

Article

Morphological Transformation of a Saharan Ksar: A Diachronic and Relational Reading of Spatial Structure in Béchar, Algeria

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Abstract

Saharan ksour are undergoing a profound transformation as urbanization spreads, building practices change, and old functions give way to new ones. Their architecture and building materials have been studied extensively. What has not been documented is how these pressures reshape the spatial relations that bind a historic core's parts together. This matters because it is morphological continuity, not architectural fabric alone, that keeps a historic settlement legible once it is absorbed into a modern city. This study addresses that gap through a diachronic morphological reading of the Ksar of Béchar, in southwestern Algeria. It traces seven structuring components, the perimeter wall (Essour), defensive towers (Bordjs), gates (Bâb), the alley network (droub), collective open spaces (Rahbas/Nouader), the El Masdjid El Atik mosque, and the housing stock, across more than a century of change. The analysis draws on a triangulated corpus of historical archives, redrawn historic plans, archival photographs, 1952 and 1962 aerial imagery, recent satellite imagery, field observations, and testimonies from long-standing residents. Rather than comparing historical and current states at the level of individual components alone, the relational reading combines two analytical levels: it traces the differentiated trajectories of the seven components while simultaneously examining the persistence, transformation, and recomposition of the spatial relations between them across documented temporal states. This relational analysis reveals two differentiated morphological trajectories and one cross-cutting process. The defensive envelope (Essour, Bordjs, Bâb) has fragmented and largely disappeared. The internal structures (droub, Nouader, the mosque, housing) show strong spatial permanence beneath their architectural and functional change. And across all seven components, spatial relations have been recomposed as a system, progressively opening the once-enclosed core to the surrounding city. The Ksar of Béchar's evolution is therefore neither integral conservation nor outright erasure. It is a relational recomposition in which peripheral, boundary-defining elements erode while internal structuring relations persist. Beyond this case, the study offers a transferable, source-triangulated analytical framework for reading morphological recomposition in Saharan and other vernacular historic settlements, one directly usable in heritage conservation and historic urban landscape management strategies.

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1. Introduction

Historic urban cores are among the most exposed spaces to the pressures of contemporary urbanization. Their evolution shows up not only as the transformation or disappearance of individual buildings, but as a slower recomposition of the spatial relations that once structured them. This has pushed historic fabrics to be read as dynamic systems shaped by continuous adaptation, permanence and transformation, rather than as fixed heritage ensembles [1,2]. Recent work continues to refine this understanding through layered, GIS-supported readings of change management in historic settlements [3] and through public-value-oriented approaches to regenerated historic districts [4]. This view aligns with UNESCO's Historic Urban Landscape (HUL) approach, which asks that built structures, open spaces, spatial organization and their wider territorial setting be read together rather than in isolation [5].

This shift has fed directly into the renewal of urban morphology as a field. Since the foundational work of Muratori [6] and Conzen [7], the discipline has moved from describing built form toward explaining the mechanisms behind its change. That trajectory now runs through markedly more quantitative territory. Recent contributions include systematic reviews of spatial measurement methods [8], machine-learning and big-geodata approaches to reading morphological vitality [9–11], and fine-grained pattern extraction at meso- and micro-scale [12]. Historical GIS in particular has become central to reconstructing long urban trajectories, letting historic street networks, boundaries and functional zones be traced across successive states rather than compared only at two points in time [13,14]. A recurring finding across this literature is that the disappearance of a material element does not automatically erase its morphological role. Street networks, land-use patterns and settlement genes can keep structuring a historic fabric well after the elements that produced them have gone [15], a distinction between the permanence of structure and the transformation of built form that is now treated as one of urban morphology's central contributions to conservation practice.

Defensive and boundary components of historic settlements have drawn particular recent attention, since they are typically the first casualties of urban integration. Comparative work on the sites left behind by demolished city walls in Paris, Beijing and Moscow shows a consistent sequence: demolition and planning, redevelopment, and eventual reflective reuse, regardless of the very different political contexts involved [16]. Similar dynamics of disconnection and vulnerability tied to the erosion of a historic fabric's original boundaries and street order have been documented from Baghdad [17] to Haifa Street in the same city [18], suggesting that the fragmentation of an enclosure and the loosening of its internal order are not specific to any one region but a recurring feature of historic cores absorbed into expanding cities.

Research on Saharan ksour has, for its part, contributed substantially to understanding their architecture, construction techniques, bioclimatic adaptation and building materials [19–21]. Recent work on earthen architectural heritage in Algeria's Gourara region documents the factors driving the abandonment of traditional building techniques and the documentation strategies available to counter it [22], while studies of vernacular housing in the Souf region trace how identity is expressed through construction materials and spatial features specific to that context [23]. Broader surveys of Saharan Algerian ksour, including Ouargla, Ghardaïa, Guemar, Kenadsa and Tamentit, have likewise mapped the diversity of urban layout, dwelling type, material and

technique across the region [24]. Elsewhere in North Africa, the regeneration of Fez's medina illustrates how tourism-driven urban renewal can either revitalize or further destabilize a historic fabric depending on how it is managed [25].

Despite this substantial body of work, most of it remains centred on individual buildings, construction techniques, or the historic quarter's overall evolution treated as a single block. Studies that examine several structuring components of a historic core together (enclosure, towers, gates, circulation network, collective spaces, religious buildings and housing) and track the spatial relations between them over time are considerably rarer, and rarer still for the ksour of southwestern Algeria specifically. Existing diachronic studies generally trace the transformation of individual elements or compare successive states of the urban fabric, whereas fewer studies examine how several components and their spatial relations change together over time. Where a component's disappearance or persistence is documented, it is generally interpreted on its own terms rather than as part of a system in which the transformation of one element reshapes the role of the others. The fragmentation of an enclosure, for instance, can alter what a gate does and how internal routes relate to the surrounding city, just as a persistent circulation network or collective space can keep parts of an old spatial order legible despite substantial change in the built fabric around it.

The literature reviewed here converges on two limitations relevant to this study. First, current diachronic and HGIS-based methods are well developed for tracing single elements or an urban fabric's overall footprint, but less often treat the relations among several structuring components as an explicit object of analysis across successive states.

Second, within Saharan Ksar research specifically, the transformation of individual components (walls, gates, materials, dwellings) is comparatively well documented, but how these transformations interact, and how their combined trajectories reshape a Ksar's relationship to the surrounding city, remains largely undocumented, particularly for the ksour of southwestern Algeria.

This study addresses that gap by proposing a diachronic, multi-component relational reading of the Ksar of Béchar, built on seven structuring components (Essour, Bordjs, Bâb, droub, Rahbas/Nouader, the El Masdjid El Atik mosque, and housing) analyzed both individually and through their evolving spatial relations, rather than as isolated case studies of architecture or materials. Its originality lies in two contributions. Methodologically, it operationalizes a source-triangulated, multi-component analytical framework, in which the trajectories of the seven components are examined together with the changing spatial relations between them. The framework cross-references archives, redrawn historic plans, historical photographs, 1952 and 1962 aerial imagery, recent satellite imagery, field observations and residents' testimonies, and is transferable to other Saharan and vernacular historic settlements with similarly fragmentary documentation. Substantively, it shows that the Ksar of Béchar's evolution is neither integral conservation nor outright disappearance, but a relational recomposition. Peripheral, boundary-defining components erode while several internal structuring relations persist. This pattern becomes visible only when components and their relations are examined together.

2. The Ksar of Béchar: A Laboratory for Morphological Evolution

2.1. *Geographical Setting and Oasis Environment*

The Ksar of Béchar is located within the urban area of Béchar, in southwestern Algeria, where it constitutes one of the main historical cores of the city. Originally associated with an oasis environment, the Ksar has progressively become integrated into an expanding urban fabric shaped by successive phases of urban development. Its current spatial configuration therefore reflects the interaction between an inherited Ksar structure, the surrounding oasis landscape, and the urban growth that has developed around it over time. The Ksar now forms

a historical urban core surrounded by buildings, streets, and road networks established during different periods of urbanization. Its geographical position within Algeria and its location in relation to the present-day urban area are shown in Figures 1 and 2.



Figure 1. Geographical location of Béchar in Algeria [19].

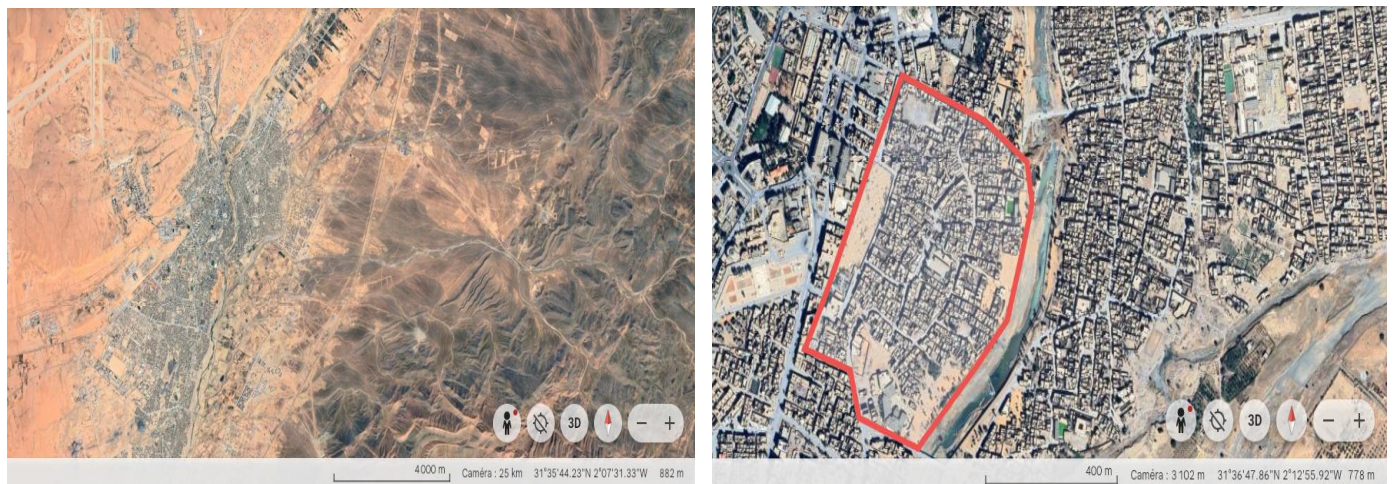


Figure 2. Satellite location of the Ksar of Béchar within the city of Béchar. Source: Google Earth; imagery date displayed by the platform: 3 July 2025.

The choice of the Ksar of Béchar as a study area is based on several characteristics. On one hand, it constitutes one of the main oasis settlements of southwestern Algeria that has undergone progressive integration into a modern urban agglomeration. On the other hand, the availability of a documentary corpus spanning more than a century, including historical archives, old maps, aerial photographs, satellite images, and field observations, makes it possible to trace morphological transformations through a diachronic approach.

Finally, the coexistence of still legible ancient structures and recent urban transformations offers a particularly favorable context for analyzing morphological recompositions.

Its historical settlement was embedded in an oasis environment combining the oued, the palm grove, gardens, and cultivated land. This configuration linked water resources, agricultural activities, and inhabited space. Proximity to the oued was an important condition for access to water and for the functioning of cultivation, while the palm grove and gardens formed the immediate productive environment of the core. Together, these elements formed a territorial organization in which residential space and cultivated areas were closely associated [26,27].

At the regional scale, Béchar also occupied a position within the routes of movement and exchange connecting settlements across southwestern Algeria. The Ksar was thus embedded both in a local environment structured by the oued and by cultivation, and in a broader territorial system.

The current situation differs considerably. The expansion of Béchar has progressively surrounded the old core and altered its relationship with the spaces that once formed its immediate environment. This gradual urbanization has profoundly transformed the interfaces between the historical core, the palm grove, and contemporary urban extensions. The Ksar therefore constitutes a particularly relevant case for examining the effects of changes in its territorial environment on the organization and legibility of its morphological structures.

2.2. Formation of the Historic Core and Development of Colomb-Béchar

The precise origins of the Ksar of Béchar remain difficult to establish. Available sources provide information on its organization, its inhabitants, and its relations with the palm grove, but they do not allow a single foundation date to be established with certainty. Despite these chronological uncertainties, the available documents make it possible to reconstruct with sufficient precision the morphological organization of the old core at the beginning of the twentieth century (Figure 3).

Sources from the late nineteenth and early twentieth centuries describe a compact settlement, protected by an enclosure and associated with the agricultural activities of the oasis. The core presented a dense built mass, broadly delimited by the Essour. The Bordjs reinforced certain points along this boundary, and the Bâb concentrated the passages between the interior and the exterior. Inside, the droub organized access to dwellings and connections with the mosque and collective spaces [28,29].

A significant change in context occurred in the early twentieth century with the establishment of French military and administrative presence. The arrival of French troops in 1903 accompanied the creation and progressive development of Colomb-Béchar. New administrative, military, and commercial functions appeared around the old core. This evolution did not lead to an immediate disappearance of the Ksar or of its agricultural environment. Documents from the early and mid-twentieth century instead show a coexistence between the Ksar, the palm grove, and the new spaces of Colomb-Béchar. After independence, urban expansion progressively intensified the integration of the core into a more extensive agglomeration.

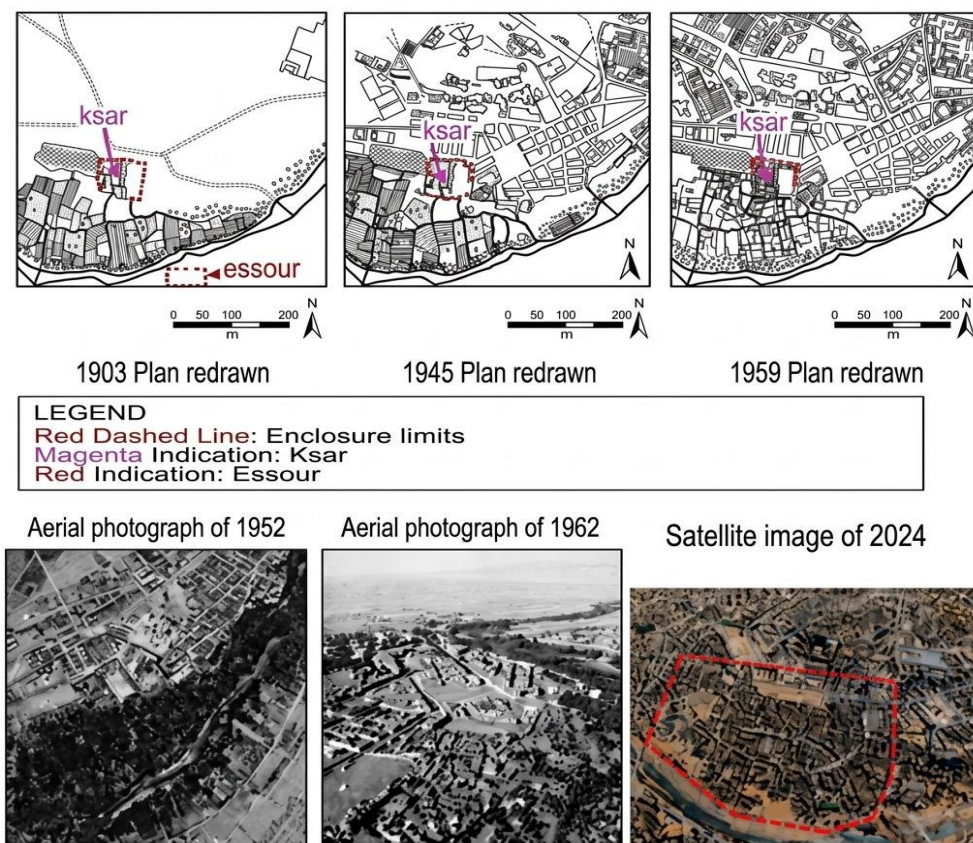


Figure 3. Formation of the historic core and development of Colomb-Béchar through cross-referenced documentary sources: redrawn plans, aerial photographs, and satellite imagery from different dates.

These various historical stages do not constitute merely a succession of chronological events. They also reflect a gradual evolution in the relationships between the old core, its oasis environment, and the newly urbanized spaces. They thus form the historical context within which the morphological transformations examined in the following sections take place.

