

Vernacular principles in contemporary architecture: Ghardaïa, Ural region

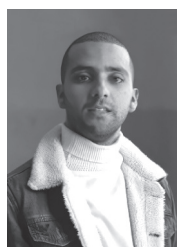
Abstract. Contemporary architecture often faces the challenge of achieving sustainability while responding effectively to local climatic and cultural conditions. Despite the rich knowledge embedded in vernacular architecture, its potential as a model for sustainable architecture is still underexplored. This study examines vernacular practices in two contrasting contexts — Ghardaïa in North Africa and Ural Region in Russia — highlighting how local culture and environmental conditions shape construction techniques and adaptive strategies. By analyzing lifestyles, habits, and the advantages of building methods in hot-arid and cold climates, the study demonstrates that vernacular architecture provides a pathway to sustainability, optimizing local resources, integrating cultural values, and fostering strong site-specific connections. These findings suggest that vernacular principles can inform sustainable contemporary architecture and be adapted to diverse contexts globally.

Keywords: vernacular architecture, traditional architecture, architecture anonym, sustainable contemporary architecture, construction methods, cultural adaptation, local materials, dry region, cold region

Тшалаби И. Принципы вернакулярной архитектуры в современной архитектуре: Гардая и Урала

Аннотация. Современная архитектура сталкивается с задачей достижения устойчивости при одновременном эффективном учёте местных климатических и культурных условий. Несмотря на богатый опыт, заложенный в вернакулярной архитектуре, её потенциал как модели для устойчивого проектирования остаётся недостаточно изученным. В данной статье рассматриваются вернакулярные практики в двух контрастных контекстах — Гардаи в Северной Африке и Екатеринбург в Уральском регионе России — с целью выявления того, как местная культура и природные условия формируют строительные технологии и адаптивные стратегии. Путём анализа образа жизни, привычек, а также преимуществ строительных методов, адаптированных к жаркому засушливому и холодному климатам, показано, что вернакулярная архитектура представляет собой путь к устойчивому развитию, оптимизируя использование местных ресурсов, интегрируя культурные ценности и формируя тесную связь с окружающей средой. Полученные результаты свидетельствуют о том, что принципы вернакулярной архитектуры могут служить основой для проектирования современной устойчивой архитектуры и быть адаптированы к различным контекстам на глобальном уровне.

Ключевые слова: вернакулярная архитектура, традиционная архитектура, анонимная архитектура, современная устойчивая архитектура, методы строительства, культурная адаптация, местные материалы, засушливый регион, холодный регион



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Introduction. Problem Statement and Research Objective

Energy consumption in the construction sector is expected to continue increasing [13], in connection with the growing challenges posed by global climate change. In this context, there is a growing need for architectural approaches that can respond effectively to environmental pressures while maintaining cultural and functional relevance. Traditional vernacular constructions inherently incorporate principles of sustainability, as they are adapted to microclimatic conditions and site-specific characteristics. These forms of architecture demonstrate how local knowledge and resources can generate efficient and context-responsive built environments.

Vernacular architecture is essentially historical up to a certain period and developed without the professional intervention of architects [4]. It refers to spontaneous settlements that develop independently, or to the uncontrolled expansion

of the outskirts of large cities [2]. The built environment is not controlled by an individual but is the result of vernacular processes shaped by local conditions and practices [1]. In recent years, vernacular architecture has attracted increasing interest within the academic community [6], being perceived as a potential solution for sustainable construction, particularly in response to climate change [6] and rising energy consumption. Many studies have focused on its characteristics, such as the use of local materials [11], climatic adaptability, and low environmental impact.

Many researchers have explicitly linked vernacular (traditional) architecture with sustainability and environmental performance [9]. From the same perspective, A.A.M. Sayigh goes even further, highlighting that vernacular architecture offers practical and transferable models for addressing contemporary sustainability challenges within the architectural field [15]. From a different geographical perspective, A. Ginzburg



Figure 1. a) The location of Ghardaïa, Algeria. Wikimedia Commons. URL: https://commons.wikimedia.org/wiki/File:Algeria_20_Wilaya_locator_map-2009.svg; b) The location of the Ural Federal District within the Russian Federation. Wikimedia Commons. URL: https://commons.wikimedia.org/wiki/File:Map_of_Russia_-_Urals_Federal_District.svg

examines traditional Russian wooden architecture and its environmental performance [3], demonstrating that vernacular dwellings in cold-climate regions are characterized by a high degree of adaptation designed to ensure thermal efficiency and withstand long-term climatic constraints. These studies demonstrate that vernacular architecture should not be understood merely as a system of cultural heritage, but rather as a sustainable and adaptable architectural framework applicable across diverse climatic contexts [2]. However, most of this research does not lead to general principles applicable to contemporary architecture on a global scale. Furthermore, comparative studies between different regions, such as hot-arid and cold environments, remain limited.

Therefore, this study aims to examine how vernacular architecture contributes to sustainability by adapting and applying general principles. It proposes a comparative analysis between Ghardaïa and Ural Region in order to identify transferable sustainable principles that can inform contemporary architectural practice. Ghardaïa, located in the M'zab Valley in southeastern Algeria (Figure 1), has a hot desert climate with very hot summers, often exceeding 45° C, and milder winters, and is distinguished by its vernacular Arab-Islamic housing. Ural Region, located in the southern in the Asian part of Russia, experiences very cold winters that can drop to -20° C and warm.

Literature Review

There is a lack of knowledge regarding the use of vernacular architecture principles and their role in achieving sustainability. In general, vernacular architecture is a broad term [10], that refers to any construction built without the involvement of professional architects: a traditional

Aboriginal dwelling; a hastily assembled refugee tent; or a temporary shelter constructed from improvised materials by homeless individuals [17].

