UNVEILING THE MORPHOLOGY OF SAHARAN HERITAGE: EXPLORING URBAN HERITAGE IN THE ALGERIAN SAHARA

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ABSTRACT

This study is dedicated to exploring the Ksuran heritage of the Algerian Sahara, aiming to reveal the abundance and variety embedded within each ksar. Employing a comprehensive analytical approach, we meticulously examine four fundamental aspects: the urban layout, the dwellings, the materials utilized, and the construction techniques employed. To accomplish this research, extensive field visits were conducted, encompassing photography, on-site surveys, and engaging discussions with experts to gain profound insights into the distinctive characteristics of each region. Our findings unveil a remarkable and diverse heritage, exhibiting variations from one region to another, ultimately reflecting the unique traditions and capabilities of the Saharan population.

Keywords: Saharan Ksar, Algerian Heritage, Ksar of Ouargla, Ksar of Ghardaia, Ksar of Guemar, Ksar of Kenadsa, Ksar of Tamentit.

Introduction

Heritage possesses significant developmental potential and serves as a means of fulfilling various artistic, aesthetic, and recreational needs. It encompasses multiple values of existence, as noted by HANAFI et al. (2021). Over time, heritage has evolved from an individual concept to a collective one, and from a sectoral perspective to a global perspective, highlighting its broad and ethical nature (HAMMOUDI, 2014).

According to CHOAY (1988), heritage has its origins in the familial, economic, and legal structures of a stable society, deeply rooted in a specific space and time. Urban heritage, in particular, represents the collective memory of a city, encompassing its overall landscape and portraying the distinctive characteristics of a specific historical era (WANG, 2011). However, when the term "urban heritage" is mentioned, many planners and managers tend to primarily think of "monuments," inadvertently excluding historic residential areas and city centers, which also hold significant importance as urban heritage (STEINBERG, 1996).

Heritage, as highlighted by HANAFI et al. (2021), goes beyond being a mere witness and marker of history, serving as a boundless source of inspiration for architecture, art, and urban planning.

The urban heritage in Algeria embodies a remarkably diverse and multifaceted reality. From the ancient "medinas" in the agricultural plains and coastal areas, to the colonial towns, and the extensive chain of ksur spanning from southern Morocco to southern Tunisia, the
urban heritage of Algeria is undeniably rich (COTE, 2005).

The term "Ksar" derives from the Arabic word "Qasr," meaning castle or fortified village, which itself originates from the Latin term "Castrum," denoting a fort or stronghold. In Berber, the equivalent terms are "Ighrem" or "Akham."

According to MAZOUZ, a ksar etymologically refers to a palace and represents a fortified complex constructed primarily for defensive purposes (MAZOUZ in COTE, 2005). These complexes exhibit a distinct architectural form characterized by densely clustered dwellings constructed using traditional local materials such as pisé or toub (HAMMOUDI, 2014).

The pronunciation of the word is "Gsar," resulting from a phonetic alteration of the Arabic root "qasr," which signifies something short or limited. It denotes a confined space accessible only to specific social groups, reserved for their exclusive use (Mousaoui, 1994).

A ksar denotes a collection of closely packed houses forming a compact habitat enclosed by defensive walls and often marked by watchtowers. This traditional form of habitation emerged due to a combination of physical, historical, and socio-economic factors (AIT EL HAJ, 2006).

The strategic distribution of Saharan Ksur is notable, with some located along trade routes traversing the desert, such as the gold routes connecting African countries like Ghana, Mali, and the Sahara with North African cities. Others were situated in areas with access to water sources. Consequently, the Sahara hosted various types of Ksur scattered across numerous regions, including valleys such as the MIZAB valley, the ZIBAN, the SOUF, the RIGH, the MYA, the GOURARA, the TOUAT, and more (AHRIZ et al., 2017).

The Algerian Sahara, in particular, showcases the captivating architecture of the Ksurian style, which eloquently expresses a social configuration shaped by centuries of accumulated knowledge. This architectural expression is prevalent across the various Ksurian regions of the Sahara, particularly among the Zénètes and the Mozabites. These human settlements not only preserve the intricate organization of social relationships but also provide inhabitants with a sense of security and thermal comfort due to the ingenious craftsmanship and expertise of their builders.

