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PRESENTATION

It is with great pleasure and sincere honor that we present this volume, which brings together the contributions and reflections from the 2025 edition of the **ISLAH – International Conference on Islamic Architectural Heritage**, held at the Polytechnic School of Sousse.
This event marks a significant milestone: ISLAH is being organized for the first time in Tunisia, and more broadly, for the first time in Africa, in the historic city of Sousse—whose rich architectural heritage and vibrant cultural identity offer an inspiring setting for scientific exchange and creative exploration.

Guided by the theme **"Where Heritage Meets the Future,"** this edition invited researchers, practitioners, students, and enthusiasts to examine the essential relationship between Islamic architectural heritage and the contemporary challenges of design, sustainability, and urban resilience.
The contributions gathered in this book reflect the diversity and depth of the discussions held around key themes such as:

- sustainability and innovation in design,
- Islamic architecture in the modern era,
- urban and environmental resilience,
- education, transmission, and community engagement.

Through these works, the conference's mission comes to life: fostering high-level academic dialogue, sparking new ideas, encouraging interdisciplinary collaboration, and opening new pathways for the preservation, reinterpretation, and enhancement of Islamic architectural heritage.

We extend our heartfelt gratitude to all partner institutions, the scientific and organizing committees, and the speakers and participants whose commitment made this event possible.
May these pages continue the spirit of openness, dialogue, and innovation that animated ISLAH 2025, and inspire future research, projects, and perspectives dedicated to our shared heritage.

Welcome to this journey where heritage meets the future.

Amel RJEB LASSOUED

Architect and Urban Planner

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Color as A Culture and Architectural Expression : A Comparative Historical Analysis

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ABSTRACT

Architecture has long reflected the cultural, ideological, and environmental values of societies, and color has been central to this expression. More than ornament, color has historically functioned as a symbolic language, shaping how built environments communicate identity, spirituality, and authority. This study investigates the use of color in architecture across selected civilizations and movements, including Ancient Egyptian temples, Greek polychromy, Byzantine and Gothic traditions, Islamic mosques, Ottoman tilework, 19th-century revival styles, modernism, and postmodernism.

Findings show that color was consistently employed to reinforce ideological and religious narratives. In Egypt, red, blue, and green symbolized vitality, divinity, and rebirth, while in Gothic cathedrals stained glass transformed light into a metaphor of transcendence. Islamic and Ottoman architecture emphasized vibrant blues, greens, and golds, reflecting Qur'anic imagery and cultural identity. Modernism reduced color to neutrality in pursuit of rationalism, whereas postmodernism revived expressive palettes to challenge uniformity and restore symbolic meaning.

The analysis further demonstrates that color selection was shaped by environmental adaptation and material innovation, from synthetic pigments in antiquity to industrial ceramics and paints in the 19th century. Islamic architecture, in particular, reveals both continuity and transformation: its chromatic traditions remain influential today, where reflective surfaces and traditional palettes are being adapted for sustainable and climate-responsive design.

By tracing these patterns, the study highlights the enduring role of color as a medium of cultural identity, symbolic expression, and environmental adaptation in architectural history and its contemporary relevance.

Keywords: cultural identity, architectural heritage, symbolism, Islamic architecture, sustainability, color theory.

1. INTRODUCTION AND RESEARCH QUESTIONS

Architecture is not only a physical construct but also a cultural and ideological expression of the societies that shape it. Just as individuals carry identity through appearance and behavior, built environments reflect the identity of their creators through form, material, ornamentation and color. From ancient civilizations to modern metropolises, color has served as a powerful medium for symbolizing beliefs, asserting political ideologies, and reinforcing cultural memory.

The relationship between color and architecture extends beyond aesthetics. It embodies philosophical, religious, and environmental dimensions. Colors signal power, spirituality, and artistic intent; they shape how a building is perceived, remembered, and situated within its cultural context. As Pietro Zennaro argues, "Color is not just perception—it is culture" (Zennaro, & Gasparini, 2010). Similarly, historical theorists such as Brusatin emphasize the symbolic and emotional weight of color across eras, associating it with both truth and transformation (Brusatin, 2000).

At the intersection of aesthetics, philosophy, and cultural history, color within architecture has been investigated by classical and modern theorists to reveal its layered meanings. Goethe's color theory addressed not only the optics of color but also its psychological and symbolic effects in spatial contexts (Goethe, 1810/1970). Merleau-Ponty's phenomenological perspective highlights how color in architecture shapes perception, experience, and the lived environment (Merleau-Ponty, 1945/2012). Brusatin (2000) further situates color as a medium of cultural memory and transformation within architectural expression. Considering these frameworks, this research positions color as both a symbolic code and an environmental medium—linking ideology, materiality, and the dynamics of perception.

This study aims to investigate how the use of color in architecture evolved across historical periods and styles, focusing particularly on its ideological, religious, and environmental underpinnings. It examines diverse architectural traditions from ancient Egyptian temples and Greek polychromy to Gothic cathedrals, Islamic mosques, and postmodern urban design highlighting how color served as a dynamic element in constructing architectural meaning.

This study examine the following research questions:

What patterns of color usage emerge across different architectural periods and regions?

How was color historically related to dominant ideologies and religious doctrines?

Is there a discernible connection between the color strategies of Islamic and European architecture?

The hypothesis of the study state that there is a recurring relationship between color selection and prevailing ideological or religious frameworks in both historical and modern architectural movements.

2. METHODOLOGY

This study employs a historical and interpretive approach to examine how color has been used in architectural traditions across time. Rather than relying on quantitative data, the research draws from a selective review of scholarly literature, visual analysis of well-documented architectural examples, and comparative reasoning to explore the cultural meanings of color.

The method consists of two primary components:

1. Thematic Literature Review:

Relevant academic sources were reviewed to identify how color was interpreted and applied in different architectural movements. The selection included historical studies, philosophical texts, and color theory in architectural discourse. Emphasis was placed on sources that discuss symbolism, ideology, and cultural values attached to color in built environments.

2. Comparative Visual Interpretation:

Using a set of representative case studies—such as Ancient Egyptian temples, Greek polychromy, Byzantine churches, Umayyad and Ottoman mosques, Gothic cathedrals, and modernist/postmodernist works—the research compares the symbolic and aesthetic functions of color. The study identifies patterns, contrasts, and contextual meanings within these examples to understand the broader ideological and environmental factors influencing chromatic choices.

This approach allows for a cross-cultural reading of color in architecture, focusing particularly on the intersections of belief systems, cultural identity, and environmental adaptation, while also touching on the continuing relevance of color in contemporary Islamic architectural discourse.

The analytical approach was structured through a matrix that explores color in architecture across three dimensions: (1) Symbolic/Ideological—color as linked to religious meanings, power, and cultural identity; (2) Environmental/Adaptive—how chromatic choices respond to climate, light, and sustainability, including advancements in pigments and materials; and (3) Material/Technical—the technical innovation and practical application of color in architecture. This matrix not only clarifies the comparative method but also connects the historical narrative to contemporary theoretical discourses.

3. HISTORICAL ANALYSIS OF COLOR IN ARCHITECTURE

Ancient Egyptian Architecture

Among the earliest civilizations, Ancient Egypt demonstrated an advanced understanding of color, both technically and symbolically. Egyptians were pioneers in producing synthetic pigments, including the earliest known blue dye, showcasing their chemical innovation (Orna, 2022). The Egyptian word for “color” was iwn, a term that also meant “disposition,” “character,” or “essence” suggesting that color was seen as intrinsic to the nature of objects and beings (Orna, 2022).

Color was not limited to interior decoration; it was widely applied to tombs, temples, statues, and architectural façades. While much of the external color has faded due to centuries of environmental exposure, traces remain on monuments such as the Temple of Esna, confirming the widespread use of vibrant pigments (Hartwig, 2012).

Figure 1. Painted columns of the Temple of Esna, Egypt. (Egypt Tours Portal. (2019)

According to Melinda Hartwig, Egyptian painting and architecture were deeply embedded in political, religious, and social functions. Pharaohs used color as a form of visual propaganda asserting power, divine legitimacy, and order (Hartwig, 2012).
The symbolic meanings of colors were central to Egyptian visual culture:

- Red represented vitality and power but could also signal chaos or destruction.
- Blue symbolized the heavens, divinity, and the life-giving waters of the Nile.
- Yellow was associated with the eternal and the divine, often used for the skin of gods.
- Green signified regeneration, vegetation, and rebirth.

Temples, especially during the New Kingdom, often featured vibrant painted reliefs both inside and outside. Color acted as a spiritual and ideological medium, linking the material world to the divine.
In sum, color in ancient Egyptian architecture was not merely ornamental; it was a semiotic system a language that conveyed cosmological, religious, and political values embedded in the built environment.

