

# THE URBANIZATION PRINCIPLES OF BOU-SAÂDA'S KSAR "ANALYSIS OF THE FORM AND CONTENT"

## *Principes d'urbanisation du Ksar de Bou-Saâda « Analyse entre la forme et le contenu »*

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### **RESUME**

Cette étude analyse le mode d'occupation du sol urbain dans l'ancien tissu urbain du "Ksar" de Bou-Saada, de sept à huit siècles, ville située à 250 km au sud de la capitale Alger, dans le haut plateau. Elle se concentrera sur l'analyse de la structure urbaine, à partir d'éléments ponctuels (placettes et carrefours –intersections de voiries-) et linéaires (rues, ruelles et impasses) et leurs relations en tant qu'éléments de liaison avec le milieu bâti. Puis, nous passons à l'analyse des réseaux d'équipements publics et d'espaces verts du Ksar. Ensuite, nous abordons dans ce contexte, l'analyse de la typologie urbaine des unités d'habitations et pour en déduire, enfin, les principes constants et le contenu spirituel de ce ksar afin de les prendre comme éléments de base au cours de l'élaboration des plans architecturaux et de la planification urbaine des quartiers résidentiels et des unités d'habitations individuelles, et cela dans un cadre, qui assure d'une part les exigences des générations présentes et futures, et d'autre part, qui prend en compte ces constantes comme points de départ pour l'occupation du sol urbain ayant des dimensions historiques, culturelles, sociales, économiques et environnementales issues de l'authenticité, pour assurer le développement durable.

**MOTS CLÉS:** Ksar, Principes d'urbanisme, analyse morphologique, la forme et le contenu, authenticité, développement durable, (dimensions historiques, culturelles, sociales, économiques et environnementales), Bou-Saada.

### **ABSTRACT**

This paper is an attempt to analyze the land use in the old settlement, the "Ksar" of Bou-Saada, a seven to eight century old town situated at 250 km south of the capital Algiers in the high plateau. Emphasis will be on the urban fabric as in form and structure. This study will focus on both punctual (squares, crossroads and intersections) and linear (streets, alleys and cul-de-sacs) urban entities and their relationship with the immediate built environment.

Then, we pass on to the analysis of networks of public facilities and green spaces in the Ksar. Finally, and within the same context, the housing units will be investigated in order to depict the typological constants and variables principles underpinning the spiritual content of the ksar. The outcome of this research is aimed at providing designers at different scales with the necessary understanding and knowledge to address the needs of present and future generations as well as historical, cultural, social, economic and environmental dimensions of authenticity to ensure sustainable development.

**KEYWORDS:** Ksar, principles of urban planning, morphological analysis, the form and content, authenticity, sustainable development, (historical, cultural, social, economic and environmental dimensions), Bou-Saada.

### **1 INTRODUCTION**

Talking about the urban and architectural principles is referring to a multidimensional referential (historical, cultural, social, economic and environmental). Also, speaking about references in conceptual terms helps understanding how dimensions of time link as in past,

present and future, because the present that we live emanates from the past and the future is to a certain extent, a result of the present; consequently, the present can be regarded as a meeting point of the past and the future. One can confidently argue that a critical review of cities throughout different historical periods, can unveil layers much like a painting where the foreground and background

work tightly to communicate ideas in a way that speaks loudly of the painter, his/her civilization and his or her cultural and social salient traits.

These cities can also be regarded as reflection of people's cultural, social and economic values as well as the civilizational and spiritual principles of their inhabitants. These principles actually underlay the identity of a community as the city acts a mirror that reflects the identity of its inhabitants, the faithful expression of their constituencies and their architectural and urban heritage.

Both in the Maghreb and orient, cities (towns) have suffered massive imported urban forms which were not adaptable to social, economic, cultural and climatic factors ([1], [2], [3] and [4]). It seems that we are designing buildings and cities according to imported criteria and methods, which ultimately yield constructions resembling dead bodies. The reason is probably the fact that the construction of cities is not only an exploitation of land through the erection of buildings, the provision of public amenities, the construction of roads and different networks, but through the implementation of values and principles as well. It is strongly advocated in this paper that the research about the authentication of urban and architectural principles through an analytical study of ancient cities helps uncovering the characteristics and to the constant rules that determine the spiritual contents of buildings and cities. It offers at the same time a reservoir of architectural form that can shape the built environment for centuries to come.

## A- THE PROBLEM

It is true that the Ksar suffers from many problems particularly in terms of management due to the deterioration of structures already very old, but in the present study, we will be looking at the difference between form and content, because if in the past form had been adapted to Man as a fundamental element in the conceptualization and development of architectural plans and urban planning, today the city is witnessing a great expansion relying more on accommodating the mechanical factor and getting further away from realizing the constant principles that reflect the cultural, social, economic and environmental values.

Although the state of deterioration of the Ksar is such that it is becoming more and more incompatible with the daily life requirements of the present generation, we assume that the content and the principles of Ksar could still be valid and unchangeable over time. Therefore, the objective of this part of the analysis is to identify these principles and spiritual content of Ksar in order to apply them to the elaboration of architectural and urban plans that address the requirements of present and future generations.

