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Formation and evolution of residential buildings in the Djelfa region of Algeria

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Abstract: This study endeavours to refund the evolutionary trajectory of residential building within the Djelfa region of Algeria, a landscape characterised by the cohabitation of sedentary and nomadic modes of existence. The investigation reconstructs the typological development by examining its earliest roots, namely the rudimentary forms of habitation – the hut and the tent – respectively adapted to sedentary and nomadic lifestyles. A sample encompassing approximately sixty dwellings situated within the town of Djelfa and its environs was meticulously selected, ensuring representation of diverse typological features such as size, spatial arrangement within the urban fabric, orientation, accessibility, and internal spatial organisation. This analysis aims to discern both diachronic and synchronic variations: the enduring linkages between residential building types across time and the co-existence of concurrent typologies. The research reveals a dynamic of organic links of continuity throughout this evolutionary process, punctuated by transitional phases that give rise to novel building solutions. These innovative solutions, upon achieving a degree of stability, tend to be replicated in a serialized way. The study underscores the pivotal role of the urban courtyard house within this evolutionary narrative, emphasising its remarkable adaptability and capacity for diversification. This adaptability stems from its ability to evolve in response to varying initial layout conditions, driven by principles of iso-orientation and the direction of access within the enclosed space. The courtyard house serves as a foundational substratum for subsequent residential types, including the row house and the apartment building. The succession of residential typologies exhibits a cyclical oscillation, characterised by periods of expansion wherein the residential building expands through modular replication of the elementary cell, followed by periods of contraction and urban densification, leading to a reduction in unit size through subdivision of the plot.

Keywords: building type, typological process, tent, courtyard house, row house, apartment block, Djelfa

INTRODUCTION

This research investigates the genesis and subsequent transformations of residential structures, grounded in the principle of organicity (Strappa, 2016). This principle posits, firstly, a gradual increase in the complexity of residential building types. Secondly, it suggests that transitions between morphological periods occur when the potential for mutations within a specific building type becomes exhausted. Organicity, in this context, signifies the inherent continuity and interconnectedness between evolving building forms. Importantly, organicity is not an intrinsic property of a structure but rather a metric for assessing the degree of coherence and interdependence among the elements constituting a structure, a degree that fluctuates across historical periods. Consequently, organicity provides a valuable framework for comprehending the interdependent relationships between the physical manifestations of the built environment, their spatial co-existence and their historical derivation from each other over time.

This succession of dominant architectural solutions during distinct historical periods is referred to by the concept of typological process. This concept was proposed in the 1960s by Saverio Muratori and subsequently developed by Gianfranco Caniggia, the founders of the Italian School of Processual Typology (Gauthiez, 2004). A typological process presents a 'progressive differentiation' perceived in several historical built types over time within a cultural area. The typological process is the result of historical evolution, where one dominant type gives way to another through an accumulation of small changes to the first type during a period of slower building activity. The typological process is a key concept in urban morphology because it links the analysis of old forms and the design of new ones (Moudon, 1994; Gokce and Chen, 2018).

Reconstructing the typological process aims to uncover the enduring transformations that building types experience within a cultural region over time (Caniggia and Maffei, 2001, p. 54). This framework provides a means of understanding the 'how' and 'why' behind the evolution of the built environment (Kropf, 2009). Moreover, it allows to recognise enduring patterns or the resilience of particular historical solutions when adapted for contemporary use (Gokce and Chen, 2018). However, empirical investigations that comprehensively trace the typological process across its entire historical trajectory, from its earliest origins, remain scarce. Furthermore, its application to non-

European contexts is still relatively underdeveloped (Whitehand et al. 2014).

The object of study in the present research is residential buildings in the Djelfa region of Algeria, belonging to the Ouled Nail mounts. This territory, located between the Tell with its temperate climate to the north and the arid Sahara to the south, has seen two complementary lifestyles coexist since the dawn of time: the sedentary lifestyle based on arboriculture and housed in villages called ksour; and the nomadic lifestyle based on livestock and cereal growing and whose habitat is the tent or group of tents. This is a territory with uncertain boundaries, non-isotropic geomorphological features and monotonous landscapes (Fig. 1).

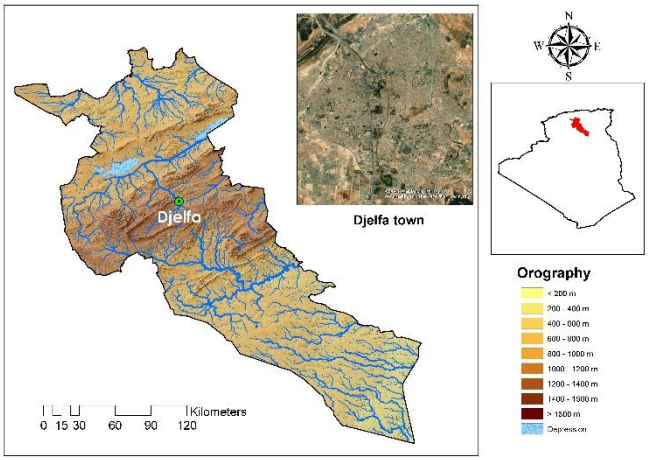

Fig. 1. Location of the study area. (Source: Authors, 2024)

However, since French colonisation in 1852, the ksour, which were strictly speaking shops and warehouses, have tended to disappear because the needs for which they were created no longer exist. They have been replaced by new centres, including the town of Djelfa, which has compensated for the disappearance of the ksour. Here, nomads can obtain supplies more widely and more conveniently, in a more modern way and better suited to current conditions. The square of Djelfa was created by imperial decree on 20 February 1861, ratified by Napoleon III after a proposal and study of the site and its natural and strategic characteristics. The agricultural settlement came into being thanks to the importance of the souk and the fertility of the land in front of the settlement. The town of Djelfa became the region's capital in 1974, and as a result has experienced a very high rate of urbanisation.

Historically, this region has not been the cradle of major urban centres which, through the stratification and complexification of their forms, could have constituted a field for architectural and urban studies. This region has been chosen to test the cognitive tools involved in reconstructing the typological process of residential building and to measure their methodological effectiveness. The more diverse and documented the forms, the easier the process of studying them and the more diverse the possibilities for interpreting them. The opposite is true in marginal regions, where forms tend to be more spontaneous and 'natural', subject to simple laws that are difficult to discern (Heffaf and Bestandji, 2021).

However, the reconstruction of a typological process of the built environment in the Djelfa region, as a predominantly nomadic steppe territory, is confronted with several difficulties insofar as its history is only possible in broad outline and becomes blurred as soon as we focus on a precise question in a given locality (Poujol, 2014). Given the elusive nature of this space and the limited nature of the historical sources available, this operation appears to be extremely difficult. The sources, which are often incomplete, are difficult to link together in order to obtain a coherent view of a specific period in the past. Given the sheer size of the area, a representative sample of the entire study area, necessary to carry out relevant analyses, is difficult to achieve. Conceived as a succession of terroirs that are difficult to identify, and whose boundaries are uncertain and changing according to the variable scale of the movements of nomadic populations, its delimitation as a prerequisite to its study is already a very arduous task.