Ancient Greek Architecture

The popular perception that ancient Greek architecture was characterized by pure white marble is a misconception shaped by Enlightenment-era scholars such as Johann Winckelmann, who idealized whiteness as a symbol of purity and aesthetic perfection (Winckelmann, 1764). In reality, Greek temples and sculptures were richly decorated with polychromy. Archaeological research confirms that pigments such as red, blue, and green were widely applied to façades, sculptures, and decorative details (Netti, 2019).

Figure 2. Modern reconstruction of Parthenon polychromy based on pigment analysis. The façade was originally decorated with vivid reds, blues, and golds. (Hittorff, 1851)

The Parthenon provides a prime example of this practice. Originally, its sculptural decorations and architectural details were highlighted with strong contrasts of color such as the "archaic triad" of red, white, and blue later enriched with ochre and metallic tones (Hellmann, 2002). Over centuries, exposure and weathering erased much of the original pigment, reinforcing the myth of colorless Greek architecture. However, modern techniques, including ultraviolet imaging and pigment analysis, have revealed traces of this vibrant polychromy.

The symbolic functions of Greek color extended beyond decoration. Certain pigments were considered precious and associated with religious rituals and divine presence (Brecoulaki, 2014). Polychromy therefore carried both aesthetic and cultural meaning, embedding architecture within the broader cosmology of Greek society.

Byzantine Architecture

Byzantine architecture represents a significant transformation in the use of color, where chromatic choices were closely tied to both materiality and spiritual symbolism. Unlike earlier civilizations that often painted their façades, Byzantine builders increasingly relied on the inherent colors of construction materials brick, stone, and marble while reserving the most vibrant decoration for interior spaces.

The most famous example, Hagia Sophia in Constantinople (modern-day Istanbul), demonstrates this dual approach. From the outside, its pinkish hue results from the natural tones of stone and brick. Inside, however, the vast dome and walls were adorned with glittering mosaics of gold, deep blues, and rich reds, intended to evoke the heavens and reflect divine light (Brown, 1999). The chromatic experience was therefore not only visual but spiritual, designed to guide worshippers from earthly space into a transcendental atmosphere.

Figure 3. Hagia Sophia, Istanbul. Exterior pink tones from brick and stone contrast with the interior's vibrant mosaics of gold, blue, and red, symbolizing divine illumination. (Ayasofya Camii, 2023)

Another notable example is the Chora Church (Kariye Mosque), which similarly employed warm exterior tones from brickwork while reserving intense interior mosaics for religious storytelling. These strategies illustrate how Byzantine architecture used color selectively restrained and material-driven outside, symbolic and immersive inside.

In this way, Byzantine color was less about external ornamentation and more about creating a theological narrative, where mosaics and pigments became tools of spiritual communication.

Gothic Architecture

Gothic architecture (12th–16th centuries) marked a new era in the symbolic use of color, particularly through its innovative stained-glass windows. Unlike earlier traditions where color was applied mainly to surfaces, Gothic architects transformed light itself into color. Cathedrals such as Chartres, Notre-Dame, and Sainte-Chapelle in France became masterpieces of chromatic spirituality.

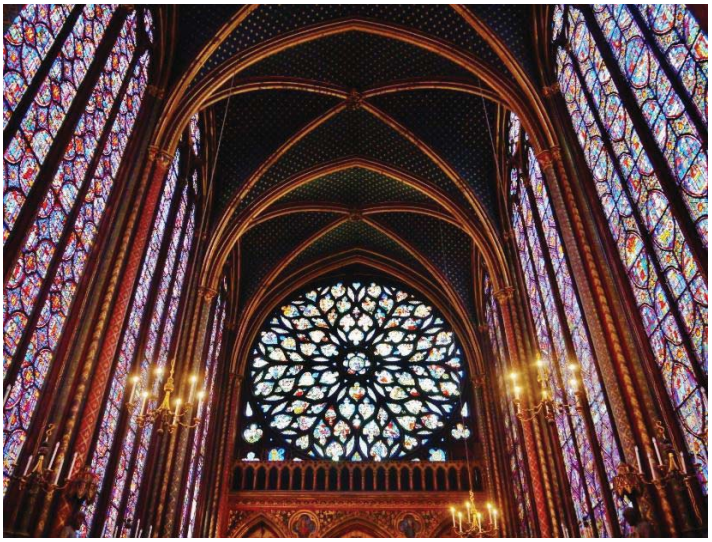

Figure 4. Interior of Sainte-Chapelle, Paris (13th century). The stained glass, dominated by deep blues and reds, exemplifies how Gothic architecture transformed light into sacred color. (Zairon, 2017)

Stained glass windows, with their deep blues, radiant reds, and luminous golds, were designed not only for aesthetic impact but also for theological meaning. Light was considered a manifestation of the divine, and colored glass turned sacred interiors into immersive, transcendent spaces (Caviness, 1997). Beyond windows, traces of polychromy also survive on Gothic portals and sculptures, revealing that façades were once more colorful than the stone surfaces visible today (Prache, 1995).
The chromatic symbolism of Gothic architecture reinforced religious teaching. Blue often represented the Virgin Mary and heavenly protection, red signified Christ's sacrifice, and gold was associated with divine glory. In this way, Gothic color created a spiritual atmosphere that instructed, inspired, and moved worshippers, transforming architecture into a didactic and emotional experience.

Chromatic Strategies in Islamic Architecture: From Umayyad to Persian Traditions

In Islamic architecture, color holds a central role in shaping both the spiritual and cultural experience of space. The Umayyad period (661–750 CE) marked the beginning of monumental mosque construction, where mosaics and colored stones were used to communicate religious ideals. The Great Mosque of Damascus, for example, features expansive mosaics of green, blue, and gold that symbolize paradise and eternal life (Bloom & Blair, 2013). These colors were not arbitrary but drawn from Qur'anic references that describe heaven as a garden with rivers and lush vegetation. Through such choices, Umayyad architecture used color to create a sacred environment linking the earthly and divine.

Figure 5. Mosaic decoration in the Great Mosque of Damascus (8th century, Umayyad period). Gold, green, and blue tones represent paradise and eternal life, reflecting Qur'anic imagery (American Rugbier, 2009)

The Ottoman Empire further developed this chromatic tradition, particularly through the use of Iznik tiles in mosques and palaces. Characterized by deep cobalt blues, turquoise, greens, and touches of red, these tiles became a signature of Ottoman identity and craftsmanship (Necipoğlu, 1992). In mosques such as the Süleymaniye Mosque in Istanbul, the interplay of tile decoration, calligraphy, and light produced a spiritual atmosphere that embodied both power and piety.
To further contextualize the diversity of Islamic chromatic strategies, this section expands the analysis to include additional regional examples—namely, Mamluk Cairo, Andalusian Spain, Moroccan, and Persian architecture. Each presents unique applications of color for both symbolic and adaptive

purposes. Mamluk mosques in Cairo demonstrate intricate tilework and stained glass to control daylight and manage heat. The Alhambra in Andalusia combines detailed stucco, glazed tiles, and reflective pools to create a cool, vibrant environment in the Iberian climate (Bush, 2011). Moroccan architecture is renowned for its zellige tile mosaics, which employ blues and greens for both visual cooling and spiritual symbolism. Persian architecture often features turquoise domes and extensive polychrome tilework, evoking both environmental adaptation and celestial harmony (O'Kane, 2011). Table 1 visually synthesizes the patterns described above, illustrating the shared and distinct roles of color symbolism and sustainability across Islamic architectural regions. This layout clarifies how regional chromatic strategies serve both aesthetic and environmental purposes, directly supporting the main findings of the present study (Bush, 2011; O'Kane, 2011).

Region	Dominant Colors	Functional Role (Climate/Sustainability)	Symbolic/Religious Significance
Mamluk Cairo	Blue, Green, Red	Tile mosaic for daylight control, cooling, reflective flooring	Paradise imagery, Qur'anic symbolism
Andalusian Spain	Blue, White, Gold	Glazed tiles for thermal regulation, reflective water features	Garden of Paradise, dynastic identity
Morocco	Blue, Green	Zellige tiles for temperature moderation, visual cooling	Spiritual cleanliness, Sufism
Persia/Iran	Turquoise, Gold	Outer domes resist solar gain, tile for reflective heating	Celestial harmony, paradise symbolism

Table 1. Regional Chromatic Strategies in Islamic Architecture

Color in Islamic architecture thus served three interrelated functions:

Spiritual – reinforcing Qur'anic imagery of paradise.

Cultural – expressing artistic identity and regional styles.

Political – projecting the authority and legitimacy of rulers through monumental decoration.

The legacy of Islamic color symbolism continues in contemporary design, where sustainable architecture often draws on historical palettes. The use of reflective tiles and lighter tones in hot climates, for instance, reflects a continuity between environmental adaptation and cultural heritage. This demonstrates how Islamic architectural traditions remain relevant not only historically but also in today's pursuit of sustainable and culturally rooted design.