The ksur of the northern Sahara in Algeria stand out for their diverse traditional architecture, utilization of local building materials, and unique construction techniques. The builders of these ksur ingeniously worked with the available resources, taking into consideration the specificities of the desert region (MAHOUR, 2011; LABTAR & BELGUERNIN, 2021).

Ksurian architecture represents an exceptionally rich heritage (COTE, 2005). Regardless of their geographical location, these human settlements have undergone significant spatial transformations over time. This evolution is a consequence of the ongoing process of urbanization since independence. On one hand, this urbanization process has provided an opportunity for certain ksur to persist by undergoing restructuring and revitalization. On the other hand, it has marginalized other ksur, which now exhibit a structure that can no longer adapt or integrate with new living practices and the evolving urban dynamics. As a result, these marginalized ksur are experiencing advanced degradation in terms of both habitat conditions and social life.

With the aim of furthering our understanding of the distinctive urban and architectural characteristics of the ksur in the Sahara, our study has the following objectives:

- Analyze the urban structure of the ksar: By examining the layout, organization, and spatial arrangement of the ksur, we aim to identify the key elements that contribute to their unique urban form.
- Investigate traditional houses: We will explore the architectural features, design principles, and functional aspects of the traditional houses within the ksur, aiming to uncover their significance in expressing the cultural identity and lifestyle of the inhabitants.
- Explore materials and construction techniques: We will examine the specific building materials, such as pisé or toub, as well as the construction techniques employed in
different regions. This analysis will help us understand the adaptation of architectural practices to the desert environment and the factors influencing material choices.

- Deepen understanding of ksour in the Algerian desert: Through our comprehensive investigation, we seek to enhance our knowledge and appreciation of the ksour as significant cultural and historical entities in the Algerian desert. By highlighting their unique qualities, we aim to contribute to the preservation, documentation, and promotion of this rich architectural heritage.

1-Methodology

1-1-Methods:
The present study aims to comprehensively examine the heritage of ksour in the Algerian Sahara, focusing on their diversity and richness. To achieve this objective, an analytical approach will be employed, with specific attention given to the unique characteristics of each ksar. The analysis will be conducted based on four main components: the urban fabric analysis, habitat analysis within each ksar, analysis of construction materials, and analysis of construction techniques. In order to gather relevant data, a diverse database has been established through the following methods (Figure 1):

- Site visits to the ksour under study, accompanied by knowledgeable guides who can provide insights into the specificities of each ksar.
- Documentation through photography, capturing visual representations of the ksour and their architectural elements.
- Creation of sketches and house plans, allowing for a detailed examination of the layout and structure of the dwellings within each ksar.
- Engaging in discussions with the inhabitants of each ksar, aiming to gather firsthand information and extract valuable insights regarding their traditions, customs, and architectural practices.

Fig. 1. Flowchart of research methodology incorporated in the study

1-1-Study area:
The study covers a range of ksour located in different regions of the Algerian Sahara, specifically the Mzab Valley, Oued Mya, Saoura, Oued Souf, and Touat. These regions represent distinct areas within the Sahara, each with its own unique characteristics and cultural influences. By examining ksour from these diverse regions, we gain a comprehensive understanding of the various architectural styles, construction techniques, and cultural nuances that shape Saharan settlements. (Figure 2).

1-2-1-The ksour of Ghardaïa (M’zab country)
The Mzab region is a natural area located in the northern Sahara within the province of Ghardaïa, Algeria, approximately 600 km south
of Algiers. It encompasses a valley that is home to a group of five ksour, which exhibit a distinct architectural style and have been collectively recognized as UNESCO World Heritage sites.

The Ibadites, who are part of the Zenâta Berber ethnic group, migrated to the Mzab region from various cities, including Basra and Kufa in Iraq, and Tiaret in North Africa. They settled in the region after the fall of their native city, Sédrata, in the 11th century. The Ibadites form a unique community in Algeria, choosing to reside in the secluded and inaccessible desert area known as Chebka to practice their religious rites in peace (MARÇAIS, 2004).

1-2-2-The Ksar of Ouargla (The valley of Oued Mya):

The Ouargla region encompasses the captivating lower valley of the Oued Mya. This majestic river originates from the Tademaït and gracefully converges with the Oued Mzab and the Oued N’sa, ultimately flowing into the Sebkhet Safloune, situated 20 km north of Ouargla (CHAOUCHE, 2007).