The use of bio-based and geo-sourced materials such as earth, wood, stone, plaster, and straw play a crucial role in reducing the carbon footprint of the building sector. These materials, widely used in vernacular architecture, are characterized by their natural thermal and hygroscopic performance. They therefore represent one of the fundamental principles of sustainable architecture. Through simple construction techniques, often based on a low-tech approach¹, and a fine adaptation to local climatic conditions, they ensure effective thermal comfort in both hot and humid climates as well as in cold environments. This constructive logic enables a harmonious integration of architecture into its natural surroundings. Vernacular architecture cannot be reduced to a simple response to climatic constraints; it also constitutes an expression of the cultural values and lifestyles of the societies that produce it. It spatially reflects everyday practices, where the organization of interior spaces mirrors family structures and social relationships. Elements such as courtyards illustrate this dual function, responding to both climatic and cultural requirements. Thus, vernacular housing appears as a manifestation of popular culture, shaped by local techniques and resources, and aimed at meeting specific social needs. In contrast, modern architecture has often been criticized for its standardized character, its

institutional anonymity, and its disregard for regional architectural traditions [9].

In the context of Russian vernacular architecture, A.V. Opolovnikov and E.A. Opolovnikova studied the traditional Russian izba, focusing on its architectural organization, construction techniques, local materials, and relationship with traditional ways of life [5]. In Algeria, particularly in the M'zab Valley, A. Rav éreau examined Mozabite architecture in relation to its territory, climate, local materials, construction traditions, and human needs [14]. Didillon et al. studied traditional Mozabite houses, focusing on their spatial organization, domestic practices, and relationship with the physical and social environment [9]. In addition, D. Ouahrani investigated traditional and modern houses in Ghardaïa through field studies of lighting, temperature, and residential use, highlighting the importance of courtyards and limited openings in shaping the environmental conditions and patterns of use of traditional houses [12]. These studies show that traditional houses in both Russia and Algeria were shaped by the interaction of environmental conditions, local materials, construction techniques, spatial organization, and socio-cultural practices.

Despite the growing body of research on vernacular architecture, relatively few studies have systematically examined the underlying vernacular principles that can inform contemporary sustainable architecture across different global contexts. This study proposes a comparative analysis between Ghardaïa and Ural Region in order to identify transferable sustainable principles that can inform contemporary architectural practice.

Unlike many previous studies on vernacular architecture, which mainly investigate a single climatic

¹ Florian M.C. What is Low-Tech Architecture: Comparing Shigeru Ban and Yasmeen Lari's Approaches // ArchDaily. — 16 June 2024. — URL: <https://www.archdaily.com/1017671/what-is-low-tech-architecture-comparing-shigeru-ban-and-yasmeen-laris-approaches/> (дата обращения: 02.09.2026).

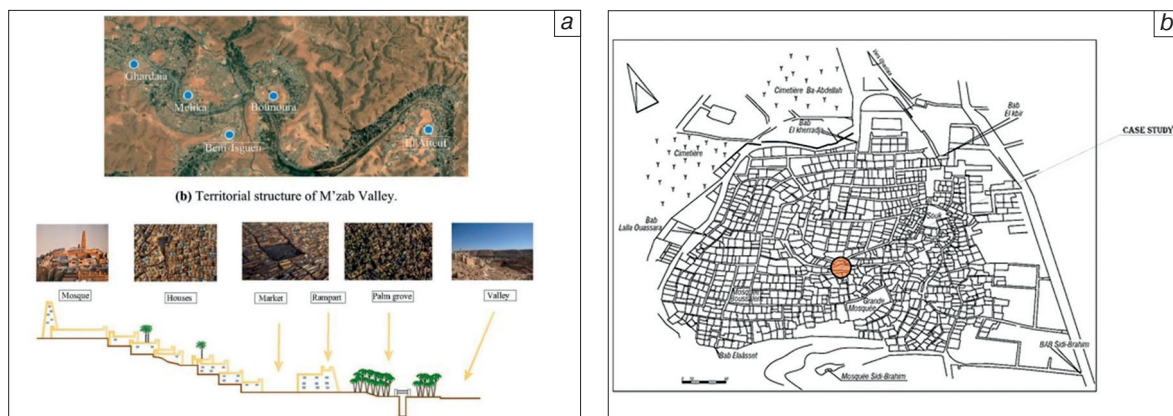


Figure 2. a) coupe of case study dwelling in Ksar El-Atteuf . (Treated by the author). World Heritage Classification and Tourism: Divergent Trajectories in Marrakech Medina (Morocco) and M'Zab Valley (Algeria) . Source: https://www.researchgate.net/figure/Territorial-structure-of-MZab-Valley-in-Algeria-and-its-urban-system-Ghardaia-1_fig1_373867790; b) Location of the case study dwelling in Ksar El-Atteuf . Assessing the Impact of Urban Area Size on Thermal Comfort in Compact Urban Fabrics Considering the Saharan City of Ghardaïa, Algeria. Sustainability, 17(5), 2213. Source: <https://www.mdpi.com/2071-1050/17/5/2213>

or cultural context [2], this research adopts a cross-comparative approach between two extreme environments: a hot-arid context (Ghardaia) and a cold continental context (Ural). Most existing works tend to analyse vernacular architecture either as a cultural heritage system or as a climatic response strategy [6], but rarely as a framework that allows direct comparison between contrasting environmental conditions. As a result, the transferability of vernacular principles across different climates remains limited in the literature [5].

In contrast, this study focuses on identifying shared and adaptable principles of vernacular architecture by analysing how similar concepts – such as spatial organization, material selection, and climate adaptation strategies – are expressed differently under opposite climatic constraints. This comparative reading makes it possible to move beyond context-specific observations and toward more generalizable principles [7]. Therefore, the main contribution of this research lies in shifting the analysis from isolated case studies to a comparative framework that highlights the potential of vernacular architecture as a transferable model for contemporary sustainable architecture across diverse geographical and climatic conditions [4].