## B- IDENTIFICATION OF BOU-SAÂDA'S KSAR AS A CASE STUDY

The Ksar, or the old Medina of Bou-saâda lies northeast of the city bounded by the wadi (river) on the east, the palm

groves north, and the urban sprawl of the city in the west. Its foundation came to complement the work of the Almoravids who founded places of cult and learning across the Arab Maghreb, relying on men like Sidi Thameur, bearers of knowledge and wisdom to spread Islam ([5], [6] [7] and [8]). However, it is argued that.

The Bedarna, a Bedouin tribe were Sidi Thameur's hosts, they were the original owners of the land that stretched on both sides of the wadi, which they obviously had the ability to work and cultivate. That's where Sidi Thameur chose to build the first mosque called the palm- tree mosque, where he had settled with a group of people (his family, his disciples and his supporters). It is then that the land witnessed an agricultural and urban growth, due to population increase. In addition, the number of gardens grew too in parallel with the extension of urban space, because new districts were born, such as: Ichacha (first kernel which was taken as a residence by Sidi Thameur, his disciples and his supporters), then the district of Ouled Attig (descendants of Sidi Thameur), then those of Ouled Harket, Loumamine, Zoukoum and finally Ouled Ahmeida

## 2 SUSTAINABLE LOCAL DEVELOPMENT

### 2.1 Sustainable development and urban heritage

Cause of many variables in different fields, we should look for new methods for development to ensure its continuity and should find substitutes to plan and to design cities (towns) and residential quarters. "Relying on occidental concepts that represent only one choice from other probable ones for solving problems in other areas. Instead of that, we should put in consideration local types and their needs and the achievement ways in them" [9].

The sustain concept is represent by the very old urban through impulsive harmony with environment and the best exploitation of natural resources. All this come through years of experiences: urban has relied on auto energy such as exploiting sun, winds and the earth capacities. Those ancient experiences have given clever environmental cure such as ventilation providing, joined texture, shade, providing, the use of courts and relying on local materials. That's why we consider our cities (of the Sahara) the best example to applicate the concept of sustain on the level of the whole city and on the house's one:

- On the city's level: Designing the city and solving the problem of moving (width, length, orientation) direction is considered as a basic phase to adopt with the environment. The joined texture leads to fresh climate and decreases high temperature sun shining and sandy winds. This local climate has participated in social reactions and affinity and in land economy as well. It becomes urgent and necessary the adoption of courses and ideas of the oldest urban and make it efficient in modern urban extensions without abandoning the technological needs on the material's system's [10].

- On the house's level: Total accordance of the house with the environment either positive or negative. This has been realized through two strategies: protection and adaptation: limiting hard natural conditions giving relax to inhabitants, exploiting energy resources (sun, wind). We remark characteristics of sustain as the following:
  - a. Environment treating: Houses realize ventilation, warming and air conditioning thorough solutions without relying on energy resources at all. This is of course an interesting principle of the different sustain's ones.
  - b. Materials techniques: people have used only local materials such as: stones, bricks, clay and local wood according to completely local techniques which were economic and sustainable.
  - c. Water and energy: people had drunk from natural wells at home or from rivulets. Polluted water was inexistent at all. For energy, capacities (ventilation, lightening) all this realize the true sustain.

## 2.2 Some principles of local sustainable development

Building urban environments and sustainable buildings in our cities must be different as in the developed world volumes of problems, priorities of development, social and cultural values all these points participate in finding different fact. Shortage in services and in urban amenities, mounting in houses request all these problems need specific solutions which should respond to social and ecological dimensions at the same time.

It is strongly recommended to adjust the imported occidental modals, we need new views towards a development that protect our values and respect our cultural and civilized fact. We need a real sustainable development, we should review our priorities, our criterions, our work means and our point of view towards sustainable development. These principles aim to reliance radically on sunstain's ones and to avoid the disadvantages of the actual applicated modals through basic principles [11]:

- Earth (land) revivification: It is imposing and revivificating as a basic condition to own the land to suppress speculation which avoid the non benefit use of land.
- Economy: It aims to simplicity, to the best use of local unpurified, to cover to basic needs of living without squandering.
- Injury base: One of the strongest administrative mechanism which affects in the urban quality environment in the oldest cities. The injury base strives to eliminate the existing injury and prevents its existence for the legislative side, it used to correct, to orientate not to dictate or impose. It determinates the forbidden behaviors of

inhabitants letting them free apart this.

- Benefit bringing and injury refutation: This principle has two main basis to urban desing, respect of the sites choice and the necessary amenities volume determination for the inhabitants density. These amenities must be existed before every thing is being built.
- WAKF (AWKAF): It offers the following:
  - a. Providing services and public amenities: Public amenities such as water, streets, teaching and mosques relied on AWKAF establishments which were bringing water, paving roads and their maintenance in addition giving importance to mosques and religious schools.
  - b. Instituting a sustainable and independent financial system: Through commercial buildings exploited for public services to provide financial resources to the different services such as: payment, daily needs of buildings. This financial system was sustainable and periodical.
  - c. Contribution of inhabitants in developing their cities: AWKAF provided an opportunity to people to contribute in the towns development through maintenance, control, planification, administration and their opinion in the urban decision [12].

