

Preserving the traditional building system as a sustainable approach in the Saharan environment of Algeria

Mourad MAROC¹ and Djamel ALKAMA²

¹ Institute of Architecture and Urbanism, Saad Dahleb University. Blida01. Algeria

betarcon@yahoo.fr

² Department of Architecture, University of Guelma. Algeria

Abstract

This study intends to shed light on a forgotten Saharan architectural feature in Algeria for more than 60 years. It focuses on showcasing conventional conservation methods made from regional resources in Algeria's Saharan areas. The building, which is a piece of the vernacular history, is a reminder of the difficult times the nation has endured. In the end, it is the product of the "know-how" cultivated by desert dwellers in this field marked by the emergence of the first ksour (a collection of various residential typologies) in more than 1,000 years (in the case of the ksar el Atteuf, Ghardaia), which is regarded as a witness to the history of human habitation in these areas. This article makes the case that this "know-how," especially in traditional building in some places, is not the consequence of rash and impulsive acts. We will demonstrate that the existence of these ksour in a relatively difficult environment due to these climatic conditions has never excluded man's ability to develop this "know-how" which reflects a perfect mastery in the choice of materials through well-documented case studies and comparison with other examples in the nation. The article will also demonstrate how the geographical setting and desert dwellers have influenced the development of new materials in a way that is related to geometric, architectural, and spatial logic, ensuring both functional comfort based on dimensional control and establishing a technical method by adapting to the use of these materials in a sustainable approach.

Keywords: Saharan architecture, traditional conservation techniques, vernacular heritage, ksour, spatial architectural logic, sustainable approach.

1. Introduction

The African desert, which stretches from the Atlantic to the Red Sea, is a uniform entity because of its geology, ethnography, millennia-old inhabitants, history, and socio-political risks. It would have retained its harmony and geographical rules if European settlers had not split it into many governmental zones. Multiple times, the administrative borders during the occupied period have been added or removed. The colonizers who imposed them have vanished, but the physical features and people who made up the original Sahara still exist. Despite the ups and downs of the colonial age, its physical characteristics and human physiognomy preserve its millennia-old peculiarities. The Algerian Sahara, as it exists now, is the Sahara of importance in this context. This research makes an effort to shed light on this

region in order to examine its topography (Fig. 2) and the population that develops there, providing an explanation for the migrations of the human masses and identifying their style of life. These organic factors determine the course of human history. Nomadism and the caravan system were not a choice for Bedouins; rather, they were a result of their physical surroundings [1,4,5,6].

Saharan architecture is frequently used as an example of the hardship of living in a dry region where there is little prospect of constructing a life [9]. On the other hand, this building has been of immense historical importance for thousands of years, reflecting the history of a lengthy fight undertaken by man to maintain his continuity and existence on this region. However, how did man persuade himself to dwell in this country with all of its climatic, topographical, and environmental challenges? Has he been able to adapt, build a life, and put an end to his wanderings around the vast desert? What are the direct and indirect factors that have had a major impact on the defensive installation? Let us carefully consider the idea of adopting a new strategy to sustainability. What role do local materials play in the revolution sparked by Ksour's creation? [9,11].

To address all of these issues, it was important to expand one's understanding of the typology by identifying the materials utilized in its creation as well as its many modalities. To that purpose, we focused our research on the Gourara area of southern Algeria, which is noted for its architectural style.

