the addition, the house went through significant changes. For Gehry, this was not destined to be a simple matter of calculating so many square feet. His architecture is an art of relationships. He could not easily change one part of the house without rethinking the whole. Extending the rear wall, for example, dimmed the wall's lineup of five wood-framed glass doors, one of the most distinctive features. Gehry decided to replace the doors with large picture windows, setting one of them within a sliding frame. But since the doors echoed the wooden framework of an exposed stud wall inside, that wall also had to come down. And without the wall, the raised floor of the adjacent living room had to be extended over a sunken "talk pit".(http://www.archdaily.com/67321/gehry-residence-frank-gehry/)(February 2015).

3. TRADITIONAL ISLAMIC SINGLE FAMILY HOUSING IN ARAB COUNTRIES

Traditional architecture is used to represent the structures built by people whose design decisions are influenced by traditions in their culture. It varies widely according to the world's vast spectrum of climate, terrain and culture. It contains inherent and unwritten information regarding the modes to optimize the energy performance of buildings while using local materials. Over the course of time, these dwellings have evolved to respond to challenges of climate, building materials and cultural expectations of a particular place(Ealiwa and Taki, 2001).

The concept of family privacy and the role of women in the family and the society are reflected in the use of public, semi-private and private spaces. In the Arabic world, environments dedicated to women only or to the entire inner family are the private spaces in the house (Ealiwa and Taki, 2001). They can also occupy several outer courts dedicated to various levels of social interaction with men.

In the twenty-first century, there appears an efficient usage of courtyard as the environmental bioclimatic thermal controller at domestic and institutional levels of the built environment(Ealiwa and Taki, 2001). Air from the courtyard can only affect the internal space if it circulates through it efficiently. The courtyard provides a comfortable area during hot season. Opening and closing doors is utilized to influence the courtyard's microclimate. Moreover, these courtyards physically protect the structures against strong wind during storm and bad weather.

Culturally, the same space is dedicated to the private outdoor relaxation of women and children. Courtyards are particularly effective in climates where extreme diurnal temperature is quite likely. They act like cups holding cool air (cooled at night) to be used during the daytime. It should also be noted that courtyards also provide outdoor areas that are well protected from distractions or dangers outside the home. The study evaluates the coincidence present in the ability of the courtyard to provide thermal comfort as well as privacy, as demanded by the Islamic laws (Ealiwa and Taki, 2001).

The most outstanding characteristics of the Arab house come mainly from its array of elements tested by people's tradition and culture, as well as environmental demands. Undoubtedly, the subtle architectural quality of these houses and the positive effect of their images do not only come from their deliberate plans, but also from their imposing exteriors. However, the aesthetic of the Arab house comes from the harmony of putting the architectural elements together as well as juxtaposing them in order to provide a variety and visual interest through change in their size and scale, maintaining at the same time the coherence and unity between the inhabited space, construction and landscape.

3.1. Overview of Islamic architecture and cultural heritage in Arab countries

The Islamic architecture has seen a wide spread around the world, especially in Arab countries, although there is a vast distance between them. Some items used in Islamic architecture were originally used by other civilizations, though with the aspects of religious and spiritual conservation, the shape, and the surrounding environment which should be taken into consideration (Peter J,2007). It is undeniable that the first written civilization appeared in the ancient Iraq, where it interacted with the natural environment of Southern Iraq. The agriculture of that region utilized rivers and dams. To achieve stability and security, rulers undertook certain strategic projects. For example, they dug channels, built temples and improved life conditions of their retinues. This led to the rise of the city and architecture which developed from 2800 to 2400 BC.

-Islamic architecture

During the last 50 years, following the trend of modernization, the Western mode started its encroachment on the territory of the great Islamic cultural heritage, as a rich storehouse of architectural heritage. The world has lost much of its historic styles and the impact of modernization has led to a rupture of continuity between the inherited morphology and more recent urban structure (Peter J,2007)s. Architectural culture is a localizing force that should bridge the gap opened by the historical conscience between the past and the present, by creating new communities which have been faithful to the traditional architecture in creating an urban environment, and encouraging the inspiration from the inherited cultural heritage,(Richard Ettinghausen,2001).

-Islamic tiling and traditional strapwork

The Islamic world has a rich heritage of incorporating geometry in the construction of intricate designs in architecture, together with tile walkways and patterns on fabric. This highly stylized form of art has evolved over the centuries from simple designs to fairly complex geometry, involving a high degree of mathematical symmetry (Richard Ettinghausen,2001). Many of these complex designs can be constructed using a strapwork method, where circles and squares are transformed into stars and overlapping lattices to form a more intricate symmetric pattern, as shown in Figure 3.1. The Alhambra Palace, the 14th century Moorish architectural wonder in Granada, Spain, contains a number of excellent examples of these Islamic structures (Figure 3.2). Although many of the patterns found in Islamic architecture can be constructed using periodic methods, such as strapwork with straight edge and compass, there are numerous examples which appear to be nonperiodic, containing symmetries which may require additional construction techniques. Architecture has relied on the science of designing and constructing buildings to meet people's physical and moral demands. Appropriate construction materials are used in accordance with the desired design.

symmetry (Richard Ettinghausen,200).

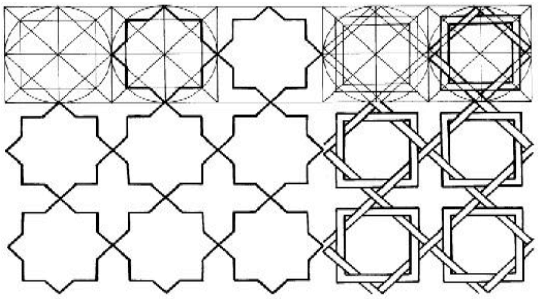


Figure 3.1: Strapwork method showing construction from circles.

Figure 3.2: AlhambraTiling, from lines to stars to overlapping lattices, Geometer's sketchpad. Photo by R. Tennant.

3.2. Islamic determinants of single family housing design in Arab countries

When the Arabs settled the desert, they used to close their houses to the outside and turn them into the courtyards which often embodied most of the missing aspects of the desert, such as water, plants, shade, a reference point and a sense of enclosure (Noor, 1991). For the people of the desert, the courtyard seemed to offer the ideal conditions they desired from an abode. Eventually, it turned to be an idealized world for them,

around which the family life evolved. The factors influencing the design of the courtyard in single family housing are listed below.

3.2.1. Climate

The courtyard in the Arab house is an effective way of building a dwelling place as well as creating an agreeable internal environment which counteracts the climatic conditions of the humid region. It acts as a modifier in hot and dry regions and allows occupants to carry on outdoor activities with the protection from the sun, dust and wind (Salem. M. Sharif, M.F.M. Zain, M. Surat,2010).

3.2.2. Building materials

Lack of suitable building materials, like burnt brick and timber, leads to vertical and horizontal restrictions on the size of a building. This makes a number of rooms compatible to each other to be grouped together around a central space within an easy reach of one another. These constrains have given the courtyard house a sense of uniformity in its widths and heights (Zakaria, Y, 2001).

3.2.3. Socio-cultural dynamics of privacy

A verse in the Quran states that, when you ask them (prophet's wives) anything, ask them from behind a curtain. Although the passage relates to the wives of the prophet (AS), all Muslims are to follow the example. Sahih Al Bukhri (RA) reports that if anyone among you asks three times for the permission to enter a house, and the permission is not granted, then they should not enter the room (Al Quran, 1919). If anyone removes a curtain and looks into the house before receiving the permission, and sees anything that should not be seen, they have committed a sin (Al Quran, 1919).However, if a man passes a door which has no curtain and is not shut, and he looks in, he has committed no sin, for the sin pertains to the people inside. The emergence of the following Islamic guidelines has had an impact on the design of a Muslim house in both direct and indirect manner:

1. Privacy of women should be respected in all circumstances at every level;

2. The entrance to a house should have a curtain, a door or some kind of screening, so that a passersby or any sort of strangers may not pee;

3. A visitor should wait for permission before entering a house. If he is not permitted, he is not allowed to get inside the house.

All these requirements mentioned above are satisfied by the design of the courtyard house Al Quran, 1919). The importance of privacy is one of the major concerns while designing a Muslim house. Yet, according to the interpretation of other guidelines, the male guest visiting the house, where the privacy is ensured, is to be accorded as much hospitality as possible and treated like a member of the family. In the Quran, Muslim is asked to treat each others as brothers.

Intelligent and precise planning makes it possible for the visitor to enter the "diwaniya[1]" (Figure 3.3) without disturbing the female members of the family. In multi-courtyard houses, the second courtyard is likely to be the family courtyard which may always be used by women exclusively, thus ensuring the complete privacy.

Figure 3.3: Diwaniya in most of the Arabian houses.

3.2.4. Courtyard privacy and climate function

The traditional Arabic house is one that has been adapted, physically and symbolically, to serve two inseparable functions. First, it serves as a shelter, providing the inhabitants with adequate protection against unfavorable outside conditions (climate). Second, it is a habitat "maskan[2]", one in which the inhabitants can comfortably satisfy their physical and emotional needs (culture).

[1] Dewaniya is the most popular word in the Arab home style. Most of the Arabian houses have a special room called dewaniya room. The function is similar to the gathering room.
[2] Maskan – house

Consequently, the courtyard seems to be the appropriate outdoor space for these functions. According to Mahgoub et al. (1999), privacy is an important factor in the arrangement of the house. The male reception area is separated from other family private areas. It has a direct access from outside without going through the house. The courtyard is restricted to family activities.

The courtyard is used by women to move between house facilities. The courtyard is an important feature of the house. It occupies half of the traditional house area. It provides privacy for women to conduct their social activities, as well as eat and sleep during hot summer seasons. (Mahmoud ,2007) states that, in a traditional Arab house, one can understand the interior disposition of the dwelling based on a number of major cellular units grouped around a central distribution space, that is, the courtyard. The space organization of such a dwelling reflects the users' needs, the spatial requirements and the incremental developments with mutual understanding among neighbors.

The courtyard house is indeed the favored typology of most Arab-Islamic cities. Their enclosed and introverted domestic space has responded ideally to the requirements of the Arabs' social order.

The courtyard is the controlled source of light, providing shade as the sun moves across the sky, and allowing a portion of the light to be used for all indoor living purposes. Thus, the courtyard becomes the inner living space. The fundamental characteristics of the courtyard house are in line with the family's tradition of isolating themselves from the public and satisfying their need for a private family life (Abarkan and Salama, 2000). Old houses are designed with a courtyard (square, rectangle, and trapezoid plan type) surrounded by buildings oriented towards the main directions, such as east–west and north–south. Blocks surrounding courtyards are usually perpendicular to each other and irrespective of the plot geometry (Gedik, 2004). Reynolds (2002) explains the social functions of courtyard as the ones allowing almost any activity to be carried on at least on a temporary basis. The author explains that the most common usages of courtyards and arcades are related to the extension of living, dining and kitchen activities. The things most frequently done in the courtyard tend to be those performed in groups. Another function of the courtyard, as elaborated by Reynolds (2002), is the "social delight" of being in a safe playground

with a great variety. It offers the children enough contact with nature to be entertained rather than to be threatened by it.

3.2.5. Neighborhood relations

The absence of windows on the external walls avoids the views out of the room as well as looking in by outsiders. The provision of raised parapets in the roof, which is used by occupants as a living space, is as much for the privacy of the neighbors as it is for the dwellers' own protection, as advised by the Prophet (SAW): if anyone spends the night on the roof of a house with no stone palisade, Allah's responsibility to guard them no longer applies (Abu Dawud, (5023); Hadith, 1992).

"He who believes in Allah and the last day should not harm his neighbor and should honor his guest".

3.2.6. Thermal comfort functions of the courtyard

The courtyard was developed mainly in response to climatic requirements. For many centuries and to the present day, the courtyard has been one of the most characteristic forms of residential architecture in warm climates (Muhaisen, 2004). The residents of such climates utilize the courtyard as a collector of cool air at night and a source of shade in the daytime (Safarzadeh and Bahadori, 2005). Courtyards are usually the heart of the dwelling spatially, socially, and environmentally.

Thermal comfort is affected by several factors, like building orientation, ventilation, and shadowing. Courtyards are developed by taking those factors into consideration. Although the size of the property, to some extent, is influential, the average sizes of the courtyards are generally determined according to the latitude. They are narrow enough to maintain a shaded area during the heat of the day in summer, but wide enough to receive solar radiation in winter. A courtyard can provide security, privacy, and a comfortable place within the house(Muhaisen, 2004). The courtyard is usually planted with trees, flowers and shrubs, not only to provide comfortable condition and a beautiful setting, but also to shade spaces adjoining, and increase the relative humidity of the place. Even without modern mechanical heating or cooling systems, the courtyard house provides a comfortable living environment through the seasonal usage of the structure sections. The mass of the walls and of the floor of the courtyard is cooled by outgoing long wave radiation, and therefore, the surface of the courtyard

floor and walls will remain cool by the following morning. In this way, the mass of the walls and of the floor of the courtyard (and not the air deposited in the courtyard) serves as a reservoir of coolness, if it is not too large and if it is well shaded (Khan, 2003). Thus, it justifies the functions of the courtyard which are to be more than just privacy.

The courtyard has an environmental advantage as well as a social one. They also serve as temperature regulators. Surrounding the courtyard, there are colonnades, while rooms are arranged to be opened towards balconies overlooking the courtyard. This arrangement allows cool air to flow through the building into every room in the house. In the daytime, when the inside windows are closed, the coolness is maintained inside the rooms by heavy thick walls that absorb the built-up heat(Muhaisen, 2004).

a) Orientation of the courtyard

Orientation of the courtyard is being considered according to climatic conditions for each district, specifically for the prevailing winds and the movement of the sun, directed inwards or outwards in relation to the windows, for the following reasons:

- To ensure natural lighting for interior spaces in the house in the desired times, though without control;
- To be suitable for humidity by ensuring ventilation.

Studies on this issue show that most windows open outwards. Especially on the higher floors, these windows are directed to the north/south orientation in order to enable the penetration of ventilation air to the interior spaces and to reduce undesirable sun rays (Gedik, 2004).

b) Ventilation of the courtyard

Natural ventilation is the process by which spaces exchange indoor air with outdoor air without the use of any mechanical system. This can be induced by wind effects, where air is driven through or out of the space via windows or other openings like louvers, holes, etc. Air movement can also be induced by buoyancy resulting from the difference between the density (due to temperature differences) of the air of the indoor and outdoor space. The lesser the density of the air, the higher the air will rise. For ventilation, the openings are not used to increase the reduced humidity in the

interior spaces of the ground floor of the traditional interior courtyard houses because there are no openings outside that ensure the movement of air (Gedik, 2004).

c) Shadowing of the courtyard

Traditional houses are usually surrounded by a wall and an interior courtyard. During the day, interior and exterior spaces pass through different shadow periods. Interior courtyard represents a source of natural lighting for the surrounding spaces. This area is not exposed to the sun's rays even in hot times due to the available trees in the interior courtyard, which create the equilibrium in internal environment of the house. This courtyard permits the removal of hot air and the maintenance of cool air inside the courtyard; furthermore, it relatively keeps the coolness of surrounding spaces (Gedik, 2004). Figure 3.4 below shows the thermal value of courtyards in the enhancing cross ventilation through shadow casting.

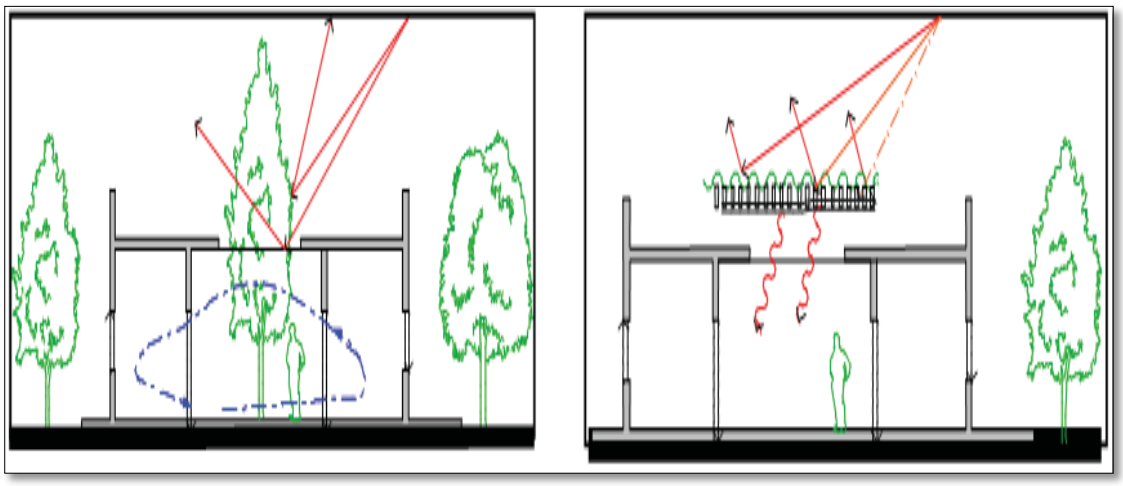


Figure 3.4: Types of natural elements for shadowing.

3.3. Characteristics of courtyard housing in Islamic (Arab) world

The Arab world has adopted the courtyard house as the basic type of a dwelling house because of its ability to satisfy the practice and living habits prescribed in the Quran and the hadith.

The characteristics of traditional courtyard houses can be summarized as follows (Edwards et al, 2006):

1. Privacy of the occupants, especially women, in relation to the outsiders and male visitors;

2. Treatment of guests;

3. Responsibility to the neighbor; and

4. Modesty in life.

The typical characters of the courtyard include the following (Edwards et al., 2006):

1. There is an enclosed space open to the sky and surrounded by rooms, accommodating diverse activities of the dwelling house;

2. With hardly any openings in the external walls, the houses are inward looking towards the courtyard, totally depending on it for light and air circulation;

3. The façade of the external wall is plain and devoid of any decoration, with the elevations expressing a play of rectangles, squares and straight lines;

4. Before subsequent expansion, the houses are usually built as one-storey structures with raised parapets in the roof accessed by a stair from the courtyard, enabling the roof space to be suitable for various purposes;

5. The courtyard may have trees, water pools, wells, awnings, etc. to soften the effects of heat and glare;

6. There are covered iwans in the courtyard, providing further protection from the sun;

7. The number of courtyards varies from one to five;

8. The main door is usually decorated, as opposed to the austere treatment of the façade and exterior walls;

9. The entrance is usually at the end of the passage to maintain the privacy of the house.

4. A CASE STUDY ON TRADITIONAL AND CONTEMPORARY SINGLE FAMILY HOUSES IN ARAB ARCHITECTURE

4.1. Tunisia

Tunisia is the northernmost country in Africa and, at almost 165,000 square kilometers (64,000 sq mi) in area, the smallest country in the Maghreb region of North Africa (www.pm.gov.tn/pm/content/index.php?lang=en,March2015).It is bordered by Algeria to the west, Libya to the southeast and the Mediterranean Sea to the north and east, as shown in Figure 4.1. As of 2013, its population is estimated as just fewer than 10.8 million. Its name is derived from its capital city, Tunis, located on the country's northeast coast(National Institute of Statistics-Tunisia". National Institute of Statistics-Tunisia. September 2014).

Figure 4.1: Map of Tunisia.

Geographically, Tunisia encloses the eastern end of the Atlas Mountains and the northern reaches of the Sahara desert. Much of the rest of the country's land is fertile soil. It 1,300 kilometers (810 mi) of coastline include the African conjunction of the western and eastern parts of the Mediterranean Basin and, in relation to the Sicilian Strait and Sardinian Channel, it features the African mainland's second and third nearest points to Europe, after Gibraltar,("Tunisia | Country report | Freedom in the World | 2015". freedomhouse.org.).

4.1.1. An underground house in Matmata (Tunisia)

Matmata is a town in Tunisia. The natives estimate that its history dates more than eight centuries back (Colany, 1984). The house in Matmata contains a collection of rooms with vaulted ceilings that reach a height of 4.5 m, with most of the rooms overlooking an interior courtyard (Figures 4.2, 4.3 and 4.4) to allow sun light to enter rooms through doors. This style of building cave houses is common in northern Africa from the past times and still exists up to now(Colany, 1984). It is cool and fresh in summer and warm in winter. You cannot see anything either from a distance or up close; the only view is just standing over these circular cavities (about 6-7 meters deep), glimpsing at the entrances to the house and an underground world full of life.

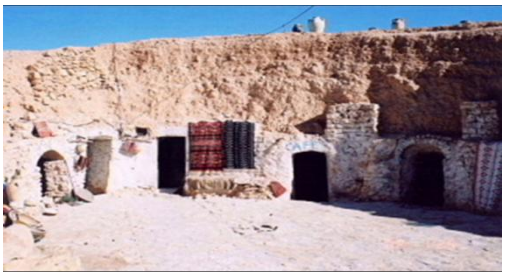


Figure 4.2: Elevation of the Matmata House.

Figure 4.3: Courtyard of the Underground House in Matmata.

Figure 4.4: Internal Vaulted Ceiling in Matmata.

4.1.2. Analysis of house models in the Core City of Tunis

Two sample houses were analyzed for their privacy (seclusion of women) and thermal comfort. Privacy could be evaluated in terms of the following (Zakaria, 2001; Mohammad Omar, 1999):

1. Inaccessibility of male visitors or passers-by to the interior of the house (women's domain);

2. Adequacy of indoor and outdoor spaces for women's private activities;

3. Hierarchy of spaces;

4. Opacity (lot coverage); and

5. Circulation complexity.

Thermal comfort could be evaluated as follows:

1. Cross ventilation (openings and their locations, size of courtyard, and orientation);

2. Temperature, humidity, and air velocity;

3. Aspect ratio;

4. Availability of shading;

5. Size of the courtyard; and

6. Building geometry.

Functional relationships for traditional interior courtyard houses are connected to socio-cultural relationships among residents. Accordingly, interior spaces are prevailing and they are connected to the courtyard which is established as an architectural element of bonding among these functions. This courtyard represents an element of movement among house spaces in addition to being a living space in a traditional house in the traditional city of Tunis(Zakaria, 2001). The design emphasizes functions of the traditional interior courtyard house and their connections to each other, as shown in Figures 4.5, 4.6, 4.7 and 4.8.

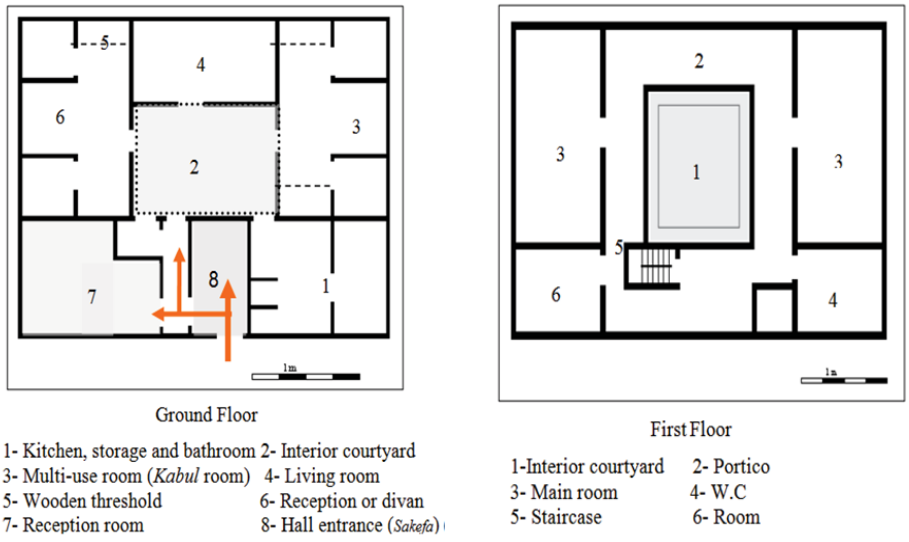


Figure 4.5: Traditional Arab interior courtyard housing in Tunis.

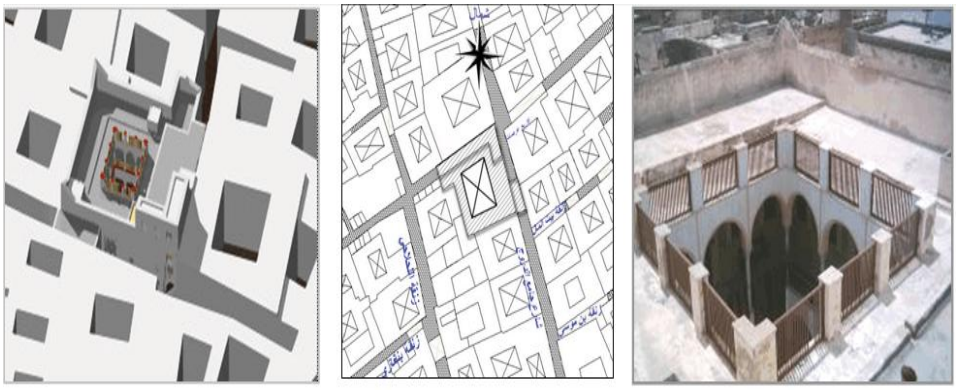


Figure 4.6: Interior courtyard house in Tunis.

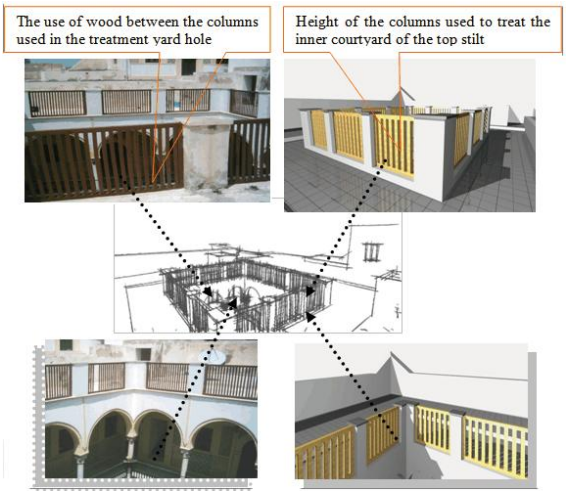


Figure 4.7:Treatment of architectural elements (solid upper and lower porous wall sections).

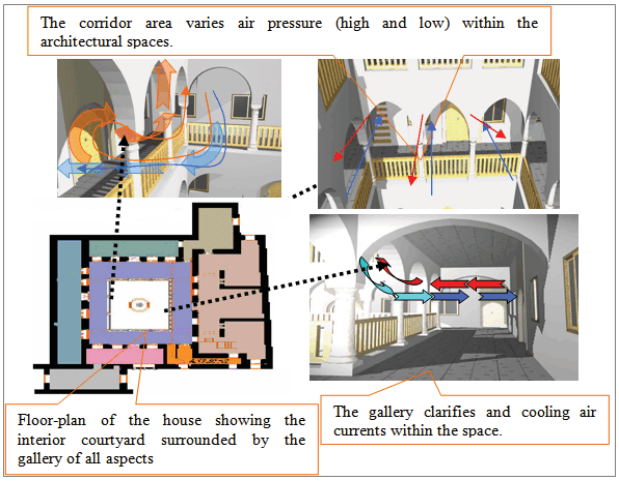


Figure 4.8: Air movement enhancing thermal comfort with colonnades as filters.