19th-Century Revival Styles

The 19th century was marked by a fascination with historical revivals, where architects reinterpreted past styles while incorporating modern materials and technologies. This period, often referred to as Historicism, saw the rise of Neo-Gothic, Neo-Classical, and Neo-Renaissance movements, each borrowing elements from earlier traditions.

Color played an important role in these revivals. In Neo-Gothic architecture, for example, polychromy was reintroduced on façades through patterned brickwork, painted stone, and stained glass. Buildings

such as the Palace of Westminster in London exemplify how color was used both structurally and symbolically to convey national identity (Stamp, 1995). In Neo-Renaissance and Neo-Classical revivals, color was expressed through contrasting stone materials, frescoes, and interior decoration, emphasizing grandeur and cultural prestige.

Figure 6. Palace of Westminster (1840–1876, Neo-Gothic Revival). The use of patterned stone and stained glass exemplifies 19th-century historicism, where color reinforced national identity (Ott, 2022)

The industrial revolution also enabled new forms of architectural coloring. The use of iron and steel allowed for decorative polychrome cast ironwork, while advances in ceramic production led to the widespread application of colorful glazed tiles and terracotta façades (Curl, 2006). In movements such as Art Nouveau, vibrant palettes mimicking organic forms further challenged the rigid uniformity of industrial architecture, reintroducing symbolic richness to the urban landscape (Atıcı, 2023).

Thus, 19th-century revival architecture used color to bridge nostalgia and modernity, combining historic symbolism with new material possibilities.

Modernism and Postmodernism

With the advent of modernism in the early 20th century, architecture shifted toward minimalism, neutrality, and functional clarity. Color was often subdued or entirely eliminated, as architects prioritized form, material honesty, and industrial efficiency. The International Style, exemplified by architects such as Le Corbusier and Mies van der Rohe, embraced whites, grays, and natural concrete finishes, viewing color as secondary or even distracting (Riley, 1995). Le Corbusier himself initially argued that “form precedes color,” insisting that architectural space could exist without chromatic intervention. Iconic works like the Villa Savoye (1931) in France reflect this preference for neutral tones and functional clarity (Le Corbusier, 1931).

Figure 7. Villa Savoye (Le Corbusier, 1931). The white façade exemplifies modernist minimalism, where color was minimized to emphasize form and function. (Centre des Monuments Nationaux, 2023)

By contrast, postmodernism in the late 20th century reintroduced bold, playful color palettes as a reaction against the austerity of modernism. Architects like Michael Graves used expressive hues to create identity, symbolism, and urban vibrancy. His Portland Building (1982) is a landmark example, featuring teal, salmon, and ochre accents that challenged the monotony of modernist glass-and-steel environments (Jencks, 1987). Postmodern architects saw color not merely as ornament but as a communicative tool, reconnecting architecture to cultural symbolism and historical reference.

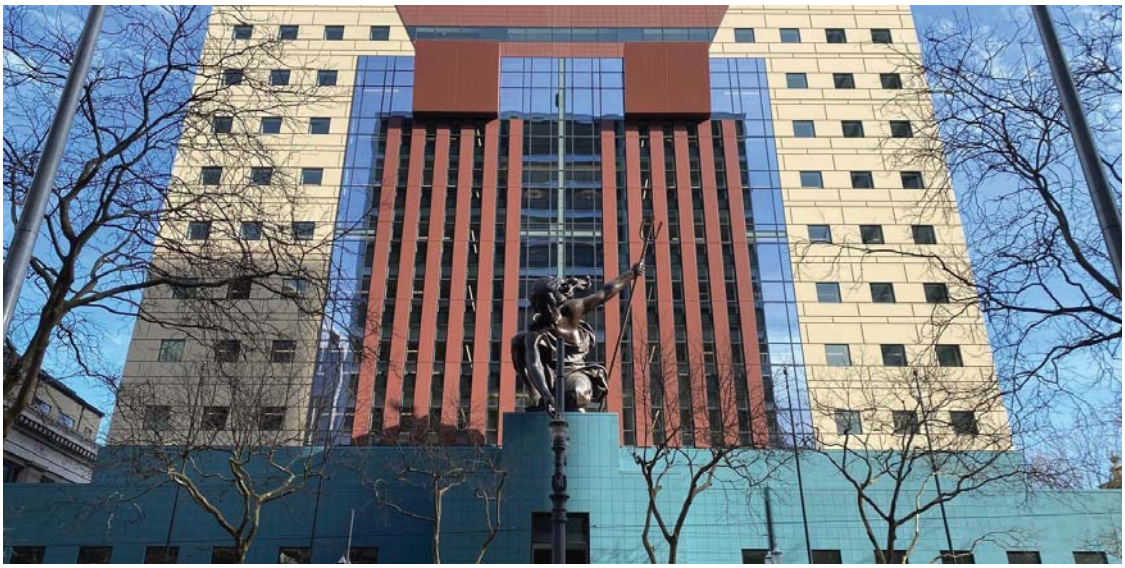

Figure 8. Portland Building (Michael Graves, 1982). Postmodern architecture reintroduced expressive, symbolic colors to challenge modernist uniformity. (Portland, 2023)

Together, modernism and postmodernism demonstrate two opposing philosophies: the former minimized color in favor of rationalism, while the latter embraced it to restore symbolism, diversity, and emotional resonance in the built environment.

4. FINDINGS AND DISCUSSION

The comparative analysis highlights that color has consistently functioned as a symbolic language in architecture, expressing ideology, religion, and political authority. A key research question for this article concerns whether there is a discernible connection between the color strategies used in Islamic and European architecture. The comparative analysis demonstrates that while both traditions used color as a means of expressing spiritual and political authority, their methods display both convergence and divergence. Islamic architecture, particularly in the Umayyad and Ottoman contexts, employs vibrant mosaics and tiles inspired by Qur'anic imagery, creating immersive visual environments that symbolize paradise and transcendence. In European Gothic and Byzantine traditions, large-scale use of stained glass and gold mosaics likewise sought to transform the perception of sacred space, channeling light and color as metaphysical phenomena. While the color palettes and symbolic associations often reflect different religious narratives, the underlying aim—a chromatic manifestation of the sacred and social order—remains closely connected across both traditions (Brusatin, 2000). This connection is further exemplified in contemporary architectural revivals and sustainable design, where both traditions inform material choices and chromatic strategies to address current environmental challenges. From the deep reds and blues of ancient Egypt to the stained glass of Gothic cathedrals and the golden mosaics of Islamic mosques, color communicated meanings beyond decoration. In postmodern architecture, expressive palettes similarly challenged uniformity, restoring symbolic and cultural dimensions to the built environment.

Color choices were also shaped by environmental and material conditions. Civilizations adapted palettes to their climates: lighter reflective tones were common in hot regions, while darker hues and stained glass enhanced the atmosphere of northern interiors. Technological advances—from the creation of synthetic pigments in Egypt to industrial paints and ceramics in the 19th century—expanded the spectrum of chromatic expression and altered how buildings interacted with light and climate.

Islamic architecture demonstrates both continuity and transformation in the use of color. Umayyad mosaics in Damascus and Ottoman Iznik tiles in Istanbul integrated spiritual symbolism, cultural identity, and aesthetic refinement. In contemporary contexts, Islamic architecture continues to employ historically rooted palettes but adapts them for sustainability. The use of reflective marble, energy-efficient glass, and durable ceramics reduces heat absorption while preserving symbolic meaning, illustrating how traditional chromatic strategies remain relevant in today's environmental challenges.

In recent years, the interface between traditional Islamic chromatic practices and sustainable architectural design has garnered increasing scholarly attention. Contemporary frameworks such as the United Nations Sustainable Development Goals (UN SDGs) and bioclimatic design principles reveal how historical color strategies—reflective surfaces, cooler tones, adaptive use of tiles and ceramics—can address modern energy efficiency and resilience challenges (United Nations, 2015). Recent studies show that integrating traditional palettes and materials can reduce solar gain, enhance psychological comfort, and improve urban resilience in hot climates. Therefore, the chromatic legacy of Islamic architecture provides not only aesthetic inspiration but also tangible strategies for environmentally responsible design in the twenty-first century.

Color has also been integral in shaping cultural identity and aesthetic experience. Civilizations distinguished themselves through distinctive palettes, which reinforced political narratives and artistic

innovation. From Rococo pastels signaling aristocratic refinement to Ottoman turquoise tiles embodying spiritual harmony, façade colors became markers of cultural identity. Even in modern and postmodern movements, where ideologies clashed over the role of ornament, color remained a powerful tool for communicating meaning, memory, and belonging.