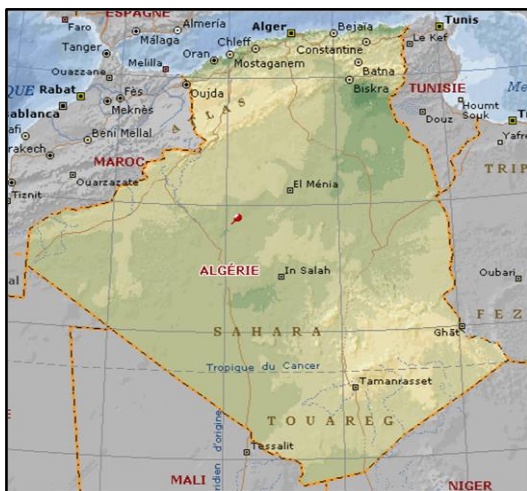


Figure 1: Map of the great Algerian desert
Source: National Mapping Institute



Figure 2 : carte géographique de l'Algérie
Source: World Atlas Mapping

1.1 Sustainability

Man has always attempted to adapt to the environment around him by attempting to become one with it, and this has shown itself in his way of life, particularly in domestic and vernacular architecture [2,13]. However, since the industrial revolution, man has abandoned this approach and proceeded to relentlessly tap into natural resources, which is currently affecting the health of our world.

The concept of sustainable development emerged in 1990, when various states became globally aware of the planet's alarming ecological situation, and is based on three essential pillars: environment, economy, and society [3,4,7], and is based on the development of these three

domains in interrelationship and continuity, while placing man and nature at the center of this development. It is a long-term evolutionary process aiming at producing an economic development policy that takes into account ecological [7,10,11] and social aspects.

1.2 Sustainable Development Objectives

Sustainable Development aims in the first place to address present population requirements for economic and social progress while not disregarding future generations.

- *The desire for more sensible resource management and the use of renewable resources.
- *Equitable development product distribution.
- *Cultural and international heritage preservation.

2. Case study

2.1 Gourara region

Gourara is an area famed for its oasis, which is flanked by the large Western erg, Touat, and Saoura, as well as the vast flat and stony Tadmait plateau that divides it from Tidikelt and is notable for its foggaras irrigation system. Gourara is part of the triangle created by Tabalkoza in the north, Tagouzi in the west, and Oufrane in the south, according to J. Bisson. It encompasses all oasis within an 80-kilometer radius (Fig. 3).

2.2 Timmimoun the Red Oasis

Timmimoun is a municipality located in the Adrar Department. It stretches for 250 kilometers and is around 100 kilometers broad in southwest Algeria, to the north of the department of Adrar. It is constructed on the outskirts of one of the Sahara's most magnificent palm orchards. Gourara's capital is famous for its location and the red hue of its buildings, which, at sunset, transform this modest oasis into a colorful fantasy. Timimoun is a patchwork of diverse and complementing landscapes [10], split into mineral and vegetable zones. It is surrounded by natural elements, making a "red oasis." This mosaic is made up of dunes, sebkha, erg, and palm groves (Fig. 4).

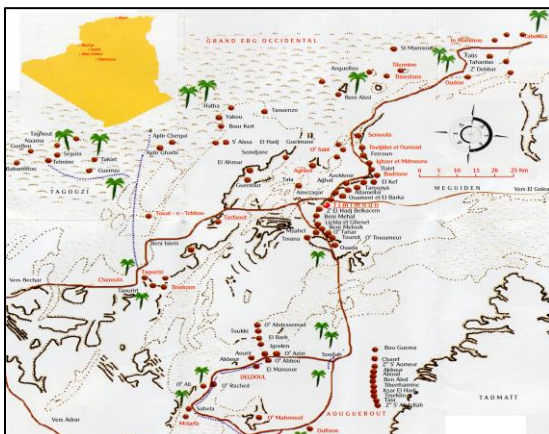


Figure 3: schematic map shows the Gourara Timmimoun situation (Source: PDAU. presentation report)

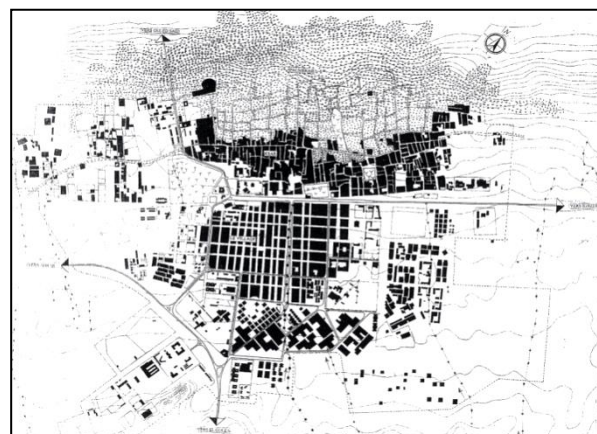


Figure 4: current schema of (Source: PDAU. presentation report)

