

# The Integration of Troglodyte Architecture into Contemporary Architecture, A Fusion of Tradition and Modernity: The Case of Dar Hi in Nefta

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## Abstract

Troglodyte architecture, characterized by the utilization of natural caves or structures carved into rock, stands as a mesmerizing testament to humanity's adaptability to its surroundings. This study explores the integration of troglodyte architecture into contemporary design, with a specific focus on Dar Hi in Nefta, Tunisia. It investigates the historical foundations, core principles, and the application of troglodyte architecture in modern architectural practices. The analysis begins with a historical overview, tracing the evolution of troglodyte structures and their adaptability to diverse environments. The centerpiece of this exploration is the detailed examination of Dar Hi, showcasing how it encapsulates traditional troglodyte elements within a contemporary architectural framework. It dissects the architectural components, materials, and design strategies employed, emphasizing sustainability and cultural preservation. Moreover, this research highlights the experiential aspect, emphasizing how Dar Hi's design fosters a sensory connection with Nefta's cultural heritage. It emphasizes how the integration of troglodyte architectural elements within the establishment creates a unique blend of tradition and modernity. By spotlighting the case study of Dar Hi, this study sheds light on the potential of harmonizing ancient architectural wisdom with modern design, aiming to inspire discussions on preserving and creatively incorporating troglodyte architecture into contemporary architectural discourse.

**Keywords:** Troglodyte Architecture; Contemporary Design Integration; Dar Hi; Architectural Preservation; Sustainability Integration.

## 1. Introduction

Troglodyte architecture, characterized by the utilization of natural caves or structures carved into rock, stands as a mesmerizing testament to humanity's adaptability to its surroundings. Originating from historically rich regions such as Cappadocia in Turkey, Andalusia in Spain, and Provence in France, this architectural form not only exudes a unique aesthetic but also embodies substantial advantages in terms of both energy efficiency and seamless integration with the natural environment.

In the contemporary architectural landscape, the integration of troglodyte architectural principles presents an innovative viewpoint on design and construction methodologies (Amen, 2021; Amen et al., 2023; Sansen et al., 2021; Ülker et al., 2021; Yilmaz, 2021). It reflects a deliberate effort to harmoniously merge traditional elements with the latest advancements in design, aspiring to craft sustainable, functional, and captivating living spaces.

This article delves into the intricate realm of integrating troglodyte architecture into modern architectural concepts. Through an exploration of diverse approaches and techniques, it aims to dissect the methodologies of construction, the nuanced selection of materials, and the immersive experiences of visitors/users within these spaces that seamlessly blend the essence of tradition with the advancements of modernity.

## 2. History and Principles of Troglodyte Architecture

Troglodyte architecture has a long history dating back to antiquity. This form of construction has evolved over the centuries, finding its roots in different regions of the world.

Thousands of years ago, the earliest signs of troglodyte architecture emerged when prehistoric humans were among the first to settle in natural shelters located in cliffs and caves, seeking refuge from the natural elements and predatory animals. The regions where troglodyte architecture flourished were specific, often characterized by rock formations particularly suited to this construction method. A symbolic example is Cappadocia in Turkey, where volcanic tuff formations provided inhabitants the ability to carve dwellings, churches, and even entire cities into the soft rock.

Troglodyte architecture demonstrates remarkable adaptability to often demanding environments. By choosing rocky and rugged sites, troglodyte inhabitants found refuge in difficult-to-access regions, thus escaping the pressures of invaders and harsh environmental conditions.

This adaptation also influenced the internal layout of troglodyte dwellings, with spaces organized to maximize the use of local resources while providing adequate living comfort. Natural air currents are often leveraged for ventilation, and rainwater harvesting systems are integrated to meet water needs: their orientations and wall thickness protect the interior from arctic winds and maintain a stable temperature inside. Furthermore, their

structures and layout enable the production of energy free of charge: in winter, the interior ambient temperature is warm, while in summer, it becomes cool thanks to the underfloor heating system.