2.3. From Oasis Ksar to Historic Core Integrated into the City

The comparison of the documented states highlights a progressive transformation of the Ksar's territorial situation (Figure 4). Initially embedded in an oasis environment clearly differentiated from built spaces, it now constitutes a historical core surrounded by the urban fabric of Béchar. This transformation concerns first its immediate environment: the agricultural spaces that once surrounded it have been partially replaced by constructions, facilities, and roadways. The relationships once established with the palm grove and the gardens have thus changed in nature.

This territorial evolution has also altered the conditions under which the various components of the core function and are perceived. The enclosure, the gates, the network of droub, the collective spaces, the mosque, and the dwellings have followed different trajectories of transformation. The issue at stake is therefore not only to identify the material changes affecting each of these components, but to understand the consequences of these transformations for their relative organization and for their relationships with the urban environment.

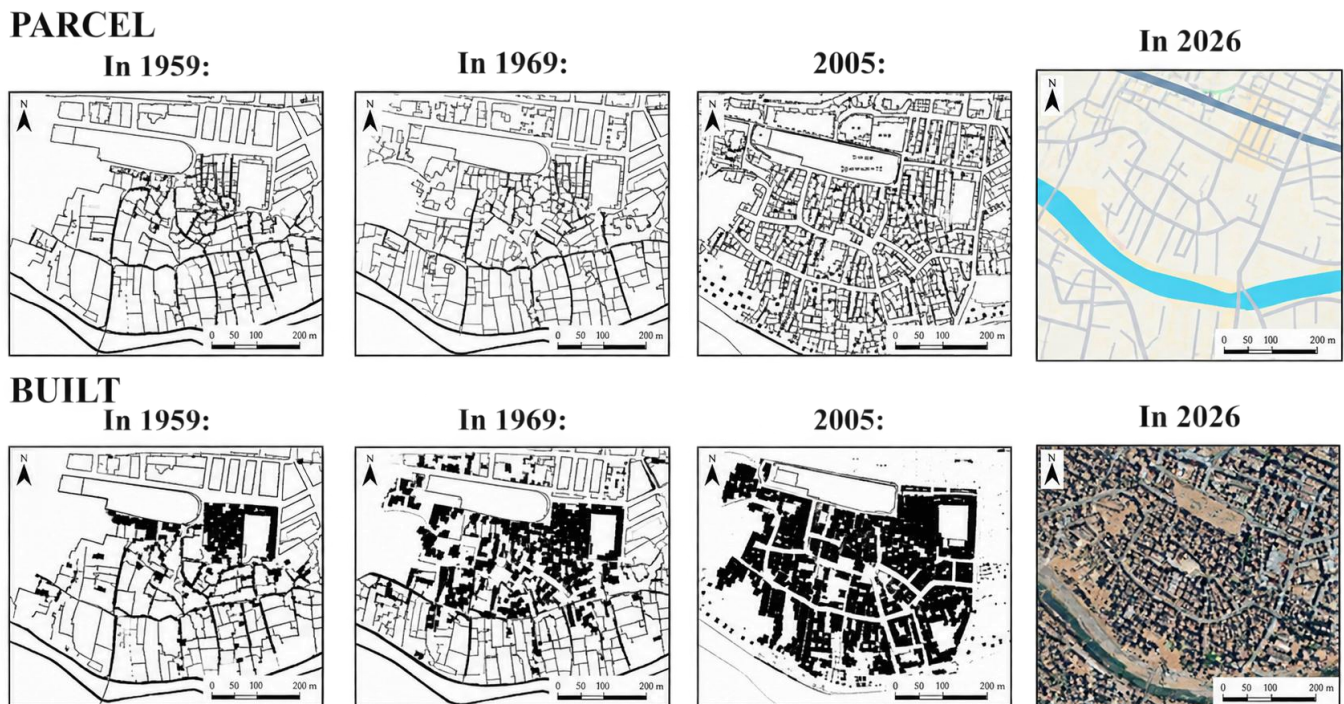


Figure 4. Progressive transformation of the Ksar's territorial context through a comparison of documented states.

The development of the city around the Ksar thus constitutes the main explanatory context for the observed transformations. However, the analysis focuses less on the general evolution of the Béchar agglomeration than on the effects of this urbanization on the internal organization of the historical core and on the relationships between its different components. This distinction allows the scope of the study to remain centered on the external morphology of the Ksar's core, without extending the analysis to the entire peripheral evolution of the city.

2.4. Conceptual Framework for the Morphological Analysis

The proposed analysis is situated within the field of urban morphology, which considers the city as the result of a continuous process of formation, transformation, and recomposition of urban forms [2,6,7,30]. From this perspective, the Ksar is understood not as an assemblage of independent elements, but as a morphological system composed of interacting components.

The term morphological component refers here to a structuring element participating in the spatial organization of the historical core. Seven components are considered: the Essour, the Bordjs, the Bâb, the Droub, the Rahbas, the El Masdjid El Atik mosque, and the dwellings. Each is examined both in terms of its own characteristics and in terms of the relationships it maintains with the other components.

The notion of morphological transformation refers to the changes observed in the form, position, dimensions, function, or spatial relationships of a component over time. Conversely, morphological permanence refers to the persistence of a spatial, functional, or structural characteristic despite successive urban changes.

The analysis is also based on the concept of morphological recomposition, understood as the progressive reorganization of the relationships between the different components of the Ksar under the effect of urban transformations. This notion does not necessarily imply the disappearance of ancient structures. It also accounts for situations in which certain components remain in place while their functions, interfaces, or

relationships with other elements evolve. The approach thus goes beyond a simple description of built elements to focus on the spatial and functional interactions that structure the historical core.

Finally, the approach is based on a diachronic reading, consisting of comparing several documented states in order to identify continuities, ruptures, and trajectories of change in the morphological components. This reading makes it possible to distinguish transformations that are genuinely observable from differences that may result from the nature or precision of the available documents.

In this study, relational recomposition is treated as an analytical object in its own right rather than as a conclusion derived only from the separate trajectories of individual components. It refers specifically to changes in the configuration, intensity, hierarchy, or meaning of the spatial relationships connecting the components of the Ksar. These include boundary–access relations between the Essour and the Bâb, enclosure–circulation relations between the Essour and the Droub, circulation–centrality relations between the Droub, the mosque, and Nouader, and built–interface relations between the Droub and the residential fabric. Relational recomposition is identified when a transformation in one component modifies the role, accessibility, continuity, hierarchy, or territorial interface of another, even when the latter remains physically present. This distinction allows the analysis to differentiate between the material transformation of a component, its permanence, and the reorganization of the relationships through which it participates in the morphological system.

3. Methodology

3.1. Methodological Approach

This research adopts a qualitative approach based on a diachronic morphological analysis. The objective is to identify the transformations of the main components of the Ksar of Béchar and to analyze their effects on the spatial organization of the historical core. The analysis relies on a comparison of several documented states spanning from the end of the nineteenth century to the contemporary period. The principles of urban morphology are used as an interpretive framework, while being adapted to the specificities of the oasis context and to the nature of the documentary corpus.

3.2. Construction of the Documentary Corpus

The diachronic morphological analysis of the Ksar of Béchar is based on a diversified documentary corpus, comprising historical, cartographic, iconographic, and contemporary sources. Given the absence of a single document capable of accurately capturing the evolution of the old core, the approach adopted favors the cross-referencing of complementary sources produced during different periods. This strategy makes it possible to reconstruct several morphological states of the Ksar while limiting the biases associated with the nature, precision, or purpose of each document.

The corpus includes historical archives, old photographs, historical plans redrawn from the original documents, aerial photographs, a recent satellite image, field observations, and testimonies from former inhabitants, as well as scientific publications used for the interpretation of certain transformations (Figure 5). Each category of documents provides specific information on the components studied and contributes to the diachronic reconstruction of the historical core.

The historical aerial photographs from 1952 and 1962 were used as documentary and visual sources for the diachronic morphological analysis. The images were examined to identify the spatial forms and morphological characteristics visible at each documented period, including the built footprint, enclosure limits, open spaces, circulation patterns,

and the relationship between the Ksar and its oasis environment. Their interpretation was based on visual comparison with the historical plans and other documentary sources. Where necessary, the aerial photographs were cropped for presentation in the figures. No georeferencing, orthorectification, spatial resampling, or geometric correction was applied to these historical photographs. Consequently, their use is qualitative and comparative rather than based on metrically calibrated image measurements.

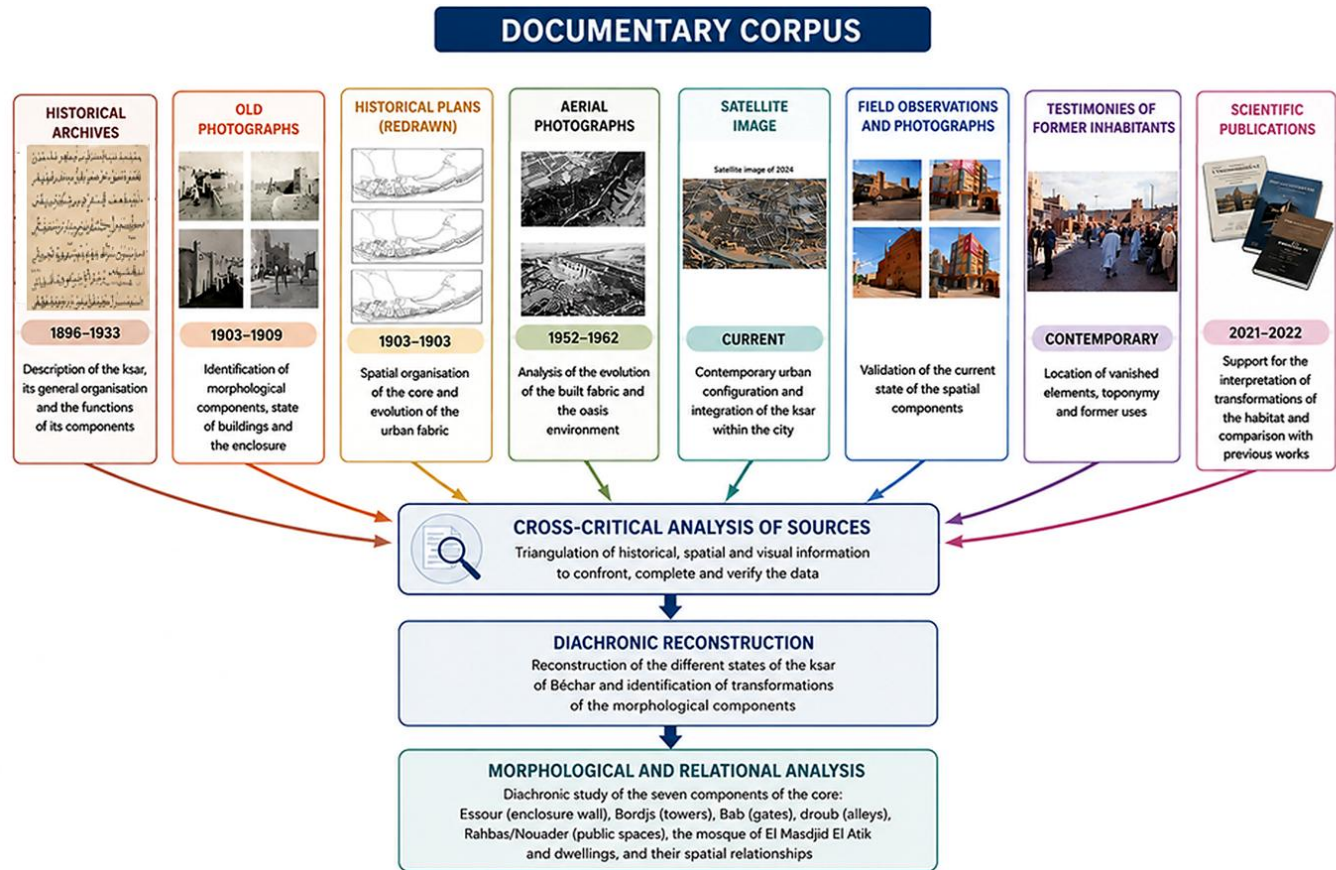


Figure 5. Schematic summary of the analytical approach and the documentary corpus used. Historical Archives (1896–1933): The authors think it’s in Amazigh language.

Figure 5 highlights the complementarity of the sources used, covering a period from the end of the nineteenth century to the present day. Archives, cartographic documents, and old photographs make it possible to reconstruct the historical states of the Ksar, while aerial photographs, the satellite image, and field observations document its evolution up to the contemporary period. Testimonies from former inhabitants and scientific publications complement this analysis by providing qualitative information useful for interpreting certain transformations. In order to strengthen the reliability of the results, no source was used in isolation; interpretations are systematically based on the critical cross-referencing of several independent documents.

The historical plans presented in this study correspond to graphic reconstructions produced based on documentary searches in the archives of the Wilaya of Béchar and consultations with local technical services, including the Direction of Urban Planning and Construction (DUC) and the hydraulic services. The cartographic inventory lists plans dated 1903, 1936, 1959, and 1969 in the Wilaya archives; a parcel-subdivision plan of the Ksar dated 1962 (scale 1:2000); and the 2005 urban plan supplied by URBAT Béchar. Supporting plan documents dated 1901, 1941, 1945, 1948, 1959, 1962, and 1969, as well as

historical photographs dated 1903 and 1909 and aerial photographs from 1952 and 1962, were used to reconstruct and cross-check the documented states.

The plans presented in this article are author-prepared analytical reconstructions rather than facsimiles of single original sheets. The analytical state labelled 1903 was drawn using plans dated 1901 and 1941; the 1945 state was reconstructed from plans dated 1945 and 1948 and the 1959 state used documents dated 1959 and 1962. The contemporary state was based on the URBAT Béchar plan dated 2005.

3.3. Operationalization of the Morphological Analysis

The analysis is based on the systematic study of the seven morphological components identified in the conceptual framework. For each of them (Figure 6), several indicators are observed in order to ensure a consistent reading of the transformations.

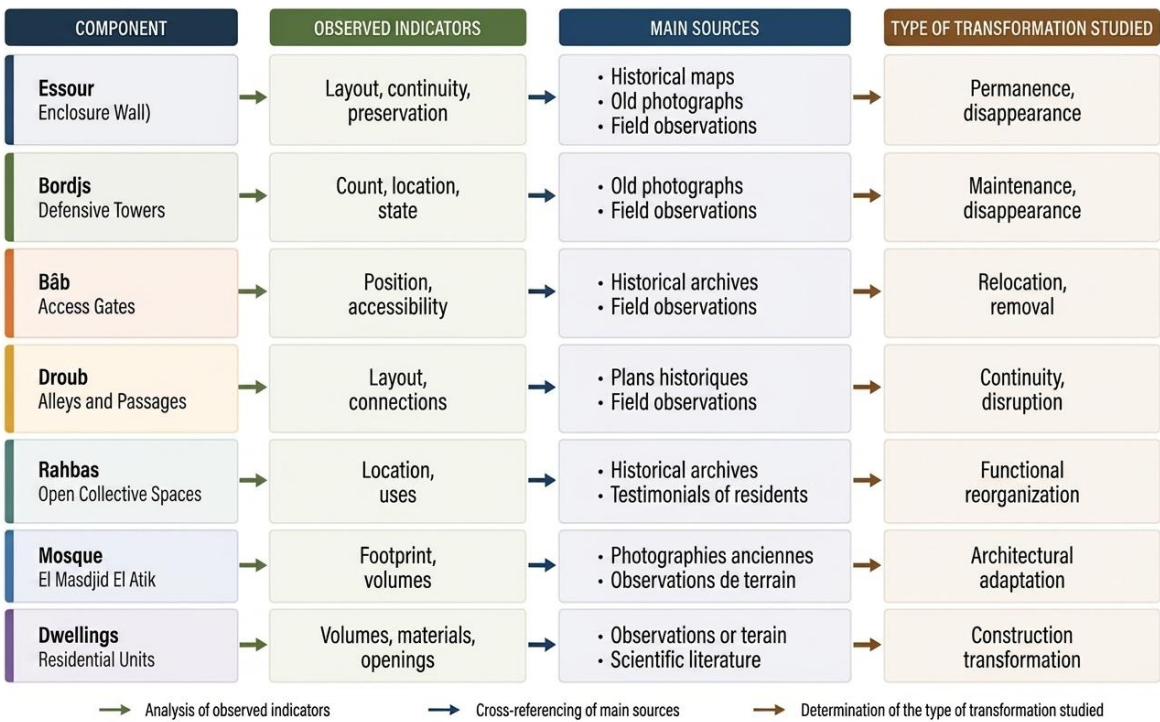


Figure 6. Analytical framework for the morphological components of Béchar’s Ksar.