2. 2.1 Ksar (definition)

"Gsar" is how the word is pronounced. It is a phonic variation of the Arabic root "qasr," which means "short and limited." This implies a constrained place, a walled settlement that only specific social groups have access to. (Fig. 5). It is a constrained and reserved location that only a few individuals can use. The ksar is an attic, or rather a group of densely packed attics. The ksar's role is agricultural. Originally, it was a communal attic used for silage for cereals, olives, and animal products, as well as a secure location for valuables. The ksar provides protection since it is a tremendous assistance in repelling raiders and finally taking refuge there if required [9,10,11].

2. 2.2 Morphology of Ksar

The buildings have the same style and are a collection of homes scattered across a ground floor or, in rare cases, a level surrounding an inner courtyard (fig.6). The ksar is defined as a compact, earth-colored, horizontal form that is intimately associated to green space, palm groves, and terroir[10,11]. The structure is based on a theory that distinguishes different levels of environmental appropriation.



Figure 5: View of the Ksar door
Said

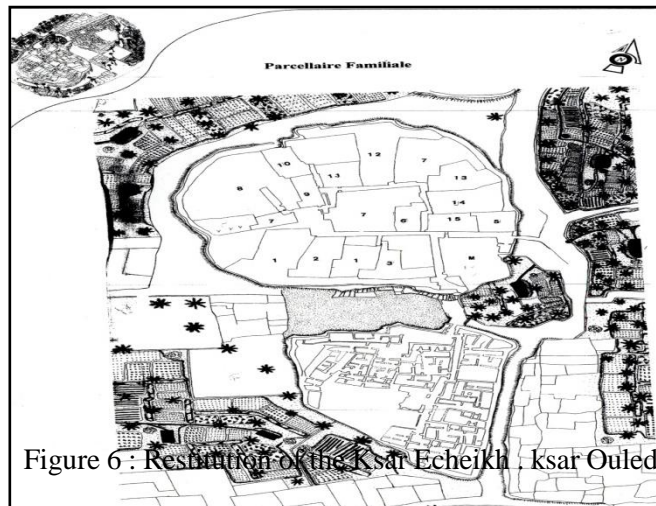


Figure 6 : Restoration of the Ksar Echeikh - Ksar Ouled

(Source: PDAU. presentation report)

2.2.3 The architectural value of the Ksour

The Ksour provide information on ancestral architectural know-how, but this does not imply that there is no architect; the masonic artisans and inhabitants who created and maintained these architectural works demonstrate an accumulated knowledge that provides information on the mastery of several techniques in the realization of this type of work, beginning with the installation of the ksour, which adheres to two critical parameters:

- *-The maintenance of floodplains and gardens in order to replenish them with new mineral and clay inputs following floods.
- *-The protection of buildings by building them on mounds overlooking the gardens and preventing flooding after each valley (l wadi) flood.

The examination of construction techniques focuses on the mastery of native resources such as stones, clays, sand, and wood from palm trees. It does, however, give knowledge about bioclimatic architecture skills. They are regarded as lessons in adapting to the conditions of settlement in the presence of water; man's genius is highlighted for a better coexistence with his environment.

2.3 Climate effects and their role in architectural comfort at the Ksar level

The following parameters characterize the climate in the Saharan regions:

The mechanical effects of the winds are exacerbated by a lack of rainfall. A severe drought in the atmosphere caused a massive saturation deficit and a significant evaporation capacity. The yearly average temperature difference between the minimum and maximum temperatures, which are $17^{\circ}.2$ for one and $29^{\circ}.5$ for the other, is $12^{\circ}.3$ C (fig7). With only 0 mm of rain, August is the driest month. February has the highest precipitation rate, with an average of 3 mm (Fig. 7).