## 3 BASIS OF THE SUSTAINABLE URBAN FORMING FOR THE SUSTAINABLE DEVELOPMENT PROJECTS

Sustainable society is the one which provides i self all its needs: air, water, land and energy resources in a limited site. The studied equilibrium in the environmental exchange between human being and environmental systems is the basis of the urban and sustainable society. Natural resources should be completed with urban plans for the continuity [13].

**Sustainable urban forming:** It is a material urban expression for social assembling of saharian by using local traditional materials to satisfy cultural needs and it gives importance to urban and accordance to variable needs and to urban organization ([14] et [15]).

Williams and Frey [16] put forward the sustainable urban forming through three elements that influence in the assembling of the town (city):

- a. Arrival possibility.
- b. Affinity, convergence.
- c. Functions incorporation (Intergration).

Barton determined also the principles of sustainable urban design as the following ([17] et [18]):

- a. Increasing of the auto insufficiency and residential adjacency designing.

- b. Fulfillment of the being needs and the realization of social and environmental aims.
- c. Urban forming around efficient energy and roads planning.
- d. Design of open vacant net and compact.
- e. Strategy of the use of energy.

#### 4 DESIGN OF THE SUSTAINABLE SITE OF BOUSAËDA'S KSAR (THE URBANIZATION PRINCIPLES IN CONSTRUCTING)

Shapes of cities can bring ventilation, the wind speed, current (stream) mutation and thermic lifting (carrying). They can also influence on the plants and print point sun lightening inside the town. We shall study the elements of sites design through: Ksar orientation, movement net and planification of the land use and their concordance all together.

##### 4.1 The Ksar orientation

Main streets in the Ksar are oriented from North East to South West to benefit from fresh (humid) wind, Shade exchange and sun lightening in streets. For façades, they are massive and oriented towards the north and the south in general. Northern façades aren't sunny but southern ones could be shaded. The strategic site of the Ksar contributed in getting pure air (situated next to a river), that's why energy is preserved and sustainable is realized.

##### 4.2 The Ksar structures

The Ksar is composed from seven districts, each district has its own mosque, its own square and its own social texture. Each tribue had its district the distrubtion of inhabitants based on social harmony. Extension is based on the revivification of the land-land had not no material value. Every body wanted to build his own house, it is possible for him to do but the operation had guided rules such as the necessity of building.

##### 4.3 Joined texture

The Ksar is formed from joined urban texture of 7 districts which are intergrated realizing land economy, auto sufficient, social tenacity, accordance with environmental conditions and minimized from the length of roads. The joined texture contributed in shading the whole Ksar and realized the possibility of reaching the different amenities easily. The Ksar realizes the most important principles of sustainable development (Social reacting, intergrated use of land, local independence, land economy and amelioration of the ecological conditions).

#### 4.4 Open vacant net

We analyze the elements that are composed for the connection: punctual (squares, crossroads and intersections) and linear (street, alleys and cul- de- sacs) and the façades as limit elements to the connection net; in order to extract the urbanization principles which were the basis of the Ksar buildings:

##### 4.4.1 Linear elements

This net which leads to houses has twist shapes, it is composed ordered and harmonious roads, based on climatic, social and economic principles ([19] and [20]):

- The road: Ensures connections between squares and public amenities such as mosques, market...etc. roads have harmonious dimensions with the ascending of the houses, the width of roads is 3 to 4 meters, it was proper to human being measures (shape 1 and shape 2).
- Alley: they are divaricated from roads, they ensure the connection between houses and main streets which lead to squares and the different amenities. Alleys are short and tight (2.5 m wide) (shape 3).
- Cul-de-sac: It's a feature in the Ksar and expresses a value in the field of urbanism and it is a quality the Islamic and Arab society that connects between neighbours. Cule-de-sac imposes a private life for neighbours and gives a private domain for them "The dead end is a basic element in the tradition of Islam. Its appearance is related to a type of building techniques that exist in Islamic towns exclusively" [21]. We can remark that 65% of cul-de-sacs roofed and built to connect houses in the upper floor. This technique deepens the principle of private urbanism in the Ksar. The width of cul-de-sacs is 0.90 m to ensure the two houses that are linked to them.



**Shape 1: The street guarantees the link between rahbates and public places. (Source: the author's work out)**



**Shape 2:** The street offers a mutual shade, the breeze and the preservation of the walls from the sun, and on the other hand it is an important wind breaker. (Source: the author's work out)



**Shape 3:** The alley serves as a liaison between the residential units and the main streets leading to the squares and public places. (Source: the author's work out)

We can extract the main principles that contributed in forming the linear elements:

#### a- Climatic principles

Realize local climate the whole day because the Ksar is situated in hot area.

- Twisted ( bent ) streets prevent entrance of wind and storms, they prevent pollution as well. Streets of then be shaded and fresh during the day, warmy in the night. The Ksar as it is built is the best from adapted Saharan climate cause of the existence of plan trees and the river and because the clever strategies used by the originators [22].
- Streets from tunnels for the air movement and substitute the temperature.