5. CONCLUSION

This study has traced the historical evolution of color in architecture, showing how civilizations used chromatic expression as more than ornament. In summary, the evidence suggests a recurring pattern: Islamic and European architectural color traditions, though rooted in distinct religious and cultural milieus, have continually shaped one another through direct exchanges and parallel developments. Both traditions have used color to forge identity, create sensory experience, and adapt to environmental context—demonstrating the enduring relevance of chromatic expression in constructing meaningful, sustainable architectural environments (Brusatin, 2000; Bush, 2011) Across time and geography, color emerged as a language of power, spirituality, and identity, linking architecture with cultural values and ideological frameworks. From Egyptian symbolism and Greek polychromy to Gothic stained glass and Ottoman tilework, each tradition demonstrated how chromatic choices reflected and reinforced collective meaning.

The findings reveal that color was never neutral. Its selection was shaped by religious narratives, political ideologies, material availability, and environmental adaptation. The contrast between the neutral palettes of modernism and the expressive hues of postmodernism further illustrates how color embodies philosophical positions as much as aesthetic ones.

Islamic architecture stands out for its continuity in the symbolic use of color, where mosaics, tiles, and calligraphic ornament created immersive spiritual experiences. In contemporary practice, these traditions are being reinterpreted to address sustainability challenges. The use of reflective marble, energy-efficient glass, and climate-responsive palettes demonstrates how Islamic architecture continues to offer lessons for environmentally conscious design while preserving cultural heritage.

Recognizing the cultural, environmental, and ideological functions of color enriches our understanding of architecture as both art and identity. Beyond its visual appeal, color remains a dynamic tool for communicating meaning, shaping experience, and linking the past with future approaches to sustainable and culturally rooted design.

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The Sustainable Construction of the Architect's Personality

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ABSTRACT

Art and architecture are trusts granted to humanity. The artist/architect expresses this trust through forms, shapes, colors, sounds, and other patterns shaped according to their own comprehension, understanding, and interpretations. Essentially, this can be seen as the reflection or transformation of the inner meaning of human existence—its created essence—into the external world, i.e., space, where the individual will also reside, adapted to the material realm. It is natural for differences to emerge when this entrusted practice is put into execution. Unfortuately as Nasır,S.H. (2016) expressed that the architects cutting their relatiosip with their inner hidden cause they became no more then executer of technology in the modern world.

Taken the Muslim arts-architecture into account, regardless of consciousness, acceptance, or denial, the artist-architect always takes their place in the field of practice as a representative hand—Yedullah—of this artistic manifestation. At this point, the issue of constructing the architect's personality becomes vitally important. Sâmiha Ayverdi (1942), on the other hand considers the reconstruction of human being with its spirituality in depth as the essence of civilization.

Here it is aimed to question the impacts of Islamic culture and metaphysics/sufi traditions on the sustainable personality build up of muslim artists and architects.

Special references would tried to be given on the main souces and philosophical understanding in the issue

Key words: *Muslim Architect's Personality Buid Up, Muslim Architect/Artist's Value Judgements, Architect's Education, Ahlāq-ı Muhammedi,*

DISCUSSION ON THE FORMATION OF THE PERSONALITY OF THE ARCHITECT/ARTIST

To an extend, understanding the products of civilization that a certain" hars"/culture has given meaning to behind the veils of secrecy in its own understanding for centuries by understanding the artist and architect who created these works. On the other hand, there is no doubt that there will be a close relationship between the personality structure of the artist-architect and the work in the context of culture.

Art and architecture are trusts granted to humanity. The artist/architect expresses this trust through forms, shapes, colors, sounds, and other patterns shaped according to their own comprehension, understanding, and interpretations. Essentially, this can be seen as the reflection or transformation of the inner meaning of human existence—its created essence—into the external world, i.e., space, where the individual will also reside, adapted to the material realm. For the architect, the concepts represented and reshaped within spatial relationships are also based on beyond the temporal relations and historical, geographical, and socio-economic contexts. It is natural for differences to emerge when this entrusted practice is put into execution due to the depth of understanding beyond the temporal.

Taken the Muslim arts-architecture into account, regardless of consciousness, acceptance, or denial, the artist-architect always takes their place in the field of practice as a representative hand—Yedullah—of this artistic manifestation. At this point, the issue of constructing the architect's personality becomes vitally important. Sâmiha Ayverdi (1974), on the other hand considers the reconstruction of human being with its spirituality in depth as the essence of civilization.

It is natural for differences to emerge when this entrusted practice is put into execution. Denying any of these differences is impossible. While some of these differences stem from the personality structure of the architect or artist, in essence, they fall within the will of the True Creator—the Ultimate Artist—who bestows the trust. For the Creator-the true artist, as the essence of the manifestation, reveals his own beauty in an artistic way with a new creation and a new being at every moment. Although the origin is singular, differences can only be explained in this way. Regardless of consciousness, acceptance, or denial, the artist-architect always takes their place in the field of practice as a representative hand—Yedullah—of this artistic manifestation. In reference to this point, many researchers and architects like Titus Burckhardt (2012), Turgut Cansever (2010), Ekrem Hakkı Ayverdi (2023), Doğan Kuban (1998) have brought into discussion the vitally important issue of the impact of the cultural identity in constructing the architect's personality

Thus, the formation and structuring of the artist-architect's personality as a means and medium in the process of artistic creation, must be thoroughly discussed. The reconstruction of the personality of the artist-architect—who has transcended the basic human level—becomes a principal matter. This process signifies the beginning, middle, and continuation of a cultural-civilizational trajectory that can only be sustained through a consistent value based approach, Şimşek (2015) and education.

Considering the human being as the subject, reviving a potentially lost or endangered value system by integrating it as a leaven into new societal norms could serve as the foundation for a sustainable model of art and architectural education thusbuildig up the architetects personality. It is undeniable that cultivating an artist-architect imbued with humane qualities must occur within a multilayered environment that transcends individual talent and personal experience. As the late Ekrem Hakkı Ayverdi (2023) noted, architecture that is founded on an idea inevitably develops upon a cultural geography—or, in other terms, a civilizational sphere. Whether called collective social ideals, a civilization's perception, or its vision, this path—reflected through shared ways of life, belief systems, conduct, science-technology, and aesthetic considerations—plays a decisive role in shaping the personality of the artist-architect.

The importance of shaping the personality of the artist as a human being applies not only within Islam but across other civilizations as well. The civilization model based on a positivist-materialist "self" that emerged with the so-called Age of Enlightenment has arguably imprisoned human value systems behind the walls of faith structures. As Samiha Ayverdi states, a civilizational vision that "discovers the secret of manifestation in human action, speech, and influence" will naturally foster a mode of being that connects humans with their essence by transmitting this spirit "from soul to soul" (Ayverdi,S. 1977). She also taken the ethereally re-building of humanity as an essential factor of civiliztin (Ayverdi,S. 1942). However, it becomes critical for the artist-architect to consciously commit to a concrete station where their spiritual garment merges the realms of matter and meaning. Through this process, a new environment opens up for the Muslim—submitted—artist, one approached with awareness and of which they are a part. This necessitates a renewed and persistent questioning of the essence of architectural education. This is a cultural/civilizational trajectory, and one expresses and creates according to the names and attributes manifest within this trajectory. Only upon reaching the point of perfection can excellence be achieved.

As we enter an era increasingly dominated by artificial intelligence and the peak of mediocrity, what has been lost in understanding civilization and in constructing the personality of the "human-artist-architect"? How might these be rediscovered? What should be sought—meanings, styles, value judgments, or the concept of personality? Perhaps, in essence, it is the human-artist spirit itself.

The near-consensus among contemporary personality builders who evaluate this inner essence in today's context is this: to apply and teach the "Muhammadan morality" (Ahlāq-ı Muḥammadī)—for the muslim artist-architect to dissolve their selfhood within the power of the Divine, to unite with Him without annihilation—is the only path toward permanence and the production of works that embody true meaning. Tasavvuf/Islamic Metaphysics (Tahralı, M. 2018) seems to be the closest path on the issue.

IN WHICH DEPTH THE ARCHITECT AND ARTIST

To express the architect's relationship—both material and spiritual—with the created world, or "kawn-u makān," it is fitting to begin with a stanza from a poem by Hacı Bayram Veli (1352–1430):

"My Lord has created a city between the two worlds;

Looking upon it, the divine face appears at its edge.

Suddenly I arrived at that city and saw it being built;

I too was being built among stone and earth."

This verse invites reflection (Nasr, 1987) on the continuous divine manifestation that unfolds with every moment, as stated in the Qur'anic verse (Rahman 55/29) "Every day He is in a state of glory (Yes-eluhu men fî-ssemâvâti vel-ard kulle yevmin huve fî şe/n)", framing human-environment relationships in terms of continuity and sustainability. The web of complex relationships between city and society, society and human, human and architect, architect and building, and building and city must be understood in terms of transformation, continuity, and rupture. The recurring construction of the architect within this continuum is crucial to understanding how their personality is formed.