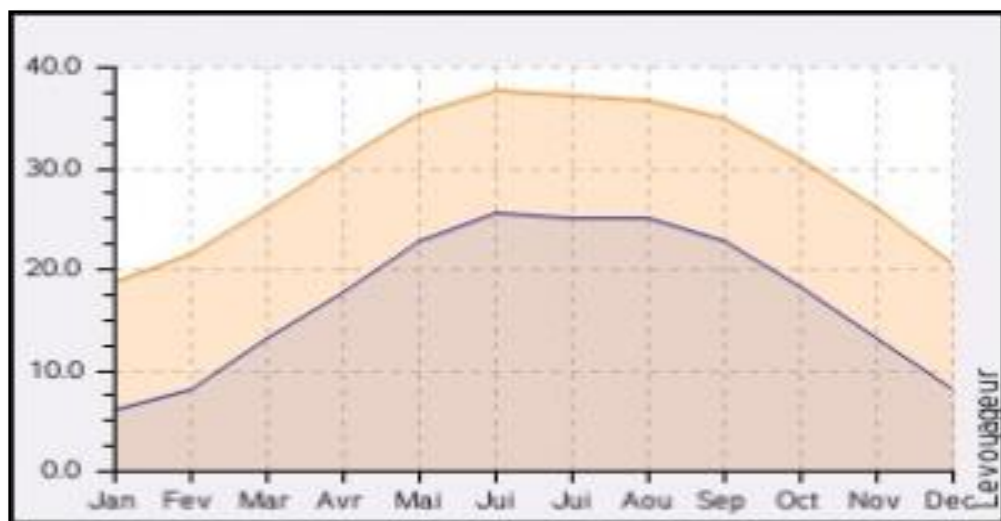


Figure7: Climate diagram

2.4 The Oasis

According to the data acquired during our investigation in many Saharan locations, the oasis served a dual purpose in terms of economic and defensive protection. The location of the oasis near the hamlet is determined by a number of elements, including the slope, the direction of the sun, the source, and the direction of the Fougara that irrigates the area. The oasis is employed to defend the institution in all circumstances seen. This dense green space goes beyond the agglomeration and forms a belt around it. The lush foliage of the oasis slows the movement of any opponent approaching from his side. Nowadays, the presence of the oasis is critical to the survival of traditional villages. The owners continue to visit their old derelict homes while tending to their crops in the oasis (Fig. 8). Some of them stayed in these structures during the harvest season. This usage, even if just seasonal, is sufficient to keep traditional dwellings alive [3,4,11].



Figure 8: The oasis of Timmimoun from the sky

3. Traditional materials and construction techniques

The Ksourian relied on his surroundings for building materials [6,8]. The oldest structures were made of stone; clay was employed as a construction material until later. In general, the home is built with thick load-bearing walls. The ceilings are composed of palm racks (jrîd) while the beams are made of palm trunks (khashba). The beams are the tree trunks, which explains the nearly uniform width of all the chambers (approximately 2.50 meters) [6,8,12].

3.1 Foundations

In general, foundations are characterized by the construction of carefully selected stone walls to ensure the building's stability to a depth indicated by the nature of the soil. It should be mentioned that this foundation concept might vary from one place to the next (Figs. 9 and 10).