The research question is therefore whether it is possible to study the residential buildings of the Djelfa region by referring solely or primarily to their physical properties and identifying distinct morphological periods in their continuous flow of transformation. Can these buildings be read in such a way as to decipher regular configurations governed by clearly describable principles? What are the residential typologies that exist in the Djelfa region? What are their characteristics and chronology? And are there any relationships of continuity between them?

The reasons for the determination of primary forms and their subsequent transformation processes are generated by mechanisms inherent in these forms. This hypothesis, although it may seem restrictive, is in fact necessary to reduce the complexity of the built phenomenon to an affordable level. *'(...) the built environment enjoys a certain autonomy in relation to the universe of functions that take place within it. It is true that the universe of functions acts as a dynamic factor, driving the evolution and diversification of forms; but the rules according to which forms change and combine belong to an autonomous system that can be analysed for its own sake'*. (Malfroy and Caniggia, 2001, p. 180)

METHODOLOGY

As part of a thesis on the principle of organicity as a key to analysing anthropic structures on the scale of the territory, the urban organism and the built unit of the central Saharan Atlas in Algeria, a planimetric examination of a sample consisting of around sixty dwellings (tents, rural houses, urban courtyard houses and apartment blocks), spread across several urban fabrics and the rural environment, was performed. Data collection lasted several years, and involved personal surveys as well as architectural surveys completed in situ. The study of these buildings enabled us to propose a typological classification, distinguishing between the main typologies and their variants (Fig. 2).

The typological process is reconstructed by identifying the succession of residential typologies over time (diachronic variations). Typologies are defined by recognising and comparing shared characteristics in the structure, spatial arrangement, and aggregation patterns of residential buildings (synchronic variations) (Corsini, 1997, p. 34; Lamani Bourahla and Cherif, 2024). As we delve further into the past, the diversity of building characteristics increases. It is crucial to distinguish the overall typological process from the internal "threads" (Caniggia and Maffei, 1979, p. 85) specific to each typology. These threads guide its evolution towards greater internal coherence, strengthening the necessary relationships between its components and consequently limiting its potential for transformation. In an organic configuration, altering the position or function of any part inevitably affects the overall structure. The components are interconnected through relationships of necessity and interdependence (Petruccioli, 2007, p. 34). This contrasts with serial configurations, where individual parts can be interchanged with minimal impact on the overall structure.

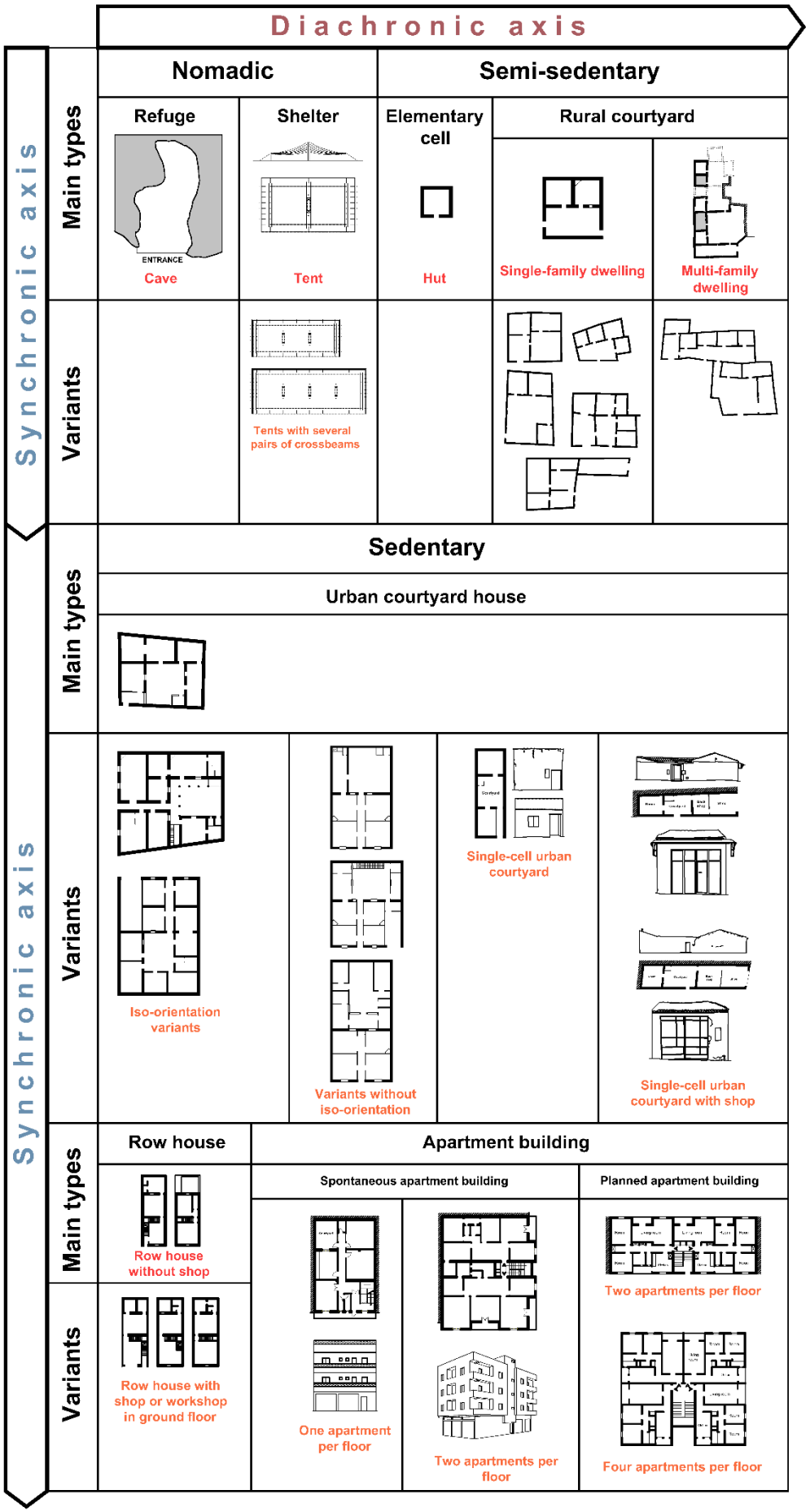

Fig. 2. Typological classification of the examples studied. (Source: Authors, 2024)

Solely relying on formal representations of the complexity and heterogeneity of built environment elements to define the evolution of residential architecture is insufficient. Categorising and describing typical features provides only a partial understanding. A more comprehensive approach involves reconstructing a logic for the evolution of building types, rooted in an understanding of the generative matrices that shaped them. This logic facilitates the identification of relationships between the characteristics of built environment components and helps to bridge 'historical gaps in memory.' Crucially, this approach necessitates the acceptance of anomalies and deviations that inevitably arise within any built environment. Typical features are certainly recognisable, but they are rarely exemplified in a single building with a clear system of relationships and arrangements of elements that are perfectly linked and serenely displayed to the observer. More often, the relationship between the elements of a building is so conflicted that it bears the marks of a long struggle for survival, in the form of successive adaptations, mutilations and constraints over time.

The reconstitution of the sequence of links that modernity has put in crisis, but not broken, contains a latent rejection of the fleeting seduction of an architecture reduced to a personalised language, the ultimate outcome of a long process of division of labour. The latter has redefined the architect's profession by entrusting him with the care of the most subversive aspects of the commercialisation of construction, to the detriment of the deep, continuous and vital structures that are at the origin of forms (Maffei and Maffei, 2011; Strappa, 1995). Based on the study of common and recognisable features of the built environment, processual typology tends to favour continuity over opposition, identifying norms and vocations rather than derogations and exceptions (Maffei and Maffei, 2011).