Recent studies emphasize that vernacular architecture should not only be understood as a climatic response system, but also as a socio-cultural and adaptive framework for sustainability. A. Rapoport [13] highlights that house forms are deeply shaped by cultural patterns and lifestyles, suggesting that spatial organization reflects social structures as much as environmental conditions. In the same line [13], J. Zong

argue that vernacular architecture embodies sustainable principles such as material efficiency, climatic adaptation, and low environmental impact, although most studies remain limited to single-case or single-climate analyses. Similarly, Malakhov [4] stresses that vernacular architecture can serve as a resource for contemporary sustainable, provided that its principles are reinterpreted rather than replicated [1]. Furthermore, M.I. Rynkovskaya and E.D. Tsurin [7] underline the difficulty of transferring international sustainability concepts into local contexts, reinforcing the importance of contextual adaptation.

In this regard, the present study extends these contributions by adopting a comparative approach between two extreme climatic contexts — Ghordaia and Ural Region — demonstrating that vernacular principles are not climate-specific but transferable when interpreted through spatial, material, and socio-cultural logics.

Methodology

1. Research Approach

This research is based on the hypothesis that vernacular architecture embodies a set of principles that can contribute to modern sustainable architecture. This study uses vernacular architectural principles as an analytical framework to evaluate how climate-responsive strategies, local materials, and socio-cultural practices can inform sustainability. The methodology involves identifying key vernacular principles in each context and comparing their environmental and cultural performance in order to derive transferable strategies for contemporary sustainable architecture.

2. Case Study Selection

In the Ural Region, two types of vernacular housing are studied

comparatively: the izba (traditional wooden peasant house) and the barak (collective workers' housing). These two forms represent different socio-spatial and functional responses to climate and industrial development. The izba reflects a traditional vernacular dwelling, while the barak represents an industrialized form of collective housing.

The selection of case studies is based on a comparative approach involving two contrasting climatic and cultural contexts: Ghardaia in Algeria and Ekaterinburg in Russia. These two cases were selected because of the diversity of their environmental conditions and the richness of their vernacular architectural heritage.

The M'zab Valley consists of five traditional ksour, where each ksar represents a distinct compact settlement or fortified village surrounded by palm groves. Their urban morphology is characterized by dense building arrangements, narrow and irregular streets, and shaded circulation spaces. The settlements are positioned on elevated terrain below the hilltops, allowing them to adapt to the local topography while reducing exposure to flooding and preserving the surrounding agricultural land. Within each ksar, the mosque occupies a central and elevated position, while residential buildings are arranged around it and progressively follow the natural slope toward the outer limits of the settlement. The selected case study is a traditional Mozabite dwelling located in the core of Ksar El-Atteuf (Figures 3 a, b), where its compact form and spatial organization are closely integrated with the surrounding urban fabric.

3. Comparative Analytical Framework

The comparative analysis is conducted through a multi-scalar framework that

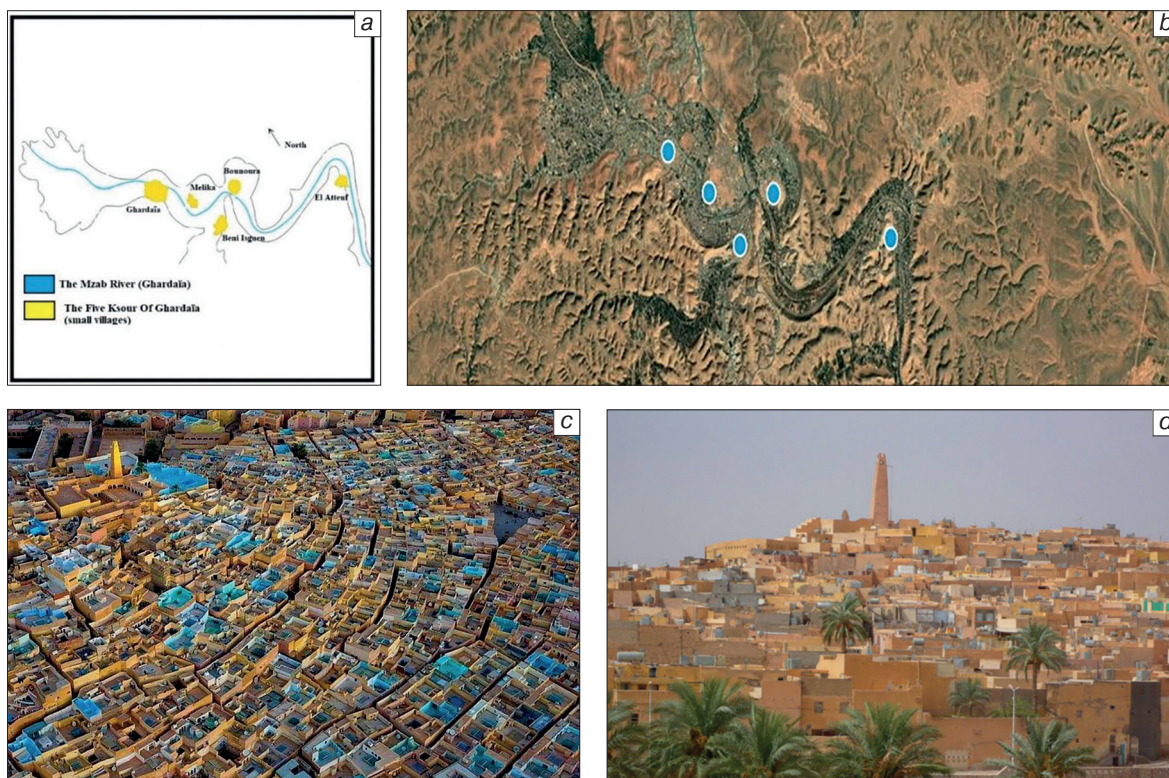


Figure 3. a) M'Zab Valley, Ghardaia, Algeria. Source: UNESCO World Heritage Centre. Source: <https://whc.unesco.org/en/list/188>; b) The distribution of the ksour of Ghardaia around the river. Source: Author's own drawing; c) M'Zab Valley, Ghardaia, Algeria, from above. Source: https://www.researchgate.net/publication/332272945_Mzabite_Heritage_in_Southern_Algeria_What_Bioclimatic_Lessons_can_Be_Learned_to_Optimize_Thermal_Comfort; d) M'Zab Town. Source: <https://www.flickr.com/photos/zoneiv/9323538810/in/album-72157634710771028/>