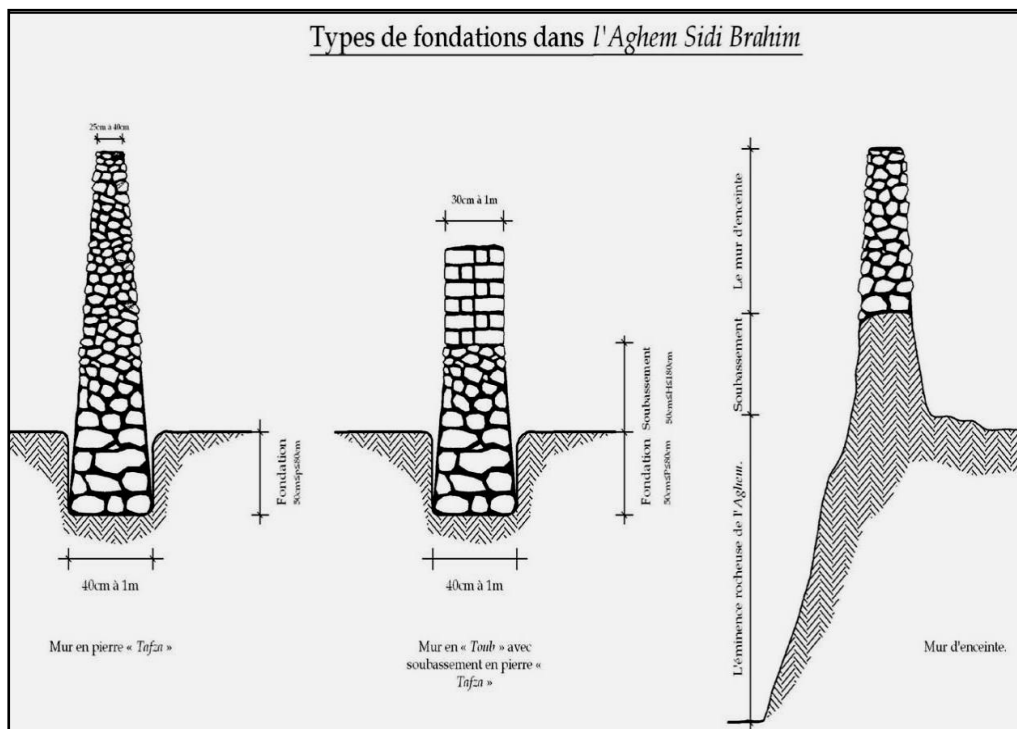


Figure 9: Model of dry stone flooding

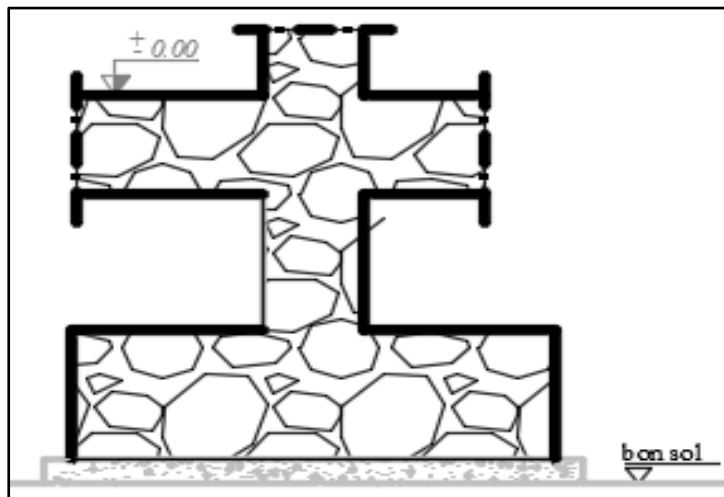


Figure 10 : Cutting a stone slender footing

3.2 Load-bearing walls

The walls used in traditional structures are rather thick, fluctuating between 25cm and 35cm in certain walls to demonstrate how vast the typology is (typically regarding Dar kbira, the huge home).

3.3 Roof and Covers

The roofs are often made of palm trunks, the dried leaves providing the cover (fig.11 & fig.12).