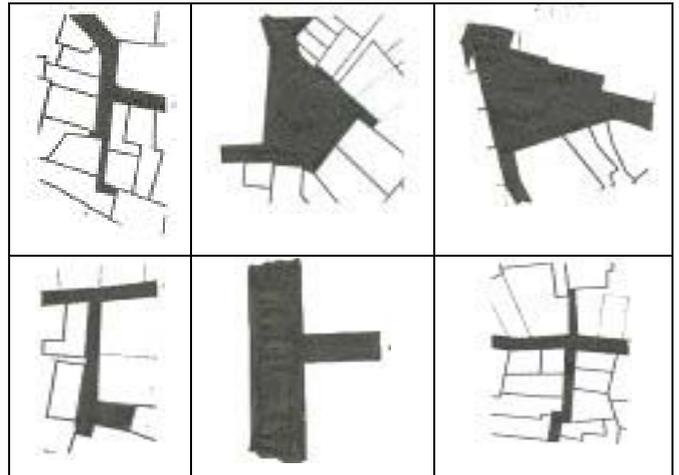
#### b- Economic principles

Preserving the land, the best exploitation of urban domains reaching the different amenities easily and quickly. "The

width of streets is planned only necessary to the crossing of two asses quite charged" [23].

#### c- Social and cultural principles

Roads net in the Ksar is a material urban expression for the background of the inhabitants through an ensemble of data such as privacy (from general to particular) and security through vacants used in social and religious events and activities. Authorities don't interfere only for giving help. All these principles serve sustain as a concept.



**Shape 4:** Streets ensure link between Rahbat (squares) and public amenities Scale: 1/1000 (Source: the author's work out)



**Shape 5:** Irregular Point Streets intersection Climatic relax (exchanged shadow and protection of wall from sun rays) (Source: the author's work out)

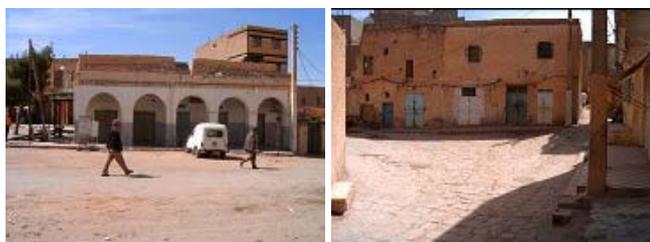
#### 4.4.2 Punctual elements

Ensemble of public courts (squares) and different intersections which are irregularated (Streets, Alleys, cule-de-sacs). They are based on determined principles:

- Intersections: The irregularated from of the link net leads automatically to irregularated intersections. For instance, intersection of street-streets, street-

alley or cule-de-sac, two street-cule-de-sac...etc. All intersections relied on different angles (sharp angles had been broken and mentioned by bricks and stones to facilitate the movement in one side and to expand the sight view angle of pedestrian in the second side (shape 4 and shape 5).

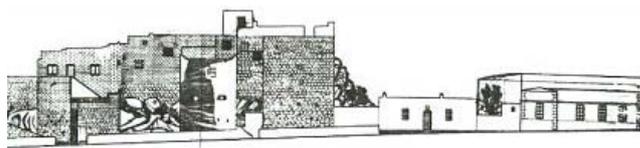
- Rahbat (squares): The Ksar texture includes irregular urban public squares in general, They are linked to streets, alleys and cule-de-sacs. Although the absence of exterior readying in these squares, they could play a great role in creating numerous jobs: social gathering and entertainment role for people and a commercial / economic role as well because they included shops, cafés, restaurants and mosques (shape 6).
- The squares stand on the principle of integration between many uses and functions (social, economic and religious functions) and between residential domains and public amenities (complete each other).
- This is one of the concepts that sustainable development requests it: the necessity of integration, mixture between activities and land use, realization of decentralization through distribution of Rahbats / squares and courts on the whole urban texture.



**Shape 6: Social gathering and entertainment role of squares plus economic and commercial roles (Source: the author's work out)**

- Urban frontages stand simplicity: Few openings, convergent ascendings buildings of terrestrial floor major in the Ksar, it's rare those of first floor-sometimes we remark the existence of (the Sakifa) which links between two frontages 12% only of vacant on frontages, which indicates the principle of shame as social privacy that reflects the identity of inhabitants.

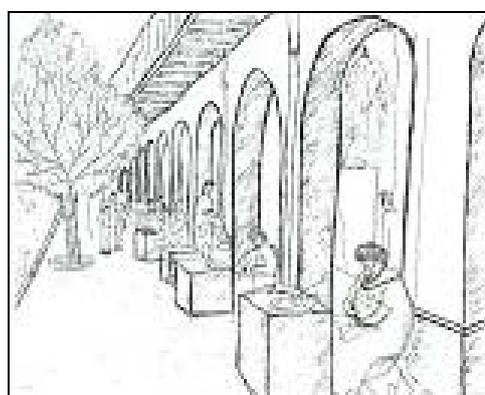
For the commercial frontages, they emerge on courts and the market. The terrestrial floor is specified different services but the first floor is for residence (integration between residence domain and public amenities) (shape 7 to shape 10).