Each indicator was assessed qualitatively by comparing corresponding morphological states across the documentary corpus. For each component, changes were examined through three complementary dimensions: physical form, function, and spatial relationships. Physical changes included modification, extension, fragmentation, or disappearance; functional changes concerned the persistence, transformation, or loss of the component’s role; and relational changes concerned changes in position, accessibility, adjacency, connectivity, or functional interfaces with other components. The conceptual categories defined above were operationalized by identifying persistence where a component or spatial relationship remained legible despite physical or functional change, transformation where significant changes occurred in form, function, or spatial relationships, and recomposition where the differentiated trajectories of several components modified their organization and relationships within the Ksar and its surrounding urban fabric. These criteria guided the classification of observed changes, with each category assigned on the basis of the evidence provided by the cross-referenced documentary sources (see results tables).

3.4. Analytical Procedure

The morphological analysis was conducted according to a progressive four-step procedure, allowing a transition from data collection to the interpretation of the transformations of the Ksar's components.

The first step consisted of a critical reading of the documentary corpus. Each source was examined according to its date, origin, scale, mode of production and purpose in order to assess its degree of reliability for the morphological analysis. The discrepancies observed between certain documents were not systematically interpreted as transformations, but were compared with other sources in order to distinguish actual changes from differences linked to the conditions of representation or production of the documents.

The second step involved reconstructing the Ksar's key morphological stages by cross-referencing historical documents. Features identifiable in each source—such as Ksar boundaries, building footprints, plot layouts, circulation routes, open spaces, and connections to the palm grove, gardens, and wadi—were mapped and then redrawn using consistent graphic conventions, including north arrows and scale bars. Given the varying scales of the source documents (1:5000 for 1945; 1:6000 for 1903, 1959, 1969, and 2005; and 1:2000 for the 1962 parcel plan), the drawings were graphically harmonized to facilitate morphological comparison, without implying metric equivalence or uniform georeferencing. Gaps in the historical plans—particularly regarding plot layouts, built structures, and **droub** (alleyways)—as well as the incompleteness of the 1962 parcel plan, were taken into account. Any reconstruction based on indirect sources or oral accounts was treated as an interpretation, and morphological changes were included only when supported by corroborating evidence. These drawings thus serve as a basis for qualitative morphological comparison, ensuring that documentary gaps are not mistaken for actual physical transformations.

The third step consisted of comparing successive states in order to identify the transformations affecting each of the seven morphological components. For each component, the analysis addressed changes in form, position, dimensions, function, state of conservation, as well as spatial relationships maintained with the other components. The categories of persistence, transformation, fragmentation, disappearance, and functional reconfiguration were assigned according to the evidence obtained from comparable documents, with a transformation retained only when it could be directly observed or confirmed by several converging sources.

The fourth step was devoted to the interpretation of the observed transformations. This interpretation was not limited to describing the modifications of each component taken in isolation, but sought to understand the morphological recompositions resulting from the evolution of their spatial and functional relationships. The results were thus placed within the broader context of Béchar's urban expansion in order to explain the mechanisms that led to the transition from an oasis settlement organized around its enclosure to a historical core integrated into the contemporary urban fabric.

3.5. Data Reliability and Study Limitations

The diversity of the documentary corpus requires a continuous critical reading. Differences observed between two documents are not systematically interpreted as morphological transformations. They may result from differences in scale, precision, purpose, or mode of representation.

Certain components, particularly the Droub, the Bordjs, and the Bâb, present discrepancies between historical sources. These situations were addressed through a systematic cross-referencing of archives, photographs, field observations, and testimonies. When information remains insufficient, the proposed reconstructions are presented as reasoned interpretations rather than as certain reconstructions.

5.3 to interpret the sequence of relational recomposition, and the correspondence between the two is made explicit there.

Table 1. Four-phase morphological sequence of the Ksar of Béchar, from the late nineteenth century to the present.

Phase	Main Documentary Basis	Dominant Spatial Condition	Components Most Affected	Principal Relational Change
Phase 1: Late nineteenth-century oasis-Ksar condition	Archival descriptions and historical documentation	Compact core enclosed within an oasis environment	Essour, Bordjs, Bâb, Droub, Nouader, housing	Boundary and access are integrated into a hierarchized internal system
Phase 2: Early twentieth-century colonial transition, 1903–1909	Historical photographs and written sources	Ksar coexisting with emerging military, administrative, and commercial spaces	Territorial surroundings, Bâb–exterior interface, Nouader–oasis interface	The external context begins to change while the internal structure remains largely legible
Phase 3: Mid-twentieth-century reconfiguration, 1941–1962	Historical plans from 1941 and 1945; aerial photographs from 1952 and 1962	Core increasingly surrounded by urbanized spaces	Essour, Bâb, Nouader surroundings, residential fabric, mosque architecture	Access and territorial interfaces become progressively more open and urban-oriented
Phase 4: Contemporary urban-integrated condition	Recent satellite imagery, field observations, and testimonies	Historical core embedded in continuous urban fabric	Defensive envelope, housing, Droub interfaces, Nouader uses	Formerly enclosed system becomes permeable while internal spatial anchors persist

4.2. *The Former Envelope of the Ksar: Essour, Bordjs and Bâb*

The envelope of the Ksar constitutes one of the most structuring components of its morphological organization. It is not limited to the enclosure wall, but results from the functional and spatial association of three complementary elements: the Essour, which materializes the boundary of the core; the Bordjs, which reinforce the strategic points along this boundary; and the Bâb, which organize the exchanges between the interior of the Ksar and its environment.

The diachronic analysis shows that these three components have undergone closely related trajectories of transformation. Their evolution goes beyond the simple disappearance of certain structures and reflects a progressive recomposition of the ways in which the historical core is delimited, protected, and made accessible.

4.2.1. *The Enclosure Wall (Essour)*

Initial morphological state: Descriptions from the end of the nineteenth century present the Ksar of Béchar as a dense core surrounded by a continuous enclosure reinforced by defensive towers [31]. The reconstruction produced from archives, old photographs, and historical plans reveals an enclosure of broadly quadrangular form, adapted to the constraints of the site and not conforming to a regular geometry.

The Essour fulfilled several complementary functions. It first constituted a clearly identifiable physical boundary between the inhabited space and the oasis environment. It also contributed to the organization of circulation by concentrating crossings at the level of the Bâb. Finally, it maintained direct relationships with the residential fabric: in several sectors, dwellings were built against the enclosure wall, while in others, particularly near the gates and towers, the wall formed a distinct structure ensuring the continuity of the defensive envelope.

This configuration gave the Ksar a strong morphological coherence, in which the built boundary, the defensive systems, and the access routes formed an integrated spatial system.

Observed transformations: The available documentary sequence indicates a progressive transformation of the enclosure during the twentieth century. Several sections of the Essour disappeared as a result of demolitions or reconstruction operations, while others were breached to create new accesses or were incorporated into more recent constructions.

Field observations confirm that the enclosure now survives only as scattered fragments. These remnants nonetheless remain identifiable by their thickness, their construction techniques, their siting, and their relationship with surrounding buildings. The comparison between the historical documentation and the current state indicates that the physical continuity that once characterized the envelope of the Ksar has thus given way to a discontinuous boundary, difficult to perceive in several sectors.

Evolution of spatial relationships: The transformation of the Essour has profoundly altered the relationships it maintained with the other morphological components of the Ksar. The fragmentation of the wall has reduced the structuring role of the Bâb by multiplying the possibilities for direct access between the core and the surrounding urban spaces. Dwellings once built against the enclosure now present, in certain sectors, openings or façades oriented toward the outer roadways.

This evolution also affects relationships with the Droub, several of whose routes now lead directly into the urban space without passing through the former gates. The Essour therefore no longer plays its original role as an interface between a clearly delimited interior space and an exterior environment.

Morphological interpretation: The observed transformations do not correspond solely to the material deterioration of the enclosure wall. They reflect a deeper evolution in the spatial organization of the Ksar. The progressive disappearance of the continuity of the Essour is accompanied by a change in the mode of functioning of the historical core, which shifts from a closed, hierarchized, and controlled space to a largely open space integrated into the contemporary urban fabric.

The analysis thus shows that the transformation of the Essour constitutes a major indicator of the morphological recomposition of the Ksar. The former defensive boundary progressively loses its structuring function in favor of a new urban interface resulting from the expansion of the city of Béchar.

Table 2 summarizes the morphological transformations of the Essour and their effects on the Ksar’s spatial relationships.

Table 2. Summary of the morphological transformations of the Essour.

Analysis Criterion	Historical State	Documented Temporal Sequence	Current State	Observed Transformation	Morphological Effects
General configuration	Continuous enclosure surrounding the core	1903–1909: old photographs document the historical enclosure and its associated defensive elements. 1941–1945: historical plans provide additional evidence on the continuity and organization of the enclosure. 1952–1962: aerial photographs provide intermediate evidence of changes in the envelope. The	Discontinuous fragments	Progressive fragmentation of the enclosure	Loss of the continuity of the enclosure

		contemporary state shows fragmented residual elements.			
Main function	Delimitation and protection of the Ksar	Historical state: the enclosure is documented as a structuring and protective boundary. Mid-20th century onward: the available sources indicate a progressive weakening of its delimiting role as the surrounding urban fabric expands. Contemporary state: residual boundary incorporated into the urban fabric.	Residual boundary integrated into the urban fabric	Functional transformation	Disappearance or weakening of the historical boundary function
Relationships with the Bâb	Access concentrated at the gates	Historical state: historical sources document access organized through a limited number of gates. 1952–1962: the aerial photographs provide intermediate evidence of changes in the relationship between the enclosure and the surrounding urban fabric. Contemporary state: multiple connections and openings modify the original access hierarchy.	Multiplication of openings	Reconfiguration of access	New modes of connection with the city
Relationships with the Droub	Routes converging toward the gates	Historical state: the available evidence indicates that the droub were organized in relation to the gates and the enclosure. Mid-20th century onward: the documentary sequence and current observations indicate a progressive development of direct connections between internal routes and the urban street network.	Direct connections to urban streets	Modification of circulation patterns	Reconfiguration of internal–external relationships
Relationships with residential buildings	Houses adjoining the enclosure	Historical state: residential buildings form a relatively coherent interface with the enclosure. Mid-20th century onward: the former peripheral edge becomes increasingly embedded in new constructions and urban extensions.	Integration into recent constructions	Transformation of built interfaces	New articulation between the core and its surroundings

4.2.2. The Defensive Towers (Bordjs)

Initial morphological state. The Bordjs constituted the main reinforcing elements of the Ksar's enclosure. Built projecting from the Essour, they were positioned at strategic points along the envelope in order to ensure its surveillance and defense. Photographs from the early

twentieth century show massive structures, characterized by relatively tall vertical volumes, pierced with small openings, in keeping with the defensive functions attributed to them.

The exact number of these towers nevertheless remains uncertain. Lamartinière and Lacroix [31] mention the existence of four Bordjs, while old photographs allow up to six to be identified. This discrepancy does not permit a definitive conclusion regarding a transformation of the enclosure. It may result from changes that occurred between the two periods of observation, from differences in the interpretation of the documents, or from the limitations inherent to the available photographs. This uncertainty leads to the number of Bordjs being treated as an interpretive datum rather than a definitively established result.

Observed transformations. Current observations show that the Bordjs are now the least legible components of the former defensive envelope. Several towers have disappeared, while others appear to have been deeply altered or absorbed into later constructions. Their identification now relies mainly on cross-referencing archives, old photographs, and field observations.

Comparison of the early twentieth-century photographs with the 1952 and 1962 aerial photographs and with the contemporary state indicates a substantial loss of the visibility of the Bordjs over time. However, the available evidence does not allow the disappearance or transformation of individual towers to be dated precisely.

This evolution results in a progressive loss of visibility of the defensive structures. The projecting volumes that once punctuated the outline of the Ksar have largely been erased, reducing the perceptibility of the elements that structured the former enclosure.

Evolution of spatial relationships. The disappearance of the Bordjs not only alters the architectural appearance of the enclosure. It also affects the spatial relationships that organized its functioning. Initially associated with the Essour, the Bordjs reinforced the most exposed sectors of the envelope and contributed to the hierarchization of the core's boundaries. Their positioning also helped to emphasize the changes in direction of the enclosure wall and to reinforce the perception of the main accesses.

With the progressive fragmentation of the Essour, these relationships have gradually faded. The available evidence indicates a parallel weakening of the relationship between the Bordjs and the enclosure, and the Bordjs no longer serve as morphological markers in reading the outline of the Ksar, which reduces the understanding of its former defensive organization and the hierarchy of its boundaries.

Morphological interpretation. On the basis of the documentary sequence, the evolution of the Bordjs can be interpreted as a progressive loss of the material and visual legibility of the defensive system. Beyond their material disappearance, it is the very structure of the defensive envelope that loses its legibility. The towers no longer fulfill their function of spatial punctuation or visual landmarks, thereby contributing to the transformation of the original defensive system into a fragmented urban boundary, of which only a few remnants still allow its initial organization to be reconstructed.

Table 3 summarizes the morphological transformations of the Bordjs and their effects on the legibility of the former enclosure.

Table 3. Summary of the morphological transformations of the Bordjs.

Analysis Criterion	Historical State	Documented Temporal Sequence	Current State	Observed Transformation	Morphological Effects
Number	Four to six towers, depending on the sources	Early 20th century: several Bordjs are documented in historical photographs. 1952–1962: aerial photographs provide intermediate states of the defensive envelope,	Reduced number, difficult to identify	Progressive disappearance and/or transformation	Loss of continuity of the defensive system

		although individual Bordjs cannot always be identified with certainty. Contemporary state: fewer identifiable towers remain.			
Morphology	Massive projecting volumes	Early 20th century: clearly identifiable projecting defensive volumes. 1952–1962: progressive alteration of the defensive envelope is observable, although the transformation of individual towers cannot always be established. Contemporary state: surviving remnants are altered or incorporated into later constructions.	Remnants or integration into recent buildings	Gradual alteration or disappearance	Erasure of visual landmarks
Function	Reinforcement and surveillance of the enclosure	Early 20th century: the form and location of the Bordjs are consistent with a role in reinforcing and surveilling strategic sectors. Mid-20th century: the available evidence indicates a progressive weakening of this role as the surrounding urban context changes. Contemporary state: the original defensive function is no longer legible.	Function disappeared	Progressive loss of the defensive function	Destructuring of the enclosure
Relationship with the Essour	Reinforcement of strategic sectors	Early 20th century: Bordjs strengthen specific sectors of the Essour. 1952–1962: the relationship remains partly observable at the scale of the defensive envelope, although individual correspondences are uncertain. Contemporary state: the original relationship is increasingly difficult to discern.	Relationships difficult to discern	Progressive fragmentation of the defensive relationship	Reduced legibility of the Ksar's outline
Relationship with the Bâb	Framing of the main entrances	Early 20th century: Bordjs participate in the spatial framing and protection of the main entrances. 1952–1962: this relationship becomes progressively less legible. Contemporary state: most of the original articulation between towers and entrances has disappeared.	Relationship largely erased	Reconfiguration of access	Weakening of the hierarchy of entrances

Figure 8 illustrates the progressive transformation of the Bordj elements through a comparison of historical views with documented conditions in 2005 and 2026.