The classification of residential types in the Djelfa region shown in Fig. 2 reveals the inherent potential of the different categories to relate to objects of the same scale and/or to belong to contemporary structures of a larger scale. In other words, '*we can easily observe the co-presence, at several scales and on the same scale, of analogous objects, both containers and contents: in a system that necessarily implies a set of rules of reciprocal behaviour, a global unity where the objects remain together and derive from this cohabitation their specific functions, their correlations and their identity*'. (Caniggia and Maffei, 1979, p. 51)

We can also see that objects of the same nature derive from each other, that is to say that the existence of each object is made possible by the succession, over time, of the existence of other objects, without which it would not have its recognisable characteristics. The relationship is therefore one of cause and effect, in which the effect is the object under consideration, but the cause is not the need, which may be the distant matrix of the need, but in reality the cause consists in the specific experience that led to the realisation of all the preceding objects. Co-presence and derivation are therefore the consequence of historicity, the conditions of existence, in space and time, of the built objects. Co-presence is a spatial correlation; derivation is a temporal correlation.

RESULTS AND DISCUSSION

Primitive roots of residential building in the Djelfa region: The hut and the tent

The residential buildings in the Djelfa region refer either to the elementary form of the enclosure, with a central space open in relation to the spatial and distributive structure, and which corresponds to the courtyard house, derived from the primitive hut. It is a heavy, thick and organic plastic structure, consisting of different elements placed in a non-repetitive manner. This implies an indirect legibility of the components and an absence of interrelationship between the interior and exterior due to the opacity of the envelope (Fig. 3 a). Or they may refer to the roof, consisting of a covered central space containing all domestic activities, and represented by the tent (Fig. 3 b). This is a fundamentally light, subtle and serial structure, or rather one based on the repetition of identical and interchangeable elements. This means that the components are immediately legible.

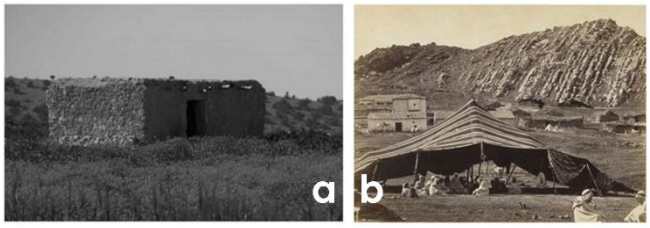

Fig. 3 a. Primitive hut in the Sen El Ba region; b. Tent in the Ouled Nail mountains. (Source: Authors, 2019)

The hut: The elementary operation of appropriating space by creating a protective enclosure generates the type of courtyard dwelling which was the basis for the formation of ancient fabrics around the Mediterranean basin. The fundamental courtyard house, identified as the archetype by analysing shared features across numerous dwelling types and variants based on the concept of enclosure, comprises four walls defining a rectangular perimeter. Within this enclosure, one or more basic living units are situated on one side. Numerous variations of the courtyard house evolved from this prototype, primarily through the gradual occupation of the internal open space. The walls themselves are typically constructed using two rows of large, undressed stones embedded in the ground, with the intervening space filled with a mixture of earth and gravel. The hut contains, at an embryonic stage, all the elements of the construction organised in four zones of architectural stratification: the base composed of the stones that reinforce the articulation with the ground; the elevation composed of the pediment; the unification constituted by the linear nodality of articulation between the pediment and the roof and the conclusion of the structure (Fig. 4).

The tent: In the Ouled Nail mounts the covering structure is represented by the tent, necessary not only in the types used by semi-sedentary groups (where some forms of hunting and breeding require, for certain periods of the year, sedentarisation), but also in the types used for total nomadism, where the external environment offers no material. In this case the shelter must be obtained by assembling elements that can be easily transported during transhumance. The characteristics of tent coverings are generated by: the mechanical specificities of the materials (resistance of canvas and ropes to bending and traction); aspects relating to the environment and use (ease of transport, rapid assembly) and integration (mobility and total adaptation to the environment).

The Ouled Nail tent is made up of crossed wooden crossbeams that act as vertical bracing supports, and canvas stretched from the ridge to the ground using other secondary bracing to gain internal space. It is designed to be easily dismantled and transported. The ridge knot (*el gountas*) is a kind of wooden tie that is placed at the top of the crossed crossbeams to prevent them from rotating and also to prevent the pressure from tearing the fabric. The tent fabric is made up of strips or *flidj* of wool mixed with goat's and camel's hair, about 60 cm wide, the length and number of which vary according to the size of the tent (Fig. 5).

Where the canvas meets the ground, a gutter called an *ounni* is dug inside to drain away run-off water.

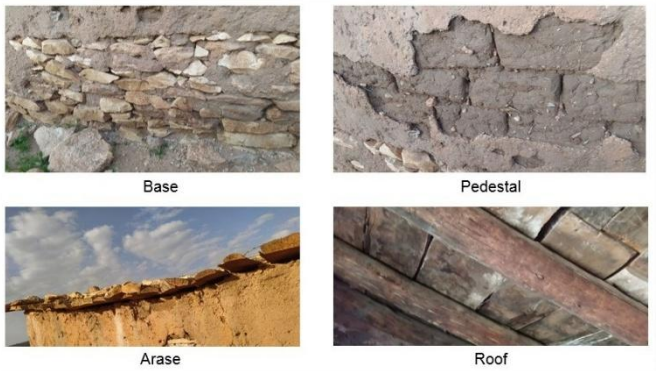

Fig. 4. Tectonic stratification in a hut in the Sen El Ba region, Djelfa. (Source: Authors, 2019)

Wooden handles are affixed to the edges of the fabric, to which pull cords are attached. These cords are then wrapped around the tent poles, tightened, and rewound to create tension. This tension must be evenly distributed not only along the short sides but also across the front and back of the tent to maintain balance. Direct application of tension to the long sides could cause seam failure. To mitigate this risk, a 'tension band' (*triga*) is employed. This band, sewn transversely beneath the fabric, is positioned at the level of the main crossbeams, effectively distributing the tension across the long sides. The tent consists of two parts, separated by an esparto curtain (*hayel*). On one side is the kitchen (*melkma*), the women's area, with an upward opening, and on the other is the room reserved for men, passing guests and new-born animals in winter (Fig. 6). The tent was sometimes supplemented by an enclosure where the animals were kept at night, defended by branches of jujube (*rouag*) (Sivignon, 1963, p. 211).

The tents of several families grouped in *s'mat* are set up in depressions in the landscape, near a watering place; they are arranged in a circle around a central courtyard, the *m'rah*, where the herd retires each evening (Fig. 7). This tent represents all the characteristics of extreme specialisation through a set of specific techniques, capable of providing optimal responses to extreme environmental conditions; however, when these are resolved, the possibilities for evolution are almost absent or, in any case, reduced to their simplest expression (Cataldi, 1986, p. 112). The typological process of the tent only concerns dimensional growth through the use of more and longer *flidj* and the addition of other pairs of crossbeams (*r'kiza*). The result is a change from a tent with a single *r'kiza* to one with two or three *r'keiz*. Tents with more than three *r'keiz* are not used for residential purposes, but for festivals and assemblies (Fig. 8).