Troglodyte architecture stands as a testament to human adaptability and innovation, tracing its roots back to ancient times. Its evolution spans diverse corners of the world, offering a fascinating glimpse into human ingenuity.

The earliest instances of troglodyte architecture emerged eons ago when our prehistoric ancestors sought shelter in natural alcoves within cliffs and caves. These early dwellings provided refuge from the harsh elements and predatory threats. Regions where troglodyte architecture thrived were characterized by specific geological formations, ideal for this unique construction method. For instance, the ethereal landscapes of Cappadocia in Turkey boasted volcanic tuff formations that allowed inhabitants to sculpt entire cities, dwellings, and religious sanctuaries into the malleable rock.

In Tunisia, troglodyte architecture is a significant component of the country's architectural heritage. The region of Matmata, situated in the south of Tunisia, is particularly renowned for its troglodyte houses. The troglodyte dwellings of Matmata are excavated into the ground, creating semi-underground structures. These houses typically feature a central courtyard surrounded by rooms carved into the cavity walls. This design offers excellent thermal insulation, helping maintain moderate temperatures despite the extreme desert climate. The village, of Amazigh origin in Matmata, is also characterized by houses dug directly into the soil composed of a mix of compact and friable quaternary clay. These dwellings are organized around a spacious well serving as an inner courtyard, around which different rooms are arranged: bedrooms, kitchen, sheepfold, and storage space, all opening onto the central courtyard.

Troglodyte architecture in Tunisia presents considerable environmental and bioclimatic advantages, particularly in the context of local climatic conditions. By utilizing rock as the primary material, these dwellings benefit from excellent natural thermal insulation. In summer, they remain naturally cool, while in winter, they retain heat, creating a comfortable interior microclimate.

In Tunisia, troglodyte architecture is an integral part of the nation's architectural narrative. The southern region of Matmata is celebrated for its troglodyte dwellings. These structures, carved into the earth, form semi-underground abodes. Their design often includes a central courtyard surrounded by rooms etched into the cavity walls. This configuration not only offers exceptional thermal insulation, maintaining temperate conditions amid the extreme desert climate, but also fosters a sense of communal living. The indigenous Amazigh village of Matmata features homes directly excavated from a blend of compact and friable quaternary clay, centered around a capacious well serving as an inner courtyard. This layout incorporates various functional spaces like bedrooms, kitchens, livestock shelters, and storage rooms, all interconnected around the central courtyard.

Troglodyte architecture in Tunisia capitalizes on its environment, reaping substantial environmental and bioclimatic advantages, especially pertinent to local weather conditions. Leveraging rock as a primary building material, these dwellings inherently possess exceptional natural thermal insulation. Consequently, they remain naturally cool in summer and retain warmth during winter, fostering a comfortable microclimate indoors.

The adaptability of troglodyte architecture to challenging environments is profound. The deliberate choice of rugged terrains offered troglodyte communities refuge in inaccessible areas, shielding them from outside threats and severe environmental pressures.

This adaptability extends to the internal design of troglodyte dwellings, maximizing local resources for optimum living comfort. Natural airflow patterns are harnessed for ventilation, while innovative rainwater harvesting systems fulfill water requirements. Orientation and wall thickness shield interiors from arctic winds, ensuring a stable internal temperature. Furthermore, the architectural layout facilitates energy production without cost: interior spaces remain warm in winter and cool in summer, attributed to the underfloor heating system.

### **3. Troglodyte architecture sites in Tunisia and the request for their integration into UNESCO's World Heritage List**

Tunisia, rich in history and cultural heritage, harbors a unique architectural treasure: the caves of Sened/Gafsa, the troglodyte dwellings of Matmata el Guédima, the ridge village of Tamezret, and finally, the ksour, these fortified collective granaries that dot the landscape. These expressions of human creativity provide insight into how the inhabitants of these regions have harnessed the resources of their natural environment to design dwellings suited to sometimes challenging conditions.