In this vast network of interactions, the architect's role is especially prominent. Although positivist perspectives may struggle to interpret this web—even superficially—engagement with the metaphysical realm both simplifies and deepens the issue, drawing us toward points where matter and meaning converge under a cosmic will. The Creator, desiring to be known, said "Be!" and it was as it is in Qur'anic verse (Ya'sin 36/82): (innemâ emruhu izâ erâdeşey-en yekûle lehu kûn feyekûn). The architect, as one of the agents through whom this universal will manifests itself, must therefore be considered a primary factor in the formation of the environment, and thus, in the formation of personality. While shaping physical space, the architect is simultaneously shaped through a continuous process of personal development. In this shaping, the values and perspectives of the civilization to which the architect belongs are fundamental.

Since art and architecture are divine trusts bestowed upon humanity, for the artist-architect, the most essential step in understanding the entrusted role of art is the discovery of the harmony set by the True and Only Artist within creation. Only by distancing themselves from personal whims can they execute the harmony embedded in their artistic rhythms, proportions, and compositions in accordance with the worldview of the civilization to which they belong—reflecting both the created cosmic order and cultural heritage. The perception of this divine harmony (Ayverdi, E.H. 2023) is therefore contingent upon a civilization's understanding.

Diversity naturally arises when this trust enters the phase of practice. Denying differences is neither possible nor desirable. While some differences stem from the personal structure of the artist-architect, they ultimately fall within the will of the Real Artist—the True Creator. Because He continually manifests His beauty through new forms of creation. While all originate from the same source, differences are best understood through this divine artistic emergence. Whether conscious or unconscious, approving or rejecting, the artist-architect inevitably assumes their role in the practical field as a representative of the divine hand—Yadullāh, as it is in Qur'anic verse (Feth 48/10) (…yedullahi fevka eydihim…). At this point, the matter of constructing human personality becomes critical.

Therefore, the formation and development of the artist-architect's personality must be explored as a means through which the creative process finds form. The journey from bashar (the corporeal human) to insān (the complete/perfect human) necessitates a reconstruction of personality. This is the foundational, progressive, and sustaining trajectory of a cultural-civilizational path—one that requires sustainable approaches and enduring education.

Undoubtedly, the sustainability of a value-based architecture is tied to the continuity of civilizational understanding within a society. The construction of the architect's personality - who brings this continuity into reality- is thus of great importance. Chief among the factors that shape this personality are the values and aesthetics of the civilization in which the architect is nurtured. These find expression not only in religious beliefs but also in ethical standards, aesthetic tastes, language, and artistic traditions. In short, the development of the artist-architect must occur within the loom of a sustainable educational model woven by a civilization with a coherent understanding of identity and continuity.

Since the subject is the human being, it becomes necessary to revive the fading value systems of societies by re-integrating them into the fabric of modern times—thus potentially establishing a sustainable model for art and architecture education. Cultivating a well-rounded artist-architect equipped with humane qualities undoubtedly requires a multidimensional environment that surpasses individual talent (Şimşek, 2015) or personal experience. As the late Ekrem Hakkı Ayverdi (2023) emphasized, architecture "based on an idea" must develop within a cultural geography—i.e., a civilizational sphere. Whether termed social ideals, civilizational perception, or vision, the collective lifestyle, beliefs, etiquette, scientific-technical achievements, and aesthetics of a society are all central to shaping the personality of the artist-architect.

Given the diversity of civilizational understandings across nations and societies, it is inevitable that perceptions of cosmic/innate harmony—and hence the construction of the architect's personality will vary. The importance of personality formation applies not only within Islamic civilization but also across Western and Eastern traditions. Since the Enlightenment, and especially with modernity's positivist-materialist ego-centric worldviews, the human value system seems to have been imprisoned behind the walls of faith and temple structures. Even when Islamic civilizations produce works with distinct forms and styles, they still emerge from the same awareness of cosmic harmony. The values that shape the architect's identity manifest through literary language, calligraphy, musical modes, decorative motifs, and architectural mass and volume—akin to the rhythmic harmony of a shared heartbeat. Without capturing this cosmic harmony, the efforts of the artist remain futile.

As Sâmiha Ayverdi noted, only a civilization that has "discovered the mystery of divine manifestation in human action, speech, and disposition" (Ayverdi,S. et al, 2021) can develop an attitude that "transmits from soul to soul" (Ayverdi, 1942), reuniting the human with their essence. For this reason, the artist-architect must pledge themselves to a concrete station that clothes them in a spiritual garment, uniting the material and metaphysical realms. Through this, a new, conscious realm opens up for the Muslim artist—one in which they are a knowing and willing participant. Consequently, the very nature of architectural education must be continuously reexamined. This is a civilizational trajectory (umrān/kultur/medeniyet); what is said and done along this path reflects the divine attributes it embodies. Perfection is only attained when the creator reaches the point of completion.

The achievement of perfection does not rest solely with the artist-architect but also with societies that must reach a similar state of maturity. This, in turn, depends on transcending the intellect and advancing toward the heart and soul. The resulting aql-i salīm (sound intellect), qalb-i salīm (pure

heart), and dhawq-i salīm (refined taste) will form the ideal environment for the emergence of meaningful architectural works.

As we enter an era increasingly dominated by artificial intelligence and a surge in mediocrity, what has been lost in understanding civilization and constructing the personality of the "human-artist-architect"? How can these be rediscovered? What should be sought—meanings, styles, value judgments, the concept of personality? Perhaps, in essence, it is the very essence of the Human-Artist.

Nearly all contemporary thinkers concerned with the formation of identity agree on the following: the implementation and teaching of Ahlāq-ı Muḥammadī (Muhammadan Ethics) is indispensable. Unless the Muslim artist-architect melts their selfhood within the Divine will and unites with Him without vanishing, they cannot attain permanence, nor can they create works imbued with true meaning.

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Fez as A Living Heritage of Islamic Architectural Ethics : A Comparative Reading with Turgut Cansever's Philosophy

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ABSTRACT

This paper explores the intersection of morality, metaphysics, and spatial form in Islamic architecture through a comparative reading of Turgut Cansever's philosophy and the urban morphology of Fez, Morocco. Defining architecture as a "moral act," Cansever (1992) emphasizes that built form must consciously embody the unity (tawḥīd) among human beings, society, nature, and the divine. Using a qualitative and comparative methodology grounded in textual interpretation and spatial analysis, the study examines how Cansever's nine ethical principles—tawḥīd (unity), iḥsān (aesthetic virtue), iʿtidāl (moderation), amānah (responsibility), tafakkur (contemplation), maḥramiyyah (privacy), traditional continuity, spiritual space, and urban and social consciousness—are spatially manifested in Fez el-Bali, the historic core of the city. Through morphological examination and hermeneutic interpretation, the research demonstrates that Fez operates as a living and dynamic expression of moral and spiritual order. Its inward-oriented courtyard houses, mosque–market–home triad, and balanced urban form exemplify an ethical integration between beauty, humility, and ecological harmony. The findings reveal that Fez materializes the moral–spatial integrity that Cansever envisioned, offering a comprehensive paradigm for reinterpreting Islamic architecture as an ethical and metaphysical discipline rather than a stylistic category. Ultimately, Fez stands as a "living heritage" where moral consciousness and spatial form coalesce in harmony.

Keywords: Turgut Cansever; Islamic architecture; Fez (Morocco); architectural ethics; tawḥīd.

1. INTRODUCTION

The relationship between human beings, space, and moral order has long been a central theme in Islamic architecture. Within this framework, the built environment is not merely understood as a technical product but as a moral and spiritual structure reflecting the unity among the Creator, humankind, and nature. Among contemporary Muslim thinkers, Turgut Cansever (1921–2009) stands out as one of the few who could articulate this relationship both through architectural practice and philosophical inquiry (Şişman, 2021). As the only architect to have received the Aga Khan Award for Architecture three times, he demonstrated his mastery in practice while also producing a substantial body of conceptual writings and interviews that constitute a unique intellectual corpus.

Although Cansever is widely recognized in Türkiye as an architect–philosopher, his ideas have yet to achieve equal visibility within international discussions of Islamic architecture. Unlike other Muslim architects and theorists—such as Hassan Fathy (1973), who emphasized vernacular wisdom and climatic adaptation; Nader Ardalan and Laleh Bakhtiar (1973), who interpreted architecture through

symbolic cosmology and geometry; or Ismail Serageldin (1990), who explored the socio-economic dimensions of Islamic urbanism—Cansever approaches architecture primarily as a moral and metaphysical act. His thought introduces an ontological and ethical depth that reconnects modern design with spiritual responsibility and moral consciousness.