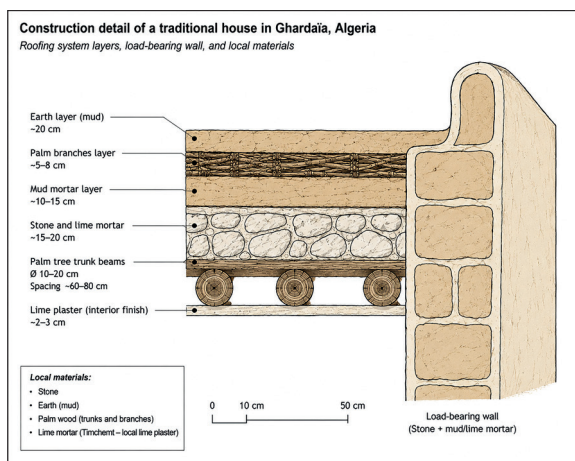


Figure 4. Construction detail showing the roofing system layers, the load-bearing wall, and the local materials used in a traditional house in Ghardaia, Algeria. Source: Author's own picture

examines vernacular principles at the urban, environmental, architectural, material, and socio-cultural scales.

3.1 Urban Scale Analysis

At the urban scale, vernacular architecture in Ghardaia and Ural Region demonstrates the principle of an accessible urban environment structured around climatic adaptation and collective accessibility.

The houses of M'zab in Ghardaia are directly dependent on the availability of water resources in the nearby valley located within the boundaries of the M'zab region (Figure 3 a, b). The plots, scattered and connected by narrow streets, and their proximity as well as their diffuse and sometimes chaotic structure create a complex network of pedestrian pathways

and a diverse landscape. This non-hierarchical grid plan (Figures 3 c, d) facilitates more equitable access to water resources, markets, and public squares, which illustrates the concept of an accessible urban environment and a non-hierarchical planning approach that creates space according to natural, social, and cultural conditions, rather than following a predetermined plan.

In Ural, the concept of „non-hierarchy through the dispersal of individual wooden houses“ (Figures 8, 9) is evident in the development of the city's and surrounding area's old architectural fabric. Before industrial transformations and modern urban planning, housing consisted primarily of individual wooden houses of the „izba“ and „barracks“ types, built independently by residents using local resources. These dwellings were not organized according to a rigid urban plan or a centralized hierarchical structure, but rather developed gradually through successive expansions, according to the needs of families and the constraints of the site. This housing model gave rise to an organic urban fabric, characterized by a significant dispersal of dwellings and a weak spatial hierarchy at the local level. Thus, spatial organization resulted from a bottom-up process rather than formal planning, reflecting a form of non-hierarchy based on the autonomy of dwellings and their direct adaptation to the environmental and social context.

3.2 Local Building Techniques and Technologies in Ghardaia

In addition to the use of local materials, M'Zab houses employ traditional construction techniques that enhance their climatic performance. The thick load-bearing walls, built with stone or earthen masonry, provide high thermal mass and delay the transfer of external heat into the interior. The roof follows a layered construction system in which palm trunks act as structural beams, closely arranged palm

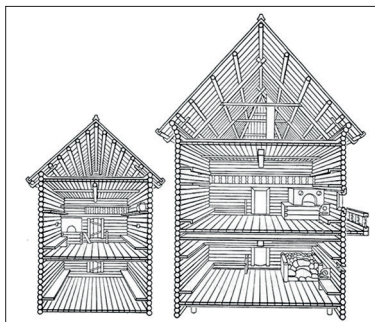


Figure 5. Structural section of a traditional Russian izba, showing the log construction, floor levels, roof structure, and interior elements. Source: Adapted from *Деревянная изба: её конструкция и декор*



Figure 6. Traditional log-wall construction using horizontally stacked timber logs and moss insulation in a Russian izba. Source: URL: Wikimedia Commons – Log-moss-building-Reboly.jpg



Figure 7. Interior of a traditional Ural izba showing the low wooden ceiling, Nizhnaya Sinyachikha, Sverdlovsk Oblast, Russia. URL: <https://ethnomuseum.ru/files/PDF/Library/Gabe/978-5-90479-076-9.pdf>

branches form the ceiling, and a layer of compacted earth provides additional thermal protection. The use of relatively small external openings limits direct solar exposure (Figure 4), while the compact organization of the dwelling and the internal courtyard contribute to shading and natural ventilation. These techniques illustrate how local construction knowledge integrates structural requirements, material availability, and climatic adaptation into a coherent building system.

In Ural Region, vernacular wooden housing reflects several construction techniques adapted to the severe cold climate. Traditional izbas were mainly constructed from locally available timber using log construction (спуб) (Figure 5), with natural materials such as moss or plant fibres used to seal the joints between logs and reduce air infiltration. Small openings (Figure 5, 6), compact building forms, and relatively low ceilings (Figure 7) helped limit heat loss and reduce the volume requiring heating. Wooden roofs, often combined with attic spaces, provided an additional thermal buffer, while raised foundations protected the timber structure from ground moisture and cold. Heating was traditionally provided by a masonry Russian stove (русская печь) (Figure 8), which stored and gradually released heat into the dwelling. These techniques demonstrate how local materials, simple construction methods, and climate-responsive design contributed to thermal protection, resource efficiency, and the durability of vernacular housing in the cold climate of Ural.