- The caves of Sened/Gafsa, carved into the slopes of Jebel Eddahra, bear witness to a horizontal troglodytic habitat. The houses are arranged with a main room for daily activities and a second room serving as a bedroom. Indentations in the walls are utilized for storage purposes. Although their exact dating is not precisely established, these dwellings likely date back to the 10th and 12th centuries



Figure 1: The caves of Sened/Gafsa

- Matmata el Guédima stands out with its lunar landscape, where small hills are excavated to create troglodyte dwellings. Each hill houses a home, with a vertically dug well serving as a courtyard. The underground layout allows light to enter while preserving coolness during the summer



Figure 2 : Troglodyte houses of Matmata.

- Tamezret is a ridge village built on the slopes of a hill. The houses are organized on multiple levels, creating an impression of stacked floors. Troglodyte dwellings are combined with constructed spaces, providing a variety of rooms and functional areas.



Figure 3: Village de Tamezert

- The ksour, on the other hand, are fortified collective granaries. Each ksar has its own layout and unique characteristics, providing insight into the social organization and storage needs of the community that inhabited it. Some ksour date back to the 16th century, while others trace their origins to the 17th and 18th centuries.



Figure 4: fortified villages/ ksours

The troglodyte habitats and ksour of southern Tunisia, as they appear today, preserve their original forms, construction methods, layout, and their initial functions. While some elements have undergone minor alterations and degradation, these have had a limited impact on the structures and building materials. The authenticity of these sites is therefore largely preserved, and their integrity is maintained for most of their components. (UNESCO 2022)

The request for the inclusion of troglodyte architecture in the UNESCO World Heritage is a crucial step toward preserving and showcasing this exceptional heritage. It aims to officially acknowledge the universal value of these sites and place them in a global perspective, thereby safeguarding them for future generations.

It is also an opportunity to showcase these architectural and cultural treasures on an international scale. Being inscribed as a World Heritage Site would draw global attention to these historical gems, stimulating cultural tourism and contributing to the economic development of the regions involved.

Moreover, this international recognition would encourage local authorities and stakeholders to intensify their efforts in preservation, conservation, and restoration, implementing sustainable management measures to ensure their long-term protection.

On January 10, 2020, an official request for the inclusion of Tunisia's troglodyte architecture in the UNESCO World Heritage was submitted by the Permanent Delegation of Tunisia to UNESCO. The request focuses on the governorates of Gafsa, Gabès, Médenine, and Tataouine, emphasizing criteria (iv) and (v) that highlight the cultural and historical significance of these sites. This initiative aims to preserve and promote this outstanding heritage, recognizing it globally.

The integration of troglodyte architecture into UNESCO's World Heritage would also provide an opportunity to foster cultural exchanges and expertise sharing between local communities and international experts, strengthening cooperation in the preservation of cultural heritage.

#### **4. Evolution of Troglodyte Architecture and its Integration into Contemporary Architecture: Case Study of Dar Hi in Nefta**

Over the centuries, troglodyte architecture has undergone significant evolution. Initially used for rudimentary shelters, it transformed into more sophisticated dwellings and even entire underground cities. Inhabitants refined excavation techniques, developed sophisticated ventilation systems, and created functional and aesthetic interior spaces.

In numerous regions, troglodyte architecture has become an essential element of cultural and architectural heritage. From rock-hewn churches adorned with frescoes to troglodyte houses with sculpted facades, these structures have become living testaments to human ingenuity and adaptation to the environment.

Today, this tradition continues to influence contemporary architecture, with architects seeking to integrate the principles of troglodyte architecture into modern designs, creating a fascinating fusion of tradition and modernity. This evolution illustrates the adaptability of troglodyte architecture and its continued relevance in the contemporary world.