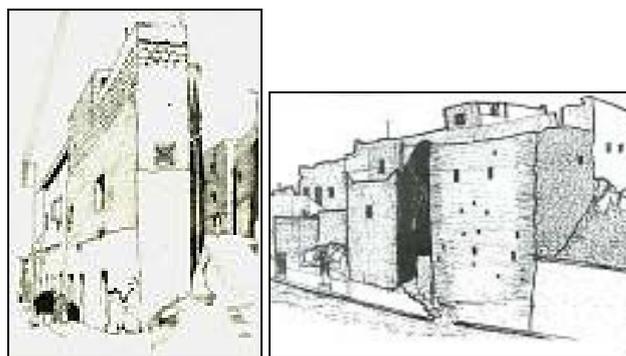
**Shape 7: Integration between residence domain and public amenities. Scale: 1/1000 (Source: the author's work out)**



**Shape 8: Commercial façades character or provider. Scale: 1/1000. (Source: the author's work out)**



**Shape 9: The façades on commercial or service onto the rahbates, As for the ground floor, it is reserved for the multiservice, the first floor is devoted to the habitat.**



**Shape 10: 12% of vacant on frontages, this indicates the principle of shame and reflects the identity of inhabitants. This indicates that these housing units were directed inwards, to realize the principle of modesty as a specific social reflecting the identity of the woman who lives in Ksar.**

(Source: the author's work out)

#### 4.5 Public amenities net

Public amenities represent 12% from the whole area of the Ksar, they included the market, shops, cafés, restaurants, hammam, stables...etc. But there are many mosques. AL-NAKHLA mosque was the biggest and the first nucleus of the Ksar. It had not only a religious role but it was as a justice place and a school of different levels.

Mosques have long shapes, relying on moderation in spending money and in the use of building materials that let them last longer. Decoration in mosques have civilization values, they relied also on the realism principle which could connect people to them (shape 11 and shape 12).



Shape 11: AL-NAKHLA mosque, the 1<sup>st</sup> nucleus of the Ksar.

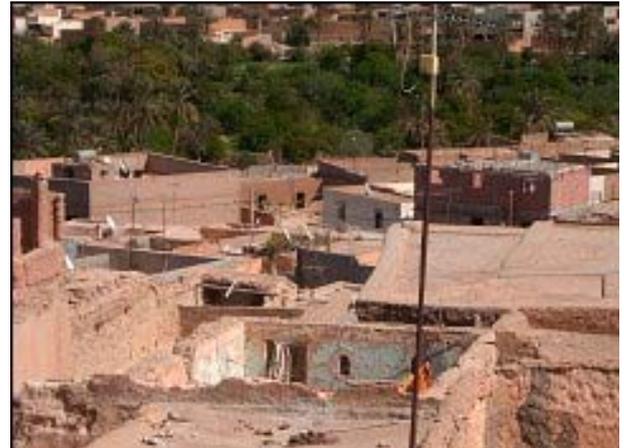


Shape 12: Mosques have long shapes, relying on moderation in spending money and in the use of building materials that let them last longer

(Source: the author's work out)

#### 4.6 Green areas net

We find no green areas in the Ksar just few ones inside houses because inhabitants were peasants at the oasis that board the Ksar. These oasis played a social and distractif role for families and they were as recruitment offices for the inhabitants of the Ksar materializing complementarity between demographic growth and work providing. Green spaces play a climatic role because they create soft atmosphere and environ mental one because they could stop the sand advance towards the agglomeration zone (Shape13).



Shape 13: Oasis played a social and distractif role for families and they were as recruitment offices for the inhabitants. (Source: the author's work out)

### 5 SUSTAIN PRINCIPLES IN THE KSAR

Through this paper we evaluate urban forming of the Ksar as the following:

#### 5.1 Varied use

Houses represent the majority of the whole area in the Ksar, but the remaining area is commercial and services shops in the terrestrial floor. The upper floor is used for habitating. Generally houses are around the streets and principal axes. The Ksar includes a lot of public amenities such as a mosque in each district from the seven ones. This means that the Ksar realized an important technique that sustainable development focuses on it which is ( the land use integration ) . This principle is nowadays is a very interesting criterion that sustainable urban planification relies on it I.e a crowded city integrates functions and services in addition economy in land.

#### 5.2 Congruence between the Ksar area and its density of population

Pollution density and the Ksar area are congruent while buildings ascending do not top one pr two floor.

Sustainable development focuses on short roads cities and small agglomerations, we can find this principle in the Ksar wherever it is founded as an assembling type instead of isolated districts. This type established a the competent use of resources and the available urban services could cover the needs of the great number of inhabitants. In addition, many oasis and gardens in the East and North of the Ksar the river were principal factors for development and life. Economy in the Ksar relied on agriculture first.

### 5.3 Cultural and social criterions

#### ▪ Social reaction

The choice of the sit, the plan of the house and the plan of the Ksar is the result of the complementary of social and cultural values, the existence of many courts and intersections in front of vivid and essential amenities realized fraternity and harmony between inhabitants, SAKIFA-which cover alleys and streets realized communication and considered also as a control place for the Ksar. For the courts, they are divided into 3 levels according to reaction levels, public domains, almost public domains and private domains. All this had given a strong affiliation feeling and total security.

#### ▪ Auto satisfaction

In the sustainable development logic that cities should guarantee the minimum of satisfaction to people, they should be independent by their natural resources, energy and raw materials.