At the heart of Ouargla lies its cherished ksar, an exceptional monument steeped in the history of the Sahara and cherished as a vital national heritage. The ksar’s significance lies in its sheer scale, intricate complexity, unique urban design, and historical allure (KADRI et al., 2015).

The ksar is enclosed by a fortification wall, punctuated by an array of seven gates. Each gate offers an entrance to a different thoroughfare within the city, although (DELHEURE, 1988) only mentions three gates. Notable among these gates are Bab Ahmid, Bab Azzi, Bab el Boustan, Bab Boushak (Bab Sultan), Bab Rebia, Bab Djedid, and Bab Ammar (GHERRAZ, 2013).

1-2-3-The Ksar of Kenadsa (The Saoura)

The Saoura region, nestled in southwestern Algeria, is characterized by the convergence of the Saoura, Guir, and Zouzfana valleys at Igli, forming a picturesque and historically significant valley (MERZOUGUI et al., 2013).

Renowned for its traditional earthen habitat, the Saoura region boasts a well-established network of human settlements, adhering to the urban model of the Islamic medina. Amongst these settlements, the ksar of Kenadsa stands as a testament to the region’s architectural heritage. Spanning an expansive area of 11 hectares, the ksar of Kenadsa comprises two distinct sections, each representing different historical periods. The first is the kasbah of ‘Sidi Elhadj,’ while the second consists of a cluster of urban entities (BOUTEBBA & MILI, 2014; MOUSSAOUI, 2013). The inception of the Kenadsa ksar dates back to the 15th century during the reign of the Saâdean dynasty when a tribe led by the revered saint Sidi El Hadj Abderrahmane sought refuge in the region. The kasbah served as the initial nucleus of the ksar (BOUMEZBEUR, 2011).

1-2-4-The Ksar of Guemar (valley of Souf)

The birth of the town in the 16th century revolved around three pivotal elements: the mosque of Sidi Messaoud, the market, and the zawiya.

The initial expansion occurred in the northern direction, centered around an arborescent road stretching from west to east (Dahraoui Gate located to the north). In the 18th century, the town experienced a second phase of development with the establishment of Ouled Hamid, resulting in a north-south arborescent layout (Bab el Gharbi gate).

A third significant development took place in the eastern part of the town, marked by the establishment of the Zawiya. This new section featured a more open and extroverted grid system, expanding its connections to the surrounding areas.

The Zawiya of Tijania, founded in the late 18th century, was positioned slightly away from the town’s central core, straddling the boundaries of the older urban area.

1-2-5-The Ksar of Tamentit (The Touat)

The Tamentit oasis, situated 10 km south of Adrar, is strategically positioned in the longitudinal band of the Touat, serving as a crucial link between the north and the south. Bordered by the Tedmaït plateau to the east, the Great Western Erg to the west, the Zaouïa oasis to the north, and the Bou Faddi oasis to the south, it occupies a significant geographical location. This oasis holds immense importance as a vibrant commercial crossroads, connecting
caravan routes and serving as a melting pot of diverse civilizations and cultures.

The inhabitants of the Tamentit oasis comprise a composite society with a rich tapestry of ethnic and cultural backgrounds. Zenets, Berbers, Arabs, Jews, and African Harratins coexist in this oasis, fostering a dynamic internal environment conducive to development and evolution. This cultural diversity has transformed Tamentit into an alluring city, attracting traders and travelers alike who seek the vast opportunities for cultural exchange, commerce, and communication it offers.

Fig.2. Case of study (Authors, 2023)

2- Results and discussion
2-1-The ksur of Ghadaïa (M’zab country)
2-1-1-The urban fabric

The urban fabric of Ghadaïa stands out as a unique exception among urban forms in the Sahara. The Mozabite space follows a precise and well-defined order, reflecting a distinct social structure and conveying a sense of coherence and rigor. It is a city where various elements converge, including the specific culture of its people, the arid and extreme climate, and limited resources (RAVEREAU, 1988). The city's development adheres to a radio-concentric scheme, with the mosque occupying a central role as a strategic element around which the entire city revolves. The mosque serves to preserve unity, foster community intimacy, and maintain the established order (see Figure 3). The urban fabric is characterized by its compactness, density, and overall homogeneity.