3.3 Environmental and Contextual Scale Analysis

At the environmental and contextual scale, vernacular architecture demonstrates the principle of contextuality through adaptation to climate, landscape, and natural conditions [7]. Contextuality is a fundamental concept in vernacular architecture, guided by both

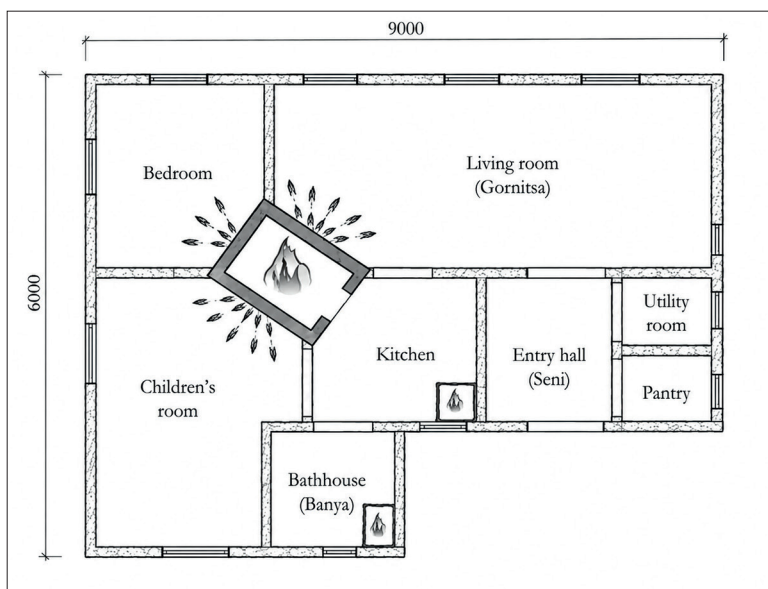


Figure 8. Typical floor plan of a traditional izba in the Ural region, Russia. Source: Adapted from L.M. Lisin, *Russian Peasant House: The History of a Building Type*, Moscow: Stroyizdat, 1986, — p. 45.

practical and aesthetic considerations (Figure 11). It is expressed through a close relationship with the natural environment, where the choice of materials, building forms, and construction techniques directly responds to local climatic conditions and their variations (Figures 12 a, b). In Ghardaia, this relationship is manifested through compact building forms, narrow and shaded streets (Figure 13), thick earthen and stone walls, small openings, and internal courtyards, which respond to the hot and dry desert climate by reducing direct solar exposure and limiting heat gains. The use of locally available materials, including stone, earth (toub), palm wood, and lime, further reflects the adaptation of buildings to the local landscape and natural resources (Figure 12a) [8]. In the Ural region, contextual adaptation responds instead to cold and snowy conditions. Traditional izba houses are constructed mainly from locally

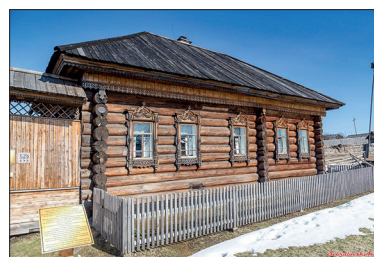


Figure 9. Traditional wooden izba representing vernacular architecture of the Ural region, Nizhnaya Sinyachikha, Sverdlovsk Oblast, Russia. Source: sverdlovskavia, 2019. URL: <https://bestlj.ru/140551-Osobennosti-uralskogo-izbostroeniya-i-derevjannogo-zodchestva.html>

available timber, while their enclosed forms and steeply pitched roofs provide protection from low temperatures and facilitate the shedding of snow (Figure 12b). These examples demonstrate that contextuality is expressed not only through the visual integration of buildings into their



Figure 10. Traditional Barrack-type building in Yekaterinburg (Ural Region) on Strelochnikov St., arc. K.T. Babykin, Yekaterinburg, 1925–1927 Source: <https://serebriany.livejournal.com/26893.html>



Figure 11. Contextuality by aesthetic. Source: https://pikabu.ru/story/izbyi_uralских_krestyan_v_muzei_selskogo_byita_i_derevyannogo_zodchestva_urala_10662588



Figure 12. a) The palm sheaths in a slab Karabag in the houses of Ghardaïa, Algeria. Source: N.E., Fellahi N., 2019. M'zab Algerian vernacular architecture: A connection between architecture and the environment. URL: <https://www.researchgate.net/publication/334263768>; b) Using tree roots for the structure in a Soviet barak interior. Source: Vog A., 2023. Shutterstock. URL: <https://www.shutterstock.com/image-photo/abandoned-interior-soviet-military-barracks-unit-2340526959/>



Figure 13. Narrow and shaded streets within the traditional Ksar of Ghardaïa, M'zab Valley, Algeria. Source: Yacine Oudjana, Pexels. URL: <https://www.pexels.com/photo/historic-alleyway-in-ghardaia-algeria-30247262>

surroundings but also through specific architectural choices that respond to climate, local resources, and landscape conditions. This approach, oriented toward the natural environment, emphasizes the need for a harmonious interaction between built structures and the surrounding landscape. Thus, architecture becomes fully integrated into nature, not only

through its adaptation to the site but also by drawing inspiration from natural conditions to generate architectural solutions rooted in environmental logic.

3.3.1 Ghardaïa: Position of the Mozabite House

In Ghardaïa, the position of the traditional Mozabite house is closely determined by the compact urban structure of the ksar. The selected case study dwelling is located in the core of Ksar El-Atteuf and is integrated into a dense fabric of closely grouped houses and narrow (Figure 14 a, b, c), irregular streets [13]. Rather than standing as an isolated building in the centre of an open plot, traditional houses are generally attached to neighbouring dwellings on two or three sides, forming a continuous and compact built mass. This arrangement reduces the external surface exposed to intense solar radiation and contributes to shading at both the building and street levels. The case study house has an irregular and compact plan and is organized inwardly around a central courtyard, reflecting the adaptation of the dwelling to the limited plot and the dense surrounding urban fabric [13]. The external openings of traditional Mozabite dwellings are generally small and are often positioned at the upper parts of the walls rather than functioning as large conventional windows. This

configuration is not motivated solely by privacy requirements; it also reduces direct solar radiation and minimizes the surface area exposed to the hot external environment. Traditional Mozabite houses may also use skylights to transmit and distribute natural light into the interior while limiting direct exposure to solar rays. At the scale of the city, the residential fabric follows the topography of the ksar: dwellings are arranged around the mosque, which occupies a dominant position, and progressively extend along the slope towards the outer limits of the settlement. The compact placement of houses, their relationship with narrow streets, and their adaptation to the topography demonstrate how the position of each dwelling contributes simultaneously to climatic protection, efficient land use, privacy, and the overall coherence of the urban structure [12].