4.2. Syria

Syria lies on the eastern coast of the Mediterranean Sea, bounded by Turkey in the north, Iraq in the east, Jordan in the south and Lebanon and the Mediterranean Sea in the west, as it can be observed in Figure 4.9. The Syrian territory is divided into four geographical regions: coast, mountain, inland and desert regions, and administratively into 14 governorates that are divided into smaller local administrations, where the village is the smallest administrative unit (Aljaser,Lamia,2000).Syria has 6 million hectares of cultivated lands; the remaining areas are desert and rocky mountains. The overall area of Syria is 185,180 km^2 and the number of Syrian citizens registered at the end of 1999 was 17,460,000 inhabitants. The average density of the population is about 87 inhabitants per km^2 and the ratio of urban population out of the overall population is close to 50%. Syria enjoys the climate that generally prevails in Mediterranean regions: cold rainy winters and dry, hot summers, separated by two short transitional seasons (Faksh,Nadim;Hilal,Fuad,2000).Heights above sea level vary from 10 m high in the City of Lattakia to 1,500 m above sea level in the city of Bloudan, near Damascus. The coastal region is characterized by heavy rainfall in winter, and moderate temperatures and relatively high humidity in summer. The inland region is characterized by rainy winters, and hot and dry summers. The daily temperature differences, from minimum to maximum, are high. The area in the mountains is 1,000 m high or more, and it is characterized by rainy winters where rainfalls may exceed 1,000 mm, as well as moderate climate in summer. The desert region is characterized by small rainfalls in winter and hot and dry summers

(CORPUS Levant is Ecole d'Avignon and General Direction of Antiquities and Museums of Syria, 2001).

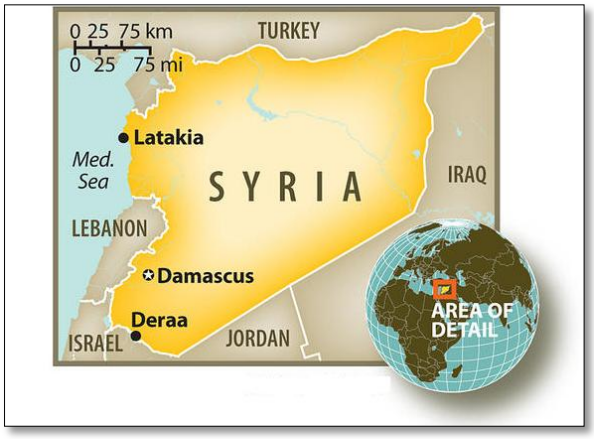


Figure 4.9: Map of Syria.

The great diversity of the Syrian landscape –hills, valleys, steppe and desert– have continuously sheltered a variety of peoples with different religions and languages; hence, many civilizations and great empires have left their marks upon Syria. This diversity is both a result and a cause of its physical geographical aspects and its history. In some areas of Syria, Assyrians have kept their customs, lifestyles and original language. In Maaloula, for example, inhabitants still use Aramean, the language spoken by Jesus Christ (Faksh,Nadim;Hilal,Fuad,2000).

Arabs make up the overwhelming majority of the Syrian population, though there are large minorities of different religions. The main language is, of course, Arabic, and the main religion is Islam.

The architectural heritage obviously bears the testimony of this variety: for centuries, the country was a crossroads of great civilizations, each of which left its architectural and cultural influence. This has naturally reflected on the architecture, habits and lifestyles of local population (Omran,Hazzar;Dabourah,George,1997).

Syria is administratively divided into 13 Governorates and a special Governorate status for the Capital City of Damascus. Each governorate is organized around a major city known as the Governorate Center-City. The countryside of each governorate is then divided into regions. In the center of each region, we find minor cities. A town must have a population of more than 20,000 to be considered a city and be allowed to administer its region. Smaller villages and farms are organized through

smaller districts within each region (Omran,Hazzar;Dabourah,George,1997).By the year 2000, a total sum of 84 urban centers had a status of a city. In the early 1970s, as the urban growth was registering its highest rates, Syria enforced a new Local Administration System (Faksh,Nadim;Hilal,Fuad,2000).

4.2.1. Important elements of the old Damascene house

4.2.1.1. Entrance (the Majaz) in a traditional Islamic house in Syria

There are two entrances in Arab houses: the majaz (the main entrance of the house), which usually opens into a courtyard, and the doorway which is the main external feature at the ground floor leve(Abdel-moniem El-Shorbagy,2010)l. The majaz is designed to open into a blank wall to obstruct views inside from the outside in order to preserve the privacy of the family. Additionally, the doorway is functional and modest, since the ostentation is discouraged according to the egalitarian basis of Islam(Abdel-moniem El-Shorbagy,2010). Al-Suhaymi house, Cairo, from 1648, is a good example that expresses the relationship between the main entrance and the courtyard, as shown in Figure 4.10. Some historians attribute the unpretentious doorway to the owner's reluctance to show off his wealth, which would attract burglars, but this is a superficial reason. In fact, in traditional Arab houses, the real entrance to the house is the one which opens into the main courtyard(Abdel-moniem El-Shorbagy,2010). In the Arab cosmology, the four walls of the courtyard indicate the four columns carrying the dome of the sky and the courtyard symbolizes their private piece of the sky. Thus, they prefer to have the main entrance open into this clean and holy space, which is on the scale of the house, rather than into the public street, which is on the scale of the city (Fathy, 1986).

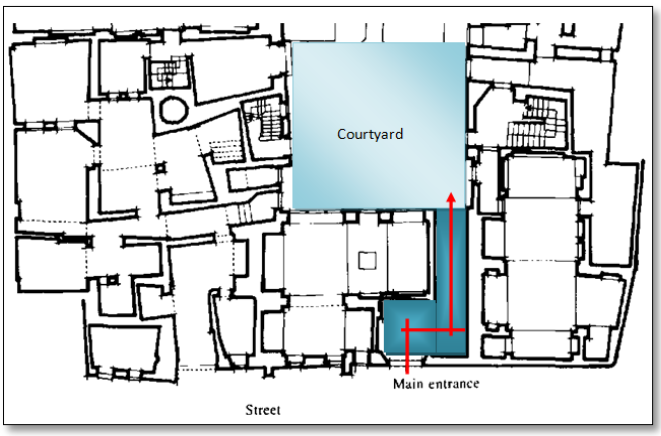


Figure 4.10: The entrance opens into the courtyard, Al-Suhaymi house, Cairo.

4.2.1.2. Walls

A) Stone walls

Stone is the main building material used in most Syrian cities. It is also used for building houses in some villages, where it is a widely available raw material (Figure 4.11). Some masons specialized just in building stone walls(Aljaser, Lamia, 2000).

In general, a number of masons are needed to build a stone wall, some of whom specialize in preparing the stone while the others build the wall. There are many types of stones, and they differ from area to area and from city to city: limestone is used in Aleppo, while limestone and basalt are used in Damascus. We will explain later why the stone used for the internal façade is ussually different from the stone used for the external façade, and why some villages in the southern areas use different size rough stones for building (Aljaser, Lamia, 2000).

Figure 4.11: Stone walls, with stone as the building material used in most Syrian cities.

B) Ashlar and dressed quarry stone walls

Stone walls have been used in all types of buildings since the beginning of urban construction. They can still be found in the old cites of Syria (The Old Cities of Aleppo, Damascus and Homs) (Faksh,Nadim;Hilal,Fuad,2000).. A variety of stones, such as ashlar and dressed quarry stone, are used in building and constructing walls. The type of stone used differs according to the wall type and its function in the building, depending whether it ia an internal or an external wall. In general, the stones come in large random shapes, which are then squared in the workshop and made into a standard rectangular shape. The stones are laid in a mortar of mud and straw. The wall is built on a stone foundation, usually with a trench in the ground around 1m deep. Then, the wall is constructed with two stone facings, with a rubble and soil fillings between them. The thickness of each stone facing is about 30 cm, and the

width of the core is about 10cm; hence, the complete wall is about 70 – 80 cm thick. One exceptional type of hewn, or dressed stone wall, presents an alternation of colors in the stone(Faksh,Nadim;Hilal,Fuad,2000).

These walls were used in the old houses of Damascus due to their durability and beauty, and were especially used for the walls opening into courtyards, giving them an aesthetic role(Omran,Hazzar;Dabourah,George,1997). They can still be observed today in the main rooms and in the inner courtyards of old prestigious Damascus houses. These walls use three types of stone: black basalt, which is strong and durable; white, yellowish, or reddish limestone that is less durable; and Mazzi Stone (found in the area of Mezzeh), which is pinkish and quite hard. The thickness of these walls ranges between 50 – 90 cm and they can reach the height of 30 m in some houses. They are constructed on a rough stone foundation. After they are cut and grouped by size, the stone courses are laid in alternating colors (black, yellow, and white) in a pattern (coursed ashlar running bond). Lime mortar (exceptionally lead) is used to bind the stones, and these walls are not rendered, as it can be observed in Figure 4. 12 (Hallaj, Omar Aziz Yens, 2001).

Figure 4.12: Ashlar and dressed quarry stone walls used in the old houses in Damascus.

4.2.1.3. Flat roofing

Stone roofing

This construction type appeared a long time ago in the southern areas of Syria, thanks to the availability of basalt, which is used in roofing. This construction type is unique in the area and this technique has reached a sophisticated level, clearly observable in the major monuments in the towns Basra, Shaba and other areas. The basalt rocks are cut to the right dimensions nearby hills and valleys where they are quarried, and it is no surprise the area is famous for its carving stone craft. In general, the construction

system is based on rectangle basalt rocks called the mizan (the scale): their dimensions are 35x37x70 cm. They are used as side beams that rest on the walls, increasing the span on which the rabid (long stones that are set over the width of the space) rests(Aljaser, Lamia, 2000). The construction system of these roofings is set in such a manner that vertical forces and horizontal forces (earthquakes) are systematically dispatched, though to a certain limit(Aljaser, Lamia, 2000). The experience inherited through history has played an important role in the continuity of this type of building. Locals have learnt to use the basalt rocks and have reached the ideal dimensions that can be endured by the hard basalt rocks, as well as the optimal span that can be tolerated by stone without breaking. This explains why the dimensions of the built units have remained almost identical over the centuries(Aljaser, Lamia, 2000), as shown in Figure 4.13.

Figure 4.13: A stone roof used in the southern areas of Syria.

4.2.1.4. Windows

The fenestration of Damascus courtyard houses is also inwardly focused. Very few windows open in the direction of the street; rather, windows and sometimes balconies are arranged around the walls of the courtyard. The transition from the relatively austere street façade, through the dark and narrow passage, into the sun-splashed and lushly planted courtyard leaves an impression on those foreign visitors fortunate enough to gain access to private homes(Hallaj, Omar Aziz Yens, 2001). Ordinarily, the windows facing the courtyard are fitted with grills, as shown in Figure 4.14, and with glass. Shutters snugly mounted within the window niche can be adjusted to control the sunlight and airflow. The upper plastered wall is pierced with decorative clerestory windows made of plaster with stained glass(Hallaj, Omar Aziz Yens, 2001). At the corners, wooden muqarnas or squinches provide the transition from the plaster zone to the ceiling.

Figure 4.14: The windows facing the courtyard house in the city of Damascus.

4.2.2. The old Syrian house (Damascene)

Old Damascene houses in Syria are palaces in the full meaning of the word. What distinguishes these houses from others is more than one item; for example, the paintings decorating the walls of these houses are the first element that can make these houses museums or galleries. Generally, the old Damascene houses were the people's rest places, presenting their aesthetical pleasures and being their representatives in their social life, http:// www.oldamascus.com/ palaces_text. htm(March,2015).

A Damascene house which is typical of oriental architecture mirrors the social requirements, copes with Islamic traditions, and relies on the raw materials found in the Ghouta "farms and gardens that were surrounding Damascus" and overlooking the mountains. Nevertheless, it is always decorated with the beautiful handicraft marveled by the hands of the habitants. The house looks solid and sealed off from the outside, but inside, all rooms overlook the spacious open courtyard with trees planted here and there and a water basin in the center (Figure 4.15). The rooms are large and comfortable,http://ammar-shawesh.weebly.com/old-damascus.html(March,2015).

More often than not, there is a second floor over the ground floor, having windows that open to the narrow streets. A quiet family life is enjoyed here amidst lovely ornaments created of gypsum, hard earth, wood or marble, making everything even more beautiful by inscriptions of Islamic calligraphy or a symphony of color and craved wood decorating the walls and the ceilings. On the walls, there are shelves where books or utensils, pots and cups, are stored in a manner meant to be decorative.

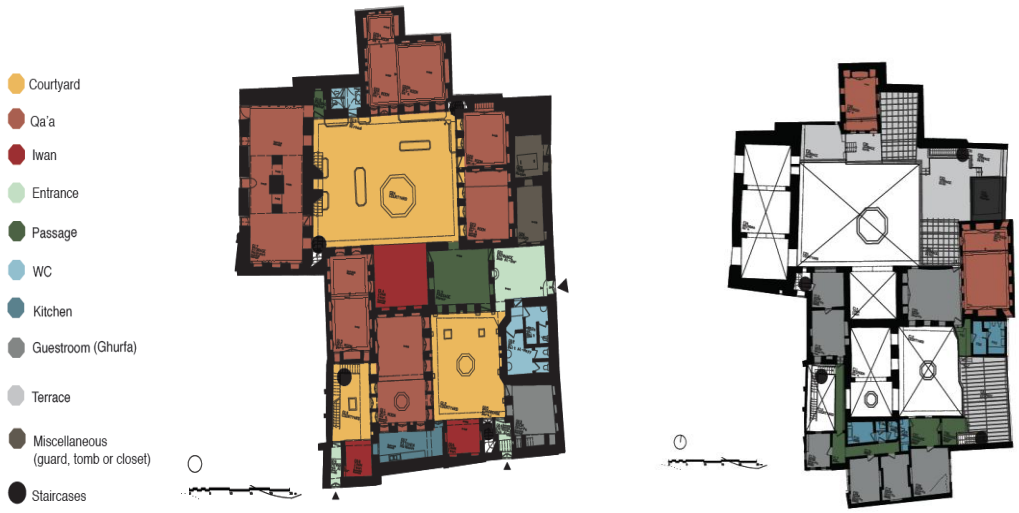


Figure 4.15: The ground floor and the first floor of the old Syrian house.

4.2.2.1. The courtyard houses of Syria

Courtyard housing dates back to the beginning of the third millennium BC, when it appeared in the buildings of Syria and those of the region between two rivers, Tigris and Euphrates. Arab nomads made use of the concept of a courtyard during their travels and stays in the desert (Amini, Mousallam Sakka, 1993). They would set up their tents around a central space, which provided shelter and security for their cattle. With the development of Arab-Islamic architecture, the courtyard became an essential typological element. It is likely that the previous nomadic desert lifestyle of Arabs had a strong influence on their permanent housing (Rabbat, Nassar, 2010). The courtyard therefore fulfils a deep-rooted need for an open living area, as it can be observed in a number of examples of courtyard houses in Aleppo, Syria (Figure 4.16) (Ferti, M. Salim, and Mandour, M. Alaa, 2008).

The traditional courtyard house in Syria is composed of three parts:

1. Basement floor;

2. Ground floor comprising the living areas; and

3. First floor comprising the private areas, called Al Haramlek.

Figure 4.16: The courtyard in a house in Syria.

The basement floor enjoys an even temperature throughout the year. It is therefore an attractive living space in periods of extreme winter or summer temperatures. The basement acts as a thermal moderator during the hot dry season, as it allows the hot air collected by the wind-catchers to be cooled and humidified before it is released to the courtyard space (http://www.muslimheritage.com/article/courtyard-houses-syria)(march,2015). It is also used for the storage of annual food supplies, as is the case in many courtyard houses of Aleppo, a city that has endured many wars. The houses are usually accessed through a modest space leading into a spacious and beautifully landscaped courtyard. The entrance door consists of one or two wooden door-leaves, reinforced with lead plates and fixed with steel nails. The small size of the external doors represents modesty, which is also demonstrated in the lack of decoration of the external windows. It is very difficult, therefore, to judge the level of wealth or poverty of the houses from their external appearance. The entrance door usually leads to a narrow passageway at the end of which another door or curtain filters the entrance to the courtyard, allowing this latter to be totally private and visually inaccessible from the outside, even if the entrance door is left open, which was frequently the case as the old city neighborhoods used to enjoy a high level of security(http://www.muslimheritage.com/article/courtyard-housessyria)(march,2015).

The transition from the outside to the inside is marked by a contrast in spatial experience, from a modest and sometimes austere entrance to a highly decorated internal open courtyard with a central fountain (and sometimes a well) and beautiful façades. Landscaping also plays an important role in the courtyard of the traditional Syrian house(Ferti, M. Salim, and Mandour, M. Alaa, 2008). It consists of two main categories: decorative planting such as climbing jasmine and rose bushes, which add

color and scent to the courtyard atmosphere, and citrus trees such as orange and lemon. The façades of the internal courtyard are highly decorated with intricate woven geometric patterns and shapes, as demonstrated in Figure 4.17.

Figure 4.17: The fountain in the Achik Bash House in Aleppo, Syria.

The iwan is an important covered open space from which the aesthetic qualities of the courtyard can be enjoyed. It provides a raised platform (one or two steps), used as a pleasant and comfortable open air reception, a seating area, and a venue for evening events, such as the playing of traditional music. The iwan is usually located on the north façade of the courtyard to catch the cool breeze during the summer(Ferti, M. Salim, and Mandour, M. Alaa, 2008). The iwan comprises two symmetrical rooms facing each other and has an ornamental front stone arch facing the courtyard. The transition from the courtyard to the iwan space is marked by a multi colored marble patterned floor, which resembles an oriental carpet. Facing the iwan is the main guest reception hall – used for special ceremonies, as shown in Figure 4.18.

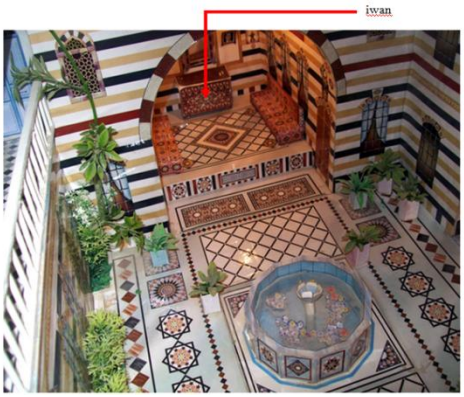


Figure 4.18: Iwan in a house in Syria.

This hall is the most decorated space in the house and contains the best items of furniture. In some houses, such as Wakil, Basil and Ghazali houses in Syria, the main guest hall is covered by a dome(Rabbat, Nassar, 2010), as presented in Figure 4.19.

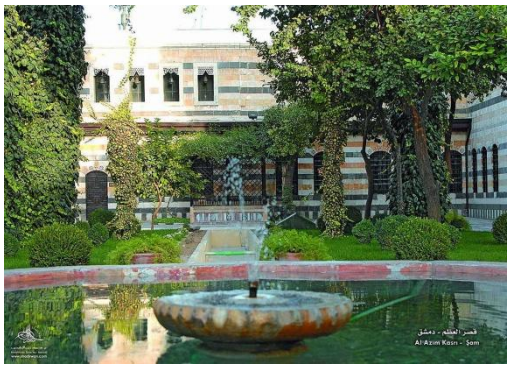


Figure 4.19: The fountain in Al-Azem Palace in Damascus, Syria.

4.2.2.1.1. The architectural elements of the Syrian courtyard house

The mashrabiya is a wooden balcony located on the outer façade of the house. It provides a cool screened space for women, allowing them to view public spaces without being seen (Rabbat, Nassar, 2010). It is usually supported by two cantilevered wooden beams, which are anchored in the external wall (Figure 4.20).

Figure 4.20: The mashrabiya.

The windows are divided into two types: those located on the external façade of the house and those located on the courtyard façades. Since the house is inward looking, the external façade windows are small, plain and located from the first floor onwards in order to avoid being overlooked by pedestrians in the narrow public streets(http://www.muslimheritage.com/article/courtyard-housessyria)(march,2015).

The courtyard windows are much larger and more decorated, providing light and ventilation to rooms. The ground floor windows are located inside the thickness of the wall and wooden shutters are positioned to the outside of the wall thickness. Other types of windows can be found at the base of the courtyard(Ferti, M. Salim, and

Mandour, M. Alaa, 2008). They are small and arched with no decorations, providing light and ventilation to the basement floor. The doors of the ground floor rooms are two-leaf wooden doors with minimum ornamental carvings; the first floor doors are, however, relatively undecorated.

In the main reception hall, wall cabinets built into the thickness of the walls are used to display ornaments, such as intricate wooden ornamental carvings. The walls around the cabinets are sometimes covered with wooden panels with calligraphic carvings matching the cabinet design(Ferti, M. Salim, and Mandour, M. Alaa, 2008). The ceilings are also highly decorated, with wooden panels displaying intricately linked ornamental geometrical shapes. This is particularly the case in the main reception hall, where the ceiling is the highest in the house and consists of intersecting wooden panels with rich carving and gold-plated designs(Ferti, M. Salim, and Mandour, M. Alaa, 2008).

4.2.2.1.2. Courtyard organization and climatic factors

The courtyard organization is appropriate to hot dry climates because it maximizes shading and facilitates the creation of a pleasant microclimate. The availability of plants and a water feature within the courtyard helps in cooling and humidifying the internal atmosphere. The construction technique, based on thick load-bearing stone masonry, provides adequate thermal mass(Ferti, M. Salim, and Mandour, M. Alaa, 2008).

The existence of cooling towers improves good summer ventilation, as hot air is funneled down into the basement, where it is cooled and released into the courtyard space(http://www.muslimheritage.com/article/courtyard-housessyria)(march,2015).
The narrowness of the external streets and passageways leading to the houses also helps in creating cool and shaded outdoor environment.

4.3. Contemporary Islamic single family houses in Egypt

The Egyptian architect and master builder, Hassan Fathy (1900-1989), was one of the first architects to break with modern architecture and find a new approach based on a conception of interpreting forms and masses from the past(Al Khateeb, Sharif, 1979). He was unique in believing that this language could exist alongside that of an aggressively modern one which cuts all ties with the past. He fully understood the

function of the elements of the Islamic-Arab house and their balanced relation to the environment. All his buildings and projects, which were mainly domestic, comprised the same architectural elements which were drawn from traditional Islamic-Arab house(Al Khateeb, Sharif, 1979). One of his important houses was the Nassif house in Jeddah, presented in Figure 4.21, which represented an opportunity for Fathy to reinterpret the traditional architecture of Saudi Arabia. The house features all the essential vocabularies of the Islamic-Arab house, such as the courtyard and "mashrabiya[3]" (Al Khateeb, Sharif, 1979).

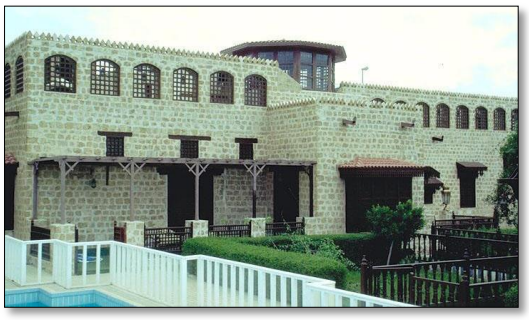


Figure 4.21: Nassif house in Jeddah (Saudi Arabia).

Another Egyptian architect whose work from the 1960s onwards has stood out in clear contrast with the modern architecture is Abdelbaki Ibrahim. He published several books discussing the historical perspective of Islamic architecture and the Arab houses. Ibrahim's Al-Nawras Tourist Village, Isma'iliya, Egypt, 1989, as shown in Figure 4.22, is an expressive example of the integration between modern architecture and abstract traditional vocabulary (www.archnet.org).

Figure 4.22: Al-Nawras Tourist Village, Egypt, 1989.

[3] Mashrabiya is the Arabic term referring to a type of a projecting oriel window that is enclosed with the carved wood latticework, located on the second storey of a building or higher, often lined with stained glass. The mashrabiya is an element of traditional Arabic architecture used since the Middle Ages up to the mid-20th century. It is mostly used on the street side of the building.

Abdel Wahed is also a dedicated Egyptian architect related to vernacular architecture and traditional building techniques. He believes that “it is the role of art, and above all of architecture, to safeguard the environment in which the tradition can survive” (Steil, Lucien, 1987). Halawa house (1972-1975) in All-Agamy, near Alexandria (Figure 4.23), exhibits the architect’s awareness of the traditional building forms such as dome, vault, loggia and mashrabiya, as well as traditional building techniques, (Steil, Lucien, 1987).

Figure 4.23: Halawa House, Agamy, Egypt, 1975.

The prominent architect Rifat Chadirji (1926) from Iraq was aware of the traditional vocabulary of the traditional architecture in Iraq and employed it to serve contemporary needs(Chadirji, Rifat, 1986). Chadirji‘s Tobacco Monopoly Building (1966) in Baghdad is a clear evidence of contemporary Arab architecture, as presented in Figure 4.24. It exhibits a synthesis of international avant-garde concepts and abstract forms derived from his own traditions(Chadirji, Rifat, 1986). For example, Chadirji employed simple projecting mashrabiyas made of brick or concrete instead of the expensive wooden ones. Chadirji‘s architecture excluded simplistic imitations of traditional features and primitive technologies “because neither is compatible with the fundamental thrust of the mechanical-aesthetic mode” (Chadirji, Rifat, 1986).

Figure 4.24: Tobacco Monopoly Building, Baghdad, 1966.

5. INFORMATION ABOUT LIBYA

Libya is situated in North Africa, on about 1,900 kilometers of the Mediterranean coast. It occupies an area of about 1,760,000 km^2 and is the fourth in size among the countries of Africa and fifteenth among the countries of the world. The country is bounded by the Mediterranean Sea to the north(Jorge Monrás, 2009).. Egypt lies in the east, Sudan to the southeast, Chad, Niger and south Algeria to the west, and Tunisia to the northwest, as it can be observed in Figure 5.1. It lies between 18º and 33º north latitude and 9º and 25º east longitude. Libya is a small country in terms of population; according to the latest national senses in 2004, the estimated population number is 5,368,585.88. 85% of citizens live in the urban districts, 65% are less than 25 years old, and most of them are Arab. There is also a large Amazigh minority, which includes the Tuareg (Jorge Monrás, 2009). Since the 8th century BC, many civilizations left their mark on the country. The indigenous Imazighen intermingled with these civilizations, and to a limited extent they intermingled with the Greeks, Romans and Byzantines, though more significantly with the Arabs, who conquered the land in the 7th century.