The creation of Dar Hi in Nefta is a concrete example of this successful fusion between tradition and modernity. Indeed, this luxury hotel embodies harmony between contemporary architecture and authentic elements of the local culture. With its 18 luxury rooms offering spectacular views of the Tunisian desert, it demonstrates how troglodyte architecture principles can be innovatively reinterpreted. Furthermore, Dar Hi's commitment to sustainable development and the use of environmentally friendly technologies attest to the ongoing relevance of this approach in the contemporary world.

Dar Hi is the result of collaboration among various architecture and construction experts. The hotel is classified as a 4-star establishment and covers a total area of 2347 square meters, with a built-up area of 1300 square meters and a non-built-up area of 1047 square meters. The project came to fruition in 2005 and has since become a notable example of successful integration between contemporary architecture and the authenticity of the local culture.



Dar Hi's architectural style can be described as an example of contemporary heritage. It stands out for its harmonious integration into its surroundings, successfully combining the old with the new by using traditional materials while incorporating modern technologies. The preservation of local culture is a core value at Dar Hi, evident from the moment one enters through a traditional palm gate. This design reflects the authenticity and attachment to the traditions of the Nefta region.

The sustainable construction strategies implemented by the hotel are numerous. The construction materials and decorations are purely natural, such as Nefta stones, marble, palm wood, organic cotton, wool, alfa, etc. Paint has been replaced with natural lime plaster with natural colorants. Moreover, the materials are locally sourced to minimize transportation costs and energy. Patrick Elouarghi, co-founder of Dar Hi, stated, "No imports, we only work with local materials. As seen in the hotel, there is palm wood, apricot wood, all walls are made of Tela region lime. When we say local products, it's from the region but also from Tunisia."

Dar Hi fits harmoniously into its exceptional environment, offering a unique experience to its visitors. The rooms are designed to create an interaction between the interior and exterior. The nine raised rooms, with varying heights, offer different perspectives while allowing complete immersion in the landscape through large bow-shaped bay windows, the Maksudra. Above, a shaded space allows guests to enjoy the view of the Nefta basin, in perfect harmony with the local culture.

The three other rooms, reproducing the general aesthetics of troglodyte houses and adorned with Nefta bricks, pay homage to the specific climate of the region. The choice of troglodyte architecture for these rooms is particularly significant given the region's climate. Being partially dug into the sand, these rooms take advantage of the natural insulating effect of the soil, ensuring a regulated and pleasant interior temperature. Furthermore, the zenithal lighting, a key feature of troglodyte dwellings, optimizes the use of natural light while offering a unique ambiance. These rooms are designed to mimic the appearance of troglodyte dwellings. They are built with Nefta bricks, showcasing meticulous attention to detail and respect for local materials. The use of these bricks not only evokes the authenticity of local architecture but also contributes to the harmonious integration of the structure into its natural environment.

The rooms embody a genuine connection with local culture and the region's history. By imitating the appearance of troglodyte dwellings, they pay homage to ancestral traditions and how the people of Nefta adapted to their environment. This connection goes beyond aesthetics; it evokes a profound respect for the region's cultural heritage. Spending time in these rooms offers a sensory experience. The colors, soft light from the zenithal lighting, and the sensation of being in a structure partially dug into the sand all contribute to creating an enveloping and memorable atmosphere.

The arrangement of the troglodyte room at Dar Hi in Nefta is a celebration of authenticity and a connection with local culture: earth-inspired tones permeate the space, creating a warm and earthy atmosphere. This color palette provides continuity with the natural desert environment surrounding Nefta. The presence of vibrant blue adds dynamic contrast, bringing a touch of liveliness to the overall ambiance. Textured and unpainted concrete is thoughtfully used, creating circular benches and stairs that bring a contemporary and industrial touch to the space. This use of raw concrete reflects a commitment to authentic and high-quality materials.