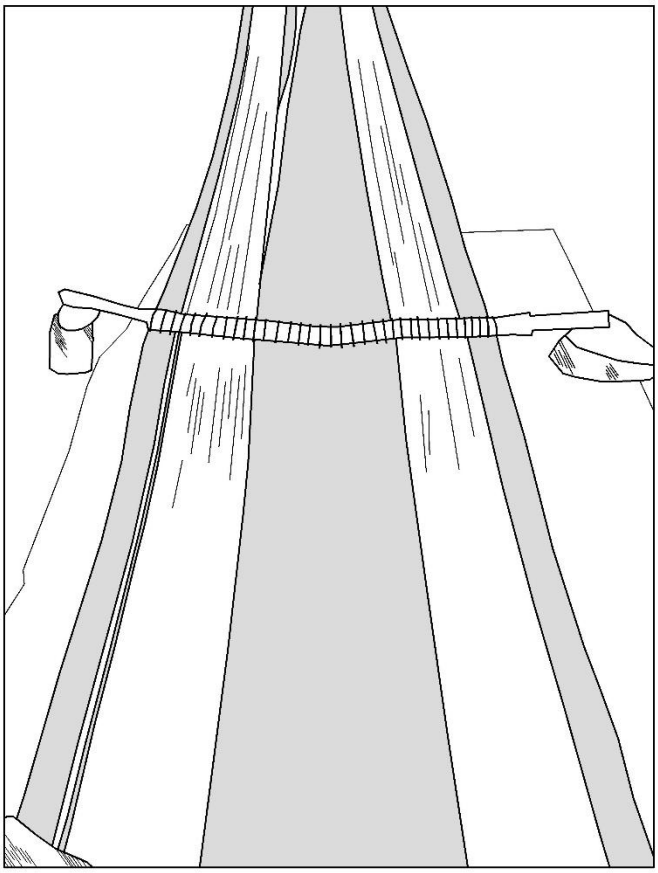

Fig. 5. *Flidj* weaving. (Source: Authors, 2020)

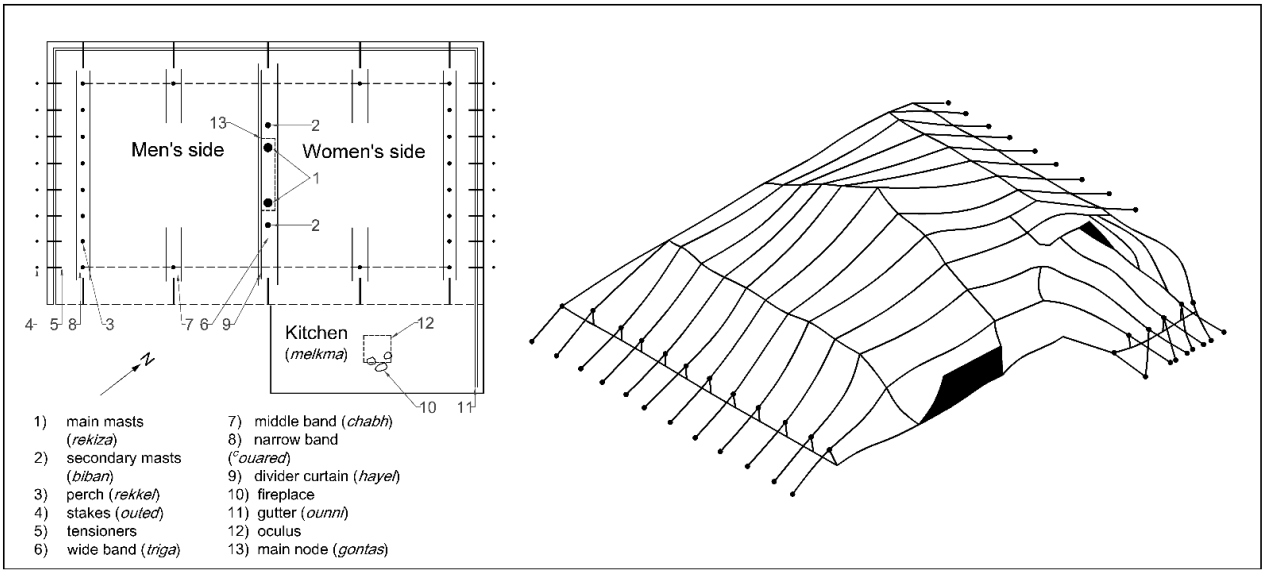

Fig. 6. Schematic plan and perspective view of a tent. (Source: De Villaret, 1995, p. 102)

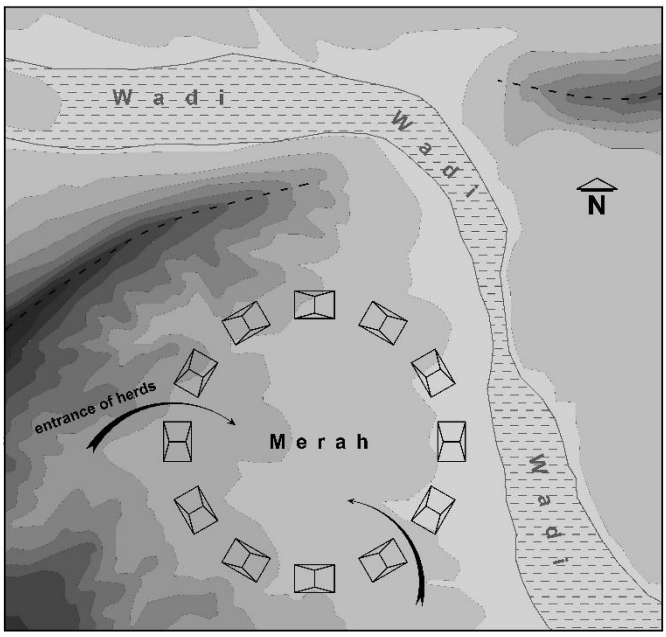

Fig. 7. Schematic drawing of a *s'mat.* (Source: Authors, 2021)

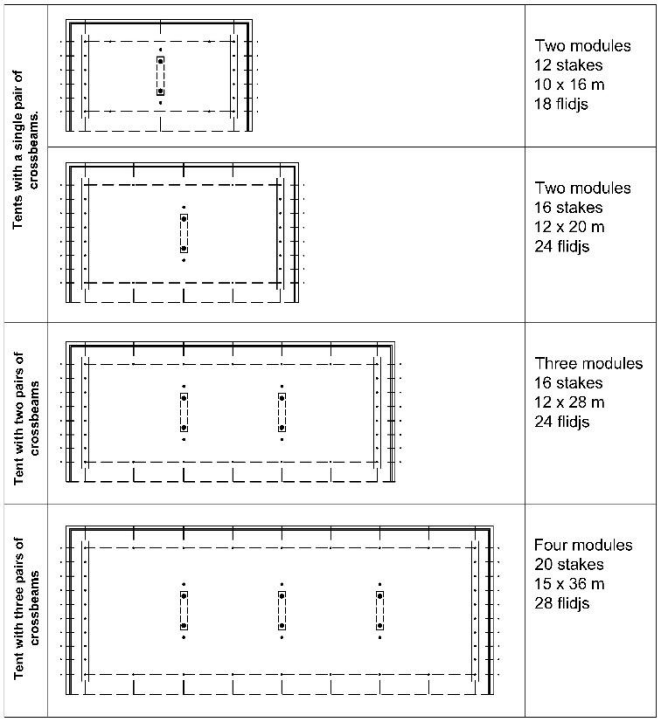

Fig. 8. Typological process of the tent by dimensional increase. (Source: Authors, 2024)