Fig.3. (A) The marketplace in the ksar of Ghadaïa (Authors, 2012) (B) An alley in the ksar of Ghadaïa (C) the mosque of the ksar of Ghadaïa
2-1-2-The traditional Mozabite houses:

The traditional houses in the Mzab valley are designed with a ground floor, a first floor, and a roof, with some variations in their configurations. Certain houses may even have a basement serving as a vestibule. The height of these dwellings generally does not exceed 7.50 meters. Most houses have a rectangular layout, although irregular patterns can be found, shaped according to the rocky structure of the soil.

The connection between the house and the public space (the street) is established through a chicane or "skiffa" entrance, strategically designed to maintain the privacy of the household from outsiders. This entrance features a door made of palm wood beams located in one of its corners. Internally, the rooms are arranged around a central courtyard known as "wast el dar," which serves as a light well and creates an introverted living environment (see Figure 4).

The courtyard serves as the focal point of the dwelling, both in terms of its shape and the spatial organization of the surrounding areas. It is typically covered, except for a window that serves as a ventilation opening, allowing natural light and fresh air to circulate between the ground floor and the first floor. The roof of the courtyard is supported by beams running through its center and parallel to the corners of the ventilation opening. In some cases, these beams are replaced by two or three columns.

![Fig.4. Plan of a Mozabite house (Authors, 2023)](image)

2-1-3-Building materials:

Given the fluctuating temperatures in the Mzab region, the local inhabitants have adapted their choice of building materials to ensure durability, insulation, and aesthetic appeal.

One fundamental building material used in the construction of houses in the Mzab Valley is stone. The local stone available is predominantly limestone, varying in size, and utilized in its natural, rough form for constructing walls and pillars. Flat stones are employed for closing openings and roofing purposes, providing a sturdy and stable surface.

Another widely employed building material is Tibchent, a reddish gypsum material found abundantly in quarries along the banks of the Mzab Valley. Locally referred to as "kedam" or "hjarelkef," Tibchent serves as a support material and is used in roofing alongside palm tree trunks and leaves obtained from the region’s oases. Additionally, lime, earth, and gravel are mixed to create a composite material used for constructing certain levels of the residential structures.

The utilization of these locally sourced materials not only addresses the region’s climatic challenges but also ensures a harmonious integration with the natural surroundings, reflecting the inhabitants’ deep connection with their environment.

2-2-The Ksar of Ouargla (The valley of Oued Mya):

2-2-1-Urban Fabric (A Harmonious Socio-cultural Tapestry):

The ksar of Ouargla, akin to other Sahara cities, exhibits a spatial organization that impeccably caters to the socio-cultural and economic needs of its residents. It represents a functional space that embodies the compact arrangement, reflecting the cohesion of its social fabric. The interplay between social morphology and urban morphology has fostered a flourishing social life within its walls (BOUCHMELO &
CHAOUCHÉ, 2015). This compact circular entity boasts a high density and exhibits a strong structure, prominently defined by significant landmarks such as the mosque (Figure 5).

Fig.5. The urban fabric of the old ksar of Ouargla (GHERRAZ, 2013)

2-2-2-Traditional Houses in Ouargla (Timeless Architectural Splendor):

Within the ksar, every house shares remarkable architectural and spatial characteristics, irrespective of variations in plot shapes, sizes, and locations. The Ouarglie house epitomizes the quintessential Saharan dwelling, typically constructed on a rectangular plan that emphasizes depth over width. These inward-facing abodes possess a facade wall that stands solid and unadorned, devoid of any openings except for a single entrance door. Delightfully, each house features an inner courtyard and a terrace, both shrouded in an aura of privacy. The entrance to the terrace is thoughtfully shielded, adding an intimate touch to the fabric of the city, artfully organized according to a hierarchy that upholds the cherished values of the Arab urban tradition (Figure 6).

Fig.6 (A) Renovated housing in the ksar of Ouargla  
(B) Ruined housing in the ksar of Ouargla (Authors, 2012)
2-2-3-Building materials
The construction of dwellings in the region showcases a rich array of building materials, prominently featuring mud bricks and stones. These materials have a profound impact on the height and thickness of the walls, resulting in diverse construction methods. In some instances, multiple techniques and materials are skillfully combined to enhance the durability of the structures or achieve specific aesthetic objectives. This creative blending of techniques and materials not only ensures the longevity of the dwellings but also adds a touch of visual appeal to the architectural landscape.