Tripoli is the capital city, with other major cities including Benghazi, Sirte, Misurata and Sabha, as shown in Figure 5.2. Arabic is the official language, while English is considered the second language, with some French and Italian. Libyan Arab Jamahiriya is an oil-producing country, with its main income coming from oil revenue, as well as some petrochemical industry and agricultural activities. Country's oil resources account for approximately 95% of export earnings, 75% of government receipts, and over 50% of the gross domestic product. Oil revenues constitute the principal source of foreign exchange. The country has an estimated per capita income of over US$ 7,000 per annum (Regional Health Systems Observatory World Health Organization, 2007).

Figure 5.1: Map of Libya.

Figure 5.2: Map of the cities in Libya.

5.1. Historical background

Due to its strategic location, Libya has been subjected to varying degrees of foreign military invasions and colonization for more than 2,500 years. The Phoenicians, Carthaginians, Greeks, Romans, Vandals and Byzantines, Arabs, Turks and most recently, Italians and the British – French administration, have ruled all or parts of the country (Birks and Sinclair, 1980; Fisher, 1978). The most significant cultural and historical changes occurred when the Arabs conquered Libya in 642 AD (Werfelli, 1976). They brought with them their religion, language, architecture, cultural values and ways of life. "The Arabs brought with them little more than their religion, the language, and their influence on the people; they offered a faith and with it a social system and culture that they could completely absorb". Islam almost immediately established roots throughout the area and during this century, most of the cities, villages and oases became influenced by the Islamic religion(Shawesh, 1996). Islam is more than a religion; it is a culture, a way of life. Over time, Libyan society was nomadic and semi-nomadic (settlements) and was affected by the socio-religious aspects of the Arab culture and Islamic instructions that effected the establishment of the urban fabric of cities, towns and villages in Libya (Shawesh, 1996). Since 1551, until the beginning of the twentieth century, the Ottoman Turks occupied the country. During this period Libya was a poor country, particularly in the late nineteenth century, following the decline of the Sahara trade. The majority of the population was dependent upon traditional agriculture, which, in turn, depended on rainfall. Drought years brought many people to the edge of starvation (Abbas, 1987). In 1911, Italian troops invaded Libya after declaring war on Turkey, and encountered hard resistance from the indigenous people, who sustained until 1931. As a result, an estimated half of the population perished in the process. Moreover, 250,000 were forced into exile to the neighboring countries(Ahmida, 1994).

After the Italians overcame the local resistance and approached their colonial objectives, they adopted the name "Libya" as the official name of the colony, which was comprised of the provinces of Cyrenaica, Tripolitania, and Fazzan. The Italians, who regarded Libya as Italy's fourth shore, began to encourage Italian efforts in Libya that were designed primarily to benefit Italian colonists (Best and Deblij, 1977). The modern period saw the beginning of new construction and transportation. Industries began to serve the needs of the colonized. The Italian control ended during the Second World War, when the country was divided into two parts. Fazzan was placed under

the control of France, while Cyrenaica and Tripolitania were administrated as Libya, an independent nation. They were approved to establish a federation of the three provinces, named the United Kingdom of Libya, as a constitutional monarchy. During this time, Libya was considered to be one of the poorest countries in the world, as indicated before. There was almost no skilled labor or indigenous entrepreneurship. In general, the economic situation was very low. As a result of its economic and financial difficulties, the Libyan Government signed a twenty year agreement with both Great Britain and the United States, which gave those countries permission to establish military bases in Libya in return for financial and economic aid (Abbas, 1987). The discovery and rapid exploitation of oil in the 1960s was another turning point in Libya's history, which assisted the process of consolidation towards a national state, extensively transforming the country's geographical and social profile (Fisher, 1978).

5.2. Geographical factors

Libya's environmental conditions have influenced its physical structure, land use, and distribution of its population to a great extent. About 94% of the total area of Libya is a desert, most of which is considered to be unproductive. About three-quarters of the population live in the major urban areas and most of the cultivated land is concentrated in less than 2% of the country's total area (Ministry of Municipalities, 1979; Abuarrosh, 1996). The topographic features vary throughout the country and include plains, mountains and deserts, as presented in Figure 5.3.

The location of settlements is along the coast in the north, stretching from the east to the west borders of the country. This area is linked to the greatest cultivation in the country. The coastal strip varies in width from 15 – 45 km, tapering close to the green mountain (Jabel Akhder) and expanding 100 kilometers in width before the western mountain (Jabel Nufusa), forming the Jefara Plain of the northwest Libya. The vast majority of population and economic activities are concentrated in this region.

The second topographic characteristic is the mountain area, which is divided into two ranges: the western mountain (Jabel Nufusa) in the south of Tripoli, and the green mountain (Jabel Akhder) in the northeast of Libya.

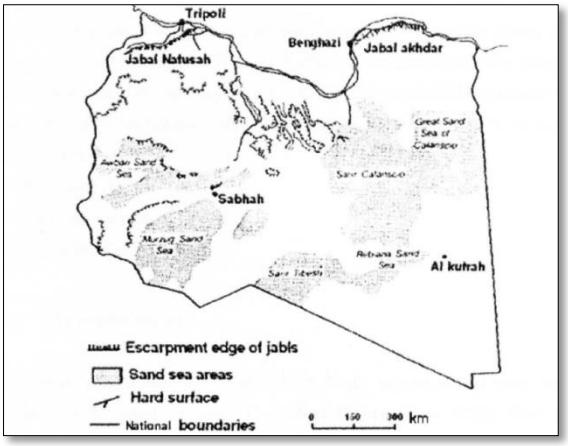


Figure 5.3: Libyan topographic map.

The former has an average width of 20 km and the height between 500 and 960 m. The land is composed of basalt, volcanic rock, limestone and gypsum-marl. The other important mountain area is in the northeast part of the country. Jabal Akhder is between 300 and 830 m high. The area consists of limestone and red soil, and contains cultivated stretches. Most of the mountain areas are covered with the shrub forest consisting of pine and juniper bushes.

The third topographic area is the desert. This begins just behind the mountains and extends toward the south, covering more than 90% of the land area. From the Egyptian border, a wedge of extreme desert extends westward with different soil types consisting of limestone, sand stone, and gypsum. In the desert, there are oases developed far apart from each other in shallow basins and valleys, where underground water reaches the surface. These oases have forests of palm trees. The land rises towards the south, reaching 2,286 m at the peak on the border with Chad (Philip's, 2000).

5.3. Climate

The climate of Libya is influenced by the Mediterranean climate, as well as the semi - Sahara and Sahara climate, as it can be observed in Figure 5.4. These are two main climate conditions of Libya. The coastal regions, which come under the dominant influence of the Mediterranean climate, are characterized by cold wet winters, and hot dry summers. The inland mountain regions are also influenced by the Mediterranean climate and receive rain in winter because of the north westerly wind. The second type is the Sahara desert's climate, which is characteristically dry, and has high temperature variations between day and night, and between summer and winter. (Rghei, 1987) points out that "Generally, in Libya, the winters are cold, especially at night, while summer days are hot and dry. There is a long period of the year when

comfortable outdoor conditions exist for half of the daylight hours of the year. Shelter is required from the Ghibli, the hot, dry and dusty winds that blow from the desert, mainly during the beginning of the summer, for periods of up to two or three days at a time. The Ghibli is a hot searing current and has been known to raise temperatures up to 40 degrees. The Ghibli affects coastal zones, too. Even though this wind prevails only for a few days, it is extremely unpleasant and brings clouds of red dust with it from the Sahara desert." For this study, the country can be divided into three climatic zones:

- The coastal region;
- The mountain region;
- The Sahara desert region.

5.3.1. The coastal region

The climate of this zone is similar to other North African coastal areas and also similar to some coastal regions of southern Europe (Daza, 1982). Most of the population lives in this region, which includes many cities such as Tripoli, Khoms and Alzawia in the west and Benghazi, Shahat and Tubruq in the east. Great humidity and high temperatures categorize the climate during the summer months. Summer temperatures do not rise above 33ºC for several months, but reach 45ºC in August. The winters are not very cold in this region. The lowest temperature, about 9 to 10 ºC, occurs in January, which is the coldest month of the year (Figures 5.4 and 5.5). It rains only during half of the year, from October to March. The maximum rainfall occurs during the months of December and January. The average rainfall is in excess of 70 mm per year, as shown in Figure 5.7. The dominant winds in the coastal zone blow from the north and northwest in all seasons (Daze, 1982). In summer, the Mediterranean breezes are of great benefit to the coastal zone. In July and August, this zone is, for a number of days, affected by the wind from the south, the Ghibli, which, as described above, raises the temperatures in this region.

5.3.2. The mountain region

This region consists of two major mountain areas of the country, as already mentioned. The mountain areas have the best summer climate, because the relative humidity is much lower than that in the coastal zone. (Ministry of Planning, 1964). In addition, the main temperatures of this zone are lower than those in other zones. In

winter, the temperature goes down to zero degrees centigrade, and snow appears on the tops of the mountains. Rainfall is more abundant than in the coastal zone due to the north and northwest winds, which come from the Mediterranean, rise over the hills, then cool and produce rainfall. This rain sustains the agricultural settlements, enabling people to settle in this area. An annual rainfall of 400 to 600 mm is recorded in Jabal Akhdar region, as observed in Figure 5. 7.

5.3.3. The Sahara desert region

The Sahara climatic zone is sparsely populated by permanent habitation. These are mainly oases, where underground water allows modest vegetation and limited cultivation. As mentioned above, most of the country's land area is situated in this region. The climate is characterized by very high annual temperatures, which are higher than temperatures in other zones. It also has a large difference in temperatures between day and night, and between winter and summer; for example, the city of Ghadames reaches a minimum temperature of – 3.6 ºC in the month of January and a maximum temperature of 47 ºC in the month of August, as observed in Figures 5.5 and 5.6. Rainfall is almost non-existent; therefore, extreme aridity is the common feature of this region (Daza, 1982). The relative humidity is low throughout the year. The Ghibli and sand storms from the southeast are frequent during the summer. The north and north westerly winds are considered the most desirable winds for summer nights, while their lower velocity makes them also less damaging during the winter months.

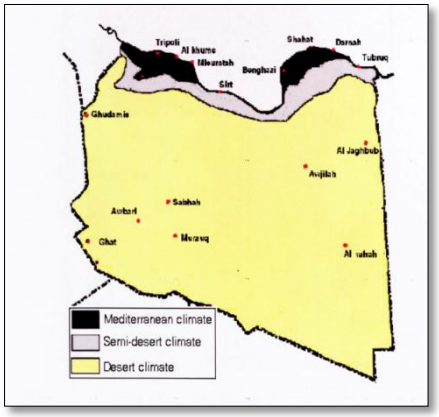


Figure 5.4: The Libyan climatic regions.

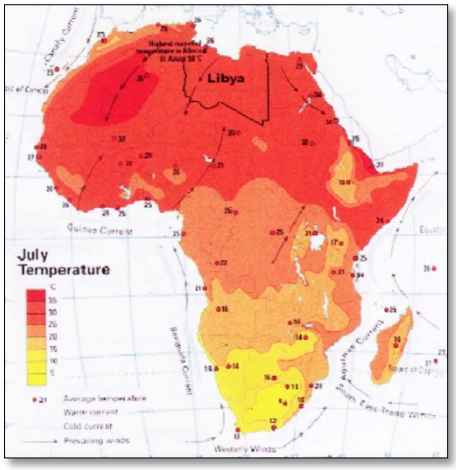


Figure 5.5: The average temperatures, warm and cold currents, and prevailing winds in July and August.

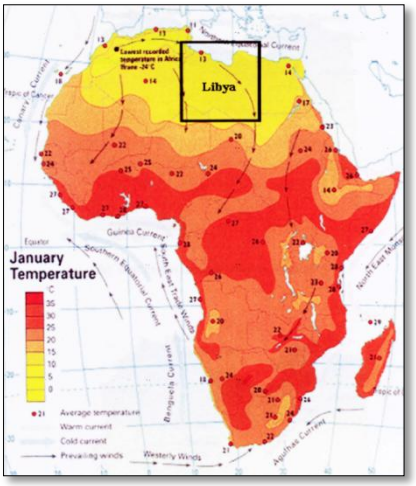
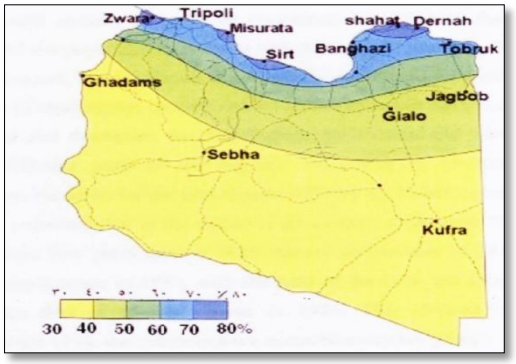
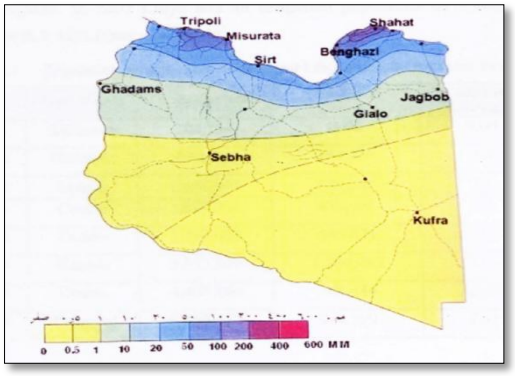


Figure 5.6: The average temperatures, warm and cold currents, and prevailing winds in January.



A) The mean annual relative humidity.



B) The mean annual rainfall.

Figure 5.7: The mean relative humidity (A) and the annual rainfall (B).

5.4. Population

Libya is a small country in terms of population. According to the latest national census in 1995, the population was 4,404,986 (Ministry of planning, 1995). Moreover, as previously noted, the population is not equally distributed throughout the country. The varieties of topography, climate and economic activities have been major factors in the distribution of population, the culture and the lifestyle of people located in different parts of the country. The population was recorded for the first time in 1931 by the Italian colonial government, when it was estimated to be 704,000 inhabitants in the entire country. Another official estimate five years later, in 1936, showed an increase of 144,417. After the country's independence in 1951, with the help of the UN, the Libyan government undertook the first population census in 1954. This showed a population of 1,088,873. Since 1954, the censuses have occurred every ten years. Table 1 shows the increase of the population. The last census in 1995 showed an average growth of 2.86% during the period 1984-1995 and 2.23% during the period 1995-2000. In 2002 Libya had an estimated population of 5,368,585, with the average growth of 2.41 % (Qusouda, 2001).

Table 1 – Population growth rates for Libyan population from 1931-1995

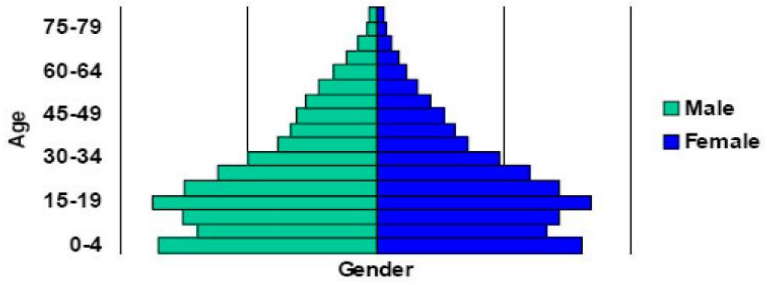
Year	Type of data	Total population	Number of increase	Rate of increase
1931	Estimate	704,124	0,00	0.00
1936	Census	848,600	144,476	3.8
1954	Census	1,088,873	240,237	1.4
1964	Census	1,564,364	475,491	3.7
1973	Census	2,257,037	692,673	4.21
1984	Census	3,637,500	1,380,463	2.86
1995	Census	4,404,986	768,486	2.23
2004	Estimate	5,368,585	964,599	2.41

Source: NCID (National Corporation for Information and Documentation, 2000).

The high rate of growth is the result of a number of factors. The most significant of them appear to be, primarily, the improvements in general health standards, resulting in lower infancy death rates; and secondly, an increase in immigration into the country, especially by Libyan returning immigrants. These factors have caused a drift of people to the main cities and have had a major influence on population distribution, reinforcing the trend towards urbanization.

Population indicators specify that the Libyan population is relatively young, with 33% of them being under 15 years of age. Over the last 30 years, Libya's population has grown at rates of about 2-3% per year. As a result, the working-age population has been growing at about the same rate in the 1990s and is still growing currently (IMF, 2003; UNPD, World Population Prospects). However, population growth takes place only in the urban areas, while the rural population shows a slight decline. Average population density varies from 150 inhabitants/km^2 in the northern region to less than 1 inhabitant/km^2 in the rest of the country. About 75% of the population is concentrated in 1.5% of the country, mainly in the coastal areas (Libya Arab Nutrition Profile – Food and Nutrition Division, FAO, 2005). The population is essentially urban.

Population pyramid for 2001



Source: UNAIDS, 2002

5.5. Economic development

The Libyan economy is highly dependent on the production of energy resources, such as oil. The energy sector of the Libyan economy contributes for about 95% of export earnings, 25% of GDP, and 60% of public sector wages. Because of this reliance on petroleum production as the main source of revenue for the economy, it will be difficult for the Libyan economy to continue to grow swiftly as the world begins to demand fewer energy resources. In fact, this was seen in 2008-2009; for the fiscal year (FY) 2008, the rate of GDP growth was 6.0% and in the FY 2009 the rate of growth was 3.8%(http://data.worldbank.org/indicator)(March,2015). Despite massive investment in agriculture and non-petroleum-related industry, the percentage of Libya's GDP derived from oil has remained fairly constant and economic diversification is therefore an important challenge for Libya's sustainable development (http://web.worldbank.org)(March,2015).

In order to try and pursue the diversification that will be necessary for the continued growth of the Libyan economy, the Libyan government has begun to try and move away from a socialist economy towards a more market-driven one. The Libyan government has begun the process of privatizing certain sectors of the economy, although slowly, in the hopes of encouraging more development in the country(http://data.worldbank.org/indicator)(March,2015). Libya has also decided to resume relations with Western nations by renouncing its weapons of mass destruction programs, as well as having admitted to terror attacks such as the Lockerbie bombing in Scotland in 1992. This has allowed all sanctions placed on Libya by the western world to be removed and foreign investment beginning to come in; however, it does not appear to be enough to help truly diversify the economy and remedy high levels of inflation and unemployment.

Libya faces an unemployment rate estimated to be 30 percent. This high unemployment rate is particularly prevalent among the younger generations who are highly educated. Inflation is also a problem for the Libyan economy, standing at 10.4% in 2009(http://data.worldbank.org/indicator)(March,2015). It is widely believed that, in order to combat this high unemployment, Libya has to expand other sectors of its economy(http://web.worldbank.org)(March,2015). However, this may not be possible in some cases because of external factors outside the government's control.

The agriculture sector cannot expand much more because of the country's problems with water shortages. Even with the completion of the government funded Great Man-made River built to help improve the irrigation, the agriculture sector will not be able to create enough jobs to effectively reduce the high unemployment rate.

Though oil production has rewarded Libya to have one of the higher GDP rates per capita in the region, it remains to be seen whether or not the Libyan government can mobilize resources in a way to keep the economy moving forward.

The government is also working to allow greater transfers of wealth to the people of Libya(http://web.worldbank.org)(March,2015). It began to undertake reforms in 2008 in order to accomplish this goal, and it announced the development of Wealth Distribution Programme. This program has been placed on hold until the implications of such a program are better understood in regards to the implication of such a program on the economy. The government is also working to undertake more public work programs in order to increase employment. However, there is still a demand to increase the government's willingness towards social assistance programs so they could truly benefit the population.

6. CULTURE, SOCIETY AND RELIGIOUS INFLUENCES ON LIBYAN HOUSING

6.1. The concept of home

The home is a place for important family rituals, practical work, discussions, etc. Crucial features of the individual's identity are developed in the parental home, either in line with or in opposition to it. (Ali,2005) describes the house as one of the basic needs of people, built to provide shelter and protection. Also, Roaf et al. (2003) describe the buildings as our third skin. To stay alive, we need shelter from elements using three skins. The first is our own skin, the second is a layer of clothes, and the third is the building.

6.1.1. Home and identity

The concept of home has multiple origins and is difficult to define. Its symbolic charge is strong. People live in a world of symbols that they themselves have created. The objects they make, their artifacts, express their intentions and meanings. This is, of course, also true of "what is commonly viewed as mankind's greatest and most tangible artifact" (Lantz, 1996), the home. However, what do our homes and the things they contain actually mean to us? In answering this question, some scholars emphasize the relationship between home and identity. According to the architect (Redvall ,1987), people seek three values in their regions, i. e. in their homes: identity, privacy and security. If this is the case – where the home is an integrated part of the individuals' identity – then it "cannot be reduced to an apparatus for suiting a number of practical purposes. It is not a housing machine, but instead a complicated fabric of symbols, dreams, ideals and aspirations" (Lantz, 1996). Housing is a place that is secure, allowing the individual and the household to express their identity through reshaping the domestic environment (Svensson et al, 2003).

6.1.2. Home and culture

When considering the relation between home and identity, it can be claimed that the concept of home is highly ideologically and culturally charged. As Gaunt and Lantz

(1996) point out, “home is an ideological concept. It also has a personal existential charge.” The individual’s perception of the meaning of home is, accordingly, a social and cultural construction. Thus, culture and lifestyle are probably two most important components in the construction of the concept of home. (Cooper ,2003) confirms that “building and settlement patterns are material expressions of the cultures that construct them”.

Some forms of living, e. g. the extended family, are indeed more common in certain non-western societies, especially traditional societies. However, elderly immigrants from the developing countries have often already experienced half-modern forms in their homeland. In most non-western societies, significant changes in traditional forms of living have taken place since the middle of the 20th century As Gaunt and Lantz (1996). Thus, many elderly immigrants from developing countries have experienced sharply contrasting living conditions during different periods of their lives. During their childhood and youth, they lived under more traditional conditions, characterized by extended families and a hierarchical family structure.

6.2. The meaning of home

In all cultures, the concept of home has a number of meanings. Taking a perspective on defining and categorizing the meaning of home, Lewin (2000) based this categorization on several authors (Baker et al., 1987; Csikszentmihalyi and Rochberg-Halton, 1981; Hayward, 1977; Rakoff, 1977) and their definitions, summarizing the following aspects:

- The home as a security and control;
- The home as a mirror of personal views and values;
- The home as an influence and a place for change;
- The home as permanency and continuity;
- The home as a centre for family relationship;
- The home as a centre of activities;
- The home as a retreat from the surrounding world;
- The home as personal indicator;
- The home as a concrete structure;
- The home as a place to own.

6.3. Libya's social structure

Libyan social structure is influenced by the social background of tribalism, which may be described as the sense of loyalty that a person feels towards a particular social group. The anthropologist Linda Layne defines tribalism as "the placing of family ties before all other political allegiances". This tribal affiliation can be understood as a complex network of kin relations. It has been said of the Bedouins that they traditionally place great importance on the role of honor. In this case, all individuals in the tribe are responsible for the actions of other members. However, it remains an important fact for the family and the tribe, as well as the single family unit represented by the tribe. Tribalism is more common in rural areas, as people tend to live in the closer-knit groups or small towns. However, people in cities may still experience this sense of loyalty towards particular social groups. As such, some modern parts of Tripoli where people have migrated from similar social backgrounds may be described as being tribal in nature. Nevertheless, education has had a huge impact on tribalism and fewer people nowadays have the same sense of tribal affiliation.

The term "tribalism" has been decreased in usage; however, many of the characteristics are still evident, such as kinship systems, specific components, and identity systems involving units. Tribes have collective identities which are a paramount in the comprehension of the system of life for these units, especially from the perspective of social and cultural anthropology. However, Southall refers to three problems spawning from the concept of a "tribe" (Southall, 1998):

1. Definition – the term can be ambiguous, imprecise, or there may be conflicting definitions or the failure to be consistent with the usage of the term;

2. Illusion – this involves the misapplication of the term by other groups;

3. Transition and transformation – this involves the use of the term "tribe" in relation to phenomena that are actually products of modern influences.

Southall maintains that the "tribal society may be largely a phenomenon of the past, but it is still of enormous intellectual and human importance". He argues that studying tribal societies should be carried out in more specialized fields, such as through kinship, ritual, politics and economics, among others. Tribal society has two

dimensions. Firstly, there is the dimension of transformation. Some tribal societies have been transformed over long periods of time. Secondly, there is a distinction between the transformation of the situation of the communities and the transformation of those who descend from these communities. Southall says that, at the present time, one should use the term "ethnic group" rather than "tribe" (Southall, 1998).

Tripoli harbors many ethnic groups from different countries and nationalities which could not be described as 'tribal'. The policies of development in Libya have faced problems due to the fact that these ethnic groups do not always mix. Certain policies are specifically aimed at integrating people by restructuring the population in the Tripoli society.

Libyan social structure used to be tribal, and tribes were arranged in a pyramidal lineage scheme of sub-tribes. The family as a social unit was influenced by tribalism; in fact, it was the basic unit of tribal life. Fifty years before the discovery of oil, the country's tribes operated, to a large degree, as autonomous political units. Inhabitants were then identified as members of a tribe; true Bedouins leading a nomadic or semi-nomadic existence accounted for about a quarter of this total.

Libyan society is tribal in nature and there are many different tribes which exist within it. There are two types of tribal structures in Libya: the one in the north and the other in the south. The northern tribes comprise approximately 80% of the population. They are found along the Mediterranean coast and approximately 100 km towards the south. The northern tribes are considerably larger than the southern ones, which only make up for approximately 20% of Libya's population. The southern tribes exist in the desert and oasis communities, which extend down to the borders of Chad, Niger and Sudan(El-Hawat, 1994). Two tribal structures have distinct characteristics. The northern tribes are predominantly settled and live in urban areas. They work in areas such as agriculture, industry, commercial and urban services. The Mediterranean lifestyle and culture has had a noticeable impact on their way of life, and so did the Arabic and Islamic culture. On the other hand, the southern tribes practice a more nomadic way of life in the desert. Their occupations are in the areas such as animal husbandry and trade. Some of these communities are settled and their lifestyle can be described as semi-urban; however, they continue to be influenced by desert geographical conditions. In spite of the differences between the northern and southern tribes, two sets of communities are socially and economically integrated by factors

such as modernization, technology, unified national education, mass media and social interactions resulting from marriage and friendship (Omar Emhamed Elbendak, M.A, 2008).