The courtyard house

In the courtyard house type, the shape of the building coincides with the boundaries of the plot and its configuration is not closely linked to the street, so that any side of the plot can face the street without interfering with the internal organisation of the structure. The unbuilt space dominates the built space, as it must act as a mediator between the inside and outside of the enclosure as well as the internal distribution of rooms (Fig. 9). The courtyard house type has no external openings, which only appeared recently, from the 19th century, following a long process and exclusively in urban areas. The fact that a room has only one source of light, that of the courtyard, means that the room is most often wider than it is deep, especially in places where the roof is made of Phoenician Juniper beams, the length of which rarely exceeds two meters (Fig. 10). This configuration is not only linked to structural constraints, but is deliberately chosen, because it allows the first rays of sunlight to reach the back wall and thus prevent mildew.

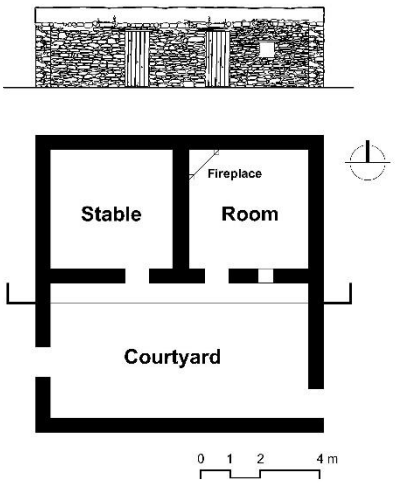

Fig. 9. Plan and section of a single-family courtyard house in the Sen El Ba region, Djelfa. (Source: Authors, 2019)

Fig. 10. Roof in a courtyard house. (Source: Authors, 2023)

The row houses each have their own load-bearing walls within the plot, thus reducing interactions to a minimum during the construction process. The courtyard house, on the other hand, requires a higher level of participation, since the common wall with the adjacent units must accept the neighbour's beams, which presupposes a strong social harmony and thus a higher level of organicity.

The rural courtyard house: The analysis of the typological process of the courtyard house begins with the rural version. The limited changes it undergoes allow a clearer reading of the basic type and the first diachronic variations. The built unit, which corresponds in this first stage of development to the elementary cell itself, is oriented to take maximum advantage of direct sunlight, which corresponds to an east-southeast exposure. Because

the choice of orientation depends more on production needs than on the building itself, this rule is rigid in rural areas (Fig. 11) but less strictly respected in cities, even if it also prevails in the majority of townhouses.

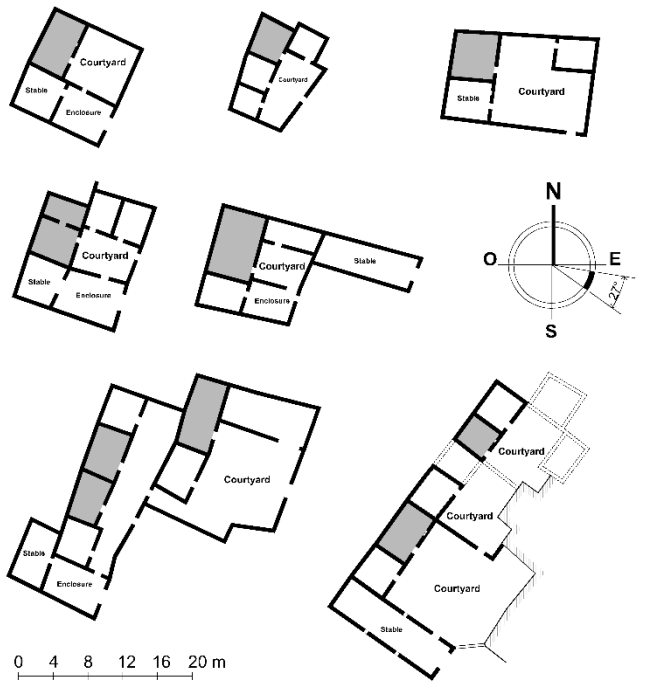

Fig. 11. Iso-orientation of rural houses in the Sen El Ba region; variations in orientation are minimal, within a range of no more than 27° for the selected sample. (Source: Authors, 2024)

The rural courtyard is generally composed of two to three cells, one is residential and the others serve as tool spaces, storage and stable. Its transformations are made by the juxtaposition on the previous courtyard of a new courtyard, thus passing from a single-family house to a multi-family house.

The urban courtyard house: In urban areas, courtyard houses are combined to form courtyard fabrics of relatively low density, particularly in old neighbourhoods that have been spared from intensive urbanisation. On aerial photographs, this organisation resembles a checkerboard where solids alternate with voids. To make the most of the sun, and according to the principle of iso-orientation, courtyard fabrics are generally aligned from east to west, with courtyards facing south. The other paths, whether or not they are oriented east-west, simply act as general traffic routes.

The analysis showed that courtyard fabrics can be grouped into three basic categories:

- Open series fabrics, which represent a form of linear urbanisation characterised by extensive growth. Unlike denser and more complex urban fabrics, these groups develop along main axes, with each row of plots served by a path (Fig. 12 a). The internal organisation of the blocks is marked by an asymmetry between the north and south facades. While the south facade opens generously onto the courtyard, the north facade is often blind;

- Double-row or closed series exits that consist of a layout of two series of contiguous lots and a path that provides access to the courtyards either from the unbuilt side for the lots occupying the north margin or from the built part for those located to the south of the route (Fig. 12 b);

- Deep triple or quadruple series fabrics that appear when the distance between pre-existing routes is greater than twice the size of the lot. When a built type is consolidated and its size is too small for a back-to-back aggregation, adapted to the interval between the two parallel routes, we observe a progressive occupation of the interior area by introducing dead ends or secondary access routes (Fig. 12 c).

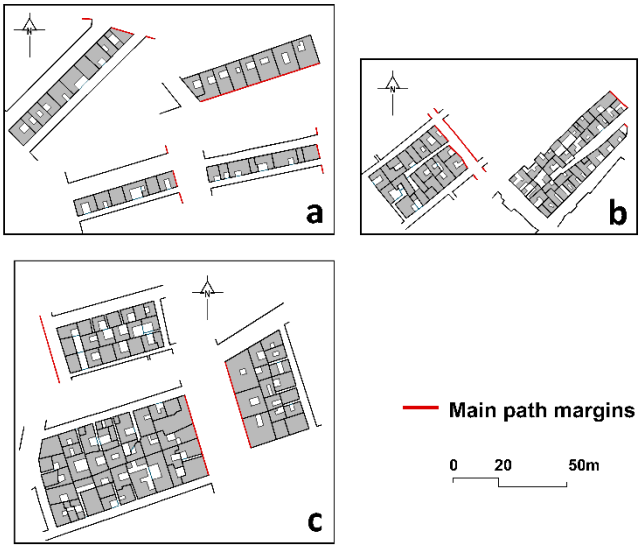

Fig. 12. Typology of the insertion fabrics of urban courtyard houses. (Source: Authors, 2024)

In the city, and given the predominance of a south-east orientation, the original built part inside the enclosure is either parallel or perpendicular to the route. There are then only three possible variants of access for the house. In the first case, on a route tending to be oriented east-west, the houses aligned on its northern margin will have their parts built on the back of the enclosure; those on the southern margin will be built on the edge of the street itself, in this second case the entrance is through the body of the building itself, where, in order not to limit the possibilities of distribution, it is pushed to the end of the plot. While on a path-oriented north-south, the houses will be built orthogonally to the street by leaning against the northern lateral side of the enclosure and the entrance is located in the centre of the free side (Fig. 13).