2-3-The Ksar of Kenadsa (The Saoura)
2-3-1-The urban fabric
The spatial arrangement of the ksar is meticulously crafted with a dual purpose: to facilitate independent lives for the various quarters while ensuring the unity of the entire community. At its core, the Zaouia (Islamic religious community) and the new Ben Bouziane Mosque stand as a nucleus, around which the different parts of the ksar revolve, distinguished by their morphology, function, and social status of the inhabitants (Figure 7).

Located in the center, the district of the "Mrâbtin" accommodates the nobles (Shurfâ) and notables, who are descendants of Sidi M’hassan Ben Bouziane. They reside in magnificent residences known as "Dwiriyat." Surrounding this nucleus, in the lower part of the ksar, lies the original ethnic group, the "Thata," and the "El-malah" quarter, where the Jewish population resides. In the upper part, migrant populations have settled, seeking the blessed "Baraka" bestowed by the Sheikh. The configuration of the ksar faithfully reflects the ethnic composition and socio-economic organization of the community (Figure 7, B).

Numerous droub (trails) within the ksar bear the names of genealogical groups, such as derb Dkhîsa, Hjâwa, A’mûr, Hmiyyân, and Ulâd Sîdî `Alî. Others are named after specific trades, like Darb al-haddâda (street of blacksmiths) or the fakhkhâra.

Two main roads run through the ksar: Derb Es Souk and Derb Dkhissa. Several public places link these two axes: the ksar square, the mosque square, the Sidi M’barek fountain, the cemetery and its mausoleums, Bit El Khalwa and the Sheikh’s house (Figure 8).

![Fig.7. Urban entities of the Kenadsa ksar (BOUTABBA & MILI, 2014)](image)

![Fig.8. the different types of roads in the ksar of Kenadsa (BOUTABBA & MILI, 2014)](image)
2-3-2-The traditional houses of Saoura:
Most houses in the area typically comprise a ground floor and a roof, which serves as an open space accessible via a staircase and ladder positioned in one corner of the house. The roof area spans the entire footprint of the house and serves multiple purposes. Some sections are designated for storage, hanging laundry, or housing poultry. Enclosing this rooftop area is a low wall, not exceeding half a meter (0.50 m) in height. During hot summer nights, the rooftop becomes an inviting space for sleeping, while during the day, it is utilized by women for drying clothes and grains. Particularly for children, including young girls, the roof serves as an ideal playground for their favorite games.

To enter a residence, one passes through palm wood doors, immediately encountering a hollowed-out area known as the Matmoura. Just beyond the Matmoura lies the courtyard, which serves as a central hub connecting various parts of the house. From the courtyard, one can access different rooms, including the Lebiout (bedrooms) and the guest room, which is distinctly separated from the other rooms to ensure privacy and hospitality.

The Dwiriyat (Figure 9) represents a collection of exceptionally splendid dwellings, showcasing the diverse and rich artistic craftsmanship prevalent in the city. These remarkable structures stand as a testament to the mastery of various arts and crafts within the community, exemplifying the beauty and cultural heritage of the region.

Fig. 9. (A) and (B) architectural ornamentation in the ksar of Kenadsa (C) and (D) the Dwiriyat at the ksar of Kenadsa

2-3-3-Building materials:
The houses were built with large bricks made locally from clay and sand. They are generally rectangular and vary in size from 0.10m to 0.15m thick, 0.20m wide, and 0.40m long. Clay is mainly used to build the outer walls, which are locally called al-high. Their thickness often varies between 0.40m and 0.60m. Their foundations are no more than one-meter-high and are usually built of medium-sized stones, bound with clay mortar.

2-4-The Ksar of Guemar (valley of Souf)
2-4-1-The urban fabric:
- The urban fabric is characterized by a strong presence of mosques, with approximately ten notable ones.
- The cemetery stands out due to its extensive size and the presence of straight streets.
- The plots of land in the area are regular in shape, typically consisting of four to six modules.
- Traditional meeting places can be found throughout the town (refer to Figure 10).
- A West-East gap has been established, connecting the national road N°3 to the vicinity of the town center.
- In 1997, the Algerian public authorities, with support from UNESCO, initiated a renovation project. This included facade restoration, enhancement of the shops (such as doors, friezes, and plaster), focusing on the western gap and the old market.
2-4-2 The traditional houses of Souf:
- The houses feature an internal courtyard, typically square in shape, around which the living rooms are arranged. This layout consists of repetitive modules controlled by domes, ranging in height from 1.60 to 1.80 meters. Each room usually encompasses two to three modules.
- The orientation of the houses is influenced by the external topography of the land. Meanwhile, the interior spaces are designed to meet various requirements, including social and climatic considerations (refer to Figure 11, A and B).
- Notable transformations can be observed in the western and northern peripheries of the area. These include elevations, terraces, and the use of materials such as breeze block and red brick.