3.3.2 Ural Region: Position of the Izba

In the Ural region, the traditional izba represents a different relationship between the dwelling, the land plot, and the surrounding settlement. Unlike the dense and interconnected fabric of the Mozabite ksar, the izba was generally developed as an individual wooden dwelling associated with a domestic plot and positioned within a dispersed pattern of houses. The dwelling formed the main built element of the plot, while the surrounding open space could accommodate household and agricultural activities (Figure 15). This organization allowed the house to maintain a direct relationship with the street and the neighbouring properties while preserving a degree of autonomy for each household. Within traditional settlements and the older wooden districts of the region, individual houses were gradually developed according to the needs of families and the physical conditions of the site rather than according to a highly centralized urban structure. As a result, the izba contributed to an organic and relatively dispersed urban fabric in which the position and orientation of individual dwellings responded to local conditions. The compact form of the house, together with its placement on an individual plot, also supported adaptation to the cold climate by concentrating the heated living space and reducing unnecessary exposure to severe winter conditions [5]. The windows of traditional Ural izbas are generally larger and more numerous than those of Mozabite houses. They are positioned directly on the external walls of the main living spaces, usually at eye level, to provide daylight and views outside. In northern izbas, windows were

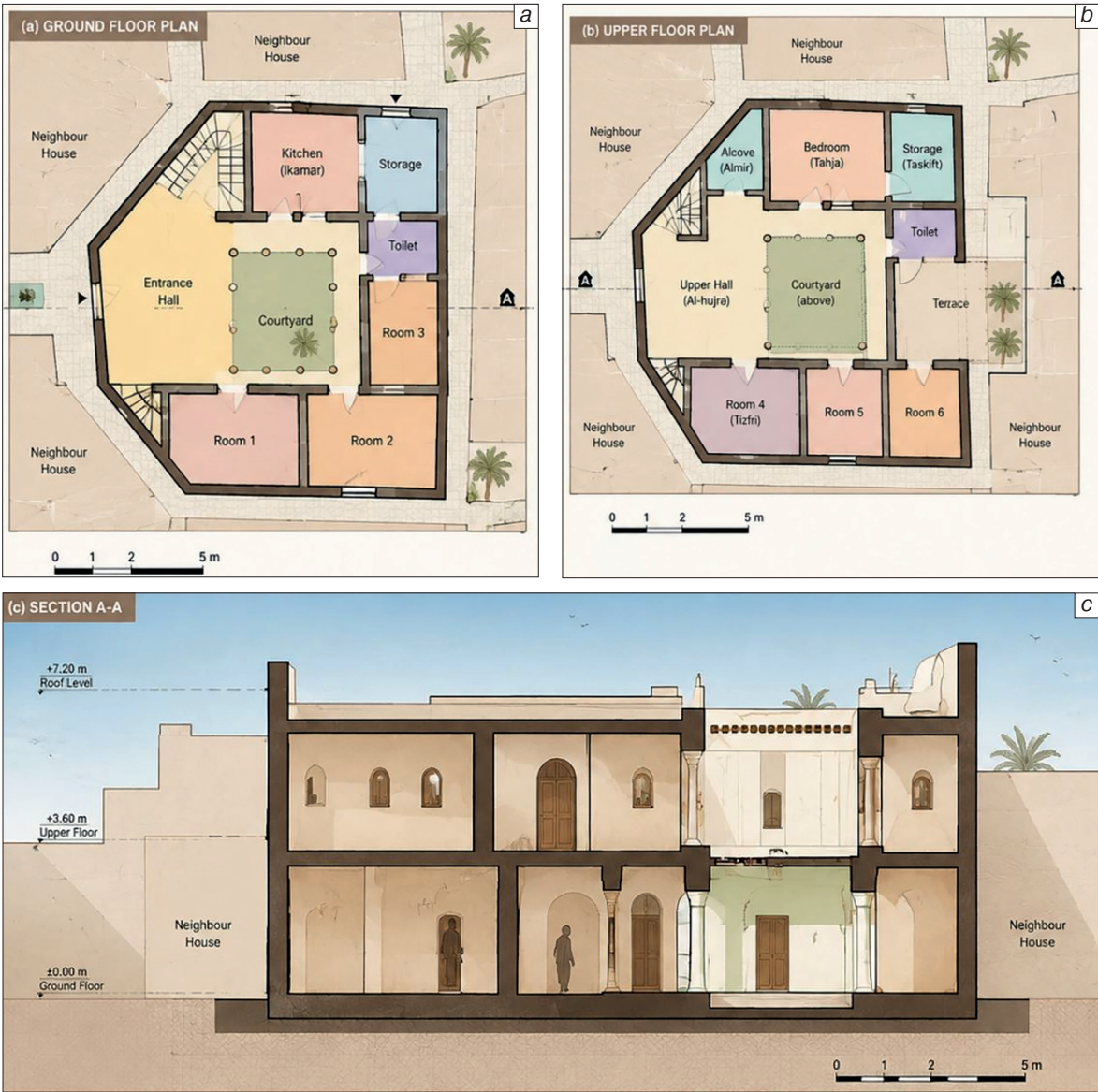


Figure 14. a) Ground floor plan of a traditional house in Ksar El-Atteuf, Ghardaia; b) Upper floor plan of a traditional house in Ksar El-Atteuf, Ghardaia; c) Section A-A of a traditional house in Ksar El-Atteuf, Ghardaia. Treated by the author

sometimes concentrated on the upper living level, while utility areas could have few or no windows.