### 5.4 Environmental and ecological accordance

"Sustain" is not a new term in the Ksar, it was known and practiced by the inhabitants in their urbanization and their life style through environmental accordance and the best exploitation to the natural environmental resources represented in:

- Getting linked to green open spaces: Reaching oasis and gardens is simple cause of possibilities have been created through links between the green open spaces and the Ksar.
- Natural manners to prevent pollution: The joined forming of the Ksar, The nature of buildings oriented towards the inside and the walls that surround the Ksar and the gardens all this protected the sit (the Ksar) from sand dunes and dust. Tight and covered streets, the interior sowed courts minimized pollution as well.
- Naturel manners uses in lightening, ventilation and air conditioning: The joined plan of the Ksar, the streets, exterior vacant (spaces), interior courts, the use of SAKIFA that gives shades, the use of local building materials, plan-trees, the small openings in frontages all this help in having local climate by

using accordant techniques with the environment without charge.

### 5.5 Identity and distinctive quality

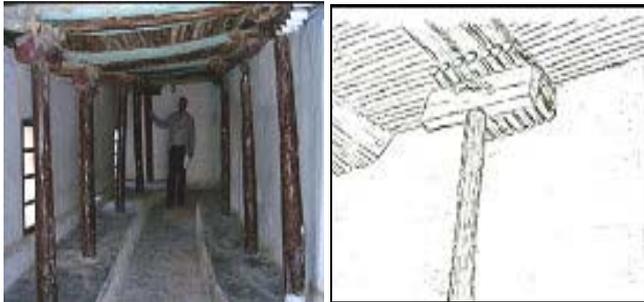
Privacy of identity and trait:

- The clarity of urban and joined texture: forming and the distinctive architecture in the Ksar is a specific identity for it. Houses are simply built without complication through using tradition means and spontaneity in constructing, roofs are stretched on purpose to benefit from their space.
- Flexibility and possibilities of accordance with variables: The principle of continuity is taken in consideration during the construction of the Ksar i.e in the future coming generations will be able to change, to develop and find flexible domains for movement. An opportunity is always given to sons and grand sons for horizontal and vertical extension. For the natural system (Oasis...) a flexibility in realizing economic and environment balance according to sustainable systems.

## 6 RESIDENTIAL TYPES IN THE KSAR

Houses and public buildings have two kinds of constructive structuring ([7] and [24]). Structuring of supporting walls of big works for the buildings starts from the stone bases to reach the subfundation and sometimes they surpass it to the terrestrial floor and reach the first floor other times. Each Kind of residences is linked automatically to the economic abilities of each family. Other houses are built of bricks that are plastered of clay and lime. Openings in walls have square and. Roofs rely on great wooden rafters (trees of the mountain and plan-trees trunks) linked into one another by wooden branches followed by a tick layer of compressed clay. But when the distance between walls is more than 3.5m, a second method of structuring was adopted, it is in dependant structuring: It is based on hard wood pillars covered of spurs in the en. They are symmetrical and have a square cutting formed of palm-trees trunks followed by a layer of branches (wooden ones) to support the biggest principal large beams. At the end a lay of compressed clay is put. It is obvious and clear that the man who built the Ksar and dwelt it was a clever one, he could treat well his total environment, preserve and protect it. He started from the principal of acclimation with comprehensive environment, he could exploit the natural sides that surround it with all its components such as mountains, plateaus, plains, rivers, rocks, mould, trees and palm-trees oasis ...he could produce from them local and economic building materials and had Known how to create buildings and how to from urban texture and adapted architectural constructions with the other natural environmental elements such as the climate (Heat and wind) without forgetting the cultural and social environmental elements (shape 14).

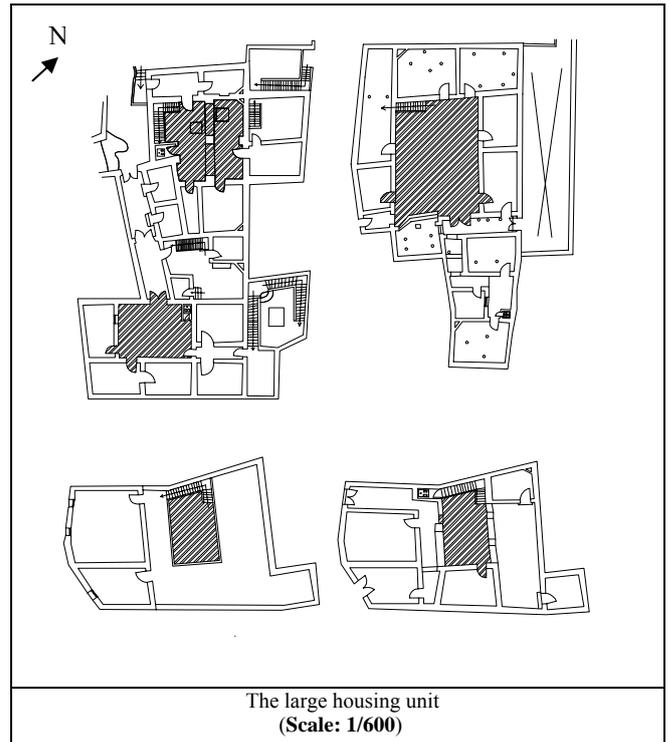
Shape: Production of local and economic building materials.