2-4-3 Building materials:
The Sufi habitat embodies the use of local materials, particularly Timchent, which contribute to its distinctive character. The traditional dome design transitions into vaults, with widths ranging from 80 to 90 cm. These vaults are supported by sturdy palm trunks and reinforced with metal beams, allowing for more spacious rooms within the structure (Figure 11, B).

Fig.10. Organizational diagram of the Ksar of Guémar (evolution through time)

Fig.11. (A) courtyard of a traditional Sufi habitat
(B) Plan of a traditional Sufi habitat (Authors,2023)
2-5-The Ksar of Tamentit (The Touat)

2-5-1-The urban fabric:
Tamentit is characterized by a continuous group of kasbahs and ksur (Figure 12 A), seamlessly interconnected and arranged on both sides along the main east-west axis, leading towards the lush palm grove. These architectural entities are delineated by sturdy ramparts, with entrances marked by distinctive thresholds and unique architectural treatments. The urban fabric within these entities showcases a remarkable compactness, reflecting a deep-rooted concern for efficient use of space and rationality. The layout of roads is irregular, featuring narrow alleys and covered passages, some of which culminate in dead ends, contributing to the charming complexity of the urban environment.

The morphological diversity of the ksur presents a captivating richness, stemming from the fusion of various cultures and ethnicities. The Berber Taorirtes, the Arab-Islamic Kasbahs, and the Jewish ksur each contribute their unique urban forms, further enriching the tapestry of Tamentit’s architecture.

A well-defined urban spatial hierarchy is evident, with a progression from public to private spaces, manifested through the hierarchical system of streets, alleys, cul-de-sacs, and individual houses.

The presence of rahbats (squares), serving as meeting places and hubs of exchange, also plays a significant role in the structural and spatial organization of the city. They act as focal points at the intersections and junctions of different lanes, contributing to the overall urban landscape (Figure 12, B).

2-5-2-Housing in Tamentit:
- The introverted orientation or blind facade to meet the bioclimatic and socio-cultural need (privacy) (Figure 13, A);
- The interpretation of privacy through spatial hierarchy from the outside in: (entrance door, transitional baffle, West eddar, and the different rooms and inner rooms...Etc). (Figure 13, B);
- Spatial rationality introduces in the dimensioning of the rooms, the arrangement of the toilets in elevation and next to the external walls to facilitate the recovery of waste.
- The dwellings generally contain three levels, and the spaces are nomadic in use, with the Dahliz (basement) and the ground floor often being used day and night in winter, and only during the day in summer, while the terraces are used during the day in winter, and at night in summer.
Building materials:
- The use of local materials such as stone, clay or Toub (in the form of bricks or other) and palm trunks for roofing;
- In its totality, the physical state is dilapidated, with ruins dominating the oldest parts of the ksour, and partial decay in the rest;
- We note the existence of in-situ renovations in a complete way at the level of the Zaouia of Sidi Ouali, and in a partial way in some dwellings of the other ksour.

Discussion (summary of the analysis):
After conducting a comprehensive study and analysis of the urban fabric, housing, materials, and construction techniques, it is essential to provide a concise synthesis to emphasize the similarities and differences among the ksour within the study corpus. The table presented below (Table 1) provides a summary overview of these commonalities and distinctions.