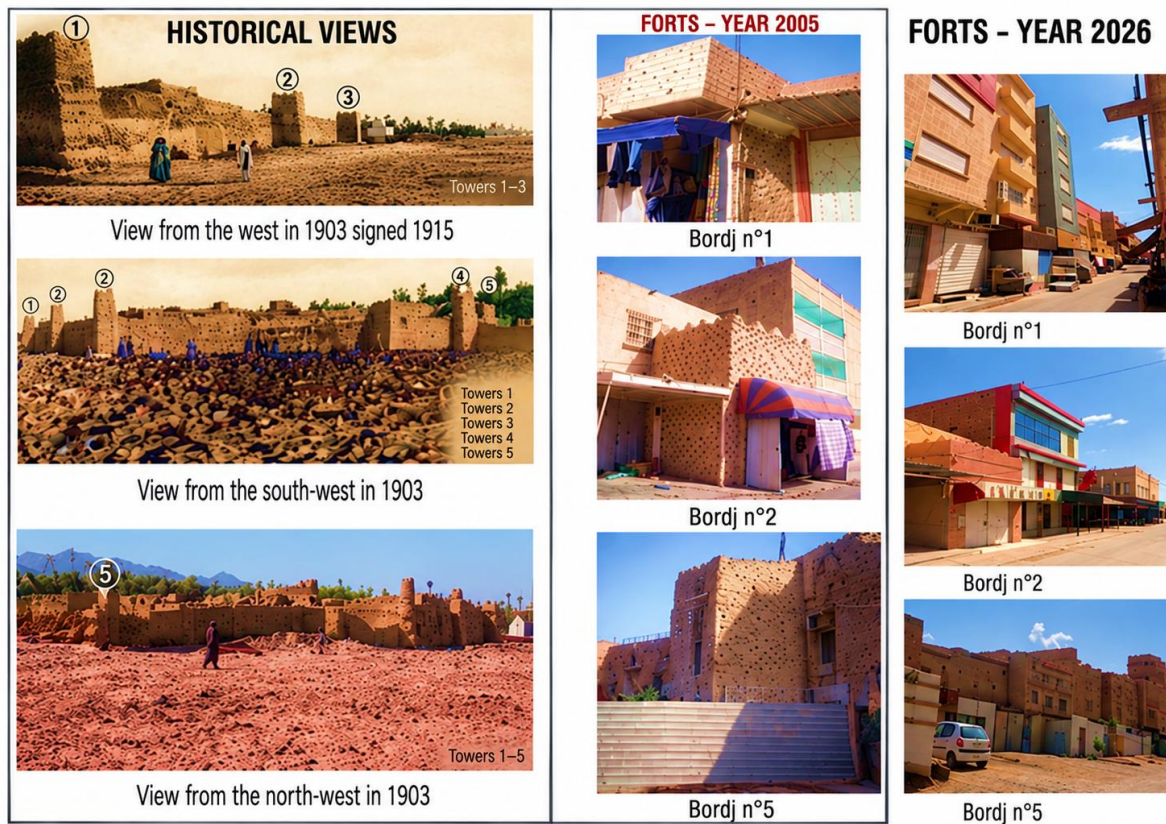


Figure 8. Reconfiguration of the “Bordj” elements over time.

4.2.3. The Access Gates (Bâb)

Initial morphological state. The Bâb constituted the main crossing points through the Essour and organized the exchanges between the interior of the Ksar and its oasis environment. They concentrated circulation flows, ensuring the transition between the external routes and the internal network of Droub. Their position and documented role indicate that they contributed to the hierarchization of accesses and the control of movement.

Analysis of the corpus makes it possible to identify three main gates: Bâb El Kbir, located to the north toward Ouakda, Bâb Sidi Aïssa, to the south, near the cemetery, and Bâb El Neguab, located to the west along a route leading toward the mosque. Testimonies collected from former inhabitants describe Bâb El Kbir and Bâb Sidi Aïssa in particular as relatively wide and tall passages, preceded by entrance spaces comparable to vestibules. This information, drawn from oral memory, is treated as an element of reconstruction rather than as directly verifiable data.

Observed transformations. Comparison of the historical documents reveals several uncertainties regarding the initial configuration of the accesses. Whereas Lamartinière and Lacroix [31] mention only two gates, photographs from the early twentieth century make it possible to identify Bâb El Neguab. The available documents do not, however, make it possible to determine whether this difference results from the later opening of a new access or from an incomplete description.

During the twentieth century, the architectural structures materializing the Bâb underwent progressive transformation or disappearance according to the available documentary evidence. The former crossing structures are no longer preserved in their

original state, although some locations remain identifiable from the routes, the configuration of the Droub, and the remnants observable in the field.

The comparison of the late nineteenth-century descriptions, early twentieth-century photographs, the 1952 and 1962 aerial photographs, and the contemporary state provides a sequence of reference states for the evolution of the access system. However, this sequence does not allow the disappearance or transformation of individual Bâb to be dated precisely.

Evolution of spatial relationships. The transformation of the Bâb is directly linked to that of the Essour. The available evidence indicates that the progressive fragmentation of the enclosure was accompanied by the multiplication of openings, reducing the structuring role of the historical gates in the organization of circulation. Movement between the core and the surrounding neighborhoods is no longer concentrated at a few hierarchized accesses, but now occurs through multiple crossing points.

This evolution also alters the relationships between the Bâb and the network of Droub. The former routes converging toward the gates often remain legible, but their function of organizing circulation has progressively faded in favor of a much more open access system.

Morphological interpretation. The transformations of the Bâb can be interpreted as a shift from a controlled access system, organized around a limited number of crossing points, to an urban configuration characterized by strong permeability between the historical core and the contemporary city. The progressive disappearance of the gates therefore reflects not only the loss of architectural structures. It also reveals a profound recomposition of the Ksar’s modes of accessibility and of the relationships between internal and external spaces.

The Bâb nonetheless retain significant morphological value, insofar as their siting continues to influence the structure of the routes and the historical reading of the old core.

Table 4 summarizes the morphological transformations of the Bâb and their effects on the Ksar’s accessibility.

Table 4. Summary of the morphological transformations of the Bâb.

Analysis Criterion	Historical State	Documented Temporal Sequence	Current State	Observed Transformation	Morphological Effects
Number of entrances	Two to three gates, depending on the sources	Late 19th century: two gates are mentioned by Lamartinière and Lacroix. Early 20th century: Bâb El Neguab is identifiable in historical photographs. 1952–1962: the aerial photographs provide additional reference states for the access system and its relationship with the surrounding fabric, although individual entrances cannot always be identified with certainty. Contemporary state: historical entrances are poorly defined or no longer clearly identifiable.	Historical entrances poorly defined	Progressive disappearance and/or transformation of entrance structures	Loss of the hierarchy of entrances
Function	Control of passage	Late 19th century–early 20th century: historical sources document access through identifiable gates, whose position and role indicate a structured organization of movement into and out of the Ksar.	Open and multiple access points	Functional change	Increased permeability of the core

		1952–1962: the relationship between the entrances and the surrounding urban fabric becomes progressively more open. Contemporary state: access is no longer organized according to the historical gate system.			
Morphology	Monumental gates	Early 20th century: Bâb structures are documented photographically, including the identifiable Bâb El Neguab. 1952–1962: aerial views provide intermediate evidence of the changing envelope, although they do not allow the disappearance of each gate to be dated precisely. Contemporary state: structures survive only as remnants or have disappeared.	Remnants or disappearance	Gradual alteration or disappearance	Erasure of structures and reduced historical legibility
Relationship with the Essour	Concentrated crossings	Late 19th century–early 20th century: historical sources document crossings concentrated at defined entrances through the enclosure. 1952–1962: changes in the relationship between the entrances, the enclosure, and the surrounding fabric become progressively apparent. Contemporary state: the original concentration of crossings is largely lost.	Multiplication of openings	Joint fragmentation of the enclosure and access system	Progressive opening of the Ksar
Relationship with the Droub	Organization of internal pathways	Historical state: the available evidence indicates that the internal droub were organized in relation to the principal entrances. 1952–1962: aerial documents provide intermediate evidence of changing connections between access points, internal routes, and the surrounding urban network. Contemporary state: pathways are preserved in part but no longer display the same hierarchical relationship with the historical gates.	Pathways preserved but less hierarchical	Reconfiguration of circulation	New articulation between the core and the city

Figure 9 compares the historical gates (Bab) of the Ksar in the 1930s with their present-day conditions, highlighting changes in their form, accessibility, and spatial context.

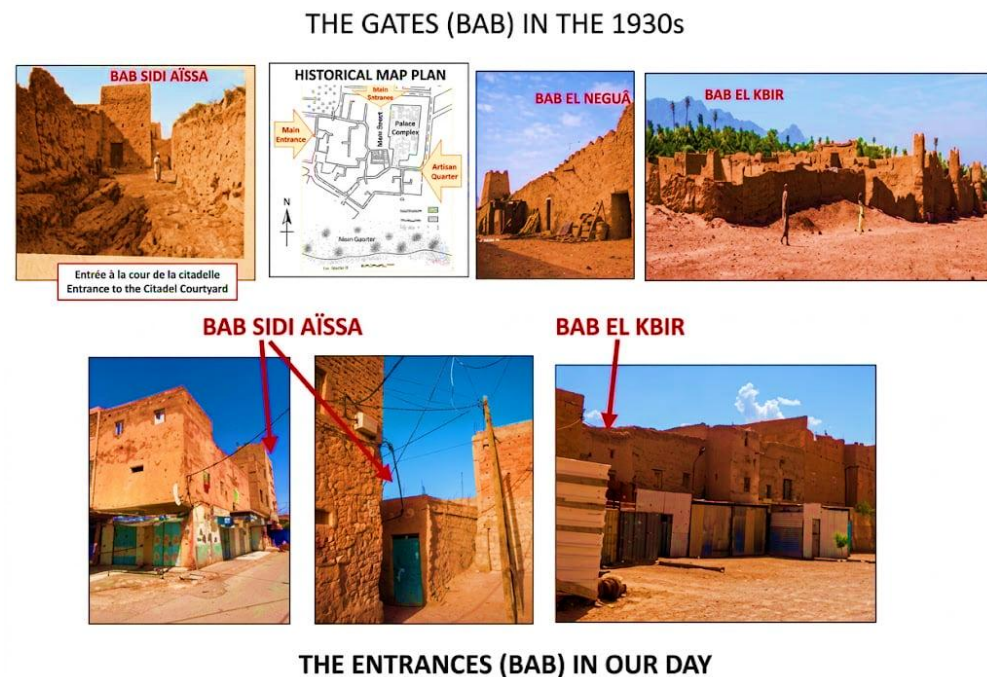


Figure 9. Transformation of the Ksar Gates (Bâb) from the 1930s to the Present Day.

4.3. The Network of Alleys and Passageways (Droub)

Initial morphological state. The network of Droub constituted the main circulation structure within the Ksar. More than a simple set of alleyways, it organized the relationships between the different morphological components of the historical core by connecting the Bâb, the residential sectors, the mosque, the collective spaces, and the gardens located outside the enclosure. The available evidence indicates that this network played a structuring role in the organization of movement within the historical core, contributing to the functional coherence of the Ksar by hierarchizing movement between public, semi-public, and residential spaces.

The initial configuration of the Droub cannot, however, be reconstructed directly from old cartographic documents. Their representation results from an interpretive reconstruction, based on cross-referencing routes still legible in the field, old photographs, the layout of buildings, relationships with the former gates, and testimonies collected from inhabitants. This approach makes it possible to identify the main pathways without claiming to reconstruct the entire original network.

Several routes retain an important place in local memory. From Bâb El Neguab, the Derb Ouled El Hirech led to the mosque, while the Derb El Dhalma served several residential sectors near it. Other routes led toward Bâb Sidi Aïssa, the cemetery, and the former gardens. These names constitute valuable markers for understanding the internal organization of the Ksar, even though their exact location sometimes remains difficult to verify from graphic sources alone.

The available evidence suggests that the Droub were organized hierarchically. Some formed relatively long axes connecting several sectors of the core, while others corresponded to secondary branches serving a limited number of dwellings. This organization is reconstructed from the spatial relations between the surviving routes, buildings, former gates, and other documented components, with several passages occasionally covered by the constructions bordering them.

Observed transformations. Field observations show that the general structure of the network remains largely perceptible today, despite the numerous transformations that occurred during the twentieth century. Several historical routes are still in use and appear

to retain their original layout, supporting the interpretation of a substantial degree of spatial continuity within the core’s internal organization.

Their morphological expression, however, has evolved. Certain previously covered sections have disappeared following the reconstruction or heightening of dwellings. Changes to façades, the introduction of new construction materials, and the diversification of building heights have progressively altered the proportions, perspectives, and spatial atmosphere of the passages.

Contemporary interventions have thus affected the architectural characteristics of the Droub more than their overall organization, although the exact extent of continuity cannot always be established for every route.

Evolution of spatial relationships. The transformations of the Droub take on their full significance when analyzed in relation to the other components of the Ksar. The available evidence indicates that, in the reconstructed historical configuration, the network functioned in close articulation with the Bâb, which concentrated access to the core, and with the dwellings that defined the built boundaries of the routes.

The progressive fragmentation of the Essour and the disappearance of several gates have profoundly altered this organization. The current configuration shows that certain Droub, once connected to the external network solely through the Bâb, now lead directly onto the urban roads created around the Ksar. This opening transforms their role, which is no longer limited to distributing internal circulation but now also participates in the direct connection between the historical core and the surrounding neighborhoods.

Changes to the built fabric also contribute to altering the relationships between the Droub and the dwellings. Reconstructions, heightenings, and the disappearance of certain covered passages progressively transform the spatial sequences that characterized the atmosphere of the traditional Ksar, without, however, calling into question the overall layout of the circulation network.

Morphological interpretation. Unlike the Essour or the Bordjs, whose transformations are expressed mainly through material disappearance, the Droub can be interpreted as illustrating a strong morphological permanence. Their layout appears to remain one of the most stable elements of the Ksar’s organization, even as the buildings bordering them have undergone profound transformations.

Table 5 summarizes the morphological transformations of the droub and their effects on the internal circulation network.

Table 5. Summary of the morphological transformations of the Droub.

Analysis Criterion	Historical State	Documented Temporal Sequence	Current State	Observed Transformation	Morphological Effects
General organization	Hierarchical network connecting the main components of the Ksar	Historical photographs and redrawn historical plans: the main structure of the network is partially documented and further reconstructed through cross-referencing with field evidence and other sources. 1952–1962: aerial photographs provide intermediate evidence of the persistence of the principal routes. Contemporary state: the main layout remains largely recognizable.	Layout largely preserved	Strong persistence with gradual local modifications	Maintenance of the historical street network

Morphology of passages	Narrow, sometimes covered passages	Historical documents and the available spatial evidence indicate the presence of narrow passages and covered sequences within the internal network. 1952–1962: the network remains identifiable, while localized changes in the built edges become progressively apparent. Contemporary state: some passages are widened, uncovered, or modified.	Passages widened or uncovered in some sectors	Modification of built forms and passage profiles	Evolution of spatial sequences
Relationship with residential buildings	Homogeneous earthen façades and covered passages	Historical state: the available evidence indicates that the droub were bordered by relatively homogeneous earthen residential interfaces. 1952–1962: changes in the built environment become progressively perceptible. Contemporary state: material diversification, vertical extensions, and new openings modify the edges of the routes.	Diversification of materials, vertical extensions, and openings	Transformation of built interfaces	Changes in visual perception
Relationship with the Bâb	Access concentrated through the historical gates	Historical state: the available evidence indicates that the internal network was organized in relation to the principal gates. 1952–1962: aerial documents provide intermediate evidence of changing connections between internal routes and the external street system. Contemporary state: multiple connections with urban streets coexist with the inherited network.	Multiple connections with urban streets	Reconfiguration of circulation	Progressive opening of the internal network
Relationship with the external environment	Network oriented toward the interior of the Ksar	Historical photographs and plans, complemented by the reconstruction of the spatial network, indicate that the droub primarily structured internal movement. 1952–1962: the changing urban context becomes increasingly connected to the Ksar network. Contemporary state: the historical routes are integrated into the contemporary street system.	Integration into the contemporary street system	Functional and relational change	Increased permeability between the Ksar and the city

This permanence confirms that the street network constitutes the structuring framework of the historical core. However, the change in the relationships between the Droub, the gates, the dwellings, and the surrounding urban space reflects a progressive

recomposition of their functioning. The Droub thus retain their role in organizing internal circulation, but they now participate in a much more open urban system than the one that characterized the original Ksar. The organization, naming, and transformation of the droub network are summarized in Figure 10.