In these three examples of urban courtyard houses, the layout is designed to optimise sunlight: the preferred orientation for the elementary cell is to the south or southeast. The built side is, in this first phase, the north side of the plot (Fig. 13 A - 1, B - 1, C - 1). Then the growth was done by leaning first against the west wall to benefit from the east orientation (B - 3, C - 3); and then against the east wall to turn towards the west (Fig. 13 B - 4, C - 4), and finally by building the annexes of the house on the south side of the plot (Fig. 13 C - 4). This cycle is often concluded by the construction of a portico on all four sides. The elementary courtyard is gradually transformed (diachronic variations) as its surface area is covered, so that the activities that previously occurred outside begin happen inside.

It should be noted that this process, obeying the law of iso-orientation, ended up producing a grammar that reinforces the legibility of the planimetry on the elevation. The facade of a courtyard house accessible from the north side and having a simple structural body, generally does not have windows and has the entire front that is built (Fig. 13 C – 1, Fig. 14 a, b, and c). A courtyard house with the south side on the street and insufficient depth to have a building on its four sides, has a facade delimited by the gables of the two lateral buildings that frame

what remains of the enclosure; the slopes of the roof are directed symmetrically inward, towards the courtyard (Fig. 14 d) (Fig. 13 B - 4). In the case where the house is located in the corner of the block, the slopes are oriented in the same direction (Fig. 14 e).

Fig. 13. Typological process of the courtyard house. The table summarises the variants of the single-family house within the limits of the original plot and with minimal specialisation: (A-1) entrance and path to an elementary cell perpendicular to the street. With the best orientation, this room remains, throughout the process, the main space of the house, i.e. the family living room; (B-1) elementary cell opposite the entrance and leaning against the back wall; (C-1) entrance from the covered part built alongside the street. Columns 2, 3 and 4 represent the successive phases of growth through progressive occupation of the open sides of the enclosure. (Source: Authors, 2024)

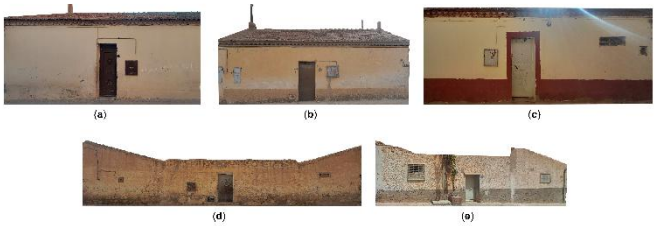

Fig. 14. Legibility of planimetric organisation at elevation level. (Source: Authors, 2024)

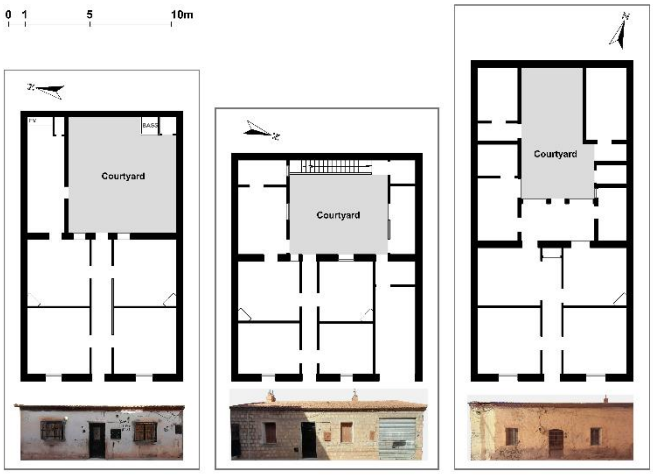

Fig. 15. Three synchronic variants of the courtyard demonstrate that the distributive character of the house is independent of orientation conditions. (Source: Authors, 2024)

Fig. 16. Subdivision of the courtyard house. (Source: Authors, 2024)

Fig. 17. Raised courtyard houses. (Source: Authors, 2024)

Windows typically appear only when a double building body exists on the front (Fig. 13: A-4, C-3). This relatively recent typological development has been solidified through usage and has spread sequentially, irrespective of layout conditions. The principle of iso-orientation, which has driven all progressive refinements and guided the courtyard typology towards greater organic forms, has ultimately reached its zenith. This has culminated in a dominant type now being mass-produced (Fig. 15).

Alteration of the courtyard house: The different types of alteration of the courtyard house will now be presented, progressing from the simplest to the most complex. The focus will be on type B-4 (see Fig. 13) due to its immediate legibility. First, the phenomenon of land fragmentation of the courtyard house with four structural modules into two separate houses, each with two modules, can be mentioned. This is achieved by building a dividing wall in the middle of the courtyard and introducing a new access to the enclosure (Fig. 16). The type resulting from this alteration was then reused for the multi-family development of large courtyard houses. The other alteration phenomenon is the substitution of the residential function of the houses that come into contact with a highly commercial area by stores and the raising of residential rooms on the first floor. In this case, the initial configuration is reproduced identically in the upper floor, this type is known as *A'lae* (raised courtyard house) (Fig. 17).

The process of fragmenting the courtyard can reach the limit by subdividing the courtyard once again into two structural modules to end up with a single-cell courtyard house on the front (Fig. 18 A). This also occurs following the destination of a cell overlooking the street for commerce or work and which will subsequently become an autonomous built unit. In this particular case, the cell doubles in depth to have a room dedicated to the back shop (Fig. 18 B). This diachronic variant of dimension constitutes the embryo of the future row house.