Table 1. Summary of the analysis of the ksours

<table>
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<tr>
<th>All the ksur</th>
<th>Similarities</th>
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<tr>
<td></td>
<td>The ksour in the study corpus exhibit various similarities and shared characteristics, which include:</td>
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<td></td>
<td>✓ Strong connection to agriculture, with each Ksar located within its own palm grove, except for Guemar.</td>
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<td>✓ Delimitation of the Ksar through the use of ramparts.</td>
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<td></td>
<td>✓ Site selection based on considerations of security and refuge.</td>
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<td></td>
<td>✓ Very dense urban fabric with closely spaced buildings.</td>
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<td></td>
<td>✓ Narrow and winding streets, contributing to a maze-like layout.</td>
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<td></td>
<td>✓ Urban spatial hierarchy, with a clear progression from public to private areas.</td>
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<td></td>
<td>✓ The souk (marketplace) and the mosque serving as prominent and structuring elements of the urban fabric.</td>
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<td></td>
<td>✓ Housing plans designed to prioritize privacy for the inhabitants.</td>
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<td></td>
<td>✓ Retention of the chicane entrance in houses, ensuring a level of privacy and security.</td>
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<td></td>
<td>✓ The courtyard serving as the central space within the house.</td>
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<td>✓ Utilization of local materials sourced from the region for construction purposes.</td>
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<td>These shared characteristics highlight the cultural and functional aspects that shape the ksour and contribute to their distinct identity.</td>
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<td>Differences</td>
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<td>Tamentit, as a settlement, can be described by the following characteristics:</td>
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<td>✓ Tamentit is comprised of a cohesive cluster of kasbahs and ksour that are interconnected and aligned along a primary axis, forming a continuous urban structure.</td>
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<td>✓ The urban fabric of Tamentit is notably compact, with buildings closely situated and densely arranged, contributing to a sense of intimacy and interconnectedness.</td>
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<td>✓ Rahbats, designated meeting and gathering places, play a significant role in Tamentit’s social and cultural life, serving as vibrant spaces for exchange and interaction.</td>
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<td>✓ The houses in Tamentit typically span three floors, reflecting verticality in their design. Various types of houses can be found, showcasing architectural diversity within the settlement.</td>
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<td>✓ Local materials indigenous to the region, such as stone, clay, and Toub (bricks or other forms), are commonly utilized in construction. Palm trunks are employed for roofing, further emphasizing the use of natural and locally available resources.</td>
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<th>Ksar of Ghardaia</th>
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<td>The Ksar of Ghardaia, in particular, showcases several distinctive features that set it apart from the other ksour:</td>
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<tr>
<td>✓ It is situated on a sloped site, nestled between a plateau and a valley floor.</td>
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<td>✓ The presence of vertical elements is notable, such as the minarets of mosques, which add height and verticality to the cityscape.</td>
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<td>✓ The city's development follows a radio-concentric pattern, with structures radiating outward from a central point.</td>
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<td>✓ A significant feature is the Central Mosque Square, serving as a focal point for religious and community activities.</td>
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<td>✓ The market, on the other hand, is positioned eccentrically, adding a dynamic element to the urban fabric.</td>
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<td>✓ Houses in Ghardaia typically consist of a ground floor, a first floor, and an accessible terrace, providing additional outdoor space for the residents.</td>
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<tr>
<td>✓ The courtyard, an integral part of the house, is covered by a shebek, offering shade and protection from the sun.</td>
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<tr>
<td>✓ Stone is a fundamental construction material used in the Mzab, contributing to the durability and solidity of the houses.</td>
</tr>
<tr>
<td>✓ Tibchemt, another prevalent construction material in the Mzab valley, is commonly utilized. It is a mixture of lime, earth, and gravel.</td>
</tr>
<tr>
<td>✓ Vaults are employed in construction to distribute weight evenly across the walls. Tibchemt and sand mortar or lime mortar are commonly used as coverings.</td>
</tr>
</tbody>
</table>
## Differences