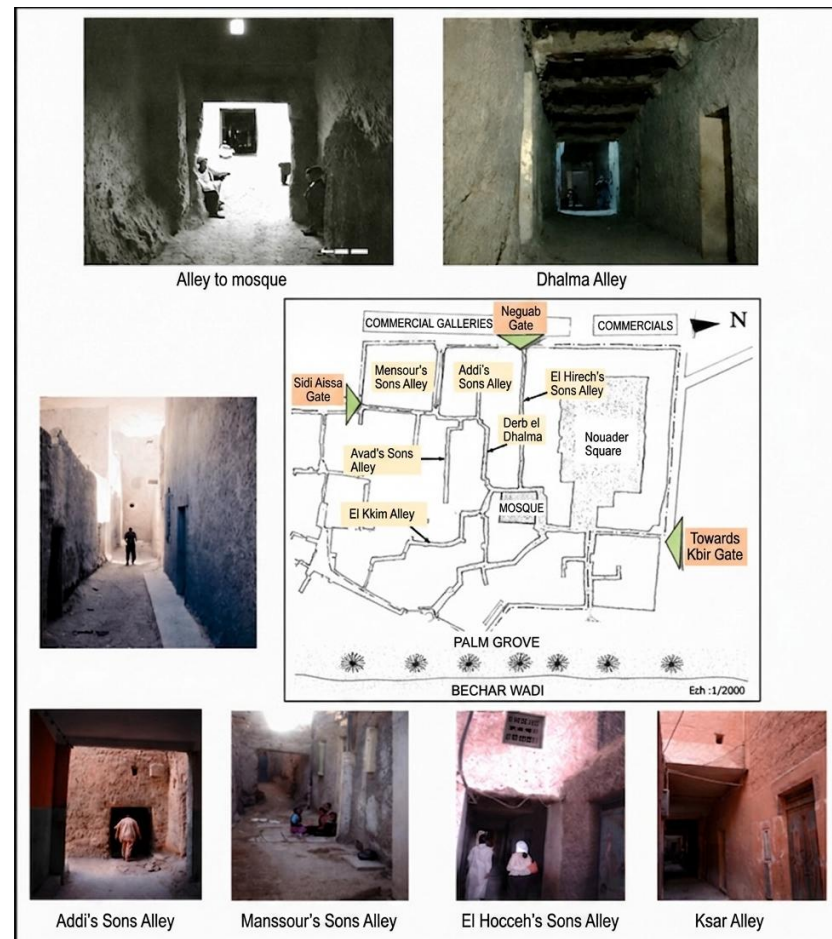


Figure 10. Network organization, naming, and transformations of the Droubs.

4.4. Open Collective Spaces (Rahbas): The Case of Nouader

Initial morphological state. The Rahbas constituted the main open collective spaces of the Ksar. Unlike the Droub, which structured circulation, these spaces formed interruptions in the continuity of the built mass and served economic, social, and communal functions. They thus contributed to the internal organization of the historical core by providing places for gathering and collective activities.

Among the Rahbas identified in the documentary corpus, Nouader stands out as the main old collective space whose configuration and functions can be established with a sufficient degree of documentary support. The other open spaces observed today cannot automatically be equated with historical Rahbas, since their origin, importance, or former function is not systematically documented. The analysis therefore focuses on Nouader, the only square whose spatial permanence is clearly attested.

Located to the north of the Ksar, near Bâb El Kbir, Nouader occupied a strategic position at the interface between the interior of the core, the routes coming from the palm grove, and the surrounding agricultural spaces. Available documentary sources describe it as a vast, approximately rectangular courtyard, covering an estimated area of 7700 m² [20]. By its dimensions, it was clearly distinguished from the simple widenings observed within the residential fabric.

This documented spatial configuration was associated with several complementary functions. Nouader accommodated operations related to the gathering, storage, and processing of harvests, while also serving as a gathering space for religious ceremonies, festivities, and collective meetings. It thus constituted an interface between the productive activities of the oasis and the communal life of the Ksar.

Observed transformations. The diachronic analysis shows that the main transformation affecting Nouader does not concern its spatial extent, which remains largely identifiable, but rather its immediate environment and its modes of use. Historical documents indicate in particular a progressive modification of its northern boundary from the 1940s onward, following new constructions. Subsequently, the progressive urbanization of the surrounding land profoundly altered the relationships the square maintained with the gardens and the agricultural spaces.

Despite these changes, Nouader still retains today its function as a major open space of the historical core. Its outline remains perceptible within the current urban structure, although certain boundaries have been altered or redefined by recent constructions.

Its uses, on the other hand, have undergone a significant evolution. Activities directly linked to the oasis economy have progressively disappeared, while the space now accommodates other collective practices, notably sporting, religious, and social activities adapted to the contemporary needs of the neighborhood.

Evolution of spatial relationships. The transformation of Nouader is observed mainly through the evolution of its relationships with the other morphological components of the Ksar. The available evidence indicates that, in the historical configuration reconstructed from the documentary corpus, the square maintained a direct relationship with Bâb El Kbir, which ensured the connection between the core, the palm grove, and the agricultural spaces. This articulation made Nouader an interface space, according to the reconstructed spatial organization, between external activities and the internal life of the Ksar.

The progressive urbanization of the areas surrounding the core profoundly altered this organization. The disappearance of part of the gardens and the integration of the Ksar into a continuous urban fabric reduced the transitional role that the square once played. Nouader now maintains privileged relationships with contemporary urban roads rather than with the original agricultural system.

Its links with the Droub, however, remain largely preserved. The square continues to constitute a point of convergence for internal circulation and remains a major spatial landmark in reading the historical core.

Morphological interpretation. Unlike several defensive components of the Ksar, Nouader is characterized by strong spatial permanence. Its extent remains identifiable despite the transformations of its environment, supporting the interpretation of a substantial continuity of its spatial form.

Its functioning, however, has evolved profoundly. The progressive disappearance of the agricultural and commercial activities linked to the oasis is accompanied by a reorientation toward primarily social, cultural, and religious uses. This evolution illustrates a phenomenon of functional recomposition without morphological disappearance, in which the permanence of the spatial form conceals a profound transformation of urban practices. Nouader thus appears as one of the principal witnesses to the transition between the historical oasis functioning of the Ksar and its integration into the contemporary city.

Table 6 summarizes the morphological transformations of Nouader and their effects on its function as a collective space.

Table 6. Summary of the morphological transformations of Nouader.

Analysis Criterion	Historical State	Documented Temporal Sequence	Current State	Observed Transformation	Morphological Effects
Spatial configuration	Large open square of approximately 7700 m ²	Historical state: Nouader is documented in the available sources as a large open space associated with the oasis environment. From the 1940s onward: changes in its northern boundary indicate a progressive transformation of its surroundings. Contemporary state: the open space remains largely preserved within an urbanized environment.	Area largely preserved	Strong persistence of the spatial form	Maintenance of a major spatial landmark
Main function	Collection of harvests, storage, trade, and community gatherings	Historical state: available historical sources associate Nouader with agricultural, commercial, and collective activities linked to the oasis system. During the 20th century: the transformation of the surrounding agricultural and built environment progressively modifies these uses. Contemporary state: social, religious, and sports activities predominate.	Social, religious, and sports activities	Functional reconfiguration	Evolution of collective uses
Relationship with Bâb El Kbir	Interface with the palm grove and gardens	Historical state: the available evidence supports a direct spatial relationship between Nouader, Bâb El Kbir, the palm grove, gardens, and the Ksar. From the 1940s onward: the surrounding limits and agricultural spaces are progressively transformed. Contemporary state: the former oasis interface is replaced or weakened by connections with the urban fabric.	Connection with contemporary urban streets	Transformation of the spatial interface	Integration into the urban fabric
Relationship with the Droub	Convergence point for internal circulation	Historical state: the available evidence indicates that Droub converged toward Nouader, reinforcing its role as a collective spatial node. Throughout the 20th century: despite changes in its surrounding environment, this internal relationship remains substantially identifiable.	Convergence function maintained	Relational persistence	Maintenance of its structuring role

		Contemporary state: Nouader continues to function as a convergence point for internal circulation.			
Relationship with the surrounding environment	Opening toward agricultural areas	Historical state: the available evidence indicates a direct relationship with agricultural areas, gardens, and the palm grove. From the 1940s onward: progressive transformation of the northern edge and surrounding agricultural spaces. Contemporary state: Nouader is enclosed within a predominantly urbanized environment and connected to contemporary streets.			
		Urbanized surroundings	Transformation of the territorial context	Loss of the direct link with the oasis system	

4.5. El Masdjid El Atik Mosque: Persistence of the Religious Landmark and Architectural Evolution

Initial morphological state. The El Masdjid El Atik mosque constitutes one of the main structuring landmarks of the Ksar of Béchar. From the earliest documented states, it occupies a central position within the internal organization of the historical core, at the intersection of several Droub, notably the route connecting Bâb El Neguab to the residential sectors. The available spatial evidence supports its role as a unifying element in the spatial structure of the Ksar, ensuring an articulation between circulation spaces, dwellings, and gathering places.

Unlike the defensive components located on the periphery, the mosque belongs to the system of internal centralities. Its importance lies not only in its architecture, but also in the relationships it maintains with the other morphological components. Its location appears to have remained stable across the documented states, making it a reference landmark for the reconstruction of the successive states of the core.

Observed transformations. The diachronic analysis shows that the main evolution concerns the architecture of the building rather than its siting. The best documented transformation concerns the minaret, absent from the 1952 aerial photograph but visible in a photograph attributed to the 1960s. This comparison makes it possible to situate its construction between these two states, although its exact date cannot be determined.

Other modifications concern the façades, the construction materials, and certain architectural elements of the mosque. However, only the transformations directly confirmed through the cross-referencing of historical documents, old photographs, and field observations are retained in the analysis. This approach makes it possible to avoid any interpretation that is not sufficiently supported by the documentary corpus.

Field observations also indicate the presence of an element interpreted as a former mihrab, potentially evidence of an earlier religious building. In the absence of archaeological or historical data confirming its origin, this observation is retained as a research hypothesis rather than as an established result.

Evolution of spatial relationships. While the position of the mosque has remained unchanged, its immediate surroundings have undergone significant transformations. Changes to neighboring dwellings, successive reconstructions, and the evolution of the Droub have progressively altered the conditions of access to the building and its perception within the urban fabric.

In the reconstructed historical organization, the mosque was directly integrated into the internal circulation system, in relation to the main gates of the Ksar and the collective spaces. The progressive fragmentation of the Essour, the disappearance of certain Bâb, and the opening of new accesses have profoundly altered these relationships. The mosque remains accessible today via the historical Droub, but these are now connected to a much more open urban road network than that of the original Ksar.

This evolution also alters the perception of the monument. Once set within a spatial sequence characterized by narrow and relatively enclosed routes, the building is now integrated into a more permeable environment in which the relationships between internal and external spaces have been profoundly recomposed.

The case of the mosque therefore shows that the persistence of a component’s location does not imply the persistence of the spatial configuration in which it was originally embedded. Its central position and connections with the Droub remain, while the relationships between these pathways, the former gates, and the surrounding urban network have been reconfigured.

Morphological interpretation. The trajectory of El Masdjid El Atik illustrates strong morphological and functional permanence, combined with limited but significant architectural transformations. While several components of the defensive system have disappeared or lost their legibility, the mosque retains its central position and its religious function, making it one of the principal invariants of the Ksar’s organization.

The observed modifications concern mainly its architectural expression and its immediate environment. The addition of the minaret, the document interventions on the façades, and the evolution of materials can be interpreted as evidence of the building’s progressive adaptation to the transformations of the neighborhood, without calling into question its structuring role.

The mosque thus appears as a marker of urban continuity, whose permanence contributes to maintaining the spatial memory of the historical core despite the profound recompositions that have occurred in the other components of the Ksar.

Table 7 summarizes the morphological transformations of El Masdjid El Atik mosque and their effects on its centrality within the Ksar.

Table 7. Summary of the morphological transformations of El Masdjid El Atik mosque.

Analysis Criterion	Historical State	Documented Temporal Sequence	Current State	Observed Transformation	Morphological Effects
Location	Central position within the Ksar	Historical state: the available evidence places the mosque in a central position within the Ksar. 1952–present: its location appears to remain stable despite the progressive transformation of the surrounding urban fabric.	Position preserved	No significant modification of location	Strong spatial persistence
Function	Place of worship and community landmark	Historical state: available evidence associates the mosque with religious and community functions. 1952–present: its religious function remains documented despite successive changes in its physical and urban context.	Religious function maintained	Functional continuity	Maintenance of its structuring role

Architecture	Building without a documented minaret in 1952	1952: the mosque is documented without a minaret. Between 1952 and the 1960s: a later documented state attributed to this period shows the presence of a minaret. Contemporary state: the minaret and subsequent façade interventions are present.	Presence of a minaret and façade interventions	Architectural evolution	Modification of the monument's silhouette
Relationship with the Droub	Direct connection to the main internal pathways	Historical state: the available evidence indicates a direct connection between the mosque and the main internal pathways. 1952–present: these relationships remain identifiable despite changes in the surrounding built fabric and access conditions.	Relationships maintained despite transformations	Persistence of connections	Preservation of internal centrality
Relationship with the urban context	Integrated into the enclosed system of the Ksar	Historical state: the available evidence indicates that access and perception of the mosque were structured by the enclosed Ksar system. From the mid-20th century onward: transformations of the Essour, Bâb, Droub, and residential fabric progressively modify its external relationships. Contemporary state: the mosque is embedded within a more open urban fabric.	Embedded within an open urban fabric	Reconfiguration of access conditions	New perception of the monument

The diachronic evolution of El Masdjid El Atik and the progressive transformation of its minaret are illustrated in Figure 11 through three documented periods.

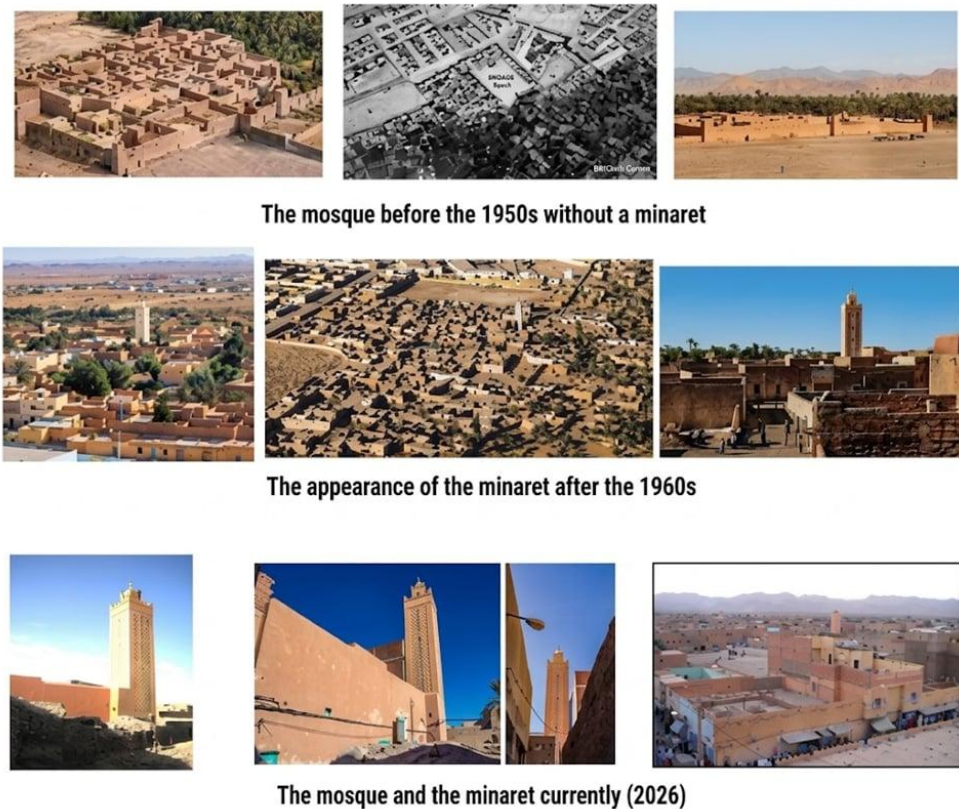


Figure 11. Diachronic evolution of El Masjid El Atik and its minaret across three documented periods.