6.3.1. Culture and Libyan society

The first task is to establish what we mean by the word “culture”, and then describe what has been found and what is the historical and social background that has shaped the present culture. Several writers establish exactly what we mean by the word “culture”. The word “culture” means that “the body of principles, cognitions, feelings and behavior is shared among a group of people in several ways" (Shawesh, 2000; cited from Altman, 1980). The word “culture” is used in this study to refer to the ideals, ideas, emotions and expressions of behavior common amongst people in one area. The shared faith, aspirations, traditions and values are reflected in the ways in which their day-to-day life is organized and in their whole way of life. Every task they tackle, every time they greet a friend or see their family, their behavior is learnt from a mixture of religious and social codes passed down from generation to generation, so that it seems natural rather than learnt. Everyone in the area will be familiar with the patterns of behavior and will conform to them. Non-conformity will be obvious, unpleasant and disturbing. (Saxena,1996) Culture shapes the behavior of individuals and groups in the society.

Libyan Arab society is immersed in Islam and the law that governs it is mainly derived from the holy Quran. Islamic faith affects relationships, rights, duties, and various dealings among individuals, communities and groups in all aspects of life. Islam in Libya is flexible enough to allow females to attend shops and sell them goods as well, such as those jobs in catering for women’s clothing; equally, women are now allowed to wear fashionable dresses such as those available in Europe. The purpose of this is to create a society free of gender restrictions, where public and single family rights are kept and maintained.

Islam has played a prominent role in the birth, culture, and ecological vista of the medieval Middle East. Therefore, any analysis of urbanization in the Arab world must start with an investigation of the essential traits of Islam, especially those that would greatly affect the establishment of cities" (Shawesh, 2000; cited from Altman, 1980).

Islamic civilization, like many other civilizations in the world, is being influenced by global life and society; hence, modern values have a clear influence on Tripoli. Contemporary western civilization has greatly influenced the lives of the average Libyan; it is especially evident in social infrastructures and social interactions in gardens and leisure centers in the cities. There are also separate clubs for each gender and relaxation spots at the seaside for fishing and water sports" (Shawesh, 2000; cited from Altman, 1980).

6.3.2. Influences of socio-cultural factors on the built environment

Every society has a culture. No matter how simple this culture may be, people tend to feel strongly that their own cultural aspects are the correct ones. Each of us is born into a complex culture that strongly influences the way we live and behave for the reminder of our lives(Ember, 1981). There is a tendency to regard those who do not share these patterns as immoral or inferior. This happens in a Muslim society like Libya as well.

Rapoport (1977) mentions that the cultural environment reflects people's value system, environmental conditions, attitudes and preferences. He believes that the physical form of the built environment results from people. This view means that a traditional way of life could dictate the design of housing, space organization, orientation of buildings and their shape, in such a way that the physical structures become symbolic of society's rules, values, beliefs and norms. Socio-cultural values such as religion, privacy, and so on are very strong forces; people build their houses to reflect these values. As (Rapoport, 1977) reports, there is a close fit between the organization of space, time meaning, communication and culture. Moreover, a group of people may have a set of values and beliefs, which are learnt and transmitted; "these create a system of rules and habits, which reflect ideals and create a lifestyle." Cultural standards are transmitted from one generation to another through the process of socializing. Even when people migrate from one part of the world to another, they take many aspects of their own culture with them(Lang,1987). The examples are manifold, just to mention Jewish and Pakistan societies in the UK.

6.4. The different roles of men and women and the influence on housing design

Another very influential aspect of life, which will require careful examination, is the role of women and men in the Libyan society. In an Islamic society, women are not

permitted to mingle freely with men, though they have to be allowed to carry out their daily activities in comfort and without feeling exposed. Each yearly cycle is broken up with various important social and religious festivals. These are the happenings that distinguish one society from another; hence, every effort has to be made to ensure those to continue to be celebrated, so that a society does not lose its identity.

The typical Islamic family is patriarchal in accordance with the Quran's sayings. "The senior male member of the household is the head of the extended family and makes the major decisions affecting its activities and welfare". In this male oriented and male dominated society, women have a subordinate role. According to the Quran, women are advised as follows: "Stay quietly in your houses, and make not a dazzling display, like that of the former times of ignorance". The Quran also advises Muslim women to be conservative in their appearance, though it does not suggest that women cannot work outside their homes. They are permitted to help their husbands in their work. The privacy of women is physically obvious in various forms of barriers, through which women can see without being seen. Men and women in the Arab and Muslim work-related areas are in two separate domains; women's activities are clearly centered on the private life of the family. The immediate result of such practice has been the separation of the house into two distinct parts. "The need to separate women is reflected in the design of a typical house" (Toulan, 1980). The Islamic religion and position of women in Islamic society plays a significant role in shaping the housing and the built environment.

This form of separation by genders existed even with the nomads, with their minimal portable dwelling or tent. A clear separation between sexes was obtained by the use of dividing partitions, which would separate the tent into two sections, and each part would furthermore be provided with its own entrance. The old Islamic houses had the same spacial design. House design was based on the need to protect the domestic life of the family, the women and her children. Although these houses were built under different conditions, in larger spaces, the rules to ensure privacy were strictly enforced (Bayazit, 1976).

6.5. Housing and privacy in Libya

Several writers define privacy stating that "the desire for privacy is a significant socio-cultural factor influencing housing design in almost every society. The form of

privacy is translated into reality in many built forms and public actions". (Alexender ,1977) wrote that the "privacy is most urgently needed and most critical in the place where people live". He was speaking in general terms, though the previous two sections on the Quran and the role of women clearly indicate that, for a Muslim society such as Libya, this is a particularly important housing demand. It is necessary to consider three levels of privacy: individual, family and community. Single family privacy is becoming a more common need than previously known. The changing patterns of life, leading to nuclear rather than extended family living, have introduced to young people the urge to have their own homes separate from a large group of relatives.

Privacy is for all, and the arrangement of space in traditional cities and villages ensures that people using public outdoor space or their own courtyards do not encroach on the privacy of neighbors. This makes the planning and arrangement of houses, public buildings and public space as important an issue as the interior layout of the house. The modem housing illustrates the potential unease produced by overlooking. Privacy is an interpersonal boundary-control process, which paces and regulates interaction with others (Altman, 1975).

6.6. Single family housing in Libya

6.6.1. Traditional single family housing in Libya

- **Houses with a courtyard and two floors from the Turkish era in the old city of Tripoli**

These houses are made usually in linear form, having one long façade all along the street in the old city. As for other aspects, they are surrounded by other houses and the reality requires that the courtyard is to stand in the middle, in a rectangular form, surrounded by main rooms. The size of this house may reach 300 m^2. The upper floor is extended to the width of the street as the extended room walls, almost touching the walls of the next house. Thus, an area of the street is shadowed, while the structure is supported from below by arches known as the Sabat, as shown in Figure 6.1. Sometimes the support is created by already made arches on the street without the sabat, as these arches are built between adjoining houses all along the street (Figure 6.2).

Figure 6.1: Sabat is built between one house and another in the old city of Tripoli.

Figure 6.2: Arches are built between one house and another all along the street.

- **Houses with one floor and a courtyard**

This type of house is found in areas which are not heavily populated, where the house extends horizontally instead of vertically. The house is usually provided with a courtyard. The entrance and men's lounge are similar to the two floor courtyard houses. The size of the courtyard is about 25-50 m^2. The height of the floor is from 3 to 4 meters. Most houses with one floor have the courtyard dimensions between 4 and 6 meters. The height may reach 3.5 m as these dimensions are near the human dimensions. However, we find that these dimensions contribute to making a nice and comfortable atmosphere inside the courtyard. The whole yard is covered in summer, providing cool setting. As for winters, the angle of reflection of the sunlight contributes in delivering a high quantity of sun rays to keep the warmth and protect it from humidity.

- **Architectural components of the Tripoli house**

Observing what is known as the Tripoli house, we may say that the name came from the unexpected questions about some other aspects which shall be introduced, such as the cultural and historical characteristics of such a house. This house, built in the heart of the city as well as in the suburbs, does not differ greatly from its typical architectural forms or models. It is usually made of one floor in the beginning with open cellars, and rooms having windows and openings. However, these windows and openings cannot be seen from the outside.

Furthermore, we find some of these buildings, whether in the city or in the suburbs, adorned with an earthy basin planted with a tree or some other plant, as it can be

observed in Figure 6.3. Likewise, we find such buildings in the city, centered by an adorned water fountain (Figure 6.4).

Figure 6.3: Earthy basin with atree in the center of the courtyard.

Figure 6.4: Adorned water fountain in the center of the courtyard.

In addition, the ceilings of these houses leading to the courtyards do not occupy a position facing the street; rather, they are built in a position to block the view to these courtyards from the public road, in a form requiring someone to lean to the left or the right. Such type of local courtyards seems to have been influenced through different stages by other types and models from the Islamic era, up to the end of the Othman era.

It seems to form a distinctive architecture, developing these constructions over time until the house has become two-floored instead of one-floored, as shown in Figure 6.5. Moreover, most of these houses have been characterized by numerous and multiple architectural elements, like window openings on façades, columns, joints and framed edges, etc.

Figure 6.5: Houses with the two floor courtyard.

- **The most important basic elements forming the house in general in the old city of Tripoli from the formation perspective**

A - Entrance: The entrance is the space utilized for entering to all other spaces, as seen in Figure 6.6. It is characterized by the complete privacy, assuring the transitional stage from the street to the house. It is continued by the Sakifa, providing the entrance into the internal courtyard indirectly. The entrance or sakifa is usually made of a corridor entered through an arched door with ornaments on all sides and with engravings typically in the forms of plants and roses, which are mostly used for entrances and sometimes with the tiling on top for the arches, as shown in Figure 6.7. Above this door, i.e. over the entrance, there is usually a room with a few balconies and with a hole underneath to enable the resident to see the visitors through it without being observed. The exit of the corridor is made on one of the corners of the courtyard to avoid seeing the whole courtyard directly.

Figure 6.7: An arched door in an old house in Tripoli.

Figure 6.6: The entranceto an old house in Tripoli.

B - Sakifa (the shed): The sakifa is the corridor leading to the house courtyard from the entrance. It has a small rest and a square overseeing directly the courtyard and being opened towards the men's hall. The sakifa is ornamented on the top by wooden roofs engraved and colored with beautiful colors, in addition to an ornamental belt on the wall with some plant drawings or architectural graphics (Figure 6.8).

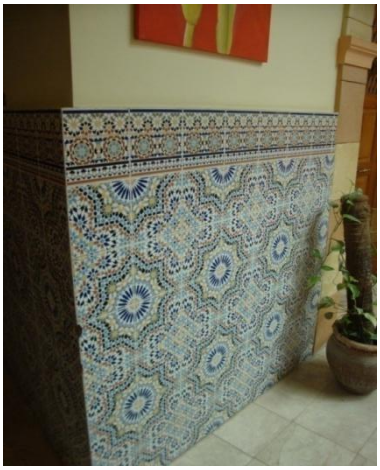


Figure 6.8: An ornamental belt on the wall with plants or architectural graphics drawn on it.

C - Men's hall: It is a room on the ground floor connected to the sakifa, usually made for welcoming male guests (Figure 6.9). Earlier, it was made in square or semi square shapes. It has an entrance near the main entrance of the house and it usually does not have an opening to the yard to isolate the guests completely from the remaining of the house. There is usually another guest room larger than it, entered through the

courtyard next to the entrance, called the basement room and used for hosting relatives or women. There are two different forms in locating men's halls. The first type is attached to the sakifa. The second is in the upper floor with an additional area on the alley by constructing sabat and without annoying the neighbors. It can have a special entrance opened to the street, as well as a bathroom in addition to another door in the first floor opened to the alley for servicing the guests. Likewise, there is a kitchen in the upper floor next to the men's hall.

Figure 6.9: The men's hall.

D - Basement room: It is almost another house inside the house, located near the storage room and the staircase leading to the upper floor. The basement room is divided into the basement, the center, two terraces and two compartments.

E - Bedrooms: These are also known as the basement room located in the second floor and entered through the alley around the courtyard. They are rectangular rooms with the width no more than 2.5 meters, though sometimes over 6 meters long. The reason behind that may be constructional, so that the beams used for roofing of these rooms do not exceed the load capacity of 2.7 m (Figure 6.10). Two suits are attached to it having one terrace each, prepared for sleeping. Underneath it, there is a storage room called the treasury, which is completely separated from the main entrance and the hosting area. Two sides are engaged with a furnished bed made of wood (the terrace), as shown in Figure 6.11.

Figure 6.10: Roof of a room.

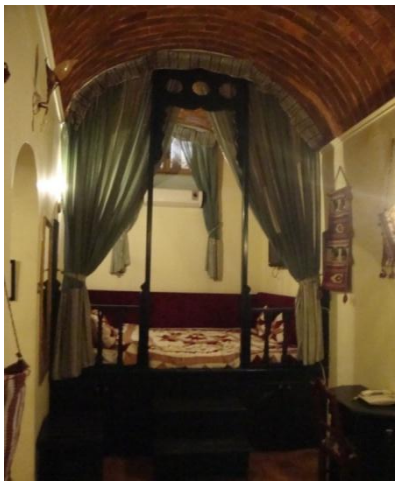


Figure 6.11: A furnished bed made of wood (the terrace).

F - Kitchen and bathroom: What distinguishes the kitchen and the bathroom is their small size. The washing basin (which is used for bathing only) and the kitchen are located in the southern part of the courtyard, with high level openings and overlooking the street from the outside, which is very useful for ventilation. As for the doors opened to the courtyard, they have ventilating openings, with dimensions of about 30×30 cm, and lighting over the door to allow for ventilating and lighting the kitchen and the bathrooms.

G - Courtyard: The courtyard has been established as an environmental solution. It is an open space in the center of the Tripoli house. We can also call it the living space of the house, as most daily activities are performed in it (Figure 6.12).

Figure 6.12: The courtyard in an old city of Tripoli.

It is usually rectangular or almost square. Its area ranges from 70-100 m^2, according to the area of the house and the ratio between the size of the courtyard and the wall dimensions in the courtyard. These dimensions are typically 1:1 in order to help in making the courtyard shadowy most of the day. The entrance to the courtyard is usually in one of the corners. It is surrounded by a supported alley connecting all of the rooms around it, in a way that the level of the alley is higher than the courtyard level. The roof of the alley is usually made of separate cellars or wooden ceilings, as shown in Figures 6.13 and 6.14, extending throughout the whole alley and connecting it to the room ceilings. These ceilings are sometimes adorned with plant ornaments suggesting the Islamic models. The rooms are spread around the courtyard and all doors and windows are opened towards it.

Figure 6.13: The roof of the alley made of separate cellars.

Figure 6.14: The roof made of wood in rawaq.

One of the courtyard advantages is that it always provides an important shadowed space to the person standing in the middle of it, regardless the side or time or season of the year or any hour of the day. There is sometimes a water fountain in the middle of the courtyard or some green plants like jasmine to help achieve the climatic satisfaction inside the courtyard and make the air well conditioned during day hours. The courtyard is used as a field of movement between the rooms and a playground for children. Washing and cooking is done along other daily activities in the courtyard. Also, giving the opportunity for social ties of the family, the mother has the total control over the movement of children, whether those who may need care or the ones who may cause trouble during play, with an easy communication with them and without having to move from one corner of the house to another, as seen in modern apartments. Some of these architectural elements and terminologies have become known by their names of Arabic origin. Others seem to come from the local slang, if not taken from the Turkish language. One of these labels is the alley (Rawaq), referring to the upper alleys connecting the walking alley between the first floor rooms, as presented in Figure 6.15.

Figure 6.15: Rawaq of the house Trabelsi.

These also represent the balconies overlooking the house courtyard. The ascending corridor (Matla) is the staircase climbing to the attic door and to what is known as the

staircase room, as shown in Figure 6.16. The booth (Kishk) is a room in the attic known as the soap room; however, this room used to be used sometimes for sitting during summer time. The cabin (maksora) is a small room without a window used for storage. The servants' house is another part of the Tripoli house, which is basically a small house with one or two rooms, a kitchen and a bathroom, and it can be entered by a corridor or an entrance from the main house. This house is utilized for service purposes and the accommodation of servants.

Figure 6.16: The staircase of the house Trabelsi.

6.6.2. Contemporary single family housing in Libya

A single storey covered dwelling unit generally with a private garden, covering an area of 170-200 m^2 and standing on the area between 300-500 m^2 represents a contemporary building system, as demonstrated in Figures 6.17 and 6.18. This house is divided into three areas: guest area, living area and sleeping area. The main entrance is covered by a veranda and opens into a small lobby (passageway) that provides access to the male reception room. This part is separated from the rest of the house to maintain privacy.

The second part is the living area consisting of a living room and a kitchen. Outer façades are opened to the back garden to allow abundant light, ventilation and views into the garden, and are covered by a veranda (Abbas, 1987). The third part is the sleeping area, which is separated from the living area to achieve more privacy and is reached by roof from a staircase located in the back of the house. The house is also surrounded by canopy to shade windows.

Figure 6.17: Front view onto a contemporary single family house in Libya.

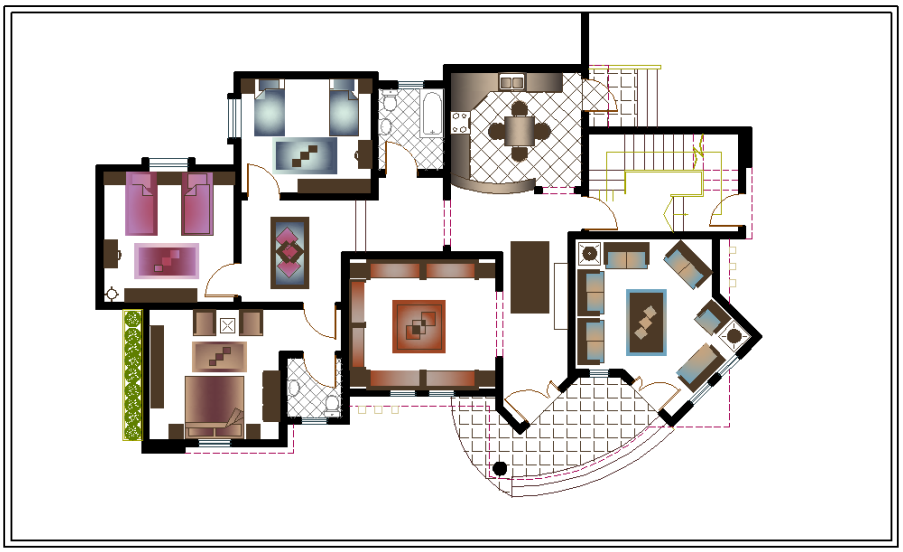


Figure 6.18: Plan of the contemporary single family house in Libya.

7. CRITERIA FOR THE EVALUATION OF ELEMENTS SINGLE FAMILY HOUSES IN LIBYA

1. Urban situation: Many people prefer living in cities, whether large or small. The city has abundant facilities and opportunities for the employment, as well as different types of services. As a consequence, Libyan population has become more urban than rural. The urban situation of settlements is one of the major factors affecting single family housing in all Libyan regions. In general, most buildings in hot climates have developed as a cluster more or less connected to each other in order to prevent the penetration of solar radiation and to provide shading. Moreover, the building designs and shapes are also appropriate to the local climate. This will be examined in the more detailed analysis.

2. Climate: The topography and climatic conditions have played a major role in shaping the residential areas and house designs in Libya. The climate is clearly one of the prime factors and thus, it will affect the building shape. It is the mainspring for all the sensual qualities that add up to a vital tropical architecture. The differences in temperature and the sun intensity have made it necessary for designing houses in Libya to suit the climate. Many elements are employed to adapt to this climate, including thick outer walls to provide insulation against the heat accumulation.

3. Socio-cultural factors: Social factors have affected the spatial organization of the house, such as entrances, as well as the separation of the house parts allocated to diverse family activities, reflecting the desire for privacy within the family and providing a sense of security. In consequence, houses have few external openings rather than an entrance door; a gate, to make it large enough to cater the family's occupational demands; and few high slits in the outer walls to allow some light in the interior and to facilitate ventilation.

4. Privacy: The other most important concept of the house design in relation to the social life is privacy. Libyan people are concerned for their neighbors, which extended to the protection of their privacy. Privacy is also highlighted within the street and in between different quarters, as well as achieving the security. Houses are built from the inside and the owner later blocks out the street with walls thick enough

to provide the sound insulation and privacy for the family. It also applies to the placement of windows to be out of the view of neighbors or passers-by in the street. Windows should not overlook the house of one's neighbors. Affording the privacy extends to the relative positions of adjacent houses, so that one could avoid overhearing the continuing private conversations in the neighboring houses.

5. Structural system: In the traditional single family housing in Libya, the structural system consists of walls and girders. The interior walls have the thickness of up to 60 cm and the outer walls have the thickness of up to 90 cm, depending on the height of the building. In the contemporary single family housing in all Libyan regions, the wall consists of reinforced concrete, where loads are distributed to concrete columns and beams in order to reduce the thickness of walls, which is to be about 20-25cm.

6. Materials and construction methods: In single family housing in Libya, builders used simple local available materials and construction methods. A mud or dried brick and limestone were used in the construction of all Saharan towns. Focusing on the benefits of using local construction materials is a solution to a number of problems, such as pollution, economy, or complicated construction. It has already been mentioned that the climate of Libya is characterized by hot, arid zones, with a very great difference between day and night temperatures. Due to the almost complete absence of cloud screening, the ground receives a great amount of solar radiation by day, while it radiates a great amount of heat out to the atmosphere by night. Therefore, the comfort of people inside buildings in such zones depends largely upon the thermal properties of the walls and the roof. The best materials are those that do not conduct heat(Nahla,2007). Limestone is considered the main construction material for walls in the traditional single family housing in Libya. It is easy to be cut and to be shaped, with a great workability, high heat resistance up to 900ºC, good thermal insulation, high compressive strength, and good resistance to environmental conditions(Nahla,2007).

7. Façade of the house: Traditional houses in Libya are laid out adjacent to each other, so there is mostly one façade facing the street. The façades of the external walls are plain and devoid of any decoration, and it is not architectural. New building materials have played a fundamental role in forming the house shape, size, and decoration. Reinforced concrete, glass and aluminum play a significant role in the

appearance of the façade whose design and decorative elements, such as cantilever balconies and verandas, are borrowed from foreign architecture.

8. Internal functional arrangements

A) Main entrance: In the single family housing in Libya, the entrance is the main component of the house, presenting the access to the internal space of the house via an internal corridor. The separation between male and female is imposed according to religious obligations and the respect for social and cultural traditions seeking to maintain privacy in Libya. The entrance in the Libyan housing usually has an L-shape, leading to a corner of the courtyard. The male room is entered through the passageway. The entrance is facing a blind wall and does not open directly to the family part.

B) Courtyard: In the single family housing in Libya, there is an open space in the center of the house that plays an important role in the family life and is used as an open-air family living room in spring, summer and autumn, particularly in summer when almost all family activities take place around it. The function of the courtyard is to deal with any wind movement to cool loggia and rooms, providing natural light whether in the daytime or in the evening; at night, it helps lightning rooms using moonlight, particularly in summer. This will be examined in more details further in the analysis.

C) Men salon: Libyan society is not different than other Arab societies in being renowned for its hospitality. According to religious and traditional teaching, the male reception room should be given special attention in relation to its position, to offer separation between other reception rooms and the remaining elements of the house.

D) Bedrooms, kitchen and bathroom: The bedrooms are used as both sitting and sleeping area. Kitchen is a place where the food is prepared and it has become an important element of single family housing in Libya. The bathroom is used for bathing. Details about dimensions of these places and their inner function, technology and openings will be discussed later in the analysis.

9. Roof: The roof in the traditional single family house in all Libya regions plays an important role in the family life, since it is the only outdoor space in the house. It is usually used for cooking and working by women, a playing yard for children, a sitting

and sleeping area during summer season, and a space for heating and the exposure to sun in the daytime during temperate and cold season (Evans, 1980).

The use of the roof in all Libya regions is encouraged by the provisions related to high external walls that secure privacy and protection from hot dusty breezes. The temperature film of air above a flat roof will vary according to the air temperature fluctuations and the intensity of solar radiation emitted to and from the sky (Evans, 1980).

10. Openings

A) Windows: In the traditional single family housing in Libya, windows help the circulation of air and light and make the house more energy efficient and visually appealing. It is a rectangular element with the dimensions of 80cm × 100 cm. Most of the windows are small and made of wood with patterned color, with iron nets to provide protection and safety from strangers. In the contemporary single family housing in Libya, windows are expanded and developed, with the increased dimensions to become about 1.20m × 1m, or 1.40m ×1.20m. They are opened to the outside rather than the inside to screen the viewing area.

B) Doors: In the traditional single family housing in Libya, doors usually have the dimensions 1m × 2.10 m. However, the main entrance usually has dimension 1.40m × 2.20m.

8. CASE STUDIES OF THREE REGIONS IN LIBYA

The objective of this study is a comparison of traditional single family houses and contemporary single family houses in three cities in Libya. They are located in three different geographical regions which are represented by Tripoli in the coastal region, Gharyan in the mountainous region, and Ghadames in the desert region. This study has been undertaken in three cities to understand and evaluate some of the significant factors in terms of architectural design and construction, materials and the inside facilities which are part of the dwelling, as well as an internal and external temperature. With respect to the design aspect, it focuses on thermal mass and the size of windows, air circulation within the house, dimensions, wall thickness, interior and exterior colors, as well as the development of modern house architecture.

8.1. Coastal region: Tripoli

The Tripoli region is geographically situated from the north of the Equator, at longitude 32 degrees, and latitude 13 degrees east of Greenwich. Tripoli area is considered the most important of the planning provinces in Libya, as it is the largest region in terms of population. The surface area reaches 225,282 km^2. It represents about 12.8% of the country's total surface. It is the most important city of the province and the country, as well as the social, economic and cultural center, and a major attraction for the movement of population inside and outside the province.

A) Traditional single family housing in Tripoli

- **House: Family Mahmoud Sola.**
- **Type: A row house in the old city center.**
- **Location: Centre of Tripoli, Al Hara Al Kabeir street, the northeastern part of the old city, near the sea, nearby the summit Hotel.**
- **Year of construction: It was built during the Italian colonization of Libya, in 1945.**
- **The total area of the house: Approximately 419 m^2.**

1. Location: The house is located in the north-eastern part of the old city, in Tripoli, near the sea, 7m above the sea level, in Al Hara al Kebir street. It is also located near the ancient summit Hotel, across the Arch of Marcus Aurelius. The house is surrounded by houses on both sides, and from the front and the back with the street and alleys, as shown in Figure 8.1.

Figure 8.1: The location of Mahmoud Sola house in Tripoli.

2. Structural system: Traditional single family houses in Tripoli were built without graphics, architectural or supervised technicians, where the number of rooms was determined by the owner according to their needs. The structural system consists of the walls of the holder, the interior walls up to 60 cm thick, and the outer walls up to 90 cm thick, depending on the building height, which is important for providing more strength and support to the house. The foundations of the building do not present the problem because the ground is either sandy or rocky and coincides with the exact length of the building. The floor has always been made of concrete and small stones. This is called “the load-bearing wall system”. The ceiling is very high, for about 4 m.