Crucially, this conceptual vision was not confined to theory but found consistent expression in his architectural practice. Through seminal works such as the Turkish Historical Society Building in Ankara (1981–1983) and the Demir Holiday Village in Bodrum (1989)—both recipients of the Aga Khan Award for Architecture—Cansever demonstrated how metaphysical principles could be translated into tangible form (Figure 1). The former exemplifies a disciplined spatial order rooted in balance, clarity, and civic dignity, while the latter embodies harmony with nature, continuity of local tradition, and ecological responsibility. Together, these projects illustrate how Cansever's ethical and spiritual framework could manifest in contemporary design practice.

Figure 1. On the left, Turkish Historical Society Building, Ankara (TTK, 2025); On the right, Demir Holiday Village, Bodrum (Archnet, 2025)

In his conceptual writings, Cansever defines architecture as an ethical discipline grounded in metaphysical principles such as *tawḥīd* (unity), *iḥsān* (aesthetic virtue), and *iʿtidāl* (moderation)—principles that later guide this paper's interpretation of Fez as a living embodiment of moral and spatial equilibrium.

In this context, the city of Fez, Morocco, is chosen as an exemplary case through which Cansever's architectural philosophy can be interpreted. Founded in 789 CE, Fez represents one of the oldest and best-preserved Islamic cities, embodying a spatial logic shaped by humility, introversion, and social balance (Burckhardt, 1992; O'Meara, 2007). Its labyrinthine streets, inward-oriented courtyard houses (riads), and neighborhoods organized around the mosque–bath–market triad provide tangible evidence of how moral and spiritual values are translated into spatial form. Conceptually, Fez can be read as the material manifestation of the harmony between human beings, the environment, and divine order that Cansever described in his writings.

The aim of this paper is to establish a conceptual dialogue between Cansever's theoretical framework on Islamic architecture and the spatial reality of Fez. It examines how the urban morphology of Fez reflects the key ethical and metaphysical principles articulated by Cansever—such as *tawḥīd*, *iḥsān*,

and *iʿtidāl*—and discusses how these principles may contribute to contemporary debates on Islamic heritage and urban identity. Through this comparative reading, the study seeks to demonstrate that Islamic architecture, as represented by both Cansever and Fez, constitutes an ethical discipline that unites the material and the spiritual within human spatial experience.

2. METHODOLOGY

This study adopts a qualitative and comparative research methodology to examine the parallels between Turgut Cansever's conceptual framework on Islamic architecture and the spatial organization of Fez. The method integrates textual interpretation and spatial analysis, allowing philosophical concepts to be read alongside their physical manifestations. The aim is not to measure forms quantitatively but to understand how moral and metaphysical principles are embodied within the urban fabric.

The analytical process consists of three stages (Figure 2). Conceptual Definition: Core principles such as *tawḥīd* (unity), *iʿtidāl* (moderation), *iḥsān* (aesthetic virtue), *amānah* (responsibility), *tafakkur* (contemplation), and *maḥramiyyah* (privacy) were identified and defined based on Cansever's major works—*Kubbeyi Yere Koymamak* (1992) and *Şehir ve Mimari* (1997)—as well as his recorded interviews and essays. Spatial Analysis: The urban structure of Fez was examined through historical maps, typological documentation, and academic studies (Burckhardt, 1992; O'Meara, 2007). Patterns of streets, courtyard typologies, neighborhood organization, and the relationship between public and private spaces were analyzed as reflections of a broader moral and social logic. Comparative Interpretation:
Cansever's concepts were then correlated with the physical patterns of Fez to reveal how metaphysical ideas spatially materialized.

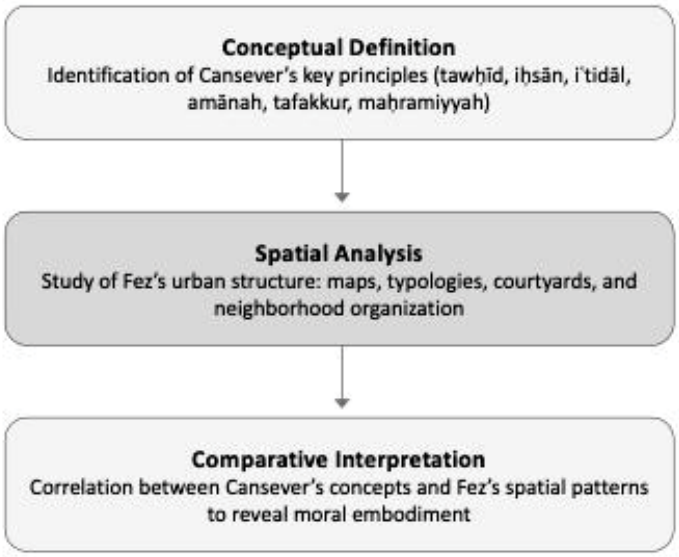


Figure 2. Methodological framework of the study

The study employs a hermeneutic approach, emphasizing meaning-making and ethical interpretation rather than formal typology. The focus area is Fez el-Bali, the oldest part of the city and a UNESCO World Heritage Site, which represents an exceptional continuity of the Islamic urban tradition. Rather than viewing Fez as a static historical relic, this research interprets it as a living manifestation of the metaphysical–moral order described by Cansever—a continually reinterpreted "spatial text."

Fez was selected not only for its remarkable preservation but also for its ability to embody a continuous moral and spiritual order. Among other historic medinas, Fez uniquely demonstrates the uninterrupted continuity of Islamic urban ethics—reflecting the living realization of principles such as humility, responsibility, and unity that Cansever emphasized.

3. TURGUT CANSEVER'S PHILOSOPHY OF ISLAMIC ARCHITECTURE

Turgut Cansever's architectural philosophy represents one of the most comprehensive attempts to reinterpret Islamic architecture within a contemporary intellectual and ethical framework. Grounded in both metaphysical thought and practical experience, this philosophy bridges the gap between traditional spirituality and modern architectural discourse. For Cansever, architecture is neither a mere artistic expression nor a technical pursuit; it is a moral responsibility derived from humankind's divine duty of *imārat al-arḍ*—the stewardship and cultivation of the earth (Cansever, 1992).

Although Turgut Cansever (1921–2009) is widely recognized as one of the most influential architect-philosophers of the twentieth century in Türkiye, his intellectual legacy remains relatively underexplored within the broader theoretical discourse on Islamic architecture. In his seminal works, Cansever establishes a profound relationship between ontology, ethics, and spatial design, arguing that architectural form must embody the principle of *tawḥīd* (unity) as the manifestation of the unity of existence.

While Cansever's approach shares a common metaphysical ground with other modern Muslim thinkers, it holds a distinctive position in terms of the ethical meaning attributed to architecture. For instance, Hassan Fathy emphasized environmental sustainability rooted in vernacular wisdom and climatic adaptation (Fathy, 1973), while Nader Ardalan and Laleh Bakhtiar interpreted Islamic architecture through symbolic cosmology, geometry, and sacred proportions (Ardalan & Bakhtiar, 1973). Ismail Serageldin, by contrast, focused on socio-economic participation and justice at the urban scale (Serageldin, 1990). Although Cansever's thought intersects with these perspectives, he distinguishes himself by viewing architecture not as a cultural or formal product but as a moral act**.** Every architectural decision—form, proportion, material, and spatial hierarchy—must render visible the harmony between human beings, nature, and the Divine. In this sense, architecture becomes an act of worship (*ʿibādah*) and trust (*amānah*), grounded in ethical consciousness (Cansever, 1992).

In this regard, Cansever's philosophy maintains both a continuity and a transformation in relation to Titus Burckhardt's metaphysical interpretation of Islamic art. Both thinkers center their understanding on the principle of *tawḥīd*; however, while Burckhardt (1992) conceives Islamic art as a symbolic reflection of the cosmic order, Cansever translates this metaphysical unity into an ethical and practical responsibility. Burckhardt's approach emphasizes the formal language of sacred art—geometry, proportion, and symmetry—as means of expressing divine unity, whereas Cansever materializes this unity through human action: moral conduct, environmental respect, and social justice. For Burckhardt, sacred art mirrors divine truth; for Cansever, architecture realizes that truth through

ethical design decisions and lived spatial order. In doing so, Cansever interprets metaphysical unity not merely as a contemplative idea but as an ethical totality manifested in the structure of lived space.

Cansever's architectural approach can be interpreted through nine ethical and metaphysical principles centered on the concept of *tawḥīd* (unity), identified and synthesized from his writings and interviews (Figure 3). These principles serve not only as a conceptual framework but also as design guidelines demonstrating how space can embody a moral language.