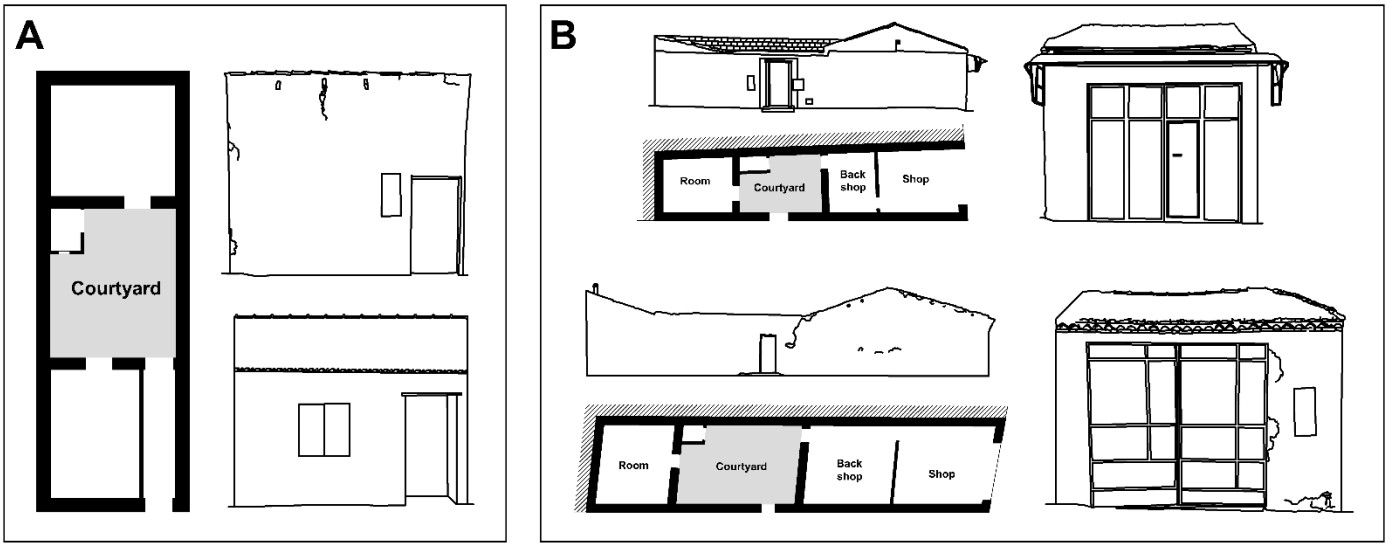

Fig. 18. Single-cell courtyard house. A: Non-specialised; B: With specialised double-body front. (Source: Authors, 2024)

The row house

There are fundamental typological differences between the courtyard house and the row house. The latter is always located along a street and closely depends on it. Its free space is behind it. The pre-eminence of the building plot and the high land value attached to its facade determine the dimensions of the plot, whose facade is equivalent to the size of an elementary cell, approximately four meters. This house is intended for a fairly significant growth in height (Fig. 19). The staircase of the terraced house consists of two L-shaped ramps, and to go up to the upper floor, one must cross the front room. The synchronous variant of the corner position of the terraced house enables to arrange a double-ramp staircase in the shape of a U, thus allowing vertical circulation that does not interfere with horizontal circulation and then makes it possible to pass from a single-family terraced house to a multi-family house with a single apartment per floor (Fig. 20).

Fig. 19. Plans Elevations of row houses; in the two examples, the top-floor window is the only one centred. On the lower floors, the window is off-centre, as the vertical circulation has been subtracted from the width of the front cell. (Source: Authors, 2024)

Fig. 20. Multi-family row house. (Source: Authors, 2024)

The row house is strongly linked to the commercial character of the street. The more commercial a street is, the greater the fragmentation of the plot, which gives rise to row houses that are deeper than wide, thus allowing the architecture to take advantage of the added value of the land on the margins of the street, to the point where the commercial character can sometimes completely overshadow the architectural expressiveness, and the entire facade is transformed into a sign (Fig. 21).

Spontaneous apartment block

The turbulent socio-economic context of the 1990s had direct repercussions on the built environment. The generalisation of housing blocks, often associated with large garages intended for rental or commercial activities, reflects an adaptation of the courtyard house to new economic constraints and changing lifestyles (Bachar, 2015). The house becomes a lucrative asset thanks to the income generated by the garages, often rented. Families, constrained by the housing crisis, opt for multi-storey constructions, thus transforming single-family houses into mini multi-family buildings (Fig. 22 A). The synchronous variant of corner position also comes, as in the case of the row house, to be transformed by equipping itself with a central staircase with double ramp that serves two apartments per floor (Fig. 22 B).

Fig. 21. Facade of a row house completely transformed into a commercial sign. (Source: Authors, 2024)

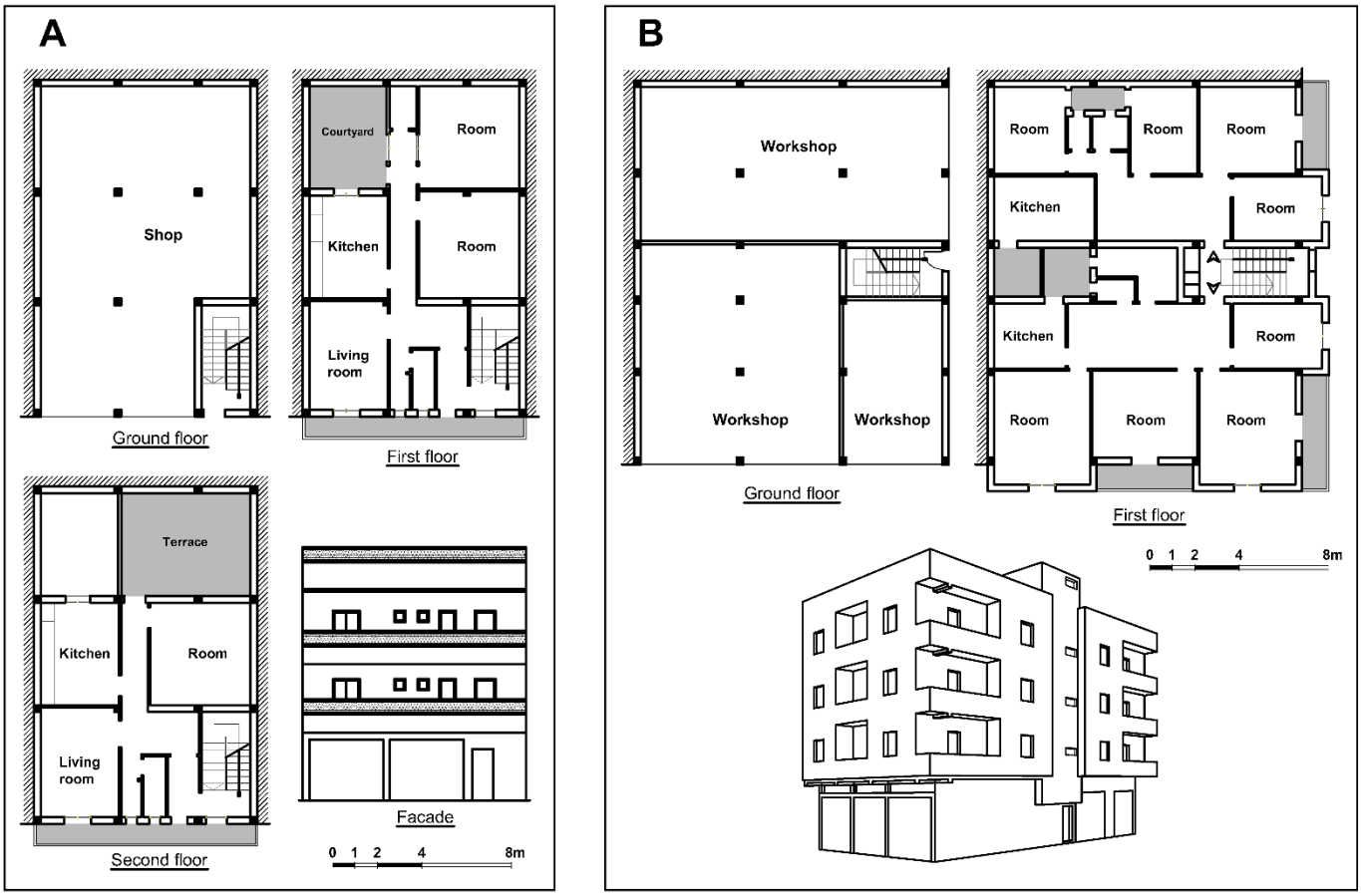

Fig. 22. Examples of apartment buildings. A: Small building with one apartment per floor; B: Corner building with two apartments per floor. (Source: Authors, 2024)