These houses are in the form of rows and have a single interface located on the narrow streets linking them to the neighbors’ houses. There is a storage water tank under the house built of flint in order to take advantage of rainwater. It has been observed that the surrounding houses are in a dilapidated condition, while some of them have almost collapsed.

The house was restored and repaired by using the same construction materials and some restructuring materials, such as gravel, cement, concrete, wood ceiling, sand,

tiles, and paint. The windows were also changed. The original materials of the building include limestone, sandstone, brick and wood. It was also observed that the ceiling of the traditional single family house was made of compressed soil or mud and straw, placed on the structure made of pine wood and wood joists, as presented in Figure 8.2.

Figure 8.2: Timber ceiling in Mahmoud Sola house in Tripoli.

3. Construction materials: Limestone is utilized in blocks sized 70 × 40 × 45 cm, locally made and used for foundations and walls. Sandstone is used for building roofs, walls and foundations as well; dimensions are almost the same as limestone. Wood consists of palm trees and olive ceiling joists, beams and carpentry. Paint is usually white in order to reflect the sun's rays. The tiles used are made of a type of marble called "the malty tiles". They are approximately 50x50cm and 60x60cm and used for coating the floor. Porcelain tiles, known as "the faience" are used for decorating the walls and the main entrance. Also, wood is used for decorating the ceiling from below, as well as the windows and doors. Iron bar windows are used in order to protect the house from any potential break-ins.

4. Internal functional arrangements in the traditional single family house in Tripoli

The analyzed house has seven rooms distributed around the courtyard, which usually presents the center of the house, with a kitchen, men salon, a toilet and stores. Rooms are rectangular in the greatest number of traditional single family housing in Tripoli, as demonstrated in Figures 8.3 and 8.4. The courtyard provides the possibility of circulating the air to the inside spaces. The dimensions of the courtyard allow natural sunlight to penetrate into all of the rooms and onto the roof. However, the courtyard

was covered by the owner in recent years due to the outdoor air pollution, rain, dust and fear of theft. The simple decoration on the façade of the house is mostly painted by white color (Figure 8.5).

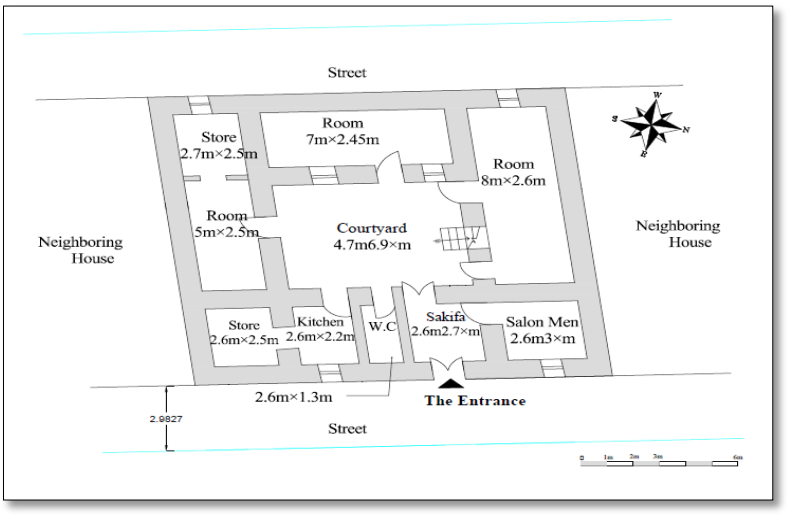


Figure 8.3: Ground floor plan of Mahmoud Sola house in Tripoli.

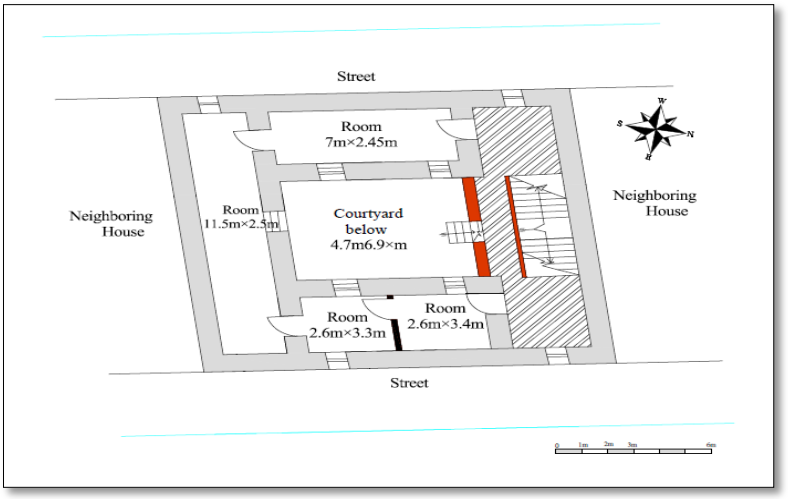


Figure 8.4: First floor plan of Mahmoud Sola house in Tripoli.

Figure 8.5: Façade painted by white color of Mahmoud Sola house in Tripoli.

A) The entrance: This is the main component of the house. It has the access to the internal space of the house via an internal corridor, and the men salon is on one of its sides, as shown in Figure 8.6. The door cannot be opened directly to the courtyard in order to prevent anyone entering directly to the courtyard. Door usually leads to the corridor. There is another door at the end of this corridor, as shown in Figure 8.7, in order to ensure the privacy of the family.

Figure 8.6: The entrance in Mahmoud Sola house in Tripoli.

Figure 8.7: Another door at the end of this corridor in order to ensure the privacy of inhabitants.

B) Sakifa or corridor: It is the part that separates all daily activities in the streets from the inside of the house. It is also a distributor, leading to the men salon. Sometimes, ceramics is placed on walls for adornment, as shown in Figure 8.8.

Figure 8.8: The Sakifa or the corridor with ceramics for adornment in Mahmoud Sola house in Tripoli.

C) **Bedrooms:** Bedrooms are in a rectangular shape and can be used for both the sitting area and the sleeping area, as presented in Figure 8.9. The dimensions in this house range from 2.5 m to 6 m, and they are not symmetric. This method of construction occurred due to the restrictions imposed by the materials used in this case, as well as the length of the palm trunks.

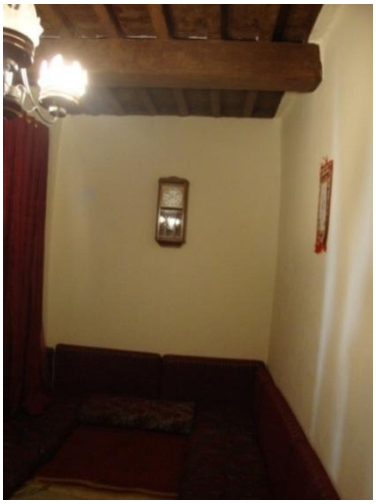


Figure 8.9: Bedroom in Mahmoud Sola house in Tripoli.

Figure 8.10: Courtyard in Mahmoud Sola house in Tripoli.

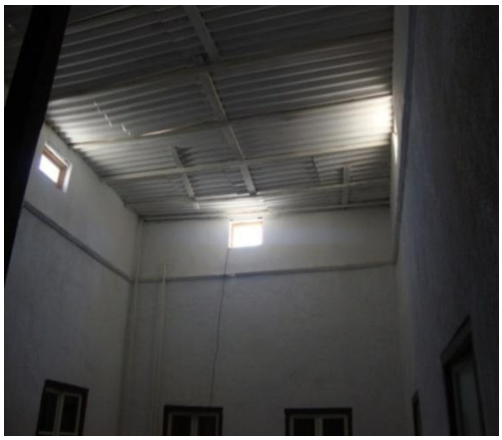


Figure 8.11: The metal cover of Mahmoud Sola house in Tripoli.

E) Men salon: It is normally situated at the side of the entrance and separated from the interior spaces of the house. It is almost square-shaped and its window is opened outwards onto the street. The furniture of the guest room consists of pieces such as a long soft bolster on mats or carpets around the room and opposite the walls, arranged for sitting on, with smaller ones for lying back. Some furniture is handmade, reflecting the skills of the women of the household in weaving and sewing. Sometimes, the same cushions can be used for sleeping.

F) Kitchen: It is a place where the food is prepared and it is small compared to a contemporary kitchen. It is usually located on one side of the interior courtyard and directly connected with it in order to facilitate movement between them. It has been shown that the design of the kitchen leans towards practicality rather than beauty. This is noticeable in the lack of color harmony in the kitchen elements, and the colors of walls and drapes. We also notice the inconsistency in the placement of door and window openings, as well as in the placement of kitchen units (Figure 8.12).

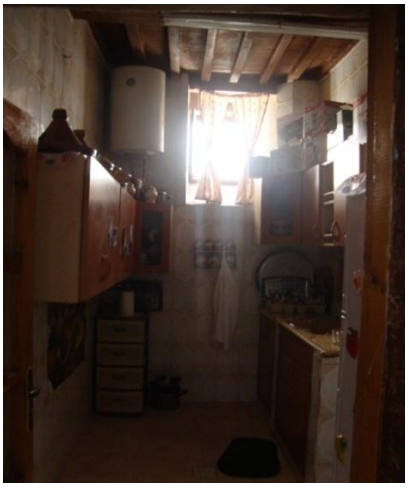


Figure 8.12: Kitchen in Mahmoud Sola house in Tripoli.

G) Bathroom: It is adjacent to the kitchen on the ground floor. It often has small, high walls and a small window to be located towards the street to allow light to enter and to assist ventilation. In the bathroom, repair and renovation works were done by the owner five years ago, through the renovation of water pipelines, sewage system and installations, as well as different shapes of ceramics on the floors and walls. There is also a small compartment in the bathroom for a shower with a curtain, a sink and a toilet, as observed in Figure 8.13.

Figure 8.13: A modern flushing toilet added recently in Mahmoud Sola house in Tripoli.

5) Roof: It presents an important part of the traditional single family house in Tripoli, where there is a smooth inclination in order to collect rainwater during the wet season for drinking and for various other purposes. It is painted white in order to reflect the sunlight falling on it and to reduce temperature. Most of the ceilings are surrounded by walls on the sides for privacy. Roof can be used for sleeping in the open air during

the summer season. It can be like a storage for dry foods such as tomatoes, and for drying the laundered clothes. It can usually be accessed directly from the centrally located internal stairs.

6. Openings

A) Windows: Windows help to circulate the air and light and make the house more energy efficient and visually appealing. They are mostly rectangular forms, 80 cm × 100 cm. Most of the windows are small, made of wood, painted in color, with iron nets to provide protection and safety from strangers (Figure 8.14).

Figure 8.14: A window in Mahmoud Sola house in Tripoli.

B) Doors: The doors secure the privacy and separate the interior rooms from each other, and provide comfort to the residents. They are also used as interior rooms separated from the outdoor surroundings. They are usually made of wood decorated on the inner side with decorative glass. There are some architectural decorations around them, made of gypsum, in order to make them much more visually appealing. Dimensions of doors are typically 1m × 2.10 m, as shown in Figure 8.15.

Figure 8.15: A door in Mahmoud Sola house in Tripoli.

7. Conclusion

After inspecting this house, we have found some drawbacks and certain good features. This house was constructed without architectural drawings, designers or supervisors. Usually, this type of house is constructed according to the needs of the owner. Over the last few years, the owners covered the courtyard because of the changeable outdoor weather conditions, such as rain and dust. It has been found that one side of the house is free from any decoration and aesthetically poor. The house does not comply with the needs of a modern family in terms of health and living conditions. However, there are some advantages; for example, the entrance has a complete privacy and it emphasizes the transition from the street to the house. It consists of "the Sakifa or the corridor" leading to the interior courtyard indirectly. There are also separate sections between men and women in accordance with the social and religious values of Libyan society. Also, it is important to mention the usage of local building materials with the purpose of providing thermal comfort to residents without using air-conditioning, which requires large amounts of electrical power.

B) Contemporary single family housing in Tripoli

- **House: Family Abdalmast Shahran.**
- **Type: A countryside house.**
- **Location: On a farm, located about 60 km east of Tripoli.**
- **Year of construction: It was built in 2011.**
- **The total area of the house: Approximately 279 m^2.**

1. Location: The house is located on an estate with an area of approximately 10,000 m^2, together with the garden and the outdoor area covered with tiles. The house expands out approximately 500m^2. The house has a square shape and rises approximately 20m above the sea level. There are some trees in this area. The forest from the north side surrounds the farm, so the house is accessible from the access road that branches out from the main road, as shown in Figure 8.16.

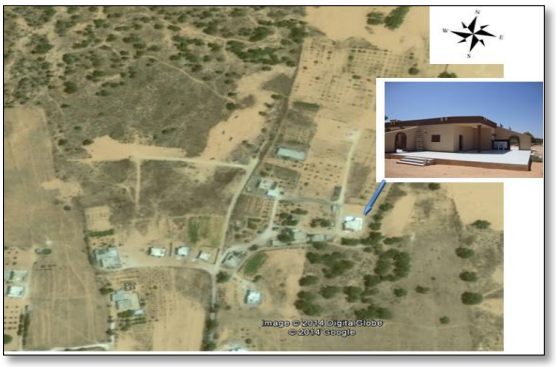


Figure 8.16: The location of Abdalmast Shahran house in Tripoli.

2.Structural system: It consists of reinforced concrete where loads are distributed on concrete columns and beams in order to reduce the thickness of walls, which are to be about 20-25 cm. The ceiling height is about 3.20 m, as demonstrated in Figure 8.17. The foundations of the house are represented through separate foundations with the dimensions 1m x 1m and the height 60cm. This method is used in building most contemporary single family houses in the coastal area. It is based on a theory of the transfer of load by beams on the fulcrum points of the house that are actually the columns. The load of each column is transferred to the bottom base and can be connected by the thresholds.

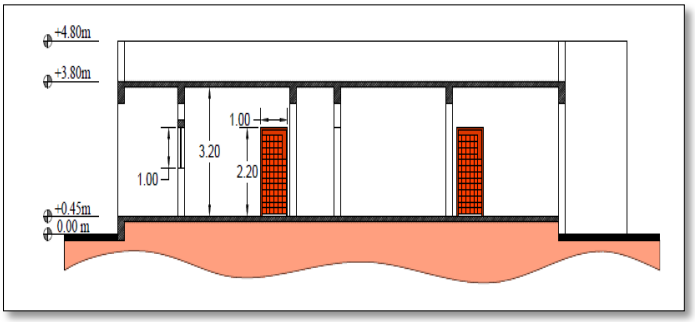


Figure 8.17: Section of Abdalmast Shahran house in Tripoli.

3. Construction materials: The house is built with concrete bricks, which is a mass of treadmill inside, dimensions 20cm × 20cm × 40cm. They are prefabricated and interconnected with cement and gravel for walls. Polystyrene is used for thermal insulation of the surface. These materials are imported from abroad and used for the house without any consideration regarding local climatic conditions. The house is not good regarding thermal insulation, so the atmosphere inside the house depends on air conditioning for cooling in summer or heating in winter. Iron is used in reinforcing the concrete for the ceiling, for columns and thresholds. Tiles, marble and ceramics are used for paving the floor and walls. Gypsum is used for decorating the house; wood is used for decorating the outside windows and arched roofs, while the Pharaonic stone is used for decorating the external walls.

4. The internal functional arrangements in the contemporary single family house in Tripoli

The house has one floor, and consists of three bedrooms, a living room, men salon, two bathrooms, a kitchen, a dining room, and a store, as shown in Figures 8.18 and 8.19.

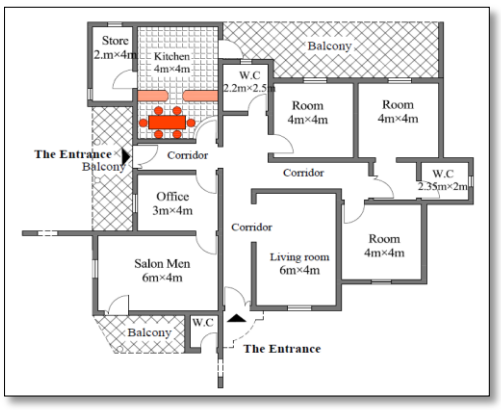


Figure 8.18: The plan of Abdalmast Shahran house in Tripoli.

Figure 8.19: Air-conditioning system of Abdalmast Shahran house in Tripoli.

A) Entrance: The entrance from the east is the main entrance of the house, often providing the first impression compared to other parts of the house. This is very important and the reason why Arabs are well known for their generosity and hospitality. Choosing the decor for the entrance in oriental Arabic style is considered a specific type of hospitality for your guests, and it determines the entrance as an important part of the appearance of the house. The entrance doors are made of iron and decorated with ornaments, while the floor is made of marble. The house actually has two entrances.

B) Corridor: The corridor represents a horizontal connection between spaces on the same level. It is about 1.40 to 1.70m, painted with colors and sometimes decorated with natural stone, as it can be observed in Figure 8.20.

C) Bedrooms: In this house, they are in the form of squares with dimensions 4m × 4m. The bedrooms are located in the wing away from the main entrance, in order to secure privacy and provide peace when the household is asleep. The bathroom is located between the bedrooms. Bedroom windows are looking outside, with dimensions 1m x 1m, in order to provide air and natural light during daytime. The floor in the rooms is tiled, and the ceiling is decorated with gypsum to make it look more beautiful.

Figure 8.20: The corridor painted by colors and decorated with natural stone.

D) Living room: The main feature of this room incorporates its multipurpose function in the daytime. It includes activities such as eating and sitting of the family, as well as its regular use by visiting neighbors and relatives, in addition to female

guests. In other words, it occupies the same functions as the courtyard in the traditional housing in Libya (Figure 8.21).

Figure 8.21: A living room in Abdalmast Shahran house in Tripoli.

E) Men salon: It is a rectangular shaped room with dimensions 4m x 6m, separated from other interior rooms of the house. Usually, it is used as a male guests' reception room. When designing the house, its position is always near the main entrance. The ceiling is also decorated with gypsum, which makes it more attractive. It has been found that Arabic salons serve as places for sitting, as shown in Figures 8.22 and 8.23.

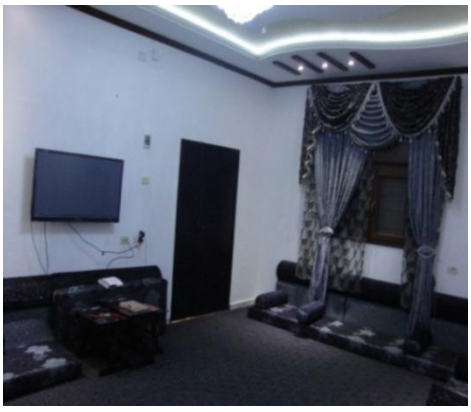


Figure 8.22: Men salon in Abdalmast Shahran house in Tripoli.

Figure 8.23: Decorated roof of the men salon in Abdalmast Shahran house in Tripoli.

F) Kitchen: It is a place where the food is prepared. It has become an important element and has witnessed drastic changes, since it used to be a part of the interior courtyard of the house placed in the rear. Walls and floors have witnessed a significant development; in the late 1990s the kitchen became an area outward-

looking with windows and doors opening to the garden or to the outside terrace. It is fully equipped with all modern appliances, as shown in Figure 8.24. It is often dimensioned 3m × 4m and attached to a small storage area.

Figure 8.24: Kitchen becomes fully equipped with all modern appliances in Abdalmast Shahran house in Tripoli.

G) Bathroom: Over the last few years, its appearance has evolved in accordance with the residents' demands. All family members use it daily, and therefore, if you take into account all the rooms, it is considered to be the most private place. Finishing materials are non-flammable, easy to work with and can bear the moisture. This house has three bathrooms, and water is usually supplied by the tank top. The bathroom includes washing and bathing facilities and a lavatory. The floor and walls are covered with tiles or mosaic, as shown in Figure 8.25.

Figure 8.25: The bathroom in Abdalmast Shahran house in Tripoli.

5) Roof: Heavyweight roof is constructed from reinforced concrete system. It is the part that cannot be divided from other elements of the house. Flat roof, thick ceiling

of about 15cm and a slope of about 1% per meter on the upper side help clearing the rainwater falling on it. Parapets are 1m high, situated on each side of the house.

6. Openings

A) Windows: Windows are expanded in comparison to a traditional house, and developed to the dimensions of about 1.20m × 1m. They open to the outside rather than the inside, screening the viewing area. They are made of high quality PVC materials that can withstand present and future climate changes (indoor or outdoor). They isolate noise, heat and prevent moisture, as well as rain, as presented in Figure 8.26.

B) Doors: Doors have dimensions of 2.20m × 1m in the interior; however, for the main entrances, the main dimensions of 1.40m × 2.20m are used for the entrance doors made of stainless steel.

Figure 8.26: Windows in Abdalmast Shahran house in Tripoli.

7. Conclusion

As a result of the study of this house, we have found a development in the construction of the house related to the modern times where technology dominates design. We take into account all empty spaces precisely in accordance with the needs of a contemporary family, as well as the design. There is a considerable interest in the outside appearance that does not seem to have a common ground with Libyan Islamic architectural styles. We can notice the expansion of the house area, as well as the interior empty spaces, such as the kitchen and rooms. The separation between men and women in the main entrance area is in accordance with the religious obligations

and the respect of the cultural and social traditions, in order to protect privacy. The house's open courtyard in the "old" house is replaced with a living room, where most of the activities of a contemporary family are performed. Likewise, some modern decor is introduced, with the use of gypsum under the basic ceilings to award it an aesthetic view. The use of imported and prefabricated construction materials make the buildings dependant on the industrial thermal comfort by supplying the house with air-conditioning, causing the excessive consumption of electric power.

8.2. Mountainous region: Gharyan

The city of Ghayran is located south of Tripoli, about 90km south, on a mountain chain called "The western mountain", as shown in Figure 8.27. The city has a population of about 161,000 inhabitants, and has the area of approximately 4,660 km^2.

Figure 8.27: The location of the Gharyan.

A) Traditional single family housing in Gharyan

The underground house is one of the dwelling types which were used by ancient civilizations in many parts of the world. It is mainly found in Italy, France and in the west part of the North African coast and China. With slight differences in design, the underground houses are used on different continents and by different cultures that have the same climatic conditions. The Gharian underground house has its own character and architectural features.

The house is located in Gharyan, south of Tripoli, Libya. The mean annual temperature outside is about 47°C. In July and August, the temperature inside the house is about 21ºC, while in January, the temperature is only 6ºC inside the house.

Mean annual relative humidity is about 35-65%, while the rainfall is 351 mm/year. In general, the climate in Gharyan is cold in winter and hot in summer. This leads people to utilize the mass effect strategy and the warmth of soil in winter and its coldness in summer.

- **House: Family Omar Belhaj.**
- **Type: The underground dwelling or the troglodyte.**
- **Location: On the edge of the mountain, in the town Bu Gheilan, approximately 18 km north of the centre of Gharyan.**
- **Year of construction: It was built in 1666.**
- **The total area of the house is about 446 m^2.**

1. Location: The underground dwelling is located at the edge of the mountain range Gharyan (to be exact, in the town Bu Gheilan). It is approximately 7 km away from the town's center and approximately 18 km away from the city of Gharyan, at the end of the access road. The area is 620m above the sea level. On the northern side, the mountains surround the house, while on the other side there are contemporary country houses and some underground houses. Most of these houses are not suitable for living. There are no other kinds of trees except for olive trees (Figure 8.28).

Figure 8.28: The location of Omar Belhaj house in Gharyan.

2. Structural system: The structural system in the underground dwelling is a solid system. After a layer of soil, which is 2-3m thick, a rocky solid layer is used to provide the base for the coherent clay layer. Internal spaces for a family are designed after digging the central courtyard with all rocky and clay layers. After that, entrances

into internal arrangements are dug, while the rooms are shaped with the solid rocky layer.

3. Construction materials: Limestone is used in building, supporting the walls of the entrance. Olive wood is used for making doors, as shown in Figure 8.29, and small stones are used for the decoration of the walls of the men's room (so-called men salon), as it can be seen in Figure 8. 30.

Figure 8.29: Olive wood is used for making doors.

Figure 8.30: Small stones are used for the decoration of the walls of the men salon.

4. The internal functional arrangements in the underground dwelling in Gharyan

The house has a very simple design. It is shaped as a huge cube in the clayey ground, forming a courtyard house, as shown in Figure 8.31. The underground dwellings consist of eight large rooms, where each room is used as a home for one family. The courtyard allows air circulation and sunlight to enter the rooms during the day. The house uses the natural moonlight during the night, especially during spring and summer, due to the lack of a roof over the courtyard, as it can be observed in Figure 8.32. In general, minimum construction material is used per unit in the entrance area. The house does not lean on any structural element, and therefore there are not any partition walls that divide the empty space. There is a space for storing grains and food, and it is located above the rooms. It can be reached using ladders made of olive branches, as shown in Figure 8.33.

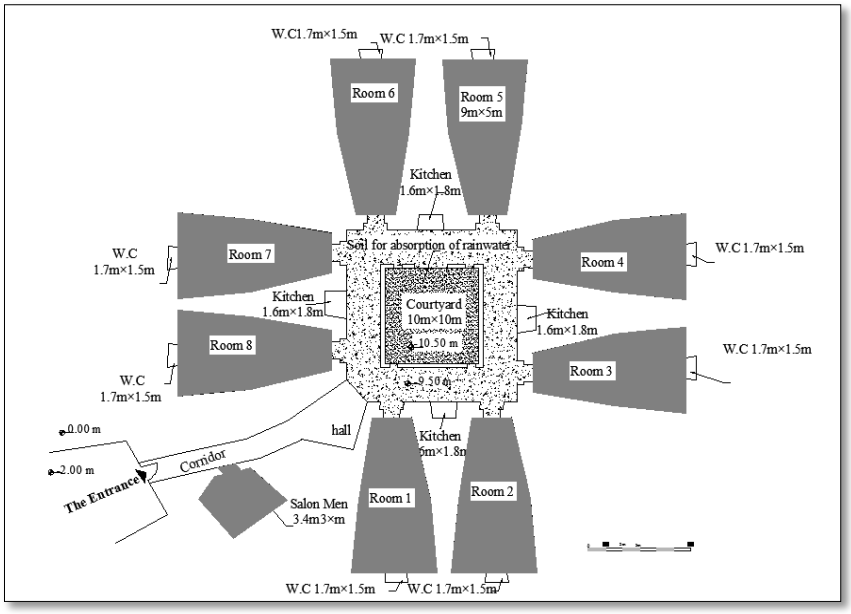


Figure 8.31: Plan of Omar Belhaj house in Gharyan.

Figure 8.32: The lack of a roof over the courtyard.

Figure 8.33: Space for storing grains and food is located above the rooms.

A) Entrance: It is the main element of the underground dwelling, through which a person can access the internal space, as seen in Figure 8.34. The systems of load-bearing walls that are covered by tree trunks, especially olive trees, are also used. The guestroom is medium-sized and it is located on the level of solid natural soil. It is accessible from the special entrance in the house. Tree trunks are also used for covering the corridor. They make a slope that connects natural ground level with the backyard level. It is the part that passes through the clay layer before the rocky layer of the ground. Natural firmness of the area is used for covering the corridor.