**Shape 14: A profile architectural construction adjustment to the elements of the natural environment such as temperature, wind, rain, as well as the social and cultural milieu.**

(Source: the author's work out)

After taking the different plans of housing units and after Analyzing the of land exploitation of these units and comparing it with one another and knowing their phases of development, we could classify them into three principal types: (shape 15).

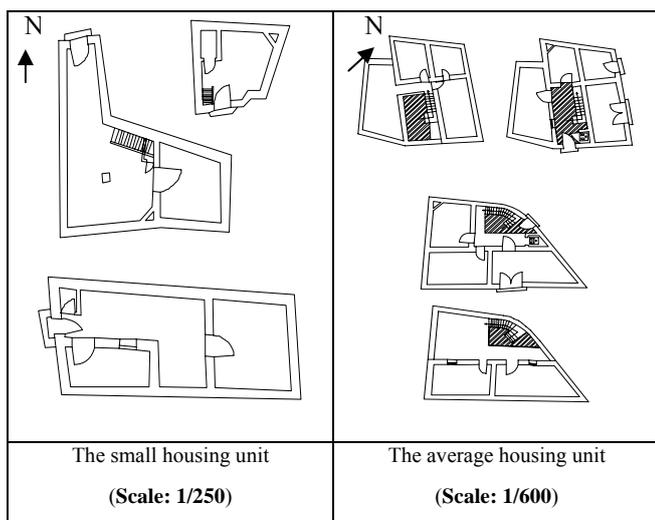


**Shape 15: The main types of homes**

(Source: the author's work out)

### 6.1 The first type: small housing units

The area of this type of housing unit varies between 15 and 40 meters. This unit represents either a home resembling a tent of a small poor family, or a shared heritage. The rate of this type in the Ksar is 28.38% and is common in cule-de-sacs, angles of units and intersections, but less frequent in main streets and public squares. It includes two rooms with a ball sometimes a small court yard.



### 6.2 The second type: the average housing unit

The area of this type range between 40 and 100m<sup>2</sup>.It occurred as a result of the growing needs of people and the multiplication of family members .The rate of this type of us its in the ksar is 50% so this type is the most dominant reveals the social and economic status through most of the ksar's inhabitants. This type is much more common in main streets and public squares. It has got between 3 and 4 rooms of multi functions. But what characterizes this type is the court as an open area that has varied volumes depend on the dimensions and the sun orientation from the one hand and the emergence of stairs leading to the upper floor formed of one or two rooms and a large terrace the other hand. "The ouragli house is a type of Saharan one interior court and terraces" [25].

The coefficient of land use varies in this mode of housing between 0.80 and 1.20. It is based on the principle of maneuverability in land exploitation. The court- in relation to the terrestrial floor –takes its volume and its variable shape from the variable dimensions and orientation to ensure acclimation with wind and sun and to offer the climatic relax to the rooms which surround it. "courts are not exposed for a long time to the sun's rays." [26]. Naturally, the air, the light and the sun-lit penetration are results to the interior courts that are considered as thermal regulators ([27], [28] and [29]). "It can be today still and taking into account the technique most advanced, only true defense against the winds desiccants charged with sand which save it provided that it is rather restricted (patio) not to create significant depressions." [30].

### 6.3 The third type ;The large housing unit

The area of this type varies between 100 and 300m<sup>2</sup> and it is the most developed type cause of the multi placion of family members and to respond their needs. The rate of this type in the Ksar is 21.62% .That's why this mode, which is less widespread, reveals to the economic abilities of a minority of the Ksar's inhabitants.

This mode exists in main street, public squares but is less present in cule-de- sac, angles and intersections. This type includes between 5 and 8 rooms of multi functions. What characterizes this housing mode is the court as a large open apace, compatible with the great size of the house and its elevation and orientation relative to the sun.

### 6.4 Façades

The rate of openings in the whole area of façades is 12%, this indicates that all façades are directed inwards. Façades are modest and short, they are not complicated at all, we can see small openings in them. Elevation of these façades are convergent. Sometimes we remark the appearance of (the SAKIFA) which links between two façades. For the commercial urban façades over look (Rahbates) that include public amenities. As for the terrestrial floor, it is reserved for multiservices, unlike the first floor is devoted for habitation materializing the principle of completarity and assembling between the domain of habitat and public amenities.

## 7 PRINCIPLE OF SUSTAIN OF RESIDENCE IN BOU-SAÂDA'S KSAR

Designing of sustainable residence could be realized though complementarity between principles of residence in the Ksar and modern technological systems which can realize the following:

- Preserving natural energy and building materials resources and relax providing for inhabitants.
- Minimizing pollution, saving energy, recycling dishes.

### 7.1 Organization of vacant areas

Residences in the Ksar were built according to the needs of inhabitants i.e there was a real evaluation to the needs according to a principle that says: we build we need then what we want:

- **The use of vacant areas:** It is the possibility of using the vacant areas day and night taking in consideration the environmental concepts, the climate and the orientation.
- **The use of multi vacant areas:** It is the possibility of vacant for different functions in the same time.
- **The re-use of vacant area:** It is a concept of rotating

again the use of vacant area (for instance a grand son takes the room of his / her grand father).

- **The use of multi vacant area forms (court, roof ...):** It is the charge of the vacant area from opened to semi opened to close through periodical constructions that gives the possibility of future extensions.
- **The collective use of vacant areas:** Such as the use of the court, the sitting-room and the living –room from the whole family. The function of the collective rooms remain as it is even if other people dwell in.