3.4 Architectural Scale Analysis

At the architectural scale, both Ghardaia and Ural Region embody the principles of multifunctionality and modular evolution through the spatial organization of dwellings. In the traditional Mozabite house of Ghardaia, interior spaces are organized around a central courtyard and designed to accommodate multiple daily activities, such as gathering, rest, cooking, and housework. Rather than rooms being strictly defined for specific functions, they remain flexible and adaptable to the needs of the family, the seasons, or the times of day. This spatial flexibility allows the dwelling to evolve gradually by adding new functional units or converting existing ones, thus embodying a pattern of modular development over time. The interior design of dwellings in Ural Region combines the functions of living, working, and dining within a single, heated space. This multifunctional arrangement can be interpreted as a response to the cold climate; concentrating activities in one place enhances thermal efficiency and reduces energy consumption.

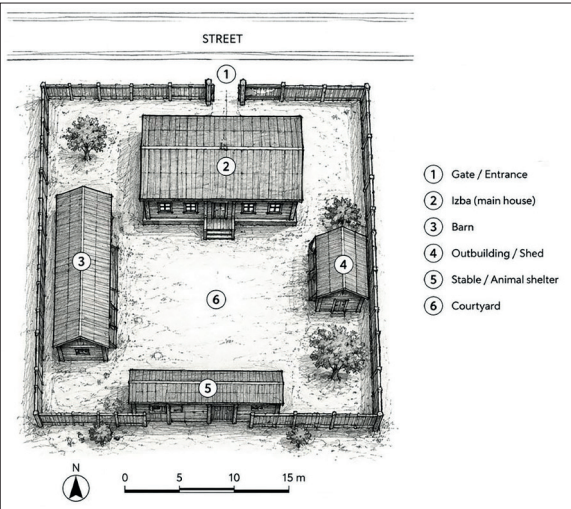


Figure 15. Schematic organization of a traditional Ural Izba within its residential plot, Source: Author's own picture



Figure 16. Multifunctional interior space of a traditional Mozabite house in Ghardaïa, Algeria. Source: <https://topdestinationsalgerie.com/la-maison-traditionnelle-mozabite-en-photos/>



Figure 17. Multifunctional domestic space in the Urals, Gornozavodsky District, Visim village, 20th century. Source: <https://choice-media.ru/tpost/n9lvlg5b1-muzei-nalichnikov-zooferma-s-alpakami-i>



Figure 18. Traditional Mozabite house constructed with local materials in Ghardaïa, Algeria. Source: Algeria Architecture, "La maison du M'Zab". URL: <https://algerie-architecture.com/en/la-maison-du-mzab/>



Figure 19. A two-story wooden house at 3 Uralskikh Rabochikh Street in Yekaterinburg (Ural Region), Russia, 1930's

In both cases, spatial organization reflects an adaptive and sustainable approach, in which flexibility and modularity contribute to meeting environmental requirements and ensuring the suitability of the dwelling for long-term use (Figure 16).

The interior space presented in Yekaterinburg (Ural Region) illustrates a domestic interpretation of multifunctionality, where living, working, and dining activities are combined within a single room (Figure 17). This example demonstrates a more fragmented, but no less significant, form of spatial integration at the dwelling level.

This organization can be interpreted as a response to the cold climate, where concentrating activities in a small, heated space contributes to energy efficiency. Although centrality is less formalized, the coexistence of multiple functions within a single spatial unit reflects an underlying principle of functional concentration comparable to that found in vernacular architecture.

Furthermore, this spatial arrangement reinforces the idea of flexibility, as it allows for continuous adaptation of the interior through the replacement or addition of functional elements over time, thus illustrating a modular development of spatial organization at the domestic level.

3.5 Material Scale Analysis

At the material scale, both Ghardaïa and Ural reflect sustainable construction strategies based on local resource availability and material reuse. Traditional Mozabite construction relies on locally available materials such as stone, earth (toub), palm wood, and lime plaster. (Figure 18). These materials are easily accessible, environmentally efficient, and often reused in construction. The recycling of building elements reflects a sustainable approach to material management and long-term resource efficiency.

The availability of local construction materials has led the Yekaterinburg (Ural region) to a building approach strongly based on the exploitation of local natural resources. The main material used is wood (Figure 19), which is abundant in the region and easily workable. These materials are often used in a sustainable and rational way: wooden elements can be reused, repaired, or transformed according to construction needs. Wood thus constitutes the primary material for load-bearing structures, walls, and roofs.

3.6 Socio-Cultural Scale Analysis

At the socio-cultural scale, architecture reflects social structures, collective practices, and cultural identity.