Planned apartment block

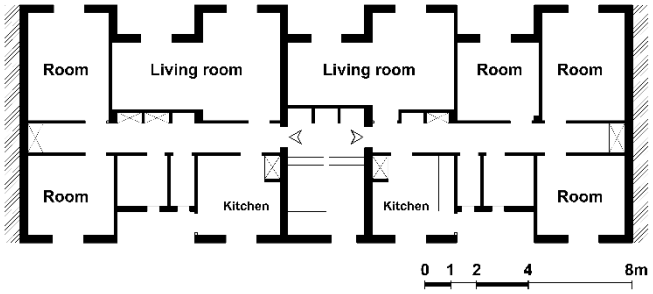

Fig. 23. Planned building with two apartments per floor in Cité El Haouas, Djelfa. (Source: Authors, 2024)

The first types of planned collective housing built in the city of Djelfa consist of buildings with two or four apartments per floor. The first is a double structural body with triple distribution in depth and contains seven bays on the facade. The central bay contains the stairwell which distributes a F3 and a F4 (Fig. 23). The second is an isolated block with four apartments per floor (Fig. 24). These typologies emerged during a phase of major peripheral urban expansion. These peripheries are characterised by their monotony and their weak integration due to the excess of individuality of the buildings, whose structure only responds to an internal logic. The excessive dimensional increase by successive modular duplication of the residential buildings does not allow their insertion into a homogeneous fabric and the spaces which surround them are poorly defined. The building is thus dissociated from context because of the disintegration of the components of the urban fabric, namely the path, the plot and the built unit.

CONCLUSION

The study of the typological process of residential buildings in the Djelfa region highlights a dynamic evolution of the built environment, marked by an alternation of morphological periods dominated by distinct types. These periods are subject to progressive transformations which, when they cross a tipping point, lead to irreversible mutations, thus giving rise to new configurations and new morphological periods. This rapid transition occurs just after a moment of stasis due to the exhaustion of the possibilities of mutation of the previous type and is characterised by its serial reproduction. However, it has turned out that these moments of transition are not the expression of a radical break. Indeed, new types of buildings often inherit certain characteristics from their predecessors. Dimensions, spatial congestion, structural and functional modularity are all elements that can be transmitted from one generation of buildings to the next.

The tent and the courtyard house, two fundamental structures, bear witness to a deep cultural significance and a strong territorial anchoring. If the tent, through its mobility and its adaptation to the most diverse environments, represents a universal archetype, the courtyard house, for its part, offers a particularly rich case study in terms of typological evolution. Indeed, starting from an initial concern to optimise sunlight, the courtyard house has seen its configuration evolve over time, responding to a higher ordering principle: the course of the sun. This submission to a cosmic rhythm has given rise to a great diversity of plans and elevations, while preserving an overall coherence within the urban fabric. Far from being fixed in an immutable archetype, the courtyard house has proven to be a particularly adaptable and diversified architectural substrate, capable of being adapted

to the most varied contexts. Its influence on the typological process is considerable, structuring urban forms over long periods and providing a solid basis for the emergence of new architectural configurations.

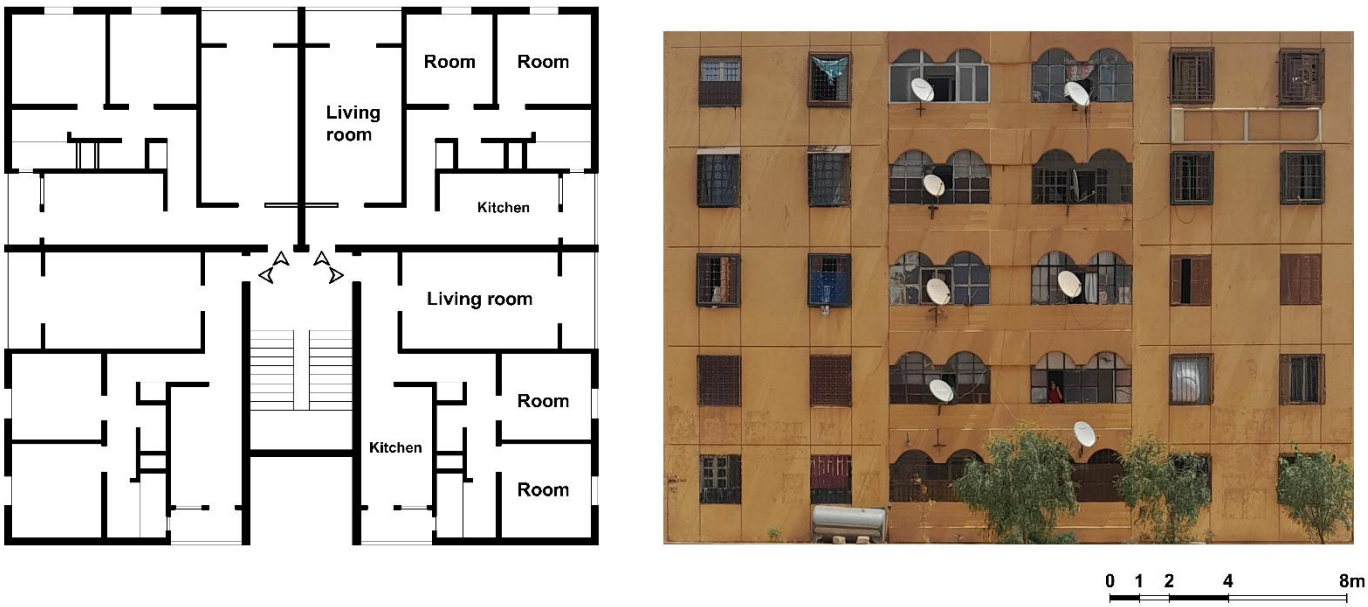

Fig. 24. Planned building with four apartments per floor in Cité 5 Juillet, Djelfa. (Source: Authors, 2024)

The evolution of residential typologies in the Djelfa region is characterised by an oscillatory movement punctuated by dynamics of expansion and contraction of urban fabrics. During periods of demographic and economic expansion, there is a tendency for the residential unit to enlarge through modular duplication of the elementary cell. Conversely, during phases of urban contraction, linked to economic crises, demographic changes or social mutations, the residential unit tends to be reduced by division. This phenomenon is often associated with a densification of the building, the fragmentation of the plots and the growth in height of the residential building.

This research requires to interpret and design the built environment 'with the same hand' (Caniggia and Maffei, 1984). It involves redrawing the process of shaping-built reality as a succession of phases. This restitution of phases guarantees the relationship between the existing and the future interventions. Redrawing the structuring phases of the residential built environment allows obtaining a homogeneous series of 'reconstructive samples' which, through their succession, are responsible for the current stage of the built environment. This stage is a provisional conclusion and a moment of transit towards a later phase: it represents both the culmination of the typological process and the matrix for future changes.

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