All these principles are the essence of sustain, they are used and applicated in the Ksar spontaneously because they are result of accumulated experiences.

### 7.2 The environmental treating

Providing shadow in the Ksar came through neighboring houses and minimizing the width of streets which are shaded with ski fats. The court is also providing shadow either by its high walls or plants and trees sowed in it. Shadow in the Ksar is natural and free. Natural ventilation is a strategic technique in the Ksar to minimize heat, and to contribute in comfortable environment for inhabitants. However, the small openings, builder could develop manners in getting natural ventilation via courts which are used as thermal regulator benefiting from oscillation of day and night temperatures.

### 7.3 Local building materials use

Building materials were taken of local environment. They last longer such as clay stones, wood and plan trees trunks palm \_trees as we know can last hundreds of years, the proof is its remaining solid till now with out renewal or restitution and even thermal and physical specifications of building materials helped walls to be the circle that minimize the exterior environment effects. Qualities of used building materials could be cited as the following:

- They are natural, able to be restorated and suitable for the Ksar climate.
- They are solid, last for a long time, they need less maintenance when they are used.
- Having best quality and great relax. In the past, criterions of maintenance had not been existed. For the age of houses which had built for more than 5 centuries is a proof of building materials fineness.
- Materials have no negative environmental effects in extracting, transporting, building or their life ending.

### 7.4 Energy preservation

Concepts of sustain focus on exploitation of self or negative energy and minimizing the reliance on the known energy

resources for economic, environmental and sanitary causes but looking for new energy resources through exploiting the components of the nature.

## 8 CONCLUSION

Through our study, we have reached a result that Bou-Saâda's Ksar is the best example (modal) in using sustain criterions because it adopted-in forming its urban environment planning and designing principles which may be used in projects of sustainable urban development:

- **Joining principle:** Through this principle urban planning in the sahara is adapted in order to realize complementarity and harmony between the parts of urban texture, providing needs and services to inhabitants through combining land uses in mutual relations realizing the following:
  - Environmental sustain: Planification of urban extension is the first mechanism used to dominate the climate. Joining could realize a harmonious environment with climatic conditions of the Saharan environment Joined buildings minimize heat during the day and they from a net of dense shadow.
  - Social sustain: Joining contributes in creating a joined society, in preserving and hardening social relations. It can maintain values and identity realizing in the end the social justice. It provides also security to reach a sustainable society.
  - Economic sustain: Joining contributes in economy, it preserves used land in building through a real estimation for needed areas for different functions. In addition, it combines functions and activities and there's a possibility to reach all the inhabitants. Joining can shorten roads as well.
- **Environmental and ecological concordance principle:** It can be through realizing equivalent urban agglomeration:
  - Natural energy use to get breeze and ventilation, this technique is brought from accumulation of experiences to determine mechanisms that treat local climate through designing of nets, streets and courts for applying bases and criterions of sustains plus the competence of energy use and exploitation of resources.
  - Flexibility and the possibility of concordance with variables: The continuity principle is taken in consideration in the Ksar, i.e. land and resources should be remained for next generations to promote and to develop.
- **Principles of streets and courts planification:** One of the characteristics of these principles is the domainial graduation, providing shaded streets, and the importance of locating courts of activities of vacant areas to under control the climate of saharian areas .In addition, it is desirable to limit negative and large vacants that have not sown grounds.

- **Principles of designing mosques and public amenities:** The mosque is the centre nucleus physically that surrounds through a strong relation with its environment that surrounds it. It is a place of worship, cultural and religious activities. Inhabitants of the Ksar had many public services such as mosques, schools and water via AWKAF (establishment of charity) Inhabitants were maintaining their districts and participating in taking decisions too.

Public amenities relied on 3 principles: mixture (mixing), assembling and decentralization. Mixing functions and then assembling them, here we notice economy in land because this can minimize the need for transportations. We can remark also distribution of amenities in a studied way that is called (decentralization).

- **Principles of a house designing:** The house that is designed according to sustain criterions should be constructed from its environment and should benefit from the capacities of its environment.

The residence relied on linked and attached principles starting from the ground pacification, the know how to design the choice of building materials, the systems of constructing till the reach of architectural details and the environmental solutions that go in harmony with the nature of heat climate. The house design was done according to social needs not to individual ones, even if the house is being destroyed other can use its components (used materials) because they can be re-used. There are other principles:

- The court: It is a past from the whole vacant area. It orientates vacants in ward.
- Organization of vacant areas: Vacant areas are used in multi functions (economy of space).
- Environmental treating: Houses could realize natural ventilation, breeze and air conditioning according to solutions that neglect resources of energy totally.
- Preservation of energy: Concepts of sustain focus on auto energy (self energy) for economic, sanitary and environmental causes and looking for new energies.
- The economic dimension: It focuses on less consuming of resources, land, water ...to save them for next generations and realizing self satisfaction and the use of vacant areas for different functions. This dimension is measured through the achieved social in come.

All these principles could be combined and modified in order to use them as indicators of planification and designing for sustainable development projects according to the diversity of society, climatic affects, social values and civilization heritage.

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