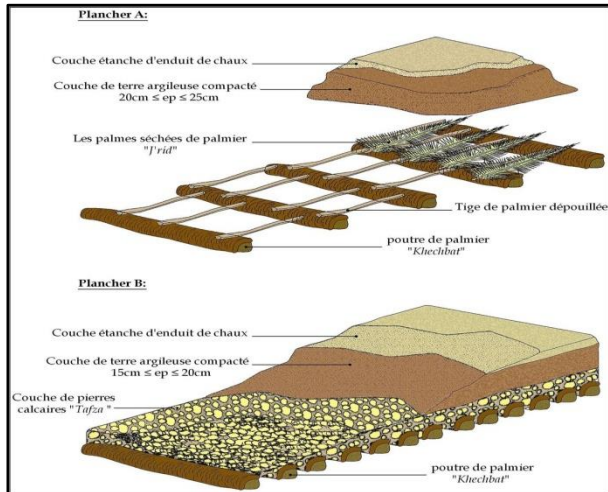
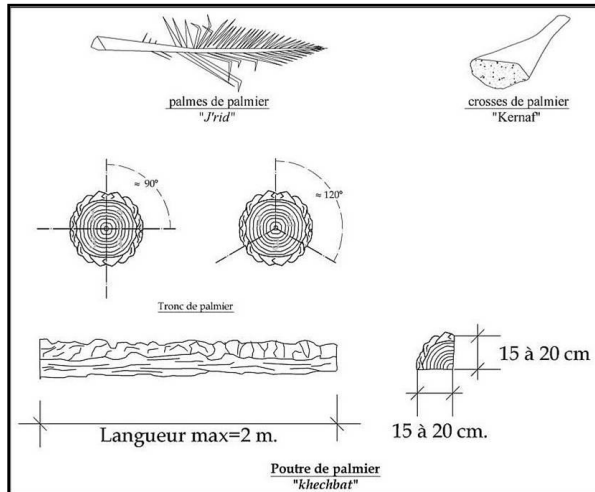


Figure 11: trunk and palm leaf section and plan view

Figure 12: detail of the traditional floor

4. System of ventilation (modern and new experience)

This project is a promising endeavor that has enabled the development of a new architectural approach seen as a solution for an important component of the Saharan environment: ventilation. According to our study in the subject of sustainability, we are certain that the outcomes of this endeavour can install a new mode of reflection in producing a certain comfort inside the Saharan typology, which will allow both to appreciate its worth.