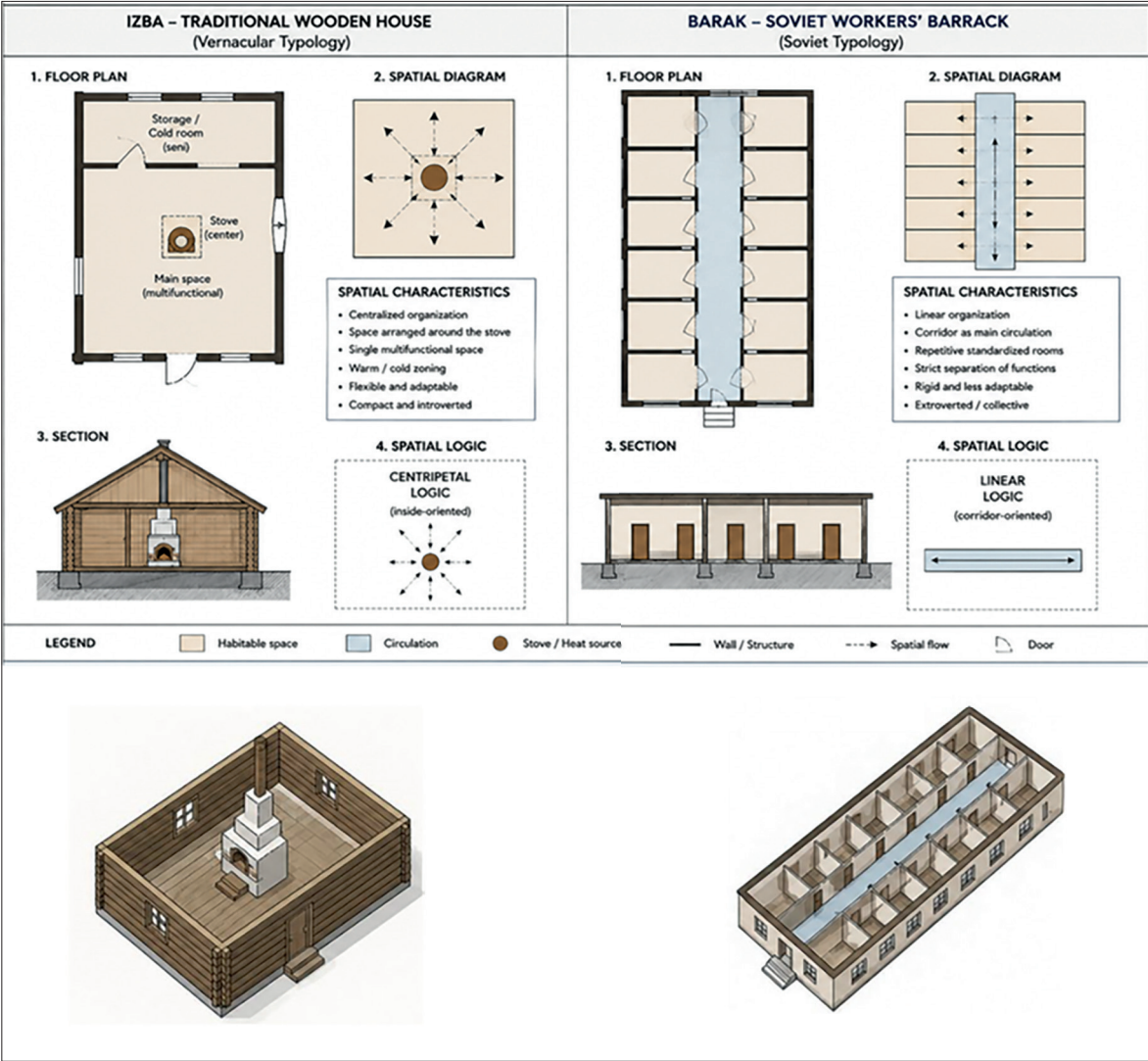


Figure 20. Spatial comparison of Izba and Barak housing typologies in the Ural Region. Source: Author’s own picture

Table 1. Comparative Analysis of Izba and Barrak Vernacular Housing Typologies in Ural Region

Typology	Type of vernacular	Materials	Lifestyle	Function	Shared Vernacular Principles
Izba	Traditional Vernacular/ 17th–19th centuries	Local wood	Individual and autonomous domestic life	Single-family dwelling	Both typologies integrate several vernacular principles discussed in this study
Barrack	Industrial Vernacular/Late 19th–20th centuries	Wood + Standardized Materials	Collective and high-density living	Collective workers' housing	

Vernacular architecture reflects social structures, collective practices, and cultural identity through spatial organization and domestic forms. Human social and cultural needs directly influence architectural and urban planning solutions in both vernacular and contemporary residential environments. Dialogue with society enables the development of projects that go beyond functional requirements, incorporating social values, cultural practices, and ways of life. In this perspective, In Ghardaia, spatial organization is strongly influenced by collective and religious life, with the mosque

playing a central role in structuring urban and social interactions. Domestic spaces reflect extended family structures and communal values, reinforcing social cohesion. While Ekaterinburg shows how different housing typologies, such as the izba and the barak, reflect the evolution from traditional family-based living to industrial collective housing. In both contexts, architecture becomes a direct expression of social structures and cultural identities, supporting and reinforcing the organization of society within its specific environmental conditions.

4. Comparative Analysis of Izba and Barak Housing Typologies
In the Ural, the izba and the barak represent two distinct vernacular and proto-industrial housing typologies. The izba reflects a traditional, self-built domestic architecture characterized by individual family organization, compact heated spaces, and strong adaptation to the cold climate through the use of local wood. In contrast, the barak illustrates a collective and standardized housing model emerging during industrialization, where spatial organization is based on efficiency, density, and shared living conditions. This comparison highlights

the transformation of vernacular principles from autonomous domestic structures to collective and functional housing systems within the same climatic context.

Spatial comparison of Izba and Barrack housing typologies in the Ural Region

The spatial organization of the izba is characterized by a compact and multifunctional layout organized around the central heating stove, which acts as an important element for both heating and domestic activities. The main living space is directly connected to the entrance and other functional areas, creating a relatively short and integrated circulation system. In contrast, the barrack typology follows a linear and repetitive spatial structure based on corridor circulation and standardized residential units (Figure 20). Several individual rooms or family units are arranged along a common circulation space, while sanitary and service facilities may be shared. Thus, the izba integrates the main domestic functions within a single-family dwelling, whereas the barrack separates several residential units within one collective structure. This difference in internal organization reflects two distinct patterns of habitation: the izba emphasizes family-centered and multifunctional domestic space, while the barrack prioritizes repetition, density, standardized units, and collective circulation.

Conclusion

This study demonstrates that vernacular architecture embodies a set of transferable sustainability principles that can be applied to contemporary architectural practice when interpreted through spatial, material, and socio-cultural frameworks. Rather than being site-specific solutions, these principles reveal a deeper architectural logic based on adaptation, flexibility, and efficient use of local resources.

Although Ghardaia and Ural Region differ significantly in terms of climate, culture, and construction materials, both contexts exhibit common principles such as contextual adaptation, multifunctional spatial organization, modular development, and sustainable material use. However, these principles are expressed differently depending on environmental constraints: Ghardaia emphasizes spatial expansion and thermal regulation in a hot-arid climate, while Ural prioritizes spatial concentration and thermal efficiency in a cold climate.

Therefore, vernacular architecture should not be understood as a fixed model to replicate, but rather as a dynamic system of principles that must be reinterpreted according to specific contexts. The main limitation of this study lies in the challenge of generalizing these principles without oversimplifying their cultural and environmental complexity. Future research could extend this comparative approach to other climatic regions in order to further validate the transferability of vernacular strategies

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