4.6. Residential Buildings: Reconfiguration of the Built Mass and Evolution of Spatial Relationships

Initial morphological state. The dwellings constitute the dominant component of the Ksar of Béchar. Through their continuous juxtaposition, they formed a compact built mass organized around the network of Droub and occasionally crossed by covered passages. This built continuity directly contributed to the definition of public spaces, to the hierarchization of circulation, and to the morphological coherence of the historical core.

The analysis focuses exclusively on the exterior characteristics of the constructions and their integration into the urban fabric. It thus examines volumes, heights, visible materials, façades, openings, roofs, and the relationships maintained with the Droub. The interior organization of the houses falls outside the scope of this study.

Historical documents and studies devoted to traditional Bécharois housing show a fabric characterized by strong constructive homogeneity. The houses were built adjoining one another, limiting the perception of individual constructions in favor of an overall reading. The façades, generally plain and with few openings, were built of earth (toub), with occasional use of palm wood for floors and roofing. Openings remained few, heights limited, and roofs mostly flat, giving the fabric a relatively uniform architectural appearance.

This homogeneity did not result solely from constructive choices. It also reflected a collective organization of space in which the dwellings directly contributed to the definition of the routes, the built boundaries, and the spatial sequences of the Ksar.

Observed transformations. The diachronic analysis reveals a progressive evolution of the built forms rather than a complete substitution of the old fabric. Field observations

today show the coexistence of several generations of construction corresponding to different moments of transformation.

This succession of construction generations provides evidence of a cumulative transformation of the residential fabric, although the available sources do not allow each reconstruction, consolidation, or extension to be assigned a precise date.

Some earthen dwellings remain visible and retain their traditional characteristics, while others have undergone consolidation, heightening, or partial reconstruction. Several buildings display hybrid structures in which old toub walls are combined with more recent elements built of reinforced concrete, hollow bricks, or concrete blocks. This coexistence of construction techniques can be interpreted as evidence of gradual adaptation rather than an abrupt break with the original built fabric.

Complete reconstructions, on the other hand, introduce more substantial changes. The use of reinforced concrete allows for taller volumes, more open façades, and new architectural forms that progressively diverge from the traditional constructive language. Openings become larger, balconies appear, and contemporary finishes locally replace earthen finishes.

These observations align with the findings of Bousnina [32] regarding the evolution of construction techniques, as well as those of Mekherbeche et al. [33], which highlight the widespread adoption of reinforced concrete structures and the increase in built volumes in the Ksar neighborhood. These studies are nevertheless used as points of comparison and are not extrapolated to the historical core as a whole.

Evolution of spatial relationships. The transformations of the dwellings extend well beyond mere architectural changes. They directly affect the spatial relationships between the different morphological components of the Ksar.

Despite numerous reconstructions, the dwellings in most sectors continue to define the boundaries of the Droub, supporting the interpretation of a relative continuity of the circulation structure observed in the previous component. The transformations therefore concern the built interfaces more than the general organization of the fabric.

The diversification of heights, materials, and façades nevertheless alters the perception of the routes. Heightenings locally reduce the proportions of the alleyways, while the progressive disappearance of certain covered passages transforms the spatial sequences that once characterized the traditional functioning of the Ksar. New openings also introduce different visual relationships between private and public spaces.

The changes appear even more pronounced at the periphery of the core. The progressive fragmentation of the Essour allows for the opening of new façades, doors, and windows oriented toward the contemporary urban roads. Peripheral dwellings, once oriented mainly toward the internal spaces of the Ksar, now develop direct relationships with the surrounding city. This evolution reflects a profound change in the spatial organization of the core, which is now more open to its urban environment.

Morphological interpretation. The dwellings illustrate a trajectory of transformation characterized by a progressive recomposition of the built mass rather than a disappearance of the historical fabric. Successive reconstructions alter the architectural expression of the buildings while largely preserving the general organization inherited from the old Ksar.

This evolution highlights a dissociation between structural permanence and architectural transformation. The building alignments, and the network of Droub supporting the interpretation of a relative continuity of the circulation structure appear relatively stable, whereas the volumes, heights, materials, and façades undergo significant changes. The transformations therefore mainly concern the modes of occupation and expression of the fabric rather than its fundamental structure.

The dwellings thus appear as the main vector of morphological recomposition of the Ksar. They reflect the progressive adaptation of the historical core to new construction

techniques, to changing ways of living, and to its integration into the contemporary city, while retaining part of the spatial logics inherited from its original organization.

Table 8 summarizes the morphological transformations of the residential buildings and their effects on the built mass and its relationship with the droub.

Table 8. Summary of the morphological transformations of residential buildings.

Analysis Criterion	Historical State	Documented Temporal Sequence	Current State	Observed Transformation	Morphological Effects
Built-form organization	Compact and homogeneous built mass	Historical state: the available evidence indicates a relatively continuous and homogeneous residential fabric structured around the Droub. Intermediate states: consolidations, partial reconstructions, and local extensions progressively modify the built mass. Contemporary state: older buildings coexist with hybrid structures and more recent constructions, producing a more diversified fabric.	More diversified urban fabric	Progressive reconfiguration	Maintenance of the overall structure
Materials	Earth (toub) and palm wood	Historical state: available historical sources indicate a predominance of earthen construction and palm wood. Intermediate states: progressive introduction of reinforced concrete and masonry materials through reconstruction and consolidation. Contemporary state: coexistence of earthen, hybrid, and modern construction systems.	Reinforced concrete, brick, concrete blocks, and mixed systems	Constructive diversification	Evolution of construction techniques
Volumes and heights	Low and relatively homogeneous volumes	Historical state: the available evidence indicates predominantly low-rise and relatively homogeneous buildings. Intermediate states: local vertical extensions and reconstruction progressively modify building heights. Contemporary state: greater variation in heights and massing is visible.	Vertical extensions and taller buildings	Transformation of building heights and massing	Modification of the urban silhouette
Façades and openings	Plain façades with few openings	Historical state: relatively restrained façades with limited openings contribute to a homogeneous architectural expression. Intermediate states: reconstructions and extensions progressively introduce new openings and façade modifications. Contemporary	Large openings, balconies, and new finishes	Architectural evolution	Diversification of built interfaces

Relationship with the Droub	Continuous definition of passage boundaries	state: larger openings, balconies, and diverse finishes are increasingly present.	Boundaries generally preserved despite reconstruction	Structural persistence	Preservation of the street network
		Historical state: available evidence indicates that residential façades provided continuous and clearly defined edges to the Droub. Intermediate states: reconstruction and vertical extensions modify some local interfaces while the general street structure remains legible.			
		Contemporary state: boundaries are generally preserved despite substantial rebuilding and architectural diversification.			

The reconfiguration of the built mass and the coexistence of successive construction generations are illustrated in Figure 12.

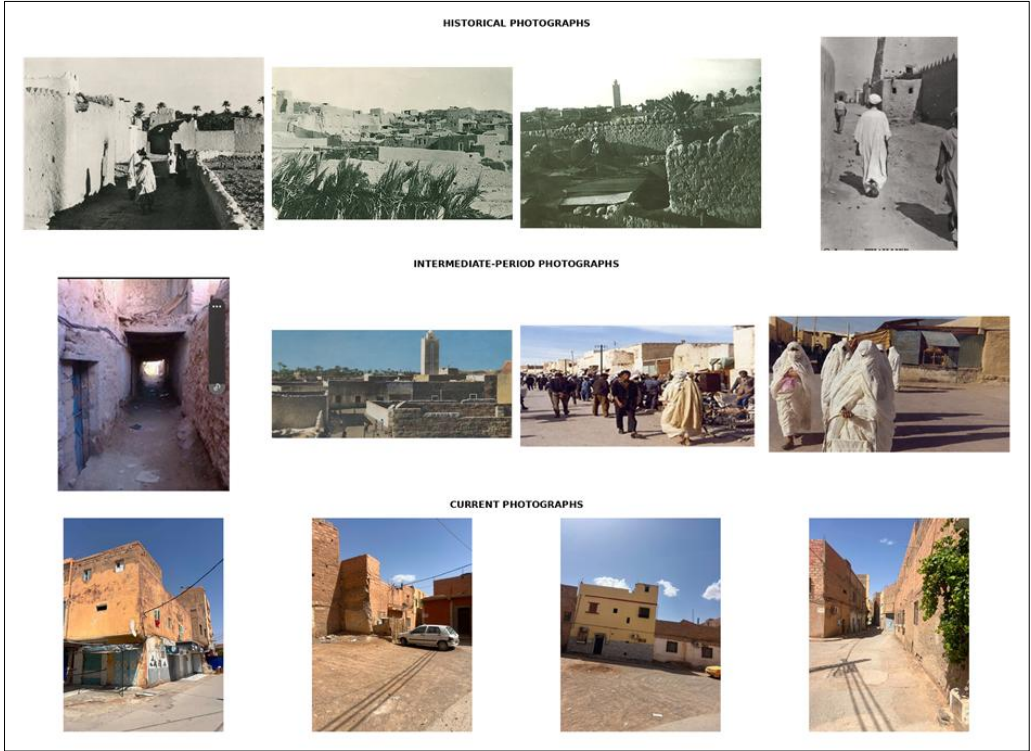


Figure 12. Transformations of residential buildings and reconfiguration of the built mass.

4.7. Relational Recomposition of the Ksar as a Spatial System

The component-level trajectories become more significant when read together as changes in the relational system of the Ksar. The historical organization was based on a relatively clear sequence of spatial relations: the Essour defined a continuous boundary, the Bordjs reinforced selected sectors of this boundary, the Bâb concentrated and controlled passage, the Droub distributed movement toward dwellings, Nouader, and the mosque, and Nouader connected the inhabited core with the agricultural and oasis environment. The residential fabric completed this system by forming continuous built edges that enclosed and channelled the internal routes.

The contemporary condition is not simply the sum of the disappearance of some elements and the persistence of others. It represents a change in the configuration of the relationships linking them. The fragmentation of the Essour weakened the boundary–access relation and allowed new connections to be established independently of the historical Bâb. As a result, the Bâb lost their exclusive role as thresholds, while the Droub changed from internally oriented routes into routes that also connect directly with contemporary urban streets. The same circulation network therefore persists spatially but operates within a different accessibility structure.

The transformation of the residential fabric reinforces this change. Although dwellings continue to define much of the physical edge of the Droub, changes in height, materials, openings, and covered passages have modified the character of the built interfaces. At the periphery, new openings and façades oriented toward urban roads have created relationships with the exterior that were previously limited or absent. The boundary of the Ksar is consequently no longer produced primarily by a defensive wall; it is increasingly produced by a mixed and discontinuous interface composed of surviving wall fragments, residential buildings, openings, roads, and contemporary constructions.

Internal centralities have followed a different trajectory. The Droub continue to connect the main sectors of the core, Nouader remains a major open-space landmark, and El Masdjid El Atik retains its position and religious function. Their permanence does not mean that their relationships are unchanged. Nouader has shifted from being an interface between the Ksar and the oasis economy to being an interface with an urbanized environment, while the mosque is now reached through routes connected to a more permeable street system. Thus, the internal landmarks persist, but the territorial and accessibility relations through which they function have been recomposed.

These observations reveal a system-wide transition along five relational dimensions. First, enclosure has changed into permeability as the continuous Essour has been replaced by a fragmented boundary with multiple openings. Second, access has changed from hierarchical concentration at the Bâb to a more distributed pattern of connections with the surrounding city. Third, circulation has changed from an inward-oriented system to a network that simultaneously serves internal movement and external urban connectivity. Fourth, centrality has persisted in the locations of the mosque and Nouader, but their interfaces and uses have been reoriented. Fifth, the built edge has changed from a relatively homogeneous and inward-facing residential envelope to a diversified interface with different materials, heights, openings, and orientations.

The relational recomposition can therefore be summarized as a transformation from a closed and hierarchized relational system to an open and permeable relational system. The former system organized movement through a continuous boundary and a limited number of controlled thresholds. The latter retains several internal anchors, particularly the Droub, Nouader, the mosque, and the general residential alignments, but connects them to the surrounding city through a less differentiated and less controlled interface. This explains how strong spatial permanence can coexist with substantial morphological transformation.

4.8. Synthesis of Transformations of the Morphological Components

The diachronic analysis reveals that the seven components of the Ksar of Béchar have not followed a homogeneous trajectory of evolution. The cross-referencing of historical archives [31], old plans (1941, 1945), old photographs (1903, 1909), aerial photographs (1952, 1962), recent satellite images, field observations, and testimonies shows that the transformations concern both the material forms and the spatial relationships between the components.

The results distinguish three main morphological trajectories. The first corresponds to the fragmentation or partial disappearance of the former defensive and access structures, particularly the Essour, the Bordjs, and the Bâb. The second concerns components that have persisted spatially while undergoing physical, functional, or architectural transformation, notably the Droub, Nouader, El Masdjid El Atik, and the residential fabric. The third is a relational trajectory, affecting the system as a whole: the roles and connections of the components have been progressively redefined as the historical core became increasingly integrated into the surrounding urban fabric.

Taken together, these trajectories indicate that morphological transformation cannot be understood solely through the material condition of individual components. Some elements have disappeared or been fragmented, while others remain recognizable; however, their persistence does not imply the persistence of the same spatial system. The main transformation therefore lies in the reorganization of the relationships through which these components contribute to the functioning of the Ksar.

The overall process can thus be characterized as a transition from a relatively enclosed and hierarchized morphological system toward a more open and permeable one. This transformation combines loss, persistence, adaptation, and relational recomposition, with several historical components remaining as spatial anchors while their connections with one another and with the surrounding city have been progressively redefined (Table 9).

Table 9. Synthesis of the diachronic trajectories, supporting evidence, main relational reconfiguration and morphological significance of the seven morphological components of the Ksar of Béchar.

Morphological Component	Diachronic Trajectory	Supporting Evidence	Main Relational Reconfiguration	Morphological Significance
Essour (enclosure wall)	Continuous enclosure in the traditional Ksar → gradual fragmentation and partial removal → fragmented residual boundary	Historical descriptions, maps and plans; old and aerial photographs; field observations and built alignments	Access progressively shifts from gates toward multiple/direct connections with the surrounding street network	Loss of enclosure continuity and increased permeability of the Ksar–city interface
Bordjs (defensive towers)	Clearly defined defensive towers → progressive disappearance or alteration → few identifiable traces, with some locations inferred	Historical descriptions and photographs; maps and aerial photographs; spatial geometry of the core	Weakening of the relationship between the defensive vertical markers and the enclosure	Loss of defensive and visual legibility of the peripheral system
Bâb (gates)	Limited and controlled access points → transformation or disappearance of gates → less clearly materialized entrances and multiple openings	Historical documents and photographs; aerial photographs; route configurations and alignments	Former controlled thresholds lose exclusivity, while the Droub establish more diversified connections with the exterior	Reconfiguration of the access hierarchy and increased permeability
Droub (circulation routes)	Hierarchical internal network organized around the gates → adaptation and partial modification → largely persistent route	Historical maps and plans; aerial photographs; current street layout and field observations	Relations with the former Bâb and the surrounding street network are reconfigured, while links with housing, mosque and Nouader persist	Persistence of the circulation framework with altered relational roles

	alignments with stronger external connections			
Nouader (collective open space)	Collective open space linked to the oasis and agricultural environment → adaptation of uses amid urbanization → maintained spatial position as a convergence point	Historical documents; maps and aerial photographs; built remains and current observations	The spatial relation with the core is maintained, while the former oasis/agricultural interface shifts toward an urban interface	Persistence of collective centrality with functional and territorial recomposition
Mosque (religious building)	Central religious component → functional continuity with architectural evolution → stable spatial position within the core	Historical documents; maps and aerial photographs; current built form and observations	The mosque remains connected to the Droub, but within a more open and integrated urban network	Persistence of religious centrality under transformed access and urban conditions
Residential buildings (dwellings)	Traditional homogeneous fabric → successive reconstruction, adaptation and densification → diversified materials, heights and openings	Historical documents; maps and aerial photographs; current built fabric and field observations	Formerly inward-oriented interfaces become more diversified, with new openings toward urban roads in some sectors	Transformation of built interfaces and emergence of a new relationship between the core and its surroundings

The arrows (→) indicate the chronological progression of morphological change, from the historical con-figuration through the successive transformations to the contemporary condition. They summarize the dia-chronic trajectory of each morphological component.