Figure 5: Troglodyte room at Dar Hi, View 1 and 2

The raw wooden furniture brings a sense of warmth and closeness to nature. It harmoniously blends with the sand tones and strengthens the connection between the interior and exterior. Bright orange accents on the headboard infuse dynamic energy into the room. This vivid color contrasts with the more neutral tones of the palette and adds a modern touch. The vintage radio and sleek-designed floor lamps bring elements of both nostalgia and modernity. They complement the room's aesthetic without overcrowding the space.



Figure 6: Troglodyte room at Dar Hi, View 3

The multicolored carpets crafted by local artisans from Nefta add a touch of authenticity and character to the space. They stand as living testaments to the traditional craftsmanship of the region. The white sheets with golden stripes, created by artisans from the area, bring a touch of luxury and refinement. They reflect attention to detail and a respect for local artisanal traditions.



Figure 7: Troglodyte room at Dar Hi, View 4

The visitor experience at Dar Hi is carefully designed to offer a complete immersion in the authenticity and local culture of the Nefta region. Every aspect of the environment, be it the architecture, decorative elements, or aesthetic choices, is intended to faithfully reflect the essence of this unique place. The use of natural materials such as Nefta stones, palm wood, and thêla lime contributes to creating a deep connection with the local environment. The simplicity and harmony emanating from both indoor and outdoor spaces create a warm and welcoming atmosphere. The room layouts, color choices, decorative elements—everything is designed to provide an immersive sensory and emotional experience. Every detail is meticulously considered to evoke the soul of Nefta and its culture.

Each room also features a private terrace, providing an outdoor space to relax and enjoy the surrounding landscape. Moreover, the troglodyte rooms are interconnected by a waterfall and an authentic bread oven, adding an extra dimension to the immersive experience offered by Dar Hi. This design strengthens the connection between different spaces and creates a friendly and harmonious ambiance within the establishment.

This thoughtful approach results in fostering a memorable and enriching stay for visitors. By living this experience, they have the opportunity to authentically connect with the place and its inhabitants while benefiting from the comfort and quality service of a high-end establishment. Therefore, the synergy between modernity and authenticity is also reflected in the overall visitor experience. By staying at Dar Hi, visitors have the chance to experience contemporary living while being immersed in Nefta's rich culture and history. It's this blend of traditional elements and contemporary innovations that makes Dar Hi an exceptional place where the past and present harmoniously converge. The experience offered at Dar Hi goes beyond mere accommodation; it provides a genuine opportunity for cultural and sensory exploration, leaving a lasting imprint in the memories of visitors.

## 5. Conclusions

The architectural marvel of Dar Hi in Nefta stands as a testament to the seamless integration of historical legacy with modern innovation. Through a meticulous blend of modernity and authenticity, Dar Hi offers an unparalleled experience, immersing visitors in the cultural tapestry and heritage of the Nefta region. This convergence of elements, spanning architecture, décor, and sustainable initiatives, underscores a profound dedication to preserving local identity while embracing contemporary advancements.

Far beyond its designation as a luxury hotel, Dar Hi represents an architectural narrative transcending temporal confines. It serves as a living embodiment of architecture's capacity to transcend epochs, creating spaces deeply

resonant with the essence of a community and its landscape. It stands not merely as a structure but as a testament to the harmonious marriage between design principles and the soul of a place. Moreover, Dar Hi serves as an inspiring exemplar showcasing how design authenticity can intertwine seamlessly, forging an indelible and immersive encounter for its esteemed visitors. By intertwining historical roots with modern sensibilities, Dar Hi offers an enduring experience that transcends mere accommodation, leaving an indelible mark on those fortunate enough to engage with its cultural narrative. In essence, Dar Hi in Nefta epitomizes architecture's transformative power, embodying a living heritage that transcends eras, encapsulating the essence of a community, and offering a deeply enriching encounter for all privileged to partake in its ambiance.

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