<table>
<thead>
<tr>
<th>Ksar of Ouargla</th>
<th>The Ksar of Ouargla possesses distinct characteristics that differentiate it from the other ksur:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>✓ It is situated on a flat site surrounded by a dense palm grove, creating a lush and green environment.</td>
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<tr>
<td></td>
<td>✓ The urban fabric of Ouargla is divided into three parts, reflecting the presence of three distinct ethnic groups within the community.</td>
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<td></td>
<td>✓ The habitat plan follows a rectangular layout, with houses being deeper in length rather than width.</td>
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<td></td>
<td>✓ Within the courtyard, there is a covered area known as Al-Sabat, providing sheltered space for various activities.</td>
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<td></td>
<td>✓ The rooms in the houses are typically rectangular in shape, aligning with the size of the wooden elements used for the roof structure.</td>
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<tr>
<td></td>
<td>✓ The construction materials used in Ouargla include bricks, mud bricks, and stones, which contribute to the solid and sturdy nature of the buildings.</td>
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<tr>
<td></td>
<td>✓ Palm wood, palm trunks, fronds, along with earthen soil, sand, and tibchemt, are utilized for the roof covering, incorporating locally sourced materials into the construction.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ksar of Kenadasa</th>
<th>The Ksar of Kenadasa exhibits distinctive characteristics that shape its urban fabric:</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>✓ The spatial organization of the urban fabric mirrors the social stratification within the ksar, reflecting the different social categories and their spatial distribution.</td>
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<tr>
<td></td>
<td>✓ The urban fabric is structured around two main axes that are interconnected by public spaces, creating a cohesive layout for the community.</td>
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<td></td>
<td>✓ The majority of houses in Kenadasa consist of a ground floor and a roof, with the architectural focus on these two levels.</td>
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<tr>
<td></td>
<td>✓ Notably, the Dwiriyat, which are splendid dwellings, stand out as residences belonging to the affluent class within the ksar.</td>
</tr>
<tr>
<td></td>
<td>✓ The houses in Kenadasa were constructed using large bricks, clay, and sand. Their rectangular shape is a distinctive architectural feature.</td>
</tr>
<tr>
<td></td>
<td>✓ Clay serves as the primary material for building the exterior walls of the houses, contributing to their strength and durability.</td>
</tr>
</tbody>
</table>
Differences

The Ksar of Guemar exhibits distinct features in its urban fabric:

✓ The urban fabric revolves around three central elements: the SidiMessaoud mosque, the market, and the Zawiya, which serve as focal points and anchor the community.
✓ Multiple gates provide access to the ksar, creating a network of roads that resembles a branching tree, facilitating movement and connectivity.
✓ The fabric is characterized by its high density, with closely situated plots that contribute to a vibrant and bustling environment.
✓ The living rooms in the Sufi habitat follow a specific architectural pattern, featuring a succession of domes or vaults, creating a visually striking interior.
✓ The housing in the Ksar of Guemar can be categorized into three types: traditional houses with domes, traditional houses with vaults, and modern houses constructed with new materials.
✓ The Sufi houses, in particular, are constructed using local materials known as "Timchent," which are specific to the region.
✓ The transition from domes to vaults in the Sufi houses is achieved by supporting the vaults on palm trunks and metal beams, enabling the creation of more spacious rooms.

By comparing these characteristics, we can gain insights into the unique qualities and variations among the studied ksur, shedding light on the diverse architectural heritage and cultural significance within each of them.

Conclusion:

The ksur, reminiscent of fortified villages with their reddish and sandy hues, represent the oldest form of construction in the Sahara. They serve as places of harmonious coexistence between nomadic and sedentary populations, often concealed within fertile areas and along ancient caravan routes.

Within this study, we have sought to highlight the remarkable richness and diversity of this Saharan heritage. The vast desert landscape is characterized by varied climates and living conditions, giving rise to a mosaic of human settlements that differ from one region to another. It is through the exploration of these unique characteristics that we gain a deeper appreciation for the remarkable resilience and ingenuity of the people who have thrived in this challenging environment.

The study corpus encompasses a diverse range of ksur, each representing a distinct Saharan region within Algeria, including Mzab, Oued Mya, Oued Souf, Saoura, and Tout. Through a comprehensive analysis of four key aspects of each ksar—urban fabric, habitat, materials, and construction techniques—this study reveals both similarities and differences among them.

Despite their unique characteristics, these Saharan ksur share a sense of unity, particularly in terms of their location, site selection, and spatial organization. The study highlights the commonality in the implantation process and the hierarchical arrangement of these settlements. However, differences arise when considering factors such as the morphology and shape of the ksur, their relationship with the surrounding palm groves, and their rural or urban nature. Variances can also be observed in the layout and design of living spaces within the dwellings, the number of rooms and floors, as well as the materials and construction techniques employed.

Ultimately, this study demonstrates how the indigenous populations' knowledge and their fundamental requirements for water and shelter have contributed to the creation of a distinct Saharan landscape. This landscape serves as a tangible expression of the traditions and cultures that characterize each society within the region.
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