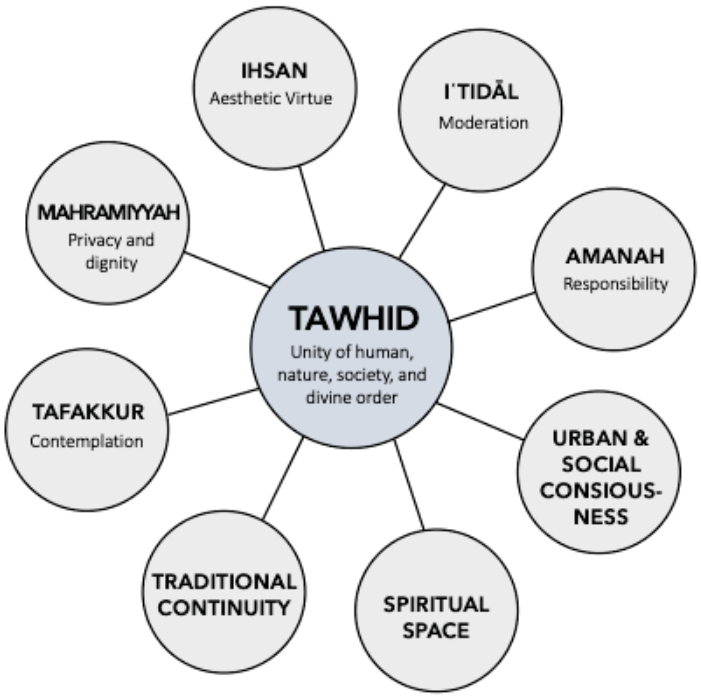


Figure 3. The diagram of nine principles reflecting Cansever's architectural approach

Tawhīd (Unity): According to Cansever, *tawhīd* is the fundamental principle of both the cosmos and architecture—it signifies wholeness. Architecture must reveal the unity among human beings, society, nature, and the divine order. Dualities such as form–function, interior–exterior, and private–public gain meaning only within this integrated whole. This view parallels Titus Burckhardt's (1992) definition of "sacred art" as the symbolic reflection of cosmic unity.

Ihsān (Aesthetic Virtue): Ihsān represents the moral responsibility to perform one's work in the most beautiful manner. For Cansever, beauty is not a matter of aesthetic pleasure but an ethical act. He (1992) conceives beauty as the outcome of an attitude that is sincere, measured, and aligned with the order of existence; therefore, architectural beauty can only emerge through purity of intention and integrity of labor.

Iʿtidāl (Moderation): Iʿtidāl signifies balance and humility in architectural expression. The harmony between simplicity and grace, light and shadow, interior and exterior reflects an ethical equilibrium. Cansever (1997) rejects all forms of excess, emphasizing that true beauty arises through proportion and moderation.

Amānah (Responsibility): As God's *khalīfah* (vicegerent) on earth, humankind carries the divine trust (*amānah*). Consequently, architects must act with environmental awareness and a moral responsibility

toward the preservation of resources. The use of local materials, climate-sensitive design, and ecological consciousness, according to Cansever (1992), are not merely technical preferences but ethical imperatives.

Tafakkur (Contemplation): For Cansever, *tafakkur* is both the method and the purpose of architecture. He (1992) defines architecture as a conscious relationship between human existence and being itself. Space should lead the human mind toward reflection and the perception of divine order. Courtyards, and the interplay of light and shadow, serve as instruments that nurture this contemplative depth (Cansever, 2006).

Mahramiyyah (Privacy and Dignity): Mahramiyyah refers to the preservation of human dignity. Architecture must safeguard personal integrity through the spatial organization of visibility, access, and thresholds. In domestic architecture, introverted layouts, transitional zones, and courtyard arrangements embody this principle. Cansever (1997) defines "moral architecture" as an architecture that protects human dignity through spatial grace.

Traditional Continuity: For Cansever, tradition is not a form to be imitated but a consciousness to be sustained. Historical experience ensures the continuity of divine order through human agency. Therefore, architecture should not merely reproduce traditional forms visually but should preserve the ethical and functional principles underlying them (Cansever, 1992). In cities like Fez, this continuity is maintained not through formal imitation but through moral and spiritual consistency (O'Meara, 2007).

Spiritual Space: Space, for Cansever, possesses not only a physical but also a spiritual dimension. He emphasizes that every building should create a "spiritual center." This applies not only to religious structures but also to houses, streets, and marketplaces—each must contribute to a sense of sacred harmony. This concept aligns with Burckhardt's (1992) understanding of architecture as "a reflection of the sacred order on earth." A spiritual space is one where the individual experiences divine serenity and is encouraged toward contemplation and tranquility.

Urban and Social Consciousness: Cansever (1997) views the city not as a mere collection of buildings but as a moral organism that balances individual and collective life. Public spaces should promote solidarity and compassion; neighborhood organizations should strengthen cooperation and mutual support. This understanding extends Ismail Serageldin's (1990) socio-economic interpretation of Islamic cities to a deeper metaphysical dimension: the city becomes the spatial expression of social justice, environmental balance, and spiritual harmony.

Collectively, these principles form a spiritual design logic in which metaphysical values are transformed into lived spatial experience. Cansever's ethical framework challenges the modernist separation of function, beauty, and morality, asserting that authentic Islamic architecture must reunite these three dimensions within a single moral whole.

Within this theoretical context, the city of Fez emerges as a living example through which Cansever's philosophy can be interpreted. As one of the oldest and best-preserved Islamic cities, Fez materializes the same moral and spiritual principles that Cansever articulates in his writings. Reading Fez through Cansever's lens reveals that Islamic architecture is not defined by formal typologies or stylistic

attributes, but by its capacity to express ethical consciousness through spatial form. The Fez–Cansever dialogue thus reaffirms the timeless validity of Islamic architectural ethics, reuniting faith, design, and urban life into a coherent spiritual order.

4. HISTORICAL AND SPATIAL BACKGROUND OF FEZ

Understanding Fez requires a simultaneous consideration of its historical continuity, cultural stratification, and spatial logic. Founded in 789 CE by Idris I as the capital of a newly established Islamic polity, the city rapidly evolved into a center of learning, spirituality, and trade. Over the course of successive dynasties—the Idrisids, Almoravids, Almohads, and Marinids—its urban structure continuously expanded, enriched by the construction of mosques, madrasas, palaces, and bazaars, transforming Fez into one of the most sophisticated cities of the Islamic world. During the thirteenth century, under the Marinid dynasty, Fez reached its "golden age," marked by the construction of monumental mosques, madrasas, and palaces that still define its skyline today. The University of al-Qarawiyyin, founded in 859 CE by Fatima al-Fihri, emerged as one of the world's earliest institutions of higher learning, further consolidating Fez's identity as a city of knowledge and faith (Tourneau, 1974; O'Meara, 2014).

Fez is composed of three main sections: Fez el-Bali (Old Medina), Fez el-Jedid (New Fez), built by the Marinids in 1276, and the Ville Nouvelle (New City), planned during the French protectorate in the early twentieth century (Figure 4). The focus of this study is Fez el-Bali, which is inscribed on the UNESCO World Heritage List and remains the most intact part of the historic city, still inhabited by approximately 200,000 people (Figure 5). With nearly 9,000 streets and more than 40,000 dead ends, Fez el-Bali constitutes the largest pedestrian urban settlement in the world (Radoine, 2008; Houdek, 2014) (Figure 6).

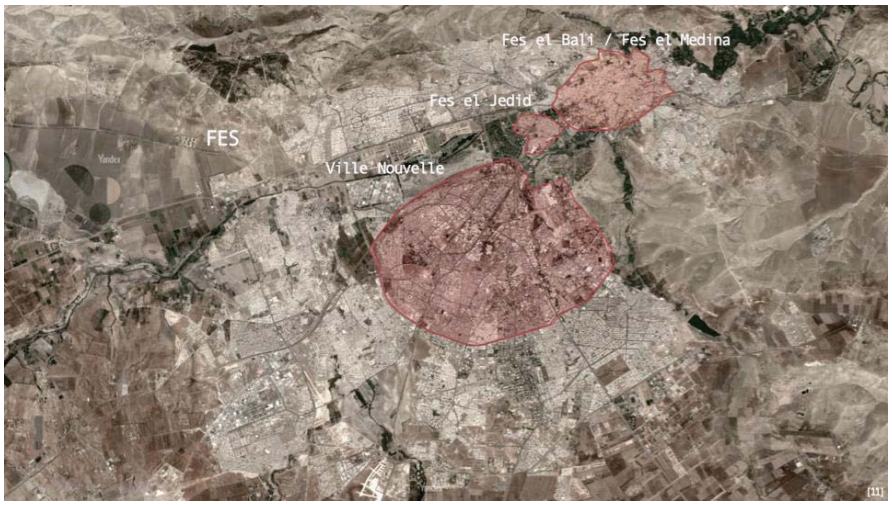


Figure 4. Aerial photo that shows Fez el- Bali, Fez el-Jedid and Ville Nouvelle. (created by the author based on Google map satellite image)