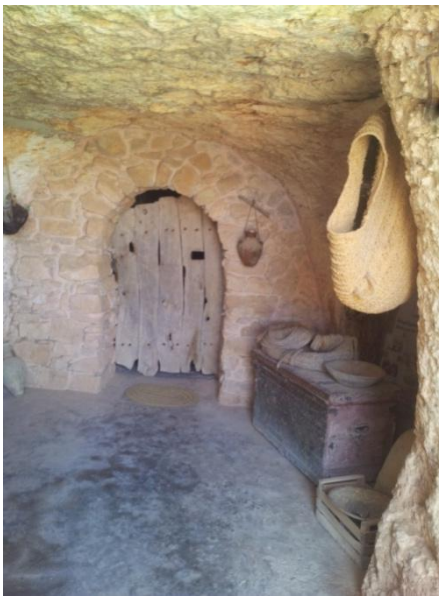


Figure 8.34: The entrance in Omar Belhaj house in Gharyan.

B) Corridor: It has to be curved in order to separate the courtyard from the men salon, and there is also a slope downwards where there is a difference between the level of the entrance and the courtyard of the house. The width of the corridor extends to 1.30m; its height is up to 2.50m, while the ceiling of the corridor is equal to a half of the arch (Figure 8.35).

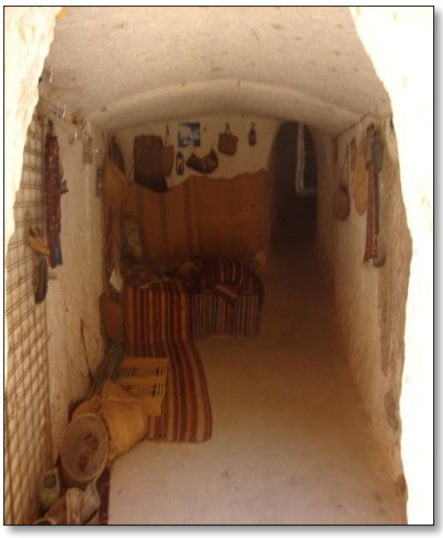


Figure 8.35: The ceiling of the corridor is equal to a half of the arch.

C) Bedrooms: They are all dug deep in a shape similar to trapezoid, where the dimensions of the entrance area are about 1.90m, and they are the smallest dimensions. When we look at the interior, the width of the room expands until it reaches approximately 5m. The room is divided by curtains into three parts. The first

part is a living room because it is located next to the entrance. The second part is in the middle of the room and it is the children's room. The third part is at the end of the room, and it is planned for a married couple. And, at the very end, there is the bathroom, which can be used only for bathing. As you can notice, the difference between these three parts is just in the ground level. Each level is elevated 15cm from the previous one. The height of the room is approximately 2.30m in the middle, as shown in Figures 8.36 and 8.37.

Figure 8.36: The bedroom of Omar Belhaj house in Gharyan.

Figure 8.37: The bedroom is divided by curtains into three parts.

D) Courtyard: In this case, it is square shaped, dimensions 10m x 10m and the height up to 9.50m. The courtyard has a number of important functions. Its natural and technical function is to arrange movement between rooms and other facilities that surround it, but are not connected. It also lowers the temperature and it is the source of natural light in rooms. Additionally, it has a social and a cultural function, when the families gather during the evening to listen to legends and stories. Likewise, it is also used for wedding and circumcision celebrations. It contains plants and trees, as it can be observed in Figures 8.38 and 8.39. The courtyard is divided into two levels, creating a passageway of 2m in width for circulation. The rest of the floor of the courtyard is about 50cm lower than the passageway. In the middle of the courtyard, a septic tank is dug into the ground and filled up with salt and organic materials. It is dug deep enough to collect the rainwater from the courtyard.

Figure 8.38: The courtyard of Omar Belhaj house in Gharyan.

Figure 8.39: The courtyard contains plants and trees in order to freshen the air.

E) Men salon: Usually, it is a place next to the entrance, and it is separated from the interior rooms for privacy. It is almost square shaped, dimensions 3.40m x 3m.

F) Kitchen: It is specific for its small size and entrance without a door. There are no other openings in the kitchen; therefore, the walls soon change color into black due to the use of wood for cooking on fire. There is a hollow opening on the wall and it can be made of wooden boards. The kitchen has many functions and various elements. As it is well known, its main purpose is cooking, but also it is used for storing some provisions, such as fat, flour and semolina, which are kept in dishes made of leather, wicker and copper, as shown in Figure 8.40.

Figure 8.40: The kitchen of Omar Belhaj house in Gharyan.

G) Bathroom: There were no bathrooms in this house. However, they were added 4 years ago by the owner, providing water by tubing from the tank top, as shown in Figure 8.41.

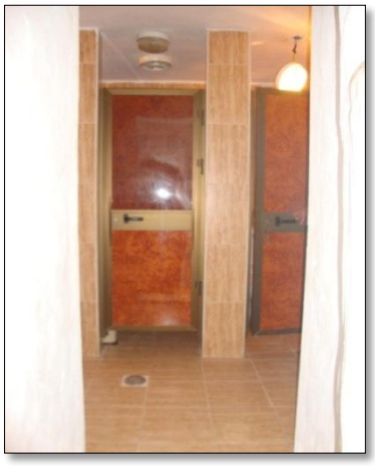


Figure 8.41: The bathrooms were added 4 years ago by the owner.

5. Roof: The height of the ceiling is approximately 2m to 2.50m at its highest point, and it is in the form of a barrel vault (Figure 8.42).

Figure 8.42: Roof is in the form of a barrel vault.

6. Openings

A) Windows: There are no windows in the interior of the room. The natural light and air come in through the door, which open towards the courtyard.

B) Doors: Their dimensions are approximately 75cm wide and 2m high. The main doors are relatively wide; thus even cattle can pass through them into the house at certain times, in order to protect them from being stolen.

7. Conclusion

The result of the study suggests that the structural system does not depend on construction materials, except at the entrance. It also greatly relies on human labor

which is employed for digging the clay. The courtyard is the first part of the house that is dug up. The walls of the interior spaces are covered with gypsum mortar in order to provide more light. Also, the material is good for chasing away the insects, because there were not any insecticides in those days. One room is considered to be like a house. There is a structural system, and it consists of simplified lines. With the presence of some manipulations at the entrance with the arches, the simplicity of the shapes reflects the interest for functionality rather than architecture. The underground dwelling or the troglodyte represents a case of optimal exploitation of environmental possibilities, such as thermal comfort, where the industrial air-conditioner is not required. This means that there is no need for the consumption of electric power. We can also notice that there is a lack of service facilities compared to the kitchen in today's house.

B) Contemporary single family housing in Gharyan

- **House: Family Arabi Belhadj.**
- **Type: A countryside house.**
- **Location: On the mountain, in the town Bu Gheilan, about 16 km north of the centre of Gharyan.**
- **Year of construction: It was built in 1994.**
- **Total area: This house is relatively large in terms of size; the total area is approximately 242 m^2, with full contemporary utilities.**

1. Location: The house is located in the area of Abu Ghilan, about 6 km away from the town's center from the north-east side, and about 17 km away from the town of Ghayran. The house is located on the part with a total area of 500m^2. There is a small park with trees around the house, surrounded from all sides with a 1.80 m high fence (Figure 8.43).

Figure 8.43: The location of Arabi Belhadj house in Gharyan.

2. Structural system: It consists of columns and beams of reinforced concrete in order to reduce the thickness of the walls to about 20-25 cm. The ceiling height is about 3.20 m. The foundations of this house are represented through separate foundations with dimensions 1m x 1m and the height 60cm. This method is used in building most individual houses in the mountainous region, since it transfers the load by beams on the fulcrum points of the house that are actually the columns. The load of each column is transferred to the bottom base and can be connected by the thresholds.

3. Construction materials: Iron is used in reinforcing the concrete for ceiling, columns and thresholds. The concrete bricks are used in building walls, which is a mass of treadmill inside, dimensions 20cm × 20cm × 40cm. They are prefabricated and interconnected with cement and gravel for walls. Polystyrene is used for thermal insulation of the surface. Tiles, marble and ceramics are used for paving the floor and walls. Gypsum is used for decorating the house; wood is used for decorating the outside windows and arched roofs, while the Pharaonic stone is used for decorating the external walls. The building is equipped with air conditioning for cooling in summer or heating in winter.

4. The internal functional arrangements in the contemporary house in Gharyan

The house consists of a salon for men, a living room, three bedrooms, a bathroom, a kitchen and external balconies, as shown in Figure 8.44. It has a lot of facilities that

can be found in a contemporary house in Tripoli, with the same utility rooms and the same structure. It is surrounded by external gardens and a fence for protection. Also, air conditioning is provided, both for cooling and heating, as demonstrated in Figures 8.45 and 8.46.

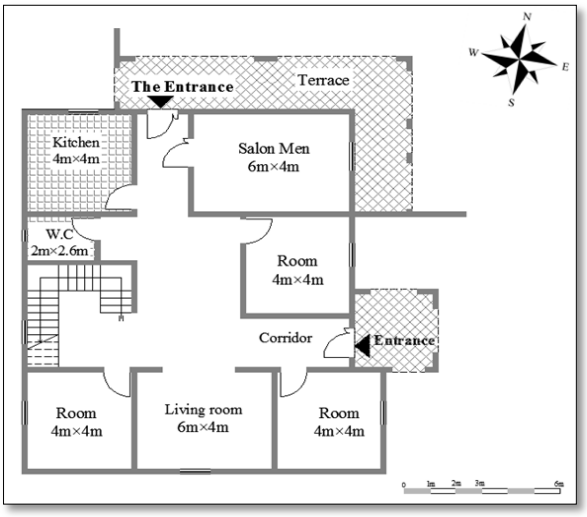


Figure 8.44: A plan of Arabi Belhadj house in Gharyan.

Figure 8.45: North façade of Arabi Belhadj house in Gharyan.

Figure 8.46: Air-conditioning system on the east façade of Arabi Belhadj house in Gharyan.

A) Entrance: The entrance from the east is the entrance of the house that often makes the first impression when someone approaching. This is very important and the reason why Arabs are well known for their generosity and hospitality. Choosing decor for the entrance in oriental Arabic style is considered a specific type of hospitality for your guests, determining the appearance of the house. The entrance doors are made of iron and decorated with ornaments, while the floor is made of marble.

B) Bedrooms: In most cases, they are in the form of square, with dimensions from 4m × 4m. The bedrooms are located in a house wing away from the main entrance in order to secure privacy and provide peace when the household is asleep. Between them there is the bathroom. The bedroom windows open towards outside. Their dimensions are 1m x 1m in order to provide air and natural light during daytime. The floor in the rooms is tiled and the ceiling is decorated with gypsum to make it look more beautiful, as shown in Figure 8.47.

Figure 8.47: The bedroom of Arabi Belhadj house in Gharyan.

C) Living room: It is characterized by all daily activities of the family, because they spend most of the time there. It is used for the reception of the relatives, neighbors and women, as well as for practicing special customs and traditions of the Libyan society, during which men and women are in separate rooms. Its dimensions are 4m x 6m, and it is considered to replace the courtyard from a traditional house (Figure 8.48).

Figure 8.48: The living room in Arabi Belhadj house in Gharyan.

D) Men salon: It is a rectangular shaped room with dimensions 4m x 6m, separated from other interior rooms of the house. Usually, it is used as male guests' reception area. When designing the house, its position is always near the main entrance. The

ceiling is also decorated with gypsum, which makes it more attractive. We have found that Arabic salons serve as places for sitting.

E) Kitchen: It is a place where the food is prepared. It has become an important element and has witnessed a drastic change from the rear exterior position next to the interior courtyard of the traditional house. Walls and floors have witnessed a significant development; in the late 1990s, the kitchen became an outward-looking area with windows and doors opening to the garden or to the outside terrace. It is fully equipped with all modern appliances, as shown in Figure 8.49.

F) Bathroom: Over the last few years, the bathroom appearance has evolved in accordance with the demands of the residents. All family members use it daily, and therefore, if you take into account all the rooms, it is considered to be the most private place. Finishing materials are non-flammable, easy to work with and can bear the moisture. Usually, water is supplied by the water supply network. The bathroom includes washing and bathing facilities and a lavatory. The floor and walls are covered with tiles or mosaic.

5. Roof: Heavyweight roof is constructed from reinforced concrete system. It is the part that cannot be divided from other elements of the house. Flat roof, thick ceiling of about 15cm and a slope of about 1% per meter on the upper side help in removing the rainwater that falls on it. Red brick slope, about 45°, is used on the roof above room stairs and balconies. It provides the aesthetic architecture of the house, using one of the engineering systems for EXA rooftops. Parapets that are 1m high are situated on each side of the house.

Figure 8.49: Kitchen becomes fully equipped with all modern appliances in Arabi Belhadj house in Gharyan.

6. Openings

A) Windows: Windows are expanded and developed, so their dimensions are about 1.20m × 1m. They open to the outside rather than the inside, screening the viewing area. They are made of high quality PVC materials that can withstand present and future climate changes (indoor or outdoor). They isolate noise, heat and prevent moisture, as shown in Figure 8.50.

Figure 8.50: The window of Arabi Belhadj house in Gharyan.

B) Doors: The dimensions of the interior doors are approximately 1m x 2.20m; they are made of wood. The dimensions of the main door are 1.40m x 2.20m.

7. Conclusion

As a result of the study of this house, we have found a development in the activities of a contemporary family. Therefore, some changes in the lifestyle have occurred, as well as dealing with people, spending time, eating and sleeping patterns, and the division of roles amongst the family members. As a result of all this, family members are organized in accordance with their specific roles in order to cope with the living situation. The main entrance area has a separation between men and women in accordance with the religious obligations and the respect of cultural and social traditions, in order to protect privacy. We can also notice an expansion of the window openings to get as much natural light. The new construction materials are imported from abroad, and used in the house without regarding the climatic conditions of local environment. This is not good for thermal insulation; hence, the internal functional arrangements in the house depend on air-conditioners in order to have thermal comfort, which as a result increases the consumption of electricity.

8.3. Desert region: Ghadames

It is located in the northern part of the African desert, about 650 km south of the Mediterranean Sea coast and the capital city of Libya (Tripoli), as it can be observed in Figure 8.51, on the intersection of 30.08 N and 09.30 E. It is located about 300m over the sea level and it has many sand-hills surrounding it as a crescent from north and west side(Nahla,2007). “Between the Maghreb and the heart of Africa, Ghadames is at the intersection of Libya’s border with Tunisia and Algeria.” The housing area of Ghadames lies on about 820 hectares. This housing zone can be classified into three main categories: firstly, the traditional houses within the old settlement, which cover about 11% of the total residential zone; secondly, scattered houses in the whole settlement that form about 15%; and thirdly, new modern houses having been built recently from concrete, constituting about 74% of the area. The common height of these houses is 2 or 3 floors; they are typically surrounded by agriculture land(Nahla,2007). The city of Ghadames has hot days and very cold nights in general. The climate in the city during winter is warm because of the desert sand; it is affected directly and quickly by the sunrays and its sands are quickly warmed and quickly cooled. In the summer period, the day is unbearably hot; however, nights are moderate, cool and comfortable(Nahla,2007). The mean maximum temperature for Ghadames from May to October is between 35°C and up to 48°C.

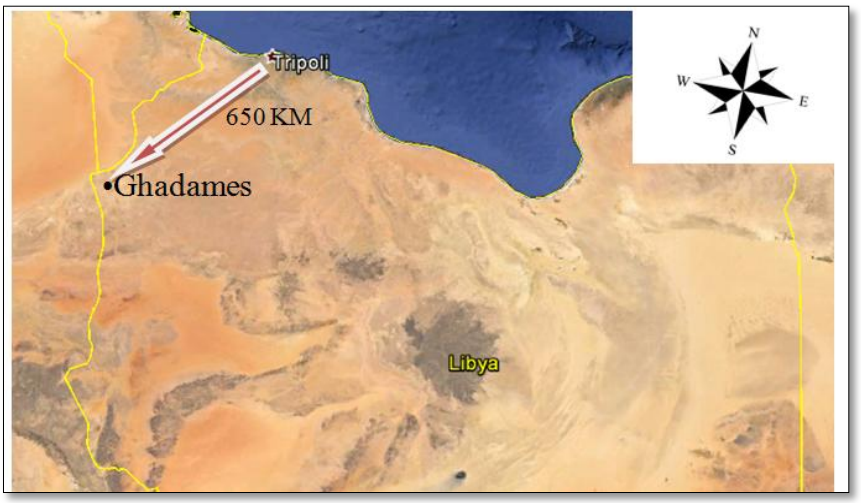


Figure 8.51: Ghadames location.

A) Traditional single family housing in Ghadames

- **House: Family Abdulsalam Ali.**
- **Type: A row house in the old city center.**
- **Location: In the old city of Ghadames, "Amazigh Street[4]", house number 684.**
- **Year of construction: Approximately 3,000 years ago.**
- **The total area of the house: It is about 224 m^2.**

1. Location: The house is located in the old town of Ghadames, in one of the streets in the town, number 684, as shown in Figure 8.52. The house is surrounded on both the lateral side and the back, with walls of a similar house, while on the front side there is a street or a passageway, called the "alleyway". The alley is a covered space that forms narrow passages, which occasionally expand.

Its width varies from 1.5m to 3m, depending on the position of the street. They are characterized by their sharp curves and breakings in some places. These curves are used for ventilation and converting the strong wind into a gentler breeze. There are openings in the ceiling of the street for the purpose of ventilation and for providing light. The distance between each opening is about 15m.

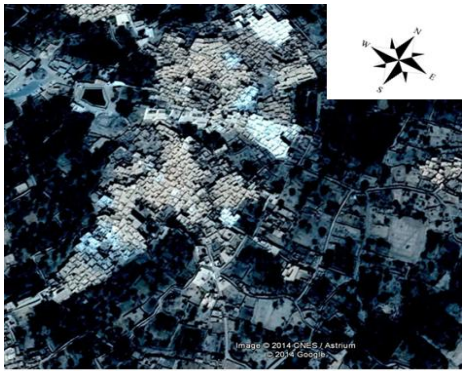


Figure 8.52: The location of Abdulsalam Ali house in Ghadames.

2. Structural system: The structural system leans on load-bearing walls, which are interconnected between the houses. The alleys in Ghadames are actually passageways

[4] Amazigh Street: It is named after the family that inhabited it since the antiquity. The old Ghadames city is divided into seven streets, and every street has the name of the family that lived in it. You can notice the names of the streets written over the entrances and passages leading to the city's neighborhoods.

between houses that are fully covered because of high temperatures. There are openings in the ceiling passageways for air circulation, as shown in Figure 8.53. The structure makes these houses firmly connected to each other in order to increase the support and provide the isolation from the external environment. The outer and inner walls are thick at the bottom and the thickness is reduced with the height increase. Their thickness ranges from 40cm to 70cm. The floor height reaches up to 2.50m in the rooms, while the height in the storage units reaches 1.60m. A septic tank is right under the bathroom and it is called “the black well”. These wells are not considered to be adequate nowadays for health and environment reasons.

A number of colors are used on the walls of the corridors in this house, which is very important for the social life in the city of Ghadames.

Figure 8.53: Openings in the ceiling alleys for air circulation.

3. Construction materials: Granite stone is used for the foundations, as presented in Figure 8.54. Also, bricks made of clay and dried in the sun are used for building; their dimensions are 10cm x 30cm x 40cm (Figure 8.55). Stumps from the palm tree are used for the ceilings, while tiny stones, clay and limestone are laid over them. They are also used for posts and lintels of the windows and doors, because there is neither reinforced iron nor reinforced concrete. Apart from using other materials as ornaments, there are also images of plants or drawings of geometrical shapes, symbols from religious books or other decorative elements. Copper pots and gypsum works can also be observed. Mirrors are extensively used, and they have a number of functions. They do not only have an aesthetic function, but are also used for reflecting

the light from the ceiling openings and transferring it to the interior rooms of the house for better lighting.

Figure 8.54: Granite stone is used for the foundations.

Figure 8.55: Bricks made of clay and dried in the sun, with dimensions 10cm x 30cm x 40cm.

4. The internal functional arrangements in the traditional single family house in Ghadames

The analyzed house has three floors and the roof, where the kitchen is located. There are three rooms; while some rooms are large, the others are small. The living room is large, because the family spends their time in it and performs their daily activities. It is considered to be the same as a courtyard of the traditional houses in Tripoli and Gharyan. Also, there is a men salon, a kitchen, storage units, a bathroom and stairs that are used for moving between floors, as demonstrated in Figures 8.56, 8.57, 8.58 and 8.59.

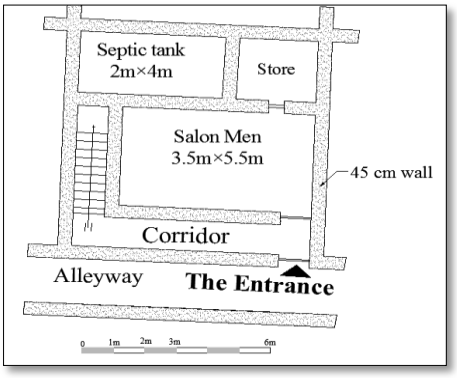


Figure 8.56: Ground floor plan of Abdulsalam Ali house in Ghadames.

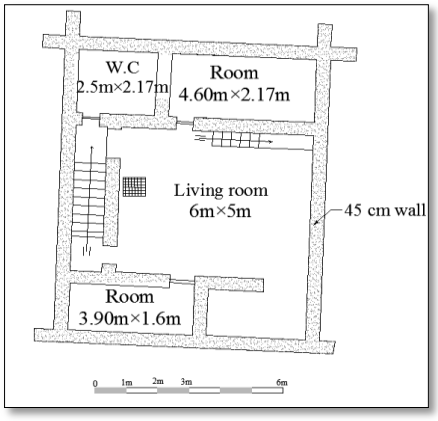


Figure 8.57: First floor plan of Abdulsalam Ali house in Ghadames.

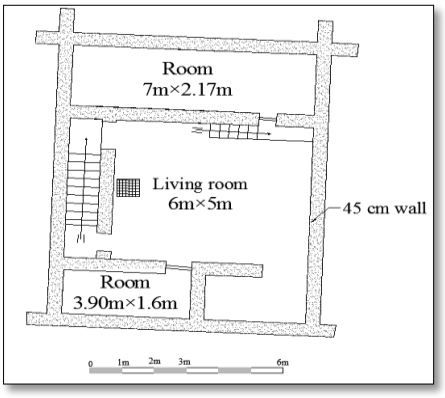


Figure 8.58: Second floor plan of Abdulsalam Ali house in Ghadames.

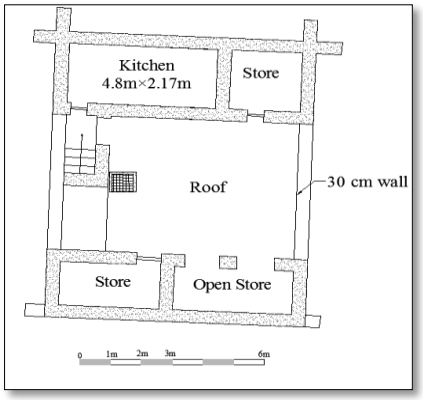


Figure 8.59: Roof plan with the kitchen and stores in Abdulsalam Ali house in Ghadames.

A) Entrance: It is the main place in the house, used for reaching the interior rooms of the house. On one side there is a salon for men, which can be reached by a corridor. The entrance is located on the ground floor, and its dimensions are 0.95m x 1.80m, as shown in Figure 8.60.

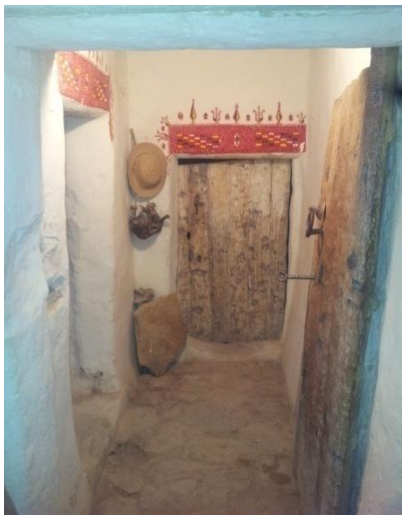


Figure 8.60: The entrance in Abdulsalam Ali house in Ghadames.

B) Corridor: In the house, the corridor does not connect interior rooms directly. However, its end has stairs that lead to the upper floor. Some decorations can be found on its walls.

C) Bedrooms: Their dimensions differ and range from 1.60m x 3.90m to 2.17m x 7m. Their dimensions cannot be measured accurately because there is not a precise regulation concerning this matter. The largest room is the central hall, dimensions 5m x 6m (Figure 8.61), and it is considered to be a form of a courtyard of the traditional house in Tripoli.

Figure 8.61: The largest room is the central hall in Abdulsalam Ali house in Ghadames.

D) Men salon: It is found here, as well as in the traditional house in Tripoli and the underground house in Gharyan. It is located next to the entrance and separated from the interior rooms. It is considered to have medium sized dimensions of approximately 3.50m x 5.50m.

E) Kitchen: It is a special place for preparing meals, and it has a different location than in a traditional house in Tripoli. It is placed on the roof to increase mutual shading, as well as to dispose heat and smoke outside the house. It also helps women move easier in the house. There are passageways on the roof of the house designed especially for women.

F) Bathroom: It is located on the first floor of the house, next to the living room. Directly under the bathroom there is a septic tank. There are not any other sanitary facilities, aside the hole for organic waste disposal.

5. Roof: It is an important part in the single family traditional house in Ghadames. It plays an important role in the life of the family, since it is the only outer space in the house. It is used as a place for cooking and performing women's daily activities. It can be used as a space for children to play, as well as for sitting at day and sleeping at night during summer (Figure 8.62). High exterior walls provide privacy and protection from hot winds and dust. The ceiling consists of stumps from the palms, and small stones and stones, as shown in Figure 8.63.

Figure 8.62: Roof for sitting at day and sleeping at night during summer.

Figure 8.63: The ceiling consists of stumps from the palms, and small stones and stones.

6. Openings

A) Windows: Some windows are small-scaled, rectangular shaped and with dimensions 30cm x 15cm. There is an opening in the ceiling of the living room used for providing natural light, with the help of mirrors placed on the walls of the living room, all the way to the men salon (Figure 8.64). It can also be used for the

circulation of fresh air, which should substitute the air from the interior that is not adequate for a daily use. It is also used for heat elimination during night, from the interior premises, accumulated during the day until the sunset. This is how interior premises and walls are cooled down in order to be pleasant during the following day (Figure 8.65).