5. Discussion: Toward a Relational Reading of the Morphological Reconfiguration of Béchar Ksar

The results show that the transformations of the Ksar of Béchar do not stem from a uniform process affecting all components of the historical core indiscriminately. On the contrary, they reveal differentiated trajectories depending on the nature, location, and role of the morphological components. More than the modification of the built forms themselves, the analysis suggests that the progressive recomposition of the spatial relationships between these components helps explain the current organization of the Ksar.

This reading aligns with contemporary approaches to urban morphology, which consider historical fabrics as evolving systems in which forms, uses, and relationships transform simultaneously [2,6,7]. It also confirms the principles of the Historic Urban Landscape approach, according to which historic centers should be analyzed as dynamic ensembles rather than as fixed heritage objects [1].

The contrast between peripheral erosion and internal permanence is explained here through the interaction of function, location, adaptability, and embeddedness in the existing spatial structure. Peripheral defensive components were boundary-dependent: their meaning and operation required a continuous envelope separating an interior from an exterior. Once urban expansion made the former distinction between the enclosed Ksar and its surroundings less operational, the wall, towers, and gates became vulnerable to removal or incorporation into new urban interfaces. Internal components were more deeply embedded in the daily reproduction of the settlement. The Droub continued to provide movement, housing continued to provide accommodation, Nouader continued

to support collective activities, and the mosque continued to support religious and social life. Their continued usefulness allowed adaptation to occur through modification rather than total replacement.

5.1. Differentiated Morphological Trajectories Across Components

The analysis of the seven components confirms that not all structures of the Ksar have undergone the same morphological fate.

The defensive components (Essour, Bordjs, and Bâb) appear as the most profoundly transformed. The fragmentation of the enclosure, the disappearance of most of the towers, and the erasure of the gates as built structures reflect a significant loss of the core's peripheral structure. Their original role of delimitation and of controlling exchanges between the Ksar and its environment has progressively faded under the effect of urbanization.

Conversely, the internal components show an evolution marked more by adaptation than by disappearance. The droub retain part of their organization despite changes to the built fabric. Nouader remains legible within the urban landscape even though its functions have evolved. The mosque maintains its structuring position despite several architectural modifications. Finally, the dwellings show strong constructive diversification while continuing to organize the circulation spaces.

The contrast between peripheral erosion and internal persistence can be interpreted in relation to the different spatial positions and functional dependencies of these components. The Essour, Bordjs, and Bâb were primarily associated with the definition, protection, and controlled access of the Ksar. Their morphological role therefore depended on maintaining a clear boundary between the inhabited core and its surroundings. The progressive urbanization of Colomb-Béchar appears to have weakened this condition: as the Ksar became increasingly integrated into the expanding urban fabric, the defensive and access-control functions of its peripheral structures may have become less compatible with the new pattern of urban connectivity. Their transformation was consequently not only a physical process; it may also reflect a declining functional relevance of their historical roles within the changing urban context.

By contrast, the droub, Nouader, mosque, and residential structure were more directly embedded in the internal organization and everyday functioning of the Ksar. Their continued use, or their capacity to accommodate new uses, appears to have favored their persistence while their material forms and functions evolved. The persistence of the droub and land subdivision, for example, provided a spatial framework within which residential buildings could be reconstructed or extended without fundamentally replacing the inherited circulation structure. Similarly, the continued religious and collective roles of the mosque and Nouader may have supported the persistence of their spatial positions despite functional and environmental changes. The differentiated trajectories observed in Béchar Ksar can therefore be understood as resulting from a combination of spatial position, functional dependence, and capacity for adaptation: peripheral components were more vulnerable because their historical roles were closely tied to separation and control, whereas internal components appear to have been more resilient because their spatial structures could accommodate successive transformations of use and built form.

These differentiated trajectories corroborate the observations of Conzen [7], according to which morphological components never evolve at the same pace. Some structures disappear rapidly while others durably retain their capacity for spatial organization. They also extend the work of Oliveira [2], which shows that urban transformations must be analyzed through the interactions between components rather than through an isolated reading of each element.

The distinction highlighted in this study therefore suggests that morphological persistence is not determined simply by the age or heritage value of a component, but by its position within the spatial system, its dependence on particular functions, and its capacity to accommodate changing uses and urban relationships. Thus, the distinction highlighted in this study between strongly altered components, adapted components, and relatively enduring components provides a more nuanced reading of the evolution of Saharan ksour. Table 10 summarizes the explanatory mechanisms behind the differentiated trajectories.

Table 10. Explanatory mechanisms behind the differentiated trajectories.

Component Group	Original Role	Position in the Settlement	Relation to Urban Expansion	Capacity for Adaptation	Observed Trajectory	Main Explanatory Mechanism
Essour, Bordjs, and Bâb	Enclosure, surveillance, and controlled access	Peripheral and boundary-defining	Directly exposed to roads, new buildings, and urban interfaces	Low, because their original function depended on continuity and separation	Fragmentation, absorption, and disappearance	Functional obsolescence combined with peripheral redevelopment pressure
Droub	Internal circulation and connection among components	Embedded within the residential fabric	Initially inward-oriented, later connected to urban streets	High at the relational level; routes can change function while retaining alignment	Spatial persistence with altered external relations	Path dependence and continued circulation utility
Nouader	Collective gathering and interface with the oasis economy	Internal open space near a major access zone	Surrounding agricultural relations replaced by urban relations	High, because the open space can host changing uses	Spatial permanence with functional reconfiguration	Adaptable open form and continued collective use
Mosque	Religious landmark and internal centrality	Centrally embedded within the Droub network	Remains accessible despite changing external context	High, because religious and social functions continue	Positional and functional permanence with architectural change	Continuity of use and central location
Housing	Residence and definition of Droub edges	Distributed throughout the internal fabric and along the perimeter	Peripheral dwellings increasingly address urban roads	High through incremental reconstruction and hybridization	Structural persistence with material and volumetric transformation	Incremental adaptation and persistence of alignments

5.2. The Persistence of Relational Structures Despite Material Transformations

One of the main insights of this research lies in the gap observed between the disappearance of certain built forms and the persistence of their spatial organization.

The fragmentation of the Essour has not entirely erased the reconstructed former boundary of the Ksar, several segments of which remain perceptible through built fragments or building alignments. Likewise, although the Bordjs have almost entirely disappeared, some former locations can still be inferred through the geometry of the core's corners. The Bâb are no longer architecturally materialized, but some former locations remain inferable through the preferential directions of the routes.

This permanence is even more evident for the droub, several of whose inherited route alignments remain legible and appear to continue to structure internal movement despite successive reconstructions of the dwellings. Similarly, Nouader retains its spatial extent even though its economic functions have been replaced by contemporary collective uses. Finally, the El Masdjid El Atik mosque remains the main spatial landmark of the core despite the transformations of its architecture.

Although the present study focuses on exterior built form, the residential transformations observed may also reflect changes occurring within domestic spaces. Changes in household needs, internal spatial organization, or domestic practices may have encouraged successive adaptations of dwellings, including extensions, new openings, vertical additions, or modifications of built interfaces with the droub. In this sense, some external transformations may represent the spatial expression of changes that originated within the domestic environment. These potential relationships cannot be established directly from the present corpus, which does not systematically document interior layouts; however, they suggest that the evolution of residential morphology should be understood as a possible interaction between domestic adaptation and the wider spatial structure. This perspective reinforces the relational reading adopted here by considering the dwelling not only as an external built component, but also as an interface between domestic organization and collective circulation space.

These results align with recent research on historical fabrics, which shows that the disappearance of a material element does not necessarily entail the erasure of its morphological role [2,34]. They also confirm the Historic Urban Landscape approach, according to which urban permanence is expressed as much through spatial relationships as through the physical conservation of buildings. In the case of the Ksar of Béchar, the permanences observed therefore concern less the architectural forms than the organizing structures of the urban fabric.

5.3. From Component Transformations to the Temporal Sequence of Relational Recomposition

Beyond the changes specific to each component, the results show that the most significant transformation concerns the evolution of the spatial relationships that once structured the functioning of the Ksar. This relational recomposition did not occur as a single transformation between a historical and a contemporary condition, but developed progressively through the accumulation and interaction of successive changes.

In the reconstructed historical organization, the Essour, the Bordjs, and the Bâb constituted a coherent system of protection and control of circulation. The gates directed movement toward the droub, which distributed access to the dwellings, the mosque, and the collective spaces, while Nouader ensured the articulation between the inhabited core and the agricultural space.

In the contemporary state, this hierarchized organization appears to have been progressively recomposed. The disappearance of portions of the enclosure is associated with a multiplication of direct connections with the contemporary city. The former gates have lost their exclusive role as access points. In some peripheral sectors, dwellings now present openings toward the urban roads. The droub now maintain more direct relationships with the outside space. Nouader is now set within a largely urbanized environment, while the mosque is now integrated into a profoundly renewed circulation system. The diachronic sequence suggests that external urbanization first altered the territorial context of the Ksar, followed by changes in the boundary and access hierarchy, which subsequently affected circulation and the relationships of internal components with the surrounding urban network.

This sequence should be read in relation to the four phases identified in Section 4.1, not as an independent chronology. Phase 1 provides the reference configuration: the

integrated system formed by the Essour, Bordjs, Bâb, droub and Nouader described above. The alteration of the territorial context corresponds to Phase 2 (1903–1909), when historical photographs and written sources document new military, administrative and commercial spaces emerging around a Ksar whose internal structure remains largely legible. The weakening of the boundary and access hierarchy corresponds mainly to Phase 3 (1941–1962), as shown by the 1941 and 1945 plans and the 1952 and 1962 aerial photographs, although changes at the Bâb–exterior interface already begin in Phase 2. The reorganization of internal circulation, and of the relationships between the droub, Nouader, the mosque and the surrounding urban network, is observed in Phase 4, on the basis of recent satellite imagery, field observations and testimonies. These correspondences should not be read as sharp breaks. The sources do not allow individual transformations to be dated precisely, and the phases overlap (Section 4.1). The sequence is therefore an order of predominance inferred from the comparison of successive documents, not a strict chronological succession. It is best supported for the first two steps, which rely on comparable plans and photographs. The third step relies on more heterogeneous sources, and the former droub network remains a reasoned interpretation (Section 4).

This recomposition supports the interpretation that morphological transformations cannot be interpreted solely on the basis of changes to the built objects. They can involve a progressive reorganization of the interactions between urban components, in line with the systemic approaches developed by Oliveira [2], Whitehand [35], and Whitehand et al. [36].

This relational interpretation builds on the systemic perspective already established in urban morphology, which recognizes that urban form results from interactions among morphological components rather [2,35,36]. Its contribution here lies in operationalizing these interactions as a diachronic object of analysis. Instead of considering component persistence and transformation separately, the analysis distinguishes between the persistence of a component, the persistence or reconfiguration of the relationships in which it participates, and the system-level effects produced when the transformation of one component modifies the spatial role or connectivity of others. The intermediate phases are particularly important in this regard, as they reveal the order in which relationships were progressively reconfigured rather than only the final condition of the historical core. This distinction helps identify forms of morphological change that remain partly invisible in component-based analyses, particularly when a spatial element persists while its relational position within the urban structure changes. The approach therefore extends the discussion of morphological permanence and transformation toward a process-oriented reading of how relations among components are progressively reorganized over time.

In this perspective, the contribution of the present study is not to propose that urban components interact, but to make the reconfiguration of these relationships explicit in a diachronic analysis of a historic core. The analysis distinguishes between the persistence or transformation of individual components and the persistence or reconfiguration of the spatial relationships in which they participate. This distinction makes it possible to identify system-level effects that may remain less visible when morphological change is assessed mainly through the condition of individual elements. It also shows how substantial morphological transformation can coexist with the persistence of important spatial anchors, whose roles and connections are progressively redefined rather than simply lost. Relational recomposition thus provides an analytical link between differentiated component trajectories and the changing organization of the urban system over time.

5.4. Scientific Contributions of the Study and Perspectives for the Analysis of Saharan Ksour

Research on Saharan ksour has primarily focused on construction techniques, earthen building materials, and the architectural characteristics of housing (Godard [26]; Hamès [27]; Bousnina [32]; Mekherbeche et al. [33]). These studies have considerably enhanced knowledge of oasis architecture, but they have rarely addressed, in an integrated manner, the interactions among the different components of the urban fabric. They have also rarely treated the relations among boundary systems, access points, circulation networks, collective spaces, religious landmarks, and housing as a distinct analytical object.

By simultaneously analyzing the Essour, Bordjs, Bâb, droub, Nouader, the mosque, and residential buildings, this research proposes a more systemic morphological reading of Béchar Ksar. It demonstrates that the evolution of the historic core cannot be understood solely through buildings or construction techniques, but rather through the combined analysis of morphological components and the relationships they maintain with one another. The contribution therefore lies not simply in considering several components simultaneously, but in showing how the transformation of one component can modify the spatial role and meaning of others.

Beyond identifying differentiated trajectories, the study also proposes an explanatory interpretation of these differences. Morphological persistence appears to depend partly on the relationship between a component and the practices that reproduce or maintain its spatial role. Circulation routes, collective spaces, religious landmarks, and residential alignments may persist when their spatial functions remain useful and can accommodate new materials or uses. Defensive boundaries, by contrast, become more vulnerable when their original territorial function becomes obsolete and their peripheral location places them under stronger pressure from urban integration. Morphological change can therefore be understood as resulting from the interaction of functional obsolescence, redevelopment pressure, spatial embeddedness, and adaptive capacity.

The temporal contribution of the study also lies in making the processual dimension of morphological change more explicit. By distinguishing successive documentary phases, the analysis shows that change is not only differentiated across components but also sequential: the surrounding territorial system changed before the internal core was fully transformed, while the defensive envelope and access hierarchy weakened before the principal internal routes were substantially reconfigured. This diachronic perspective therefore adds processual depth to the relational reading and helps explain how a historic settlement can progressively move from enclosure toward permeability through cumulative change rather than through a single transformation.

A brief comparison with other Algerian Saharan ksour provides a cautious basis for considering the broader applicability of this framework. Gherraz et al. [24], through a comparative survey of sites including Ouargla, Ghardaïa, Guemar, Kenadsa, and Tamentit, document substantial diversity in urban layouts, dwelling forms, materials, and construction techniques. Layachi [34], focusing on the Ksar of Kenadsa, similarly examines the relationships between built form and its wider landscape context. Although these studies do not apply the same seven-component relational framework, they suggest that the spatial interactions between built, open, and environmental structures can be examined comparatively across Saharan ksour. The present framework should therefore be regarded as transferable in principle, while its comparative validation remains a perspective for future research.

This approach therefore helps address the gap identified in the literature concerning the integrated analysis of oasis settlements. It also opens up operational perspectives for the conservation policies of Saharan ksour. Rather than limiting interventions to the piecemeal restoration of individual buildings, management strategies should seek to

preserve the relational structures that ensure the morphological coherence of historic cores. For example, when residential buildings bordering the droub are rehabilitated or reconstructed, interventions could maintain the inherited alignment, continuity, and spatial width of the pathways, even where the buildings themselves require substantial adaptation. Similarly, where fragments of the Essour or surviving built alignments still indicate the former boundary of the Ksar, conservation could prioritize their spatial and visual continuity rather than attempting to reconstruct missing sections without sufficient evidence. These measures would preserve the relationships between buildings, circulation routes, and historical boundaries while allowing necessary adaptation of the built fabric.