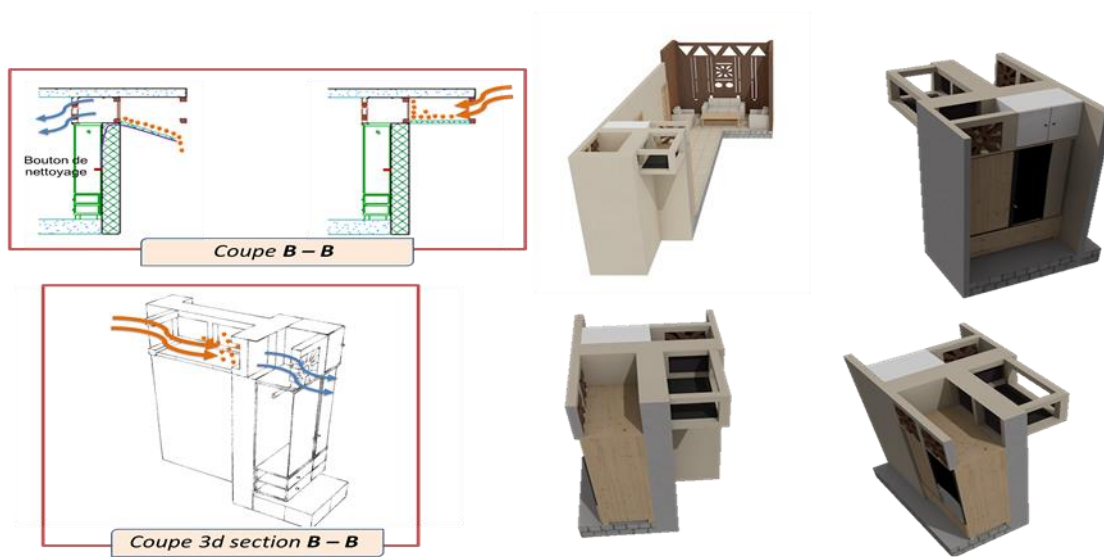


Figure 13: New natural ventilation system with sand sweeping to the outside

5. Conclusion

Following the detailed and systematic documentation of some traditional Saharan settlements in Algeria, as well as comparisons with many other examples in the scientific literature, it appears that this beautiful Desert Architecture still provides us with an opportunity to begin anew toward the creation of a great new image of the protection of the built environment in general, and desert architecture in particular. We are persuaded that the ancient materials utilized and still used by desert people in the construction of their dwellings have become critical in reinforcing their values, which are not only constructive and technical but also historical, economic, and social.

This reflection compels us to acknowledge that protecting the built environment will only be possible by adapting these materials in a new way that meets current needs, particularly in the Saharan environment, and that their structural and architectural technical value (design, spatial quality, comfort) has become a priority whose benefits must be considered globally in the sustainable development process in order to solve all of the existing problems related to this desert architecture.

References

- [1] M. Maroc, D. Alkama, "Lecture conference on earthen architecture in the Saharan environment," *AIA, Revista Arquitectura. Ingenieria Artes*, n°. 165, pp. 44–49, University of Asuncion coll.Paraguay.June. 2018.
- [2] Bandyopadhyay, S., "Harat Al Bilad (Manah). Tribal Pattern, Settlement structure, and Architecture" *Journal of Oman studies. JOS* **13**, pp. 183-262, 2004.
- [3] N. Benkari, "The defensive vernacular settlements in Oman, a contextual study," *Journal of Oman studies (JOS)*, Sultan Qaboos University, Muscat, Sultanate of Omane. 2016.
- [4] M. Maroc, "la vally du Mzab, l'histoire d'Une Architecture entre Authenticité et Modernité" *Proceeding in Seminar Of Saharan Architecture. (02)*. Djanet.Algeria. December 2012.

- [5] M. Maroc . “ l’Architecture Saharienne comme model de durabilité” *Proceeding in Seminar Of Saharan Architecture.1st Edt.* Illizi.Algeria. pp. 45-54 mars 2017.
- [6] A. Ravereau, “ Le M’Zab, une leçon d'architecture” . Ed. Sindbad, Paris, 282 p. 1981.
- [7] A. Ould Sidi , “ le Patrimoine Culturel de Tombouktou enjeux et perspectives ”. pp. 39-43, Fevrier. 2008.
- [8] Y. Terki , “ De Terre et d’ Argile ,”Exposition architecture de terre ”palais des expositions. El koudia. Tlemcen. pp. 117-149 Decembre . 2012
- [9] D. Alkama , “ Pour une nouvelle approche d’urbanisation dans les zones aides, cas du Bas-sahara”.
State doctoral thesis, Univ. Biskra, s/dir Tachrift / Farhi 349p.
- L.Khelifi. ,” Contribution à l’Evaluation du Microclimat dans les Espaces Urbain de Transition : cas d’Etude, la Région de Timimoune ”. Doctoral thesis in sciences, Epau, pp. 120–143. Mai 2017.
- [10] M. Chaouche -Bencherif, “La Micro-urbanisation et la ville-oasis; une alternative à l’équilibre des zones arides pour une ville saharienne durable cas du Bas-Sahara,” Doctoral thesis in science, 165 ,pp. 92-115. Juin 2007.
- [11] S. Badawi, " Heritage Preservation within public open spaces: the case of Qabel Street (Old Jeddah) Spacious Experience," *Advanced Technologies for Sustainable Systems.* .pp 31-40. October 2016. (livre)
- [12] Benkari N., Documentation and management plans of Harat Qasra (Rustaq), Saija (Sama'il), Al Khabt (Khaboora) and Msalimat (Wadi Al Ma'awil). Reports submitted to the Ministry of Heritage and Culture, Oman. 2015 (In press).