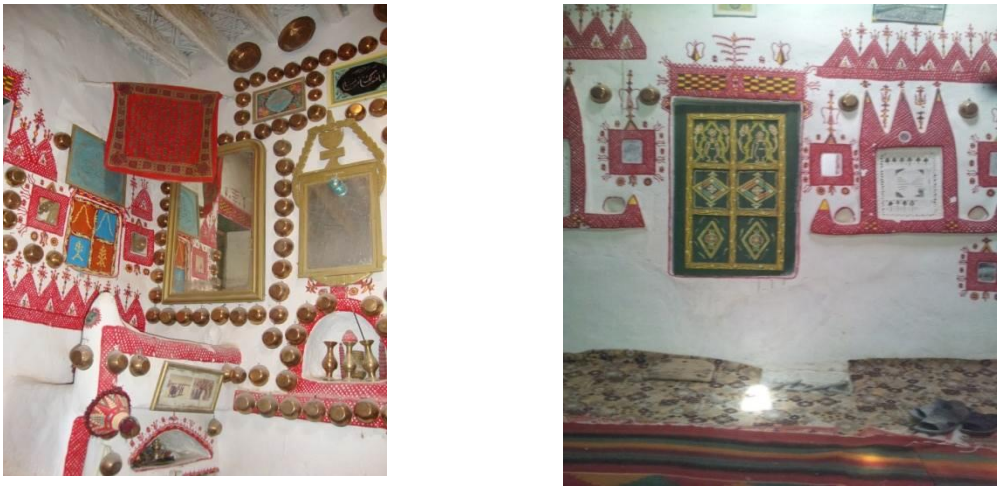


Figure 8.64: The mirrors reflecting natural light into the rooms in Abdulsalam Ali house in Ghadames.

Figure 8.65: Opening at the roof.

B) Doors: Usually, they are made of the palm tree (the trunk) which is compressed into a form of successive panels, making boards and tied by ropes. Their dimensions are 0.85m x 1.80m.

7. Conclusion: It can be observed that the house greatly depends on local materials, creating a unique urbanity, and an attractive and symmetrical structure. The construction leans on thick load-bearing walls with minimum external openings. This

system would enhance the resistance of the walls for heating, and also modify the indoor climate in the closed places in order to increase thermal comfort. The roof protects the inside of the house from the sun, but the hole in it allows the cold night air to fill in the inside of the house. This ordinary process of natural convection not only allows the replacement of the hot air with the cold air, but also cools down the heavy mass of the building. The above mentioned hole in the roof is normally closed during winter(Abdulkader,2007). Interior corridors between the houses are relatively cold during the days in summer and warm at night. The dimensions of the empty spaces are not precisely symmetrical. Likewise, the health facilities are unusable.

B) Contemporary single family house in Ghadames

- **House: Family Hussein Mohamed.**
- **Type: Two-family home on two levels.**
- **Location: Qadisiyah neighborhood, Salam Street in Ghadames.**
- **Year of construction: It was built in 2007.**
- **The total area of the house: It is about 223 m^2.**

1. Location: The house is located in Ghadames, within the district Al Qadisiya, where the local authorities made a plan to divide the land into plots of approximately 400m^2. The house is surrounded on both lateral sides with walls, while on the front side there is an access road equipped with all required facilities. There is also a football field at the back of the house, as demonstrated in Figure 8.66.

Figure 8.66: Location of Hussein Mohamed house in Ghadames.

2. Structural system: The house is made of reinforced concrete where loads are distributed on concrete columns and beams in order to reduce the thickness of the

walls to about 20-25 cm; the ceiling height is about 3.20 m. The foundations of the house are represented through separate bases with the dimensions 1m x 1m, 60cm high. This method is used in building most single family houses in the desert region. It is based on a theory of transferring the load by beams on the fulcrum points of the house that are actually columns. The load of each column is transferred to the bottom base and can be connected by thresholds.

3. Construction materials: The house was built with concrete bricks, with a mass of treadmill inside, and dimensions 20cm × 20cm × 40cm. Bricks are prefabricated, using cement and gravel for walls. Polystyrene is used for thermal insulation of the surface. The building is equipped with air conditioning for cooling in summer or heating in winter. Iron is used in reinforcing the concrete for the ceiling, columns and thresholds. Tiles, marble and ceramics are used for paving the floor and walls. Gypsum is used for decorating the house, and wood is used for decorating the outside windows and arched roofs.

4. The internal functional arrangements in the contemporary single family house in Ghadames

It consists of two floors which are functionally separated. Each floor is used by one family. It has all modern facilities and it was equipped with all facilities by the government. The first floor was chosen for the study, with the total area of about 223m^2 (Figures 8.67, 8.68 and 8.69). It consists of three bedrooms, a living room, men salon, a kitchen, two bathrooms, outdoor terraces and a staircase. This house possesses some features similar to the contemporary houses in Tripoli and Gharyan. For example, the structure itself, some building materials and air-conditioning systems for mechanical heating and cooling the air are present in all three houses.

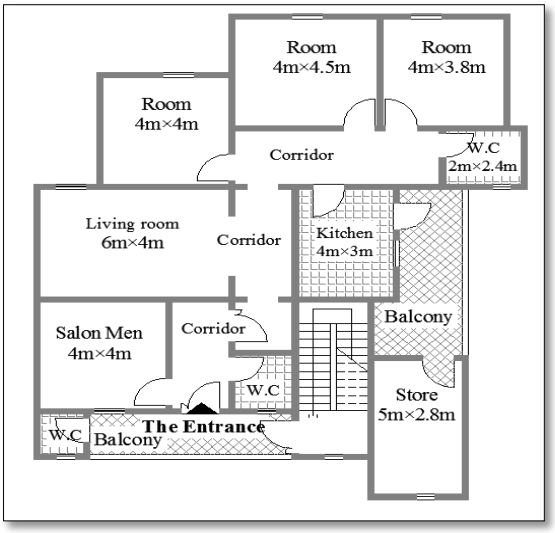


Figure 8.67: Ground floor plan of Hussein Mohamed house in Ghadames.

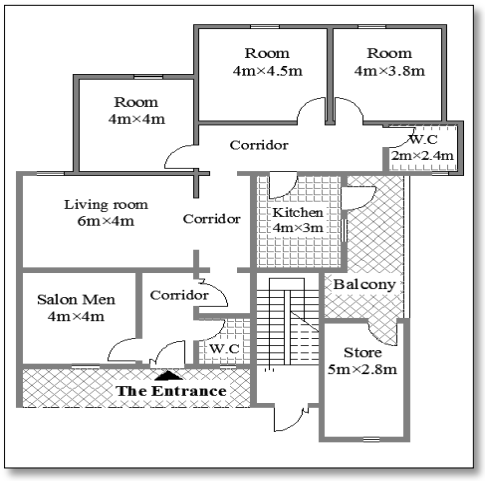


Figure 8.68: First floor plan of Hussein Mohamed house in Ghadames.

Figure 8.69: The front of Hussein Mohamed house in Ghadames.

A) Entrance: The entry of this house faces onto a blank wall to prevent any views to the interior. It does not give immediate access to the living spaces of the family.

Choosing décor for the entrance in oriental Arabic style is considered a specific type of hospitality for your guests, thus determining the appearance of the house. The entrance of this house makes the first impression compared to other parts of the house. This is very important and for that reason the Arabs are well known for their generosity and hospitality. The entrance doors are made of wood, while the floor is made of marble, as shown in Figure 8.70. On one of its sides, there is a men salon for the purpose of privacy, with a bathroom situated opposite the salon and intended for guests.

Figure 8.70: The entrance in Hussein Mohamed house in Ghadames.

B) Corridor: Its width is approximately 1.40m x 1.70m, and it is located right next to the entrance. At its end there is a door that separates the corridor itself from the interior rooms, and at the same time provides the privacy to house residents.

C) Bedrooms: Bedrooms are medium sized, from 3.80m x 4m to 4.50m x 4m, equipped with air-conditioning. The bedrooms are located in the house wing away from the main entrance, in order to secure the privacy and provide peace when the household is asleep. The bedroom windows are looking outside, dimensions 1m x 1m, in order to provide air and natural light during daytime. The floor in the rooms is tiled, and the ceiling is decorated with gypsum to make it look more beautiful, as shown in Figure 8.71.

Figure 8.71: Bedroom equipped with air-conditioning in Hussein Mohamed house in Ghadames.

D) Living room: This room is usually used for all daily activities of the family, such as eating, sitting, watching TV, receiving the visiting relatives, neighbors and women who visit female family members. It is considered to be a traditional courtyard residence in Libya. There is a traditional decoration that shows strong connections of residents to customs, social traditions and cultural heritage of the city Ghadames (Figure 8.72).

Figure 8.72: The living room in Hussein Mohamed house in Ghadames.

E) Men salon: It is a shaped as a square room with dimensions 4m x 4m, separated from other interior rooms of the house. Usually, it is used to receive male guests. When designing the house, its position is always near the main entrance. The ceiling is also decorated with gypsum, which makes it more attractive. We find that Arabic salons serve as places for sitting.

F) Kitchen: The kitchen in this house serves as a living space and a guest reception space. It is both a public and a private space, depending on the social occasion. It is a

place where the food is prepared and it has become an important element in the house. It is also used for storing small appliances and foods, and for eating family meals.

Walls and floors of the kitchen have witnessed a significant development in the past years, and the kitchen has become an outward-looking area with windows and doors opening towards the outside terrace. It has also become fully equipped with all modern appliances.

G) Bathroom: Over the last few years, its appearance has evolved in accordance with the requirements of the residents. All family members use it daily, and therefore, if you take into account all the rooms, it is considered to be the most private place. Finishing materials are waterproof, easy to work with and can bear moisture. Water is usually supplied by the water supply network. The bathroom includes washing and bathing facilities, and a lavatory. The floor and walls are covered with tiles or mosaic.

5. Roof: Heavyweight roof is constructed as the reinforced concrete system. It is the part that cannot be divided from other elements of the house. Flat roof, thick ceiling of about 15cm, and a slope of about 1% per meter on the upper side help remove the rainwater that falls on it. Parapets that are 1m high are on each side of the house.

6. Openings

A) Windows: Windows are expanded and developed; its dimensions are about 1.20m × 1m. They are opened to the outside rather than the inside to screen the viewing area. They are made of high quality PVC materials that can withstand present and future climate changes (indoor or outdoor). They isolate noise and heat, and prevent moisture.

B) Doors: The dimensions of the interior doors are approximately 1m x 2.20m. They are made of wood. As for the main door, their dimensions are approximately 1.40m x 2.20m.

7. Conclusion

During the study of this house, it has been noticed that there is a design, a development of contemporary houses, including the size required by a family. Also, the technology in the interior and exterior design is introduced, though the cultural history of the city of Ghadames is preserved by placing some of the decorations on

the interior walls. The main entrance area is used for the separation between men and women in accordance with the religious obligations and the respect of cultural and social traditions, protecting the residents' privacy. The construction materials used in building this house are considered to be prefabricated. The weather during the year is mostly very hot, and therefore air-conditioning is required indoors, which results in the large consumption of electricity in order to provide thermal comfort of the house.

8.4. A possible example for a future single family house in Libya

- **House: Mohamed Zatar.**
- **Type: A detached house.**
- **Year of construction: It was built in 2008.**
- **The total area of the house: It is about 260 m^2.**

1. Location: This house is located in an area in the outskirts or the "suburbs" of the capital city of Tripoli, called the Al Sabaa area, as shown in Figure 8.73. Before turning it into the urban area, this was a farming environment. This necessarily means that there are climatic and social considerations in the design of these houses by the nature of the surrounding urban environment. There are urban areas that are located in city centers, and houses there are different from the houses located at the edges of the suburbs.

Figure 8.73: The location of Mohamed Zatar house in Tripoli.

2. Structural system: This house is made of reinforced concrete used for the beams and columns. These have also been used in the construction of limestone walls 35 cm

thick. This system contributes in transferring the loads and resisting the external heat falling on the house during the day. The foundations of the house are represented through separate bases with dimensions 1m x 1m and the height 60cm. The ceiling height is approximately 4 m (Figure 8.74).

Figure 8.74: Exterior façade of Mohamed Zatar house in Tripoli.

3. Roof: There is no doubt that the traditional method in the construction of modern houses – roof-based, mainly on the concrete and rebar – has proven in the past to be the style of building expensive. Recent increase in the clear cost occurred after rising rebar prices in Libya; in the past few years, prices more than doubled, together with the rise in cement and reinforced concrete prices imported from abroad. This has made people rethink the possibility of the benefits from the old style in house roofs. Hence, this method has been developed and updated to conform to modern and advanced construction methods, with the use of red-resistant bricks for loads up to 200 kg / cm^2, and with the use of nerve concrete precast stress. The spaces between concrete nerves are filled with this brick without the use of any wooden frameworks for supporting the roof during processing and during casting. Additionally, the use of this system provides us with the following:

1. It minimizes the use of reinforced concrete up to about 30%;

2. The percentage of the provision in the reinforced casting iron is up to 50%.

Red bricks in the ceiling are utilized due to their ease of use, strength and durability, as well as their presence in the vicinity of human dwellings, which makes the cost of manufacturing and usage acceptably low compared with other construction materials imported from abroad. This material also demonstrates advantage in fire resistance, heat and sound insulation, and low economic costs in maintenance work.

4. Construction materials: Traditional and contemporary materials in this house have been integrated effectively, which we observe through the construction of walls and the use of limestone as a natural stone obtained locally. The use of white color in the interior walls is taken from home furnishing of sessions and mattresses and it extends to carpet elements containing various shapes and color decorations. Therefore, their presence does not constitute the interference to the eye, since the color of the walls gets along with them and reduces the severity of just giving it a chance to emerge as a decorative element. Simple and small-sized plaster ornaments are used for decorating the ceilings (Figure 8.75), while in some hallways and the kitchen wooden beams are used, which is generally accepted in the traditional houses, as shown in Figure 8.76. The introduction of indoor plants as a "plants shade" presents an enrichment of the details of the internal house, taken from a pot of pottery as an element in the Gharyan area (Figure 8.77), a mountainous distinct. The cities owe their inspiration to the pottery town, manufacturing these potteries in geometric and floral forms with the varying degrees of brown, white and red light. We can notice the use of natural stone material known in Libya as "Altravrtino – an Italian word meaning distorted" in the high ends of the surface coating, 7 cm thick. The façade ends at each side with the emergence of windows and floor cavities in the walls, which are used to put the artifacts and books. Yellow natural stone is used in the construction of fences, as shown in Figure 8.78; also, a reddish black stone is used in dressing some interior walls. Wood trellis in the garden present an aesthetic element throwing a shadow on the aesthetics of the home, as well as plants that fill the garden of flowers and present the other aesthetic element.

All floors of the house are in slabs of porcelain material embroidered in various forms and hues of dark brown color and light. All exterior and interior walls are painted white, while the doors and windows, as well as metal crafts, have been repainted in green in line with the local color and culture, considering the environmental conditions.

Figure 8.75: Plaster ornament decorating the ceilings of Mohamed Zatar house in Tripoli.

Figure 8.76: Wooden beams on the ceilings of Mohamed Zatar house in Tripoli.

Figure 8.77: Plants in the pots of pottery.

Figure 8.78: Yellow natural stone used in the construction of fences.

5. Internal functional arrangement of the house

This home consists of a men salon, two external courtyards, four bedrooms, a living room, a kitchen with a small store, three bathrooms, indoor corridors with balconies and an open rawaq, as shown in Figures 8.79 and 8.80.

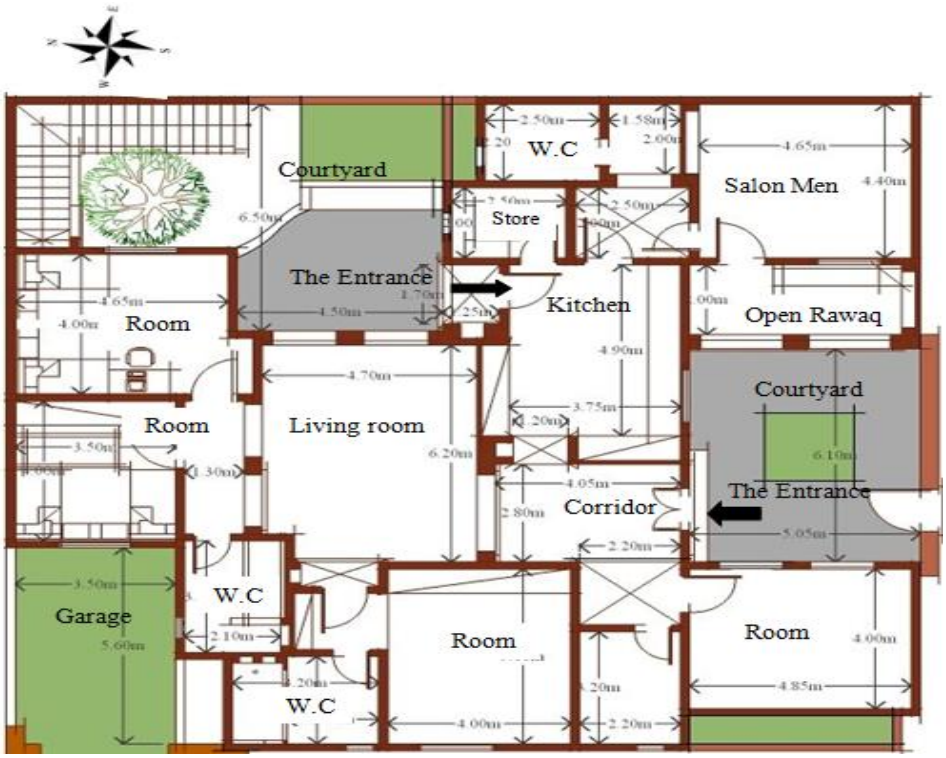


Figure 8.79: The plan of Mohamed Zatar house in Tripoli.

Figure 8.80: Façade of the house.

A) Entrance: This house consists of two entrances; one is the main entrance, while the other is a service entrance connecting a special kitchen and the outside patio. These approaches are characterized by simplicity and beauty through natural marble

finishes and white paint. The main entrance opens onto an internal vacuum distributor called the movement, and then separates from the interior spaces to achieve privacy. Above all the entrances to the house there is a lantern with a long arm and a little bit on the arm ornament of traditional metal crafts, as shown in Figure 8.81.

Figure 8.81: Entrances of Mohamed Zatar house in Tripoli.

B) Men salon: The space for receiving guests is separated from the rest of the house spaces and isolated in a separate hand to provide full privacy for the owners, as well as guests, taking into account the proximity of the kitchen. Now, it is intended as a space for sleeping of guests and as an aesthetic area with furnishing elements, as shown in Figure 8. 82.

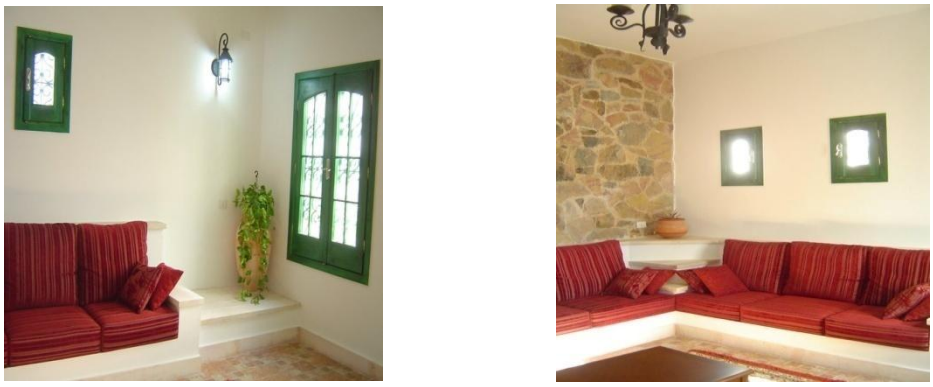


Figure 8.82: Furnishing elements in the men salon.

C) **Bedrooms:** The bedrooms are located in a private suite, where privacy and comfort are available at bedtime. Bathrooms relate to bedrooms. There is a bedroom for parents and a bedroom for children, and there is also a bedroom for the relatives of the family, near the main entrance and with a service bathroom. The main bedroom

suite is fully isolated from the rest of the house spaces. The design forecasted a link through the re-formulation of the distribution of sleeping; girls can leave the room in order to reach master bedroom at the end of the corridor.

D) Living room: It is a place where the family spends most of their time. It is used to receive visitors for women and their relatives, with dimensions 4.70m×6.20m. This room is adopted in a simple décor, using local natural materials, some wood briquettes under the roof decoration, and white color to paint the walls. There are two windows overlooking the courtyard in order to provide natural lighting during day and ventilation during night.

E) Courtyard: The use of the courtyard in the design of this house is intended to benefit from it. This is one of the traditional Libyan home elements. There are two courtyards in this house, including most of the internal spaces of the house opening towards them. It provides an aesthetic view of the house in the form of boxes or rectangles with different trends of the house, allowing the owners of this house to enjoy external meetings during different periods of the day. It can provide shade and air to sit and practice daily activities, and thus it is coordinated with gardens in different ways in these backyards. These can include tiled spaces with a small green space where species of fruit trees are grown, providing a green space and gardens of flowers. It is also a place for local trees and plants, such as "palm tree, fig tree, grape tree, lemon tree, fragrance leaf, mint, Arab roses, jasmine, and paper plant apple", which are written in the coordinates of the garden in this courtyard. (Figure 8.83)

Figure 8.83: The courtyard of Mohamed Zatar house in Tripoli.

F) Kitchen: Adequate spaces are provided for the kitchen and are in accordance with the requirements of a contemporary Libyan family. Natural yellow stone is used from coating the walls of the entrance to coating the kitchen, while the black reddish stone

is used for dressing some of the interior walls. Wood is utilized in the composition of the kitchen cabinets and ceramic cladding of the interior walls, as it can be observed in Figure 8.84.

Figure 8.84: The kitchen of Mohamed Zatar house in Tripoli.

G) Bathroom: There are three bathrooms in this home. A simple, attractive and compact finishing is used in the combination of traditional and contemporary materials. Quality mixes were used for bathrooms quality, and it is important to ensure the validity period beyond 15 to 20 years without the need for renewal.

6. Openings

A) Windows: As we noted, most of these elements open outward towards the backyard, in order to achieve privacy of the house occupants. Wrought iron as a local metal decoration is used for protecting the windows that have been manufactured, as well as for shaping the windows that have been rounded from traditional forms with some modifications in accordance with modern times. Wood is tied with green, as well as coating, to add to the aesthetics (Figure 8.85).

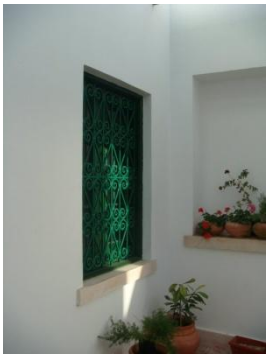


Figure 8.85: The window of Mohamed Zatar house in Tripoli.

B) Doors: They are made of wood and painted green with some traditional decorations in wood in order to be as conventional and beautiful in front of visitors.

7. Conclusion: As a result of this study, we find that the Libyan contemporary style home reflects all requirements of the third millennium of humanity and life, without losing the architectural identity and social premise. Here lies the formula of compromise between what we require and what we should be. This house and all its contents, including landscaping and the choice of plants, fruit trees and flowers with aromatic scents, known as the gardens of Libyans, are very important in the design of integrated features of the identity of the Libyan Architecture. Taking into account the principle of simplicity and the lack of wealth, we can observe that simplicity does not necessarily mean poverty and deprivation of aesthetics in architecture; rather, it means that everything is set in the right place. Usually paired with beauty, in addition to the simplicity and explicitly expressed architectural value, there are characteristics of the local architecture in Libya. Open spaces designed outside of the daily traffic circle of the house, in addition to men's reception area which is also located outside the house, present an integral part of the Libyan Muslim community composition. This is especially the case with the men salon, located near the entrance of the outer chamber to achieve audio and visual privacy and isolate men from the women's movement. The men reception room is linked to the kitchen through a small passageway, for changing the climatic conditions and for the ease of movement. It has been observed in most decorated contemporary houses that the owners do not understand the role of the elements of furniture and lighting to enrich the contents of their homes; they hastily buy a lot of decorative items and inflate the size to fill the vacuum of the house. After the completion of home, furnishing is observed over the confusion quotient with the overlap of these elements with each other. However, this house presents the use of simple decorations and small-sized plaster decoration for the bishop, while in some hallways and the kitchen wooden beams, generally accepted in traditional houses, are used, thus introducing it as a new feature, useful in the design to avoid the cost. On observing the architectural design of this home, we can address certain considerations, such as the following:

1. Climate consideration

This consideration observes the reformulation of the relationship of the block allocated to the construction of the land area. This block extends over the entire area, including the street, relying on the idea of the direction of the building to the inside, being opened to the interior courtyards. It disregards the idea of the responses

imposed by the approved building codes as a condition of the construction situation (which is incompatible with the conditions prevailing in our climate zone). The idea of adjacent blocks follows the traditional climatic treatment, while the resident becomes more in need than ever before, after dispensing the construction material dirt and mud in addition to the stone. This is achieved by natural air-conditioning of interior spaces, which have been replaced by textured cement, which is unhealthy and which necessitates the use of industrial air –conditioning, displaying one of the greatest health risks.

2. Social consideration

Climate and social considerations are settled in line in a lot of processor architectures for a home, and therefore in the entire urban planning. Contiguity mass housing with the limiting piece of land is allocated to all parties, as well as environmental protection from weather, providing visual and auditory privacy for residents.

3. Islamic identity and local culture considerations

The recurrence of such vocabulary of traditional architectural elements, and the reuse in contemporary housing reflects the lack of ideas among architects in the development of new elements and vocabulary in accordance with the spirit of the age. A point that should be noted in this conclusion is that the reduction of the cost of the building will be visible; in the long term, it will be observed in simple solutions for the dwelling furnishing, adopted by the architect, and in the cost reduction for air conditioning for the building by selecting proper materials for thermal insulation. High cost may be a little bit in the living aspects; therefore, the owner of the house should tend to consider maintenance and renewal issues either annually or every five to ten years at the latest.

8.5. Conclusion related to case studies of the three regions in Libya

- **Results of the analyses**

This study is based on a fact that the dominating form of the old architecture in Libya was greatly related to the local environment of each region with its climate, Islamic culture of the community, and the provision of local building materials. All these factors helped in the creation of a traditional single Libyan house in all regions, as analyzed in this study. Contemporary Libyan houses have been standardized in terms

of the building structure and materials imported from abroad, without taking into consideration the climate or the thermal comfort in each region. In this thesis, modern and traditional houses in Libya have been divided in three different regions: coastal, mountainous and desert region. All are studied and analyzed regarding foundation, location, building structure, building materials, wall thickness, indoor spaces, openings, building designs, privacy and connection between spaces.

1. The traditional single family housing: During the study of the traditional single family house, the researcher came across some important and valuable conclusions.