Finally, this approach, based on the cross-analysis of archival records, historical plans, old photographs, aerial imagery, field observations, and testimonies, demonstrates the value of an integrated diachronic perspective for analyzing the evolutionary trajectories of historic Saharan settlements. It may therefore provide a transferable analytical basis for studying other ksour experiencing comparable processes of urbanization and morphological reconfiguration, although comparative validation across multiple sites is still required.

6. Conclusions, Limitations and Future Works

6.1. Conclusions

This study proposed a diachronic, relational reading of the Ksar of Béchar, tracing seven structuring components, the Essour, the Bordjs, the Bâb, the droub, the Rahbas/Nouader, the El Masdjid El Atik mosque, and the housing stock, across more than a century of transformation. Rather than treating the historic core as a single evolving block or reducing its transformation to the fate of individual buildings, the analysis operationalized the relations between components as the primary object of study, cross-referencing historical archives, redrawn plans, old photographs, 1952 and 1962 aerial imagery, a recent satellite image, field observations, and residents' testimonies.

The results confirm that the Ksar's evolution cannot be described as either integral conservation or outright disappearance. The analysis reveals two component-level trajectories and one cross-cutting relational process. The defensive envelope, comprising the Essour, the Bordjs, and the Bâb, has undergone the deepest transformation. Fragmentation, disappearance, and loss of legibility have eroded its former role of delimitation and controlled access. The internal components, comprising the droub, Nouader, the mosque, and the dwellings, display a markedly different pattern. They show strong spatial and positional permanence beneath substantial architectural, material, and functional change. Across all seven components alike, a third, cross-cutting trajectory emerges. It is a progressive recomposition of spatial relationships, in which the once-enclosed, hierarchized core has become an increasingly open and permeable part of the surrounding city.

Taken together, these trajectories support the study's central argument. Morphological transformation in a historic settlement is best understood not as a property of individual built elements but as a reconfiguration of the relational system that binds them. The disappearance of a component does not necessarily erase its morphological role, just as the survival of a component does not guarantee the persistence of its original function or relations. In the case of Béchar, peripheral, boundary-defining structures have eroded while several internal structuring relations, including pathways, collective space, and religious centrality, constitute persistent relational structures that continue to anchor the historic core's legibility.

Beyond the specific case of Béchar, the study contributes a source-triangulated, multi-component relational framework that may be transferable to other Saharan and

vernacular historic settlements sharing comparable morphological components and similarly fragmentary and heterogeneous documentation. Its transferable contribution lies in combining the diachronic reconstruction of component-level transformations with the analysis of the spatial relationships connecting them. Moreover, the Béchar case points to a potentially recurrent transformation pattern documented in other Saharan ksour, characterized by the weakening or loss of former defensive boundaries and controlled access, alongside the relative persistence or adaptation of internal circulation networks, collective spaces, religious landmarks, and residential structures. While the intensity, chronology, and spatial consequences of these transformations remain context-dependent and require systematic comparative verification, this relational perspective also offers a substantive orientation for heritage practice encouraging conservation and Historic Urban Landscape strategies to treat the preservation of relational structures (such as pathway continuity, the legibility of former boundaries, the integrity of collective spaces, and the articulation among components) as a heritage objective alongside the restoration of individual built elements.

6.2. Limitations

Several limitations should be acknowledged. First, the documentary corpus is fragmentary and unevenly distributed across time. Some components, particularly the Droub, the Bordjs, and the Bâb, are documented through discrepant or partial sources, and where cross-referencing could not resolve these discrepancies, reconstructions are presented as reasoned interpretations rather than certainties. Second, the temporal discontinuity of the corpus limits the precision with which individual transformations can be dated. The analysis therefore prioritizes trajectories and spatial relations over an exhaustive, precisely dated chronology of change. Third, several elements of the reconstruction, including the configuration of the droub network, the number of Bordjs, and the interpretation of a possible earlier religious structure beneath the mosque, rely in part on oral testimony and interpretive cross-referencing rather than on directly verifiable archival or archaeological evidence. These are flagged accordingly rather than treated as established fact. Fourth, the historical plans used in the analysis are graphic reconstructions redrawn and standardized by the authors for comparability, not reproductions of original documents. This introduces an additional layer of interpretation between the primary sources and the analysis.

The analysis also deliberately excludes domestic interior layouts. Consequently, possible relationships between changes in domestic organization and the external morphology of dwellings can only be discussed as potential interactions rather than empirically established processes. Finally, the study is based on a single case. Although the analytical framework is designed to be transferable and the transformation pattern identified at Béchar appears potentially recurrent in other Saharan ksour, the intensity, chronology, and spatial consequences of these transformations cannot be established as general patterns from the present case alone. Comparative application of the framework to other settlements is therefore required to distinguish recurrent relational trajectories from those conditioned by the specific historical, functional, spatial, and documentary contexts of each Ksar.

6.3. Future Works

Several directions follow from this work. Comparative application of the framework to other Saharan and vernacular historic settlements, including Ouargla, Ghardaïa, Guemar, Kenadsa, and Tamentit, would help test whether the relational pattern identified at Béchar reflects a recurrent trajectory of Ksar transformation: the weakening of former defensive boundaries and controlled access, combined with the relative persistence and

adaptation of internal circulation, collective, religious, and residential structures. Such comparison would also help distinguish recurrent relational mechanisms from trajectories conditioned by local histories, functions, urban expansion, and documentary availability.

Methodologically, future research could also integrate Historical GIS with the relational framework developed here. This would make it possible to spatially represent, measure, and compare the relationships identified qualitatively across different historical phases and between different ksour, thereby strengthening the operational value of the framework for comparative morphological analysis and heritage inventories.

Further work could also extend the analytical scope inward by incorporating the interior organization of dwellings, which was deliberately excluded from the present study, to examine how changes in domestic spatial organization may have influenced external building interfaces, openings, extensions, and relationships with the droub, and to test whether the permanence observed at the scale of the built envelope and circulation network extends to domestic spatial logics. Finally, the relational reading developed here points toward a practical research agenda for conservation policy. It calls for identifying which specific relations between components, rather than which specific structures, are most critical to a historic core's legibility, and for testing management interventions designed explicitly to protect those relations, such as pathway continuity, boundary legibility, and the articulation of collective and religious landmarks, as a complement to conventional built-heritage preservation.

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References

1. Bandarin, F.; van Oers, R. *The Historic Urban Landscape: Managing Heritage in an Urban Century*; Wiley-Blackwell: Chichester, UK, 2012.
2. Oliveira, V.M.A. *Urban Morphology: An Introduction to the Study of the Physical Form of Cities*, 2nd ed.; Springer International Publishing: Cham, Switzerland, 2022.
3. Ma, X.; Sun, J. A Study of Historic Urban Landscape Change Management Based on Layered Interpretation: A Case Study of Dongxi Ancient Town. *Land* **2024**, *13*, 2116. <https://doi.org/10.3390/land13122116>.
4. Zhang, R.; Martí Casanovas, M.; Bosch González, M.; Sun, S. Revitalizing Heritage: The Role of Urban Morphology in Creating Public Value in China's Historic Districts. *Land* **2024**, *13*, 1919. <https://doi.org/10.3390/land13111919>.
5. UNESCO. *Recommendation on the Historic Urban Landscape*; UNESCO: Paris, France, 2011.
6. Muratori, S. *Studi per una Operante Storia Urbana di Venezia*; Istituto Poligrafico dello Stato, Libreria dello Stato: Rome, Italy, 1960; Volume 1.
7. Conzen, M.R.G. *Alnwick, Northumberland: A Study in Town-Plan Analysis*; George Philip: London, UK, 1960.

8. Zhang, P.; Ghosh, D.; Park, S. Spatial Measures and Methods in Sustainable Urban Morphology: A Systematic Review. *Landsc. Urban Plan.* **2023**, *237*, 104776. <https://doi.org/10.1016/j.landurbplan.2023.104776>.
9. Wu, J.; Lu, Y.; Gao, H.; Wang, M. Cultivating Historical Heritage Area Vitality Using Urban Morphology Approach Based on Big Data and Machine Learning. *Comput. Environ. Urban Syst.* **2022**, *91*, 101716. <https://doi.org/10.1016/j.compenvurbsys.2021.101716>.
10. He, S.; Zhang, Z.; Yu, S.; Xia, C.; Tung, C.-L. Investigating the Effects of Urban Morphology on Vitality of Community Life Circles Using Machine Learning and Geospatial Approaches. *Appl. Geogr.* **2024**, *167*, 103287. <https://doi.org/10.1016/j.apgeog.2024.103287>.
11. Jiang, Y.; Huang, Z.; Zhou, X.; Chen, X. Evaluating the Impact of Urban Morphology on Urban Vitality: An Exploratory Study Using Big Geo-Data. *Int. J. Digit. Earth* **2024**, *17*, 2327571. <https://doi.org/10.1080/17538947.2024.2327571>.
12. Huang, X.; Cheng, R.; Wu, J.; Yang, W.; Zhang, L.; Li, P.; Zhu, W. Extracting Meso- and Microscale Patterns of Urban Morphology Evolution: Evidence from Binhai New Area of Tianjin, China. *Land* **2024**, *13*, 1735. <https://doi.org/10.3390/land13111735>.
13. Yang, M.; Qian, Y.; Li, X.; Ou, Y.; Zeng, J. River Valley Urban Network and Morphology: A Study on the Urban Morphology Evolution of Lanzhou. *PLoS ONE* **2024**, *19*, e0302686. <https://doi.org/10.1371/journal.pone.0302686>.
14. Wu, Y.; Yuan, Z.; Ning, Q.; Deng, G. Study on the Spatial Morphological Evolution of Traditional Old Urban Centers Based on Space Syntax and GIS Spatial Analysis: A Case Study of the Yiyang Historical and Cultural City Protection Zone. *Front. Earth Sci.* **2025**, *13*, 1697365. <https://doi.org/10.3389/feart.2025.1697365>.
15. Liu, P.; Zeng, C.; Liu, R. Environmental Adaptation of Traditional Chinese Settlement Patterns and Its Landscape Gene Mapping. *Habitat Int.* **2023**, *135*, 102808. <https://doi.org/10.1016/j.habitatint.2023.102808>.
16. Xu, M.; Zhu, H. A Study on the Evolution of Original Sites of Fortifications from the Perspective of Historic Urban Landscape: Cases of Paris, Beijing, and Moscow. *PLoS ONE* **2025**, *20*, e0318665. <https://doi.org/10.1371/journal.pone.0318665>.
17. Al-Saaidy, H.J.E. A Dramatic Morphological Transformation from a Spontaneous, Organic Street Pattern to Pre-Planned-Based Order: Learning from Baghdad City. *Urban Plan. Transp. Res.* **2024**, *12*, 2287569. <https://doi.org/10.1080/21650020.2023.2287569>.
18. Basee, D.H.; Abdulla, Z.R. Transformation of Urban Morphology, Vulnerability and Resilience: Haifa Street Area, as a Case Study. *Ain Shams Eng. J.* **2022**, *13*, 101718. <https://doi.org/10.1016/j.asej.2022.101718>.
19. Benlahbib, F.Z.; Alkama, D.; Hadj Mohamed, N.; Harrat, Z.R.; Bennaceur, S.; Işık, E.; Avcil, F.; Hilal, N.; Hama, S.M.; Hadzima-Nyarko, M. Impact of Urban Morphology on Microclimate and Thermal Comfort in Arid Cities: A Comparative Study and Modeling in Béchar. *Sustainability* **2026**, *18*, 659. <https://doi.org/10.3390/su18020659>.
20. Benziada, R.; Kacemi, M.; Mokhtari, A.M.; Fezzioui, N.; Harrat, Z.R.; Chatbi, M.; Hilal, N.; Mansour, W.; Sobuz, M.H.R. Optimizing Urban Thermal Comfort Through Multi-Criteria Architectural Approaches in Arid Regions: The Case of Béchar, Algeria. *Sustainability* **2025**, *17*, 7658. <https://doi.org/10.3390/su17177658>.
21. Matari, N.; Mahi, A.; Chabane, N.; Harrat, Z.R.; Hadzima-Nyarko, M. Design Methodology Development for High-Energy-Efficiency Buildings in Algerian Sahara Climatic Context. *Sustainability* **2025**, *17*, 2660. <https://doi.org/10.3390/su17062660>.
22. Kassou, Y.; Alkama, D.; Bouzaher, S. Earthen Architectural Heritage in the Gourara Region of Algeria: Building Typology, Materials, and Techniques. *Heritage* **2024**, *7*, 3821–3850. <https://doi.org/10.3390/heritage7070181>.
23. Zerari, S.; Cirafici, A.; Sriti, L. Issues in the Expression of Local Identity in the Saharan Regions of Algeria: In Search of References to Vernacular Architecture. *Conserv. Sci. Cult. Herit.* **2022**, *22*, 181–206. <https://doi.org/10.6092/issn.1973-9494/17314>.
24. Gherraz, H.; Guechi, I.; Alkama, D. Unveiling the Morphology of Saharan Heritage: Exploring Urban Heritage in the Algerian Sahara. *Indones. J. Soc. Sci. Res.* **2023**, *4*, 261–277. <https://doi.org/10.11594/ijssr.04.02.15>.
25. Boussaa, D.; Madandola, M. Cultural Heritage Tourism and Urban Regeneration: The Case of Fez Medina in Morocco. *Front. Archit. Res.* **2024**, *13*, 1228–1248. <https://doi.org/10.1016/j.foar.2024.04.008>.
26. Godard, J. *L'Oasis Moderne. Essai d'Urbanisme Saharien*; La Maison des Livres: Algiers, Algeria, 1954.
27. Hamès, C. Abderrahmane Moussaoui, Espace et Sacré au Sahara. Ksour et Oasis du Sud-Ouest Algérien. *Arch. Sci. Soc. Relig.* **2005**, *130*, 113–202. <https://doi.org/10.4000/assr.2839>.
28. Céard, L. Gens et Choses de Colomb-Béchar (Sud Oranais). *Arch. Inst. Pasteur Algérie* **1933**, *11*, 37–143.
29. Benguerba, R.Z. The Impact of the French Colonisation on the Ksours of the Region of Bechar. *Dirassat* **2013**, *2*, 35–39.
30. Caniggia, G.; Maffei, G.L. *Architectural Composition and Building Typology: Interpreting Basic Building*; Alinea Editrice: Florence, Italy, 2001.

31. de La Martinière, H.-M.-P.; Lacroix, N. *Documents pour Servir à l'Étude du Nord-Ouest Africain. Tome II: Le Sud-Ouest Algérien et les Régions Limitrophes. Figuig-L'Ouest Guir-L'Ouest Saoura*; Gouvernement Général de l'Algérie, Service des Affaires Indigènes: Algiers, Algeria, 1896.
32. Bousnina, M. *Caractéristiques et Particularités de l'Habitation Saharienne Traditionnelle à Béchar*. Master's Thesis, Université Tahri Mohamed de Béchar, Béchar, Algeria, 2004.
33. Mekherbeche, Y.; Hamouine, A.; Dib, B. Transformation of the Saharan Inhabited Space in Algeria: The Case of Ksar of Bechar. *Arquitecturas del Sur* **2022**, *31*, 124–135. <https://doi.org/10.4206/aus.2022.n31-09>.
34. Layachi, A. The Archetypes of Landscape and Sustainable Design in the Ksar of Kenadsa. *A|Z ITU J. Fac. Archit.* **2016**, *13*, 79–91. <https://doi.org/10.5505/ituja.2016.05657>.
35. Whitehand, J. British Urban Morphology: The Conzenian Tradition. *Urban Morphol.* **2001**, *5*, 103–109. <https://doi.org/10.51347/jum.v5i2.3896>.
36. Whitehand, J.W.R.; Gu, K. Urban Conservation in China: Historical Development, Current Practice and Morphological Approach. *Town Plan. Rev.* **2007**, *78*, 643–670. <https://doi.org/10.3828/tpr.78.5.6>.

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