A) Coastal region (Tripoli): Social and climatic factors helped in forming specific type of the house. For example, it considers indoor and outdoor privacy, as well as similarity in the indoor space arrangement, such as the place of the men salon, the main entrance, the part for women, and the kitchen. Also, there are openings with regards to the audio and visual privacy towards the street and neighbors. The structural system is simple and it relies on the load-bearing walls that are very thick (between 60 and 90cm), in order to resist high temperatures. Moreover, the design of the house is in the rows formation so that the interior spaces are protected from the hot sun rays. Traditional houses are thought to be more adequate for the climate than the contemporary houses because of the used material characteristics, as well as the courtyard which has a role in the temperature regulation, soothing the atmosphere, providing privacy and helping move between spaces, whether horizontally or vertically. The courtyard is characteristic for the traditional housing in three regions which are the targets of this study. We can observe that the courtyard has been present for a long period of time, and that it does not oppose the social and Islamic behavior.

B) Mountain region (Gharyan): Traditional houses vary due to the lack of building materials and building structure, with the exception of the main entrance. The man decided to take a shelter in an underground dwelling. The underground dwelling is characterized by the central courtyard which is the basic element of the house. It soothes the atmosphere and facilitates movement between each indoor space. This type of house is characterized by suitability to environmental conditions, warm in winter and cold in summer. In other words, the temperature is similar to the temperature of the ground. This kind of house provides a great deal of privacy for the large family. Similarly, each family within the house has its private room and shares the other amenities with other members of the large family. However, the

underground house in Gharian isolated the family from their neighbors because of the long distance between each dwelling. Although the underground houses are very secure, they are not safe for children, old people and animals, especially at night.

There is a lack of health utilities for the residents because of the nature of technology provided during building. A strategy for building under the ground presumes the use of natural materials that are not used enough, especially nowadays. It is similar to the strategy for achieving sustainable development.

C) Desert region (Ghadames): Traditional Libyan house in this region leans on the vertical design and consists of a few floors. It also relies on local building materials that have a function to make the house more suitable to the climate in this region. High temperature leads to the consideration of the "closed design", where the dominating design is the compressed design, in order to create a shelter against the extreme climate through deep, twisted and narrow streets. This means that the construction is shadowed by the walls and the ceiling in order to be cool and comfortable, even during the hottest part of the day. The privacy has a significant role during building, through the distribution of spaces. Therefore, the passageways for women can be found on the roof together with the kitchen. Additionally, there are not many openings that face the outside, with the exception of an opening on the ceiling which has a function of providing the natural light and ventilation.

2. The contemporary single family housing: After studying the contemporary single family houses in Libya, it has been found that they have a similar design and the structural system based on concrete, which is dominant in all regions. The walls are standardized and are considered to have a relatively small thickness compared to the traditional houses (the thickness is about 20cm-25cm). The dominating weather conditions in these regions are not taken into consideration. Building materials are imported from abroad and therefore increase the building costs, apart from not being appropriate for climate of the region. The study has also found some strategy defects on a contemporary house (efficient use of energy is one of them). Contemporary houses rely on the industrial energy for the increase of thermal comfort, which as a result has the increased costs. Social interaction is deteriorated with the emergence of architecture of the "western style" due to several factors: the low level of privacy and non-correspondence in the domain of urban environment, leading to social and economic class differences in the community. The best feature is the design

development of the Libyan house which leads to providing comfort for the residents. This can be clearly seen through house planning, room sizes, openings, number of rooms, infrastructure, public facilities, the size of the kitchen and the furniture in it, as well as the finishing materials, when compared to the traditional Libyan house.

In the contemporary single family house in all Libya regions, there is an opened design towards the street, surrounded by open spaces that include gardens. In this stage of change, the urbanized life is expressed in the orientation of the houses being outward looking. The courtyard disappears and is replaced by a covered hall or a central corridor, while windows open outwards. Verandas, balconies and terraces around the house are also outward looking.

New building materials have played a fundamental role in forming the houses, regarding their shape, size, and decoration. Reinforced concrete glass and aluminum play a significant role in the appearance of the façade, whose design and decorative elements, such as cantilever balconies and verandas, are borrowed from foreign architecture.

In addition, this period is distinguished by the variety of expressions in the building façades. One of the most striking features is the increased size of glass windows.

9. CONCLUSIONS AND RECOMMENDATIONS

9.1. Conclusions

This study shows that the traditional and contemporary architecture in North Africa and the Arab world are built according to the influences of culture, climate and terrain of the building areas, especially in Libya. These traditional buildings have been developed throughout history in response to the challenges of climate, building materials and cultural expectations in a particular place. In the study, it is found that the most important characteristics of the outstanding traditional Arab house have come mainly from the collection of items that have been selected by the traditions of people, culture and environment. The significant influence on Libya was imposed by the oil discovery in 1960, as it brought lots of economic changes and rapid development in all sectors, especially in the field of housing. As a result, the government has built new houses in many areas with a new network of extensive road system, importing the construction materials from abroad without any regard to climate, social and rugged geographical environment in this country. In contrast, traditional housing in Libya is more functional, because it has the fittings to take advantage of the resources available in the country to satisfy the population requirements. Therefore, it is important to understand the traditional housing in Libya, which itself may be affected by many factors. It is clear that Islamic culture has influenced the Libyan life situation and translated it into physical aspects, which are reflected in several Libyan cities such as Tripoli and Ghadames, where the design is characterized by harmony and human scale. In addition, social and climatic factors influence the hierarchies and patterns of urban planning and housing designs. Results also indicate that social interaction has deteriorated throughout history with the advent of Western-style architecture due to several factors, such as inferior privacy level, lack of congruence at the urban structure scale leading to socio-economic stratification in communities, and detached housing having repercussions upon local lifestyle. In light of such understanding, traditional houses in Libya fulfill the socio-cultural demands of the local community, paying special attention to indoor and outdoor privacy (Jamal Alabid & Ahmad Taki,2014).Traditional single family house focuses on the functional terms more than aesthetic ones, where we find that the interfaces of traditional single family houses in Libya are solid and have no kind of

decorations, except for some of the houses where they have a mashrabiya, or a wooden balcony located on the exterior front of the house. The courtyard is the feature which is prevalent in traditional Libyan architecture in both rural and urban areas, which presents an effective way to build a home, as well as create an acceptable inside environment. It acts as a modification in hot, dry area, and allows residents to be outside with the protection from sun, dust and wind. The courtyard is a link between the spaces horizontally and vertically. The presence of plants and water fountains inside the courtyard helps hydrate the internal atmosphere.

The courtyard of a traditional house is a prime nodal point linking outside to inside and enclosing all the spaces of the house together. The courtyard serves as a transitional space (from public to private) and a functional space, and it also represents the religious center of the dwelling. It is used for cooking, getting together, for social activities, celebration of festivals, for resting, bringing light to otherwise dark areas of the house like kitchen, and for catching breeze. Generally, male guests do not access beyond this space. Privacy is one of the main concerns in the traditional Arab house design; the researcher has found that the arrangements of functions have a large role in the house design, where the male area needs to be separated from other spaces, there has to be separation between the inside and the outside, as well as from the street and neighbors. The structure also contains information on how to improve the energy performance of buildings using local materials.

Moreover, as it can be seen in traditional houses in Tripoli and Ghadames, there are other influential factors, such as private housing and the economic availability of construction materials. In addition, we note that the external openings of these houses are small and high, and that the exterior walls are constructed of the material which has a high resistance to heat. In contrast, the most contemporary houses are not suitable for the climate in Libya, because new materials, such as reinforced concrete, used in construction structures of the houses, do not take into account climatic and economic conditions, and there is an overstatement in the size of the external openings.

The appearance of the contemporary Libyan home fulfils the requirements of the modern family, where the bedrooms become used for one function, the direction of the window openings is to the outside rather than the inside, and the windows become larger than previously. Some spaces have evolved in the contemporary house, such as

kitchens and bathrooms, while the courtyard from a traditional home is replaced by a living room. The majority of population is satisfied with contemporary housing in terms of building standards, cleanliness, level of finishing, installation and furniture.

The results have revealed that the traditional single family houses have many advantages, as follows:

1. They are more suited to the climate and environment than the contemporary house.

2. There is more privacy, especially from the streets, neighbors and visitors, compared with the contemporary houses.

3. It provides greater safety for children in terms of playing in the courtyard.

Likewise, contemporary single family houses have many advantages, as follows:

1. They provide different spaces for a variety of functions, such as Arab and Western salons.

2. Quality of finishing is excellent.

3. Level of the interior space is generally good. Kitchen becomes biggish and an area outward-looking with windows and doors opening to the garden or to the outside terrace, it also becomes fully equipped with all modern appliances. Walls and floors have witnessed a significant development; they are often in dimensions 3m × 4m or 4m×4m. There is a development of the bathroom and its finishes (floor and walls are covered with tiles or mosaic). Bedrooms are located in the private suite in the house and the house contains at least three bedrooms: one room for parents with a bathroom, one room for boys and one for girls. The shape is nearly square to meet the needs of modern furniture.

4. It offers more privacy in terms of separation between brothers and sisters, each of them having their own bedrooms.

5. It is more stable from the point of structure.

The research may be extended by developing a system of comparisons and analyses, as well as questions for the residents in order to allow them to articulate their demands, dreams and preferences. This approach makes it possible to put together conclusions and guidelines for controlling the process of creating architecture which

would be in agreement with the cultural heritage, which would satisfy the future demands of contemporary Libyan society, and the Arab World in general, and which would be in accordance with the principles of ecology and sustainable development in order to create a spatial harmony and to protect the environment for future generations(Abdulkader,2007). Making use of a detailed description on the types of traditional and modern housing and then comparing their features in a Propolis methodological way can be helpful in understanding the nature of differences in the microclimate. This method is used by architects to demonstrate relations, differences and features which will constitute the basis for formulating conclusions for future solutions of the design of single family houses. The detailed description of the features of housing is presented in the static way, but it becomes dynamic when various types of housing are juxtaposed in the context of conditions (economic, geographical and cultural materials) (Abdulkader,2007). It also includes preferences of the residents, which may change with time and other social relations, thus affecting the architecture and forming future solutions. Using comparison as a research method to fully present the differences between old and new housing has many advantages. It makes possible to analyze designs from the perspective of the form, space, structure and materials used(Abdulkader,2007). It is possible to analyze the impact of topography, climate and general environmental conditions. It allows us to understand which solutions in architecture and urban planning could be preferred, appropriate or accepted by the residents, and also what impact they have on creating a suitable microclimate. The method may be used in many aspects, such as the following:

1. It facilitates the recognition of the importance of the key solutions in the investigated buildings.

2. It may serve as a model for designers of new developments, since the knowledge of the studied relations should affect architects, designers and planners, so that they design houses which would be more adjusted to the local condition and the social demands(Abdulkader,2007).

3. It can be used to verify and assess the suitability of various traditional and contemporary design proposals and their agreement with environmental conditions.

4. It may be used as a teaching tool to present the research, to understand various aspects of architecture of houses and their relations with urban complexes, to

understand the preconditions for microclimate-related comfort and its relations with architecture(Abdulkader,2007).

As we conclude in this study, in Ghadames, for example, in relation to the external treatments (colors) of traditional single family buildings in this region, the external walls have a general appearance of light colors by the brownish and pale yellow colors of sun-dried clay bricks. Top capping of the walls and stepped finishes at the corners are whitewashed, providing a characteristic feature to the external appearance of the house (Aalund, 1983). These pale and light colors are of effective impression; additionally, they improve the thermal performance of the building envelope to extreme climate conditions. Light colors are best reflecting surfaces, for their reflectivity is about 80-90% (Fethi, 1988),so they reflect most of the solar radiation that strikes the surface, which minimizes thermal loads on the outside surfaces and improves the inside microclimate within houses. The results show that the traditional single family house is more suited to the climate than the contemporary single family house. The reasons lie in the type of building materials used, and the presence and function of the courtyard, which provides good heat organization.

9.2. Recommendations

This thesis is not considered as an invitation to return back to the traditional house in single family Libya style, nor towards abandoning the contemporary individual housing schemes. Recommendations should benefit from the traditional types which have proved to be successful, trying to make it compatible in improving and developing the contemporary single family houses. This would explain the choice of materials by locals, but it would also assist to contrast these materials with the "contemporary" ones (man-made materials such as concrete, concrete brick and glass). Future works might include the following:

1. The development of local materials, and the use of new technology, through the analysis and evaluation of materials previously used, as well as an exploration of the possibility to propose new substitute construction technologies and materials having physical and chemical characteristics suitable to geographical and climatic features of Libya.

2. Possible development of designs embodying the best features of traditional and contemporary forms. We suggest the development of traditional materials for

contemporary application in construction, through the usage of building materials with the best insulation. Thick walls could also function as a high thermal mass structure, where possible. Locally produced construction materials can be used in a Libyan house, such as lime sand block and red brick for a minimum of 35 cm thick external walls, and possible the use of concrete bricks for interior walls.

3. The external façade of Libyan house should be plain, simple, beautiful and harmonious with regard to shape, size, texture, and use of colors that reflect sun rays. It should also reflect local environment and traditions. In addition, it ought to avoid excessive finishing.

4. The architect, when selecting a house design, should be aware of the local culture and climate conditions of all Libya regions to avoid problems in design, such as poor external privacy and unsuitability for climate conditions. The internal arrangements need to be kept simple, but well integrated. Likewise, any decor needs to reflect residents' taste rather than being imposed by the architect.

5. Orientation and size of windows should be designed to achieve privacy, using external elements such as masharabiya, or using one of the various new techniques that achieve privacy and climatic control. Courtyard houses could also be of high efficiency for privacy and climatic control. Overall privacy could be achieved by using thick walls.

6. The preservation of the traditional buildings and their renovation by the same local materials, improving their workability and performance, is a good method for serving and enriching the country culture.

7. To achieve privacy within a house, the arrangement of the house should include three internal functional spaces: men salon, a living room for the entire family, and rooms for sleeping. This ensures respect for the concept of separation between males and females according to Islamic instructions, and it also ensures visual and audio privacy between the men in the salon and other household members.

REFERENCES

1. Azzuz, I. Contemporary libyan architecture: Possibilities vs. realities. Libya,2000.

2. Aalund, F. Ghadames: the Pearl of the Desert, Architectural Conservation Planning, Libya,1983.

3. Abbas, H. Industrial Development and Migration Labour in Libya, Unpublished PhD thesis, The University of Manchester, UK,1987.

4. Abdel-moniem El-Shorbagy:Traditional Islamic-Arab House: Vocabulary And Syntax.Architecture Department, College of Engineering.Effat University, Saudi Arabia,2010.

5. Abdulkader, A.Comparison study of traditional and contemporary housing design with reference to Tripoli,libya.Research Institute for Built and Human Environment (BuHu) School of the Built Environment University of Salford, Salford, UK,2007.

6. Ahmida, A. The Making of Modern Libya: State Formation Colonization and

7. Al Khateeb, Sharif, Arab Architecture for Those Who Can Really Live in Style. Saudi Gazette, 19 September 1979.

8. Al Quran, (33:52, 49;10, 4;38). 1991. translated by Abdullah Yusuf Ali in the meaning of the Holy Quran, Brentwood, MO, Amana Corporation.

9. Aljaser, Lamia [Old Aleppo schools (history and architecture)]. Alradwan's House. Aleppo, Syria, 2000.

10. Aljaser,Lamia [Old Aleppo schools (history and architecture)]. Alradwan's House. Aleppo, 2000.

11. Altman, I. The Environment, and Social Behaviour Privacy, Personal Space. Territory, Crowding, Wadsworth Publishing Company, California, USA, 1975.

12. Al-Zubaidi, Maha. Vernacular Architecture Technologies… Basic Principles towards Futuristic Sustainable Architecture, 2nd Conference of BAU, Faculty of Architectural Engineering, Beirut, Lebanon. 2001.

13. Amini, Mousallam Sakka, "Islamic and Japanese Traditional Houses and Their Social Meaning: A Comparative Interpretation", Islamic Quarterly, vol. 37, 4,1993, pp. 266-79.

14. Ammora, A. Libya: city development and Urban Planning, 1st Edition, Dar Al-Multaqa for printing and publishing, Beirut, Lebanon,1998.

15 . Ashraf Salama. Culture Implies Diversity, Architectural Knowledge and Cultural Diversity,libya,1999.

16. Bash-Imam, H., "Materials and Techniques of Traditional Construction in Old City of Tripoli", UNDP, libya,1999. (In Arabic).

17. Bayazit, N., Yonder, A. And Ozsoy, A. "Three Levels of Privacy Behaviour in the Appropriation of dwelling space in Turkish Homes", In 3rd International Architectural Psychology Conference, University Louis Pasteur, Strasbourg, France, 1976.

18. Birks, S. And Sinclair, A. Arab Manpower: the Crisis of Development, Croom Helm London,1980.12

29. Bulukma, A.H and Al-Quzairi : A Study in Geography, 1st Edition, Aldar Aljamahiria for publishing & Advertising, Libya,1995.

20. Chadirji, Rifat, Concepts and Influences: Towards a Regionalized International Architecture. London, 1986.

21. Chawish, A.B. Analytic Study for the Traditional House of Ghadames, Al-Omran, Tripoli, Libya.2000.

22. Culture and Information Committee in Ghadames Municipality, “The Introduction to Investment Guide in Ghadames Micipality”, libya, 2005. (In Arabic).

23. Daze, M. Understanding the Built Environment: Crisis Change and Issue FN Needs In the Concept of Habitations and Settlement in Libya, Unpublished PhD Thesis, University of Pennsylvania, U. S. A, 1982.

24. Ealiwa, A. Designing for thermal comfort in naturally ventilated and air conditioned buildings in summer season of Ghadames, Libya. PhD Thesis, Leicester School of Architecture, De Montfort University, Leicester, UK.2000.

25. Ealiwa, M.A., A.H. Taki. "An investigation into thermal comfort in the summer season of Ghadames, Libya, 2001.

26. Edwards, Sibley, Hakimi and Land. Courtyard housing: Past, present and future,. London: Taylor & Francis,2006.

27. El-Hawat, A., Cultural and Social Aspects of Tourism in Libya, University of Alfateh, Tripoli, 1994.

28. Elwefati,N.A.Bio-climate architecture in Libya: Case studies from three climatic regions. MSc Dissertation, Middle East Technical University, Ankara, Turkey.2007.

29. Ember, R. Anthropology. Englewood, Cliffs, N. J: Prentice-Hall,1981.

30. Evans, Martin.Housing, Climate and Comfort, 1st Edition, The Architectural Press, London, Great Britain,1980 .

31. Faksh,Nadim;Hilal,Fuad [Aleppo Guide]. Tourism's Ministry. Aleppo, 2000.

32. Fallingwater. The Columbia Encyclopedia. Columbia University Press.

33. Farah, E, House Form and Social Norms: Spatial analysis of domestic architecture in Wad-Nubbawi, Sudan. Chalmers University of Technology . Sweden.2000.

34. Farnsworth House. A National Historic Landmark summary listing. National Park Service. Retrieved 2007.

35. Farnsworth House. National Historic Landmark summary listing. National Park Service. Archived from the original on 2007-10-20. Retrieved 2007-10-03.

36. Fathy, H., "Natural Energy and the Traditional Architecture", The Arabic Association of publishing, Beirut. 1998. (In Arabic).

37. Fathy, Hassan, Natural Energy and Vernacular Architecture: Principles and Examples with Reference to Hot Arid Climates. Chicago, 1986.

38. Ferti, M. Salim, and Mandour, M. Alaa, "Proportions and Human Scale in Damascene Courtyard Houses," in ArchNet-IJAR: International Journal of Architectural Research, vol. 2, issue 1, Syria 2008.

39. Fethi, Hassan. Natural Energy and Vernacular Architecture, 2nd edition, United Nations University, Tokyo, Japan, 1988.

40. Gedik, G.Z. Climatic design: an analysis of the old houses of Diyarbakır in the southeast region of Turkey. Architectural Science Review,Turkey,2004.

41. Gideon, C. Earth-sheltered dwellings in Tunisia, Library of Congress Cataloging-in-publication Data, 1984.

42. Hallaj, Omar Aziz Yens [Development Plan of the City of Aleppo]. The Rehabilitation of the Old City of Aleppo / GTZ. Aleppo, Syria 2001.

43. Hayyan Jawad Thongs of the city, Dar-Qabas for printing, publishing and distribution, the first edition, Beirut, Lebanon, 2004.

44. Jamal Alabid & Ahmad Taki . Bioclimatic housing design to desert architecture: A case study of Ghadames, Libya, HVAC&R Research, 20:7, 760-769, DOI: 10.1080/10789669.2014.953872,UK,2014.

45. Jorge Monrás: Report Of The African Commission's Working Group on Indigenous Populations/Communities,2009.

46. Lang, J. Creating Architecture Theory the Role and the Behavioural Sciences in Environmental Design, Van Nostard Reinhold Company, New York,1987.

47. Libya Arab Nutrition Profile, Food and Nutrition Division, FAO, 2005.

48. Mahmoud, S. Identity Crisis due to Transformation of Home Environment. The case of two Muslim cities Dhaka and Hofuf,2007.

49. Ministry of Municipalities, National Physical Perspective plans Tripoli, Libya, 1979.

50. Ministry of Planning and Development. Housed in Libya, Vol. 2, Athens, Greece: Doxiadis Associates, 1964.

51. Ministry of Planning, Population Census, Government printers, Tripoli Libya, 1995.

52. Nahla adel elwefati. Bio-climatic architecture in libya: case studies from three climatic regions, 2007.

53. National Institute of Statistics-Tunisia". National Institute of Statistics-Tunisia. September 2014.

54. Noor, M. The function and form of courtyard. The Arab house, University of Newcastle upon Tyne, School of Architecture, Center for Architectural research and Department Overseas,1991.

55. Omar Mohamed Elbendir, M.A,Urban Transformation and Social Change in a Libyan City: An Anthropological Study of Tripoli,2008.

56. Omran,Hazzar;Dabourah,George [The Old Buildings (reparation and conservation)]. The Alasad Library. Damascus, 1997.

57. Peter J. Lu and Paul J. Steinhardt, Decagonal and Quasi-crystalline Tilings in Medieval Islamic Architecture. Science. Vol. 315, pp. 1106-1110, 2007.

58. Rabbat, Nassar, The Courtyard House: From Cultural Reference to Universal Relevance. Ashgate, in association with the Aga Khan Program for Islamic Architecture (forthcoming in August 2010).

59. Rapoport, A. Human Aspects of Urban From. Towards a man-environment approach to Urban form and design, Pergamon Press, Oxford, 1977.

60. Regional Health Systems Observatory World Health Organization: Health Systems Profile- Libya,2007.

61. Resistance, 1830-1932. State University of New York Press, Albany,1994.

62. Rghei, A. Rural and Urban Domestic Architecture in Libya MSc Thesis, University of McGill, Montreal, Canada, 1987.

63. Richard Ettinghausen, Oleg Grabar, Marilyn Jenkins-Madina, Islamic Art and Architecture1250 –650.Yale Univ. Press, New Haven, CT, 2001.

64. Richard Levine, Michael Hughes, Sustainability Over Time: the New Imperative for Future Urban Development, in Architecture Urbanism & Time, Vision for the Future, proceedings of ARUP 2008, second international conference, Ain Shams University, Cairo, 2008.

65. Saber, M. Environment in Jeopardy: Consequences of climate change in Egypt.2004.

66. Salem. M. Sharif, M.F.M. Zain, M. Surat.Concurrence of Thermal Comfort of Courtyard Housing and Privacy in the Traditional Arab House in Middle East.Australian Journal of Basic and Applied Sciences, 4(8): 4029-4037,2010, ISSN 1991-8178.

67. Saxena, K. Re-engineering Public Administration in Developing Countries: Long Ronge planning, vol. 29 No. 5.(1996).

68. Shawesh, A. Housing and Socio-Cultural Values in Libya: an Investigation of Traditional and Contemporary Housing, unpublished PhD Thesis, University of Newcastle Upon Tyne, Newcastle upon Tyne, UK,1996.

69. Shawesh, E. The Changing Identity of the Built Environment in Tripoli, Libya, PhD Thesis, University of Newcastle upon Tyne UK, 2000.

70. Southall, A., The City in Time and Space, Cambridge University Press, Cambridge, 1998.

71. Steele, James. The Hassan Fathy Collection. A Catalogue of Visual Documents at the Aga Khan Award for Architecture. Bern, Switzerland, 1989.

72. Steil, Lucien, Tradition & Architecture. Architectural Design, v. 57, no. 5 / 6, 1987.

73. Tadao Ando, 1995 Laureate: Biography (PDF). The Hyatt Foundation. 1995. Archived from the original (PDF) on 23 August 2009. Retrieved 5 November 2009.

74. Tafel, Edgar (1979). Apprentice to genius: Years with Frank Lloyd Wright. New York: McGraw-Hill. ISBN 978-0070628151.

75. The Aga Khan Trust for Culture. The Hassan Fathy Collection. A Catalogue of Visual Documents at the Aga Khan Award for Architecture. Bern, Switzerland,1989.

76. Tunisia | Country report | Freedom in the World | 2015. freedomhouse.org.

77. Wazeeri, Y., “Applications on Environmental Architecture – The solar Design of The Courtyard, case studies from Cairo and Toushka”, 1st Ed., Madbouli Library publishing, Egypt, 2002. (In Arabic).

78. Zakaria, Y. Entrepreneurs at Home: Secluded Muslim Women and Hidden Economic Activities in Northern Nigeria. Nordic Journal of African Studies,2001.

79. Zakaria, Y., 2001. Entrepreneurs at Home: Secluded Muslim Women and Hidden Economic Activities in Northern Nigeria. Nordic Journal of African Studies., 10(1): 107-123.

80. Zimmerman, Claire. Mies Van Der Rohe. Taschen America, LLC, 2006.

81. House from Wikipedia

82. "Fallingwater". The Columbia Encyclopedia. Columbia University Press.

83. http://archnet.org/.February2015.

84. http://data.worldbank.org/indicator)(March,2015).

85. http://en.wikipedia.org/wiki/Fallingwater.January2015.

86. http://en.wikipedia.org/wiki/Farnsworth_House.February2015.

87. http://www.archdaily.com/67321/gehry-residence-frank-gehry/.February2015.

88. http://www.muslimheritage.com/article/courtyard-houses-syria)(march,2015).

89. http://www.yamay.com.ar/images/Hassan_Fathy.pdf) (February 2015).

90 . https://en.wikipedia.org/wiki/House. February2015.

91. www.archnet.org

92. www.pm.gov.tn/pm/content/index.php?lang=en(March,2015).

93.http://storiesofhouses.blogspot.com/2006/02/frank-gehrys-house-in-california.html)(March,2015).

94. http://web.worldbank.org)(March,2015).

95. http://www.oldamascus.com/palaces_text.htm(March,2015)

96. http://ammar-shawesh.weebly.com/old-damascus.html(March,2015).

LIST OF FIGURES