Figure 5. *Panoramic view of the historic core of Fez el-Bali (Wikipedia, 2025)*

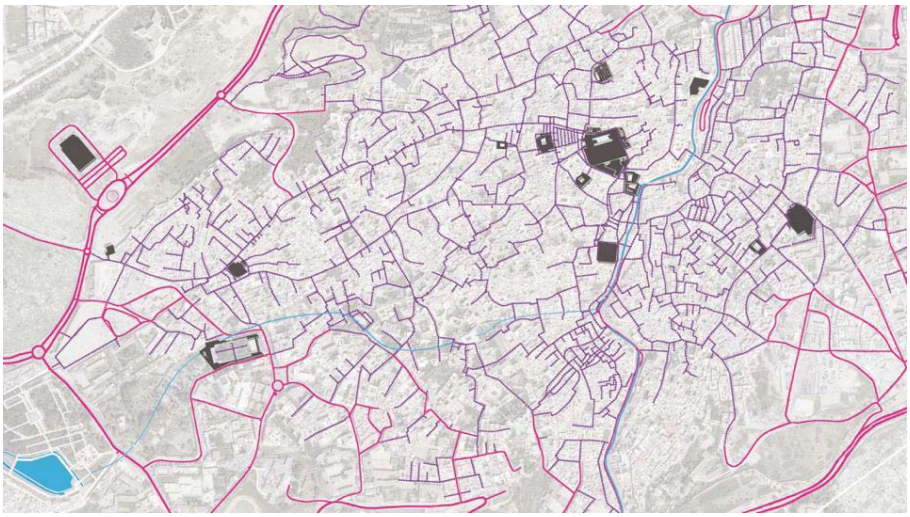


Figure 6. Pedestrian network map of Fez el-Bali (created by the author based on an Google map satellite image)

Spatially, Fez el-Bali is defined by narrow winding streets, high enclosing walls, shaded passageways, and introverted courtyard houses (Figure 7). Dwellings are typically constructed from local materials such as earth, wood, and lime, usually rising two or three stories and organized around open courtyards (Figure 8). Known as riads, these dwellings establish a delicate balance between privacy, climatic comfort, and spiritual tranquility. The courtyard—where light, water, and vegetation interact—recalls the metaphor of the paradisiacal garden, symbolizing inner peace and contemplation. The contrast between the modest simplicity of the exterior facades and the intricate ornamentation of the interiors embodies Cansever's principle of *iʿtidāl* (moderation): humility on the outside, refinement within (Figure 9).

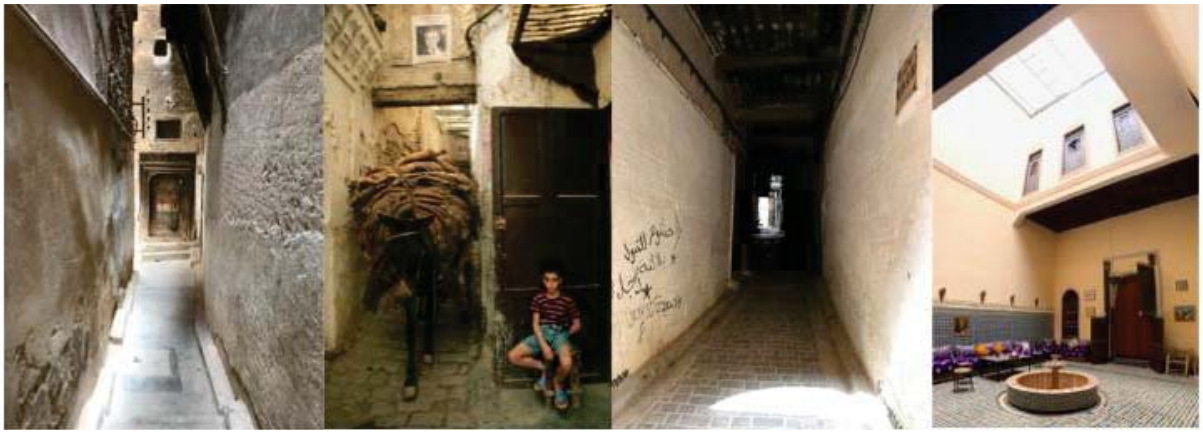


Figure 7. *Views from Fez el-Bali illustrating narrow streets, high enclosing walls, shaded passageways and introverted courtyard houses (photographs by the author)*

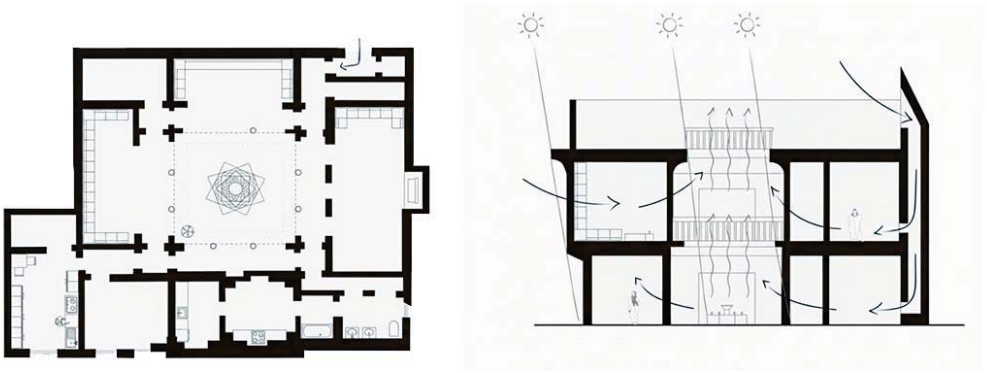


Figure 8. Schematic plan and section of typical Fez dwelling that rising two stories and organized around open courtyard

Figure 9. Left: exterior views of riads in Fez (photographs by the author); Right: interior views of Riad Naila (Booking, 2025)

The morphological order of Fez el-Bali reflects a harmonious balance among human, natural, and cultural systems. The dense street pattern restricts excessive sunlight, while the proximity of buildings creates shade and promotes thermal comfort. As illustrated in Figure 10, the urban fabric is structured around main mosques and commercial corridors, with residential quarters extending organically around them. This spatial hierarchy—linking worship, trade, and dwelling—embodies Cansever's conception of tawḥīd (unity), where the city becomes a moral organism integrating spiritual, social, and productive life within a coherent whole that mirrors divine order.

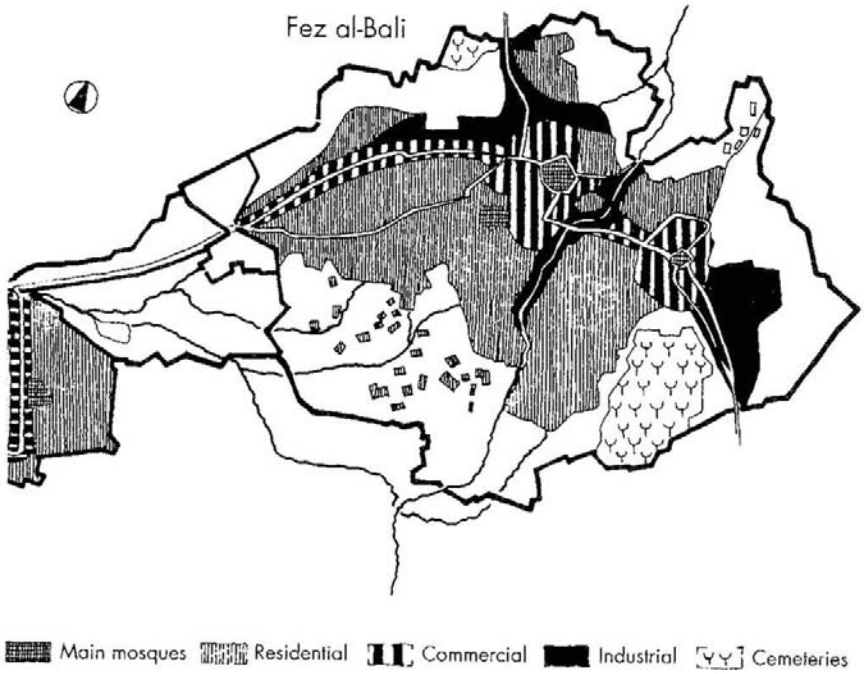


Figure 10. Diagram showing the development of the residential fabric within the walled city of Fez al-Bali (Bianca, 2000)

Culturally, Fez represents a convergence of Berber, Arab, and Andalusian traditions. The Berber influence is visible in the compact, fortified urban form, while Andalusian influence emerges in ornamentation, calligraphy, and geometric patterns (Figure 11). The closed façades of the streets express a social ethos of humility and privacy, reflecting both Islamic moral values and the architectural ethics articulated by Cansever. Each wall serves as a boundary of dignity and silence, separating the outer world's noise from an interior realm filled with light, water, and life. This spatial duality corresponds to the Sufi ontology of *bāṭin* (inner) and *ẓāhir* (outer)—a metaphysical reflection on the movement from the visible to the invisible, from the material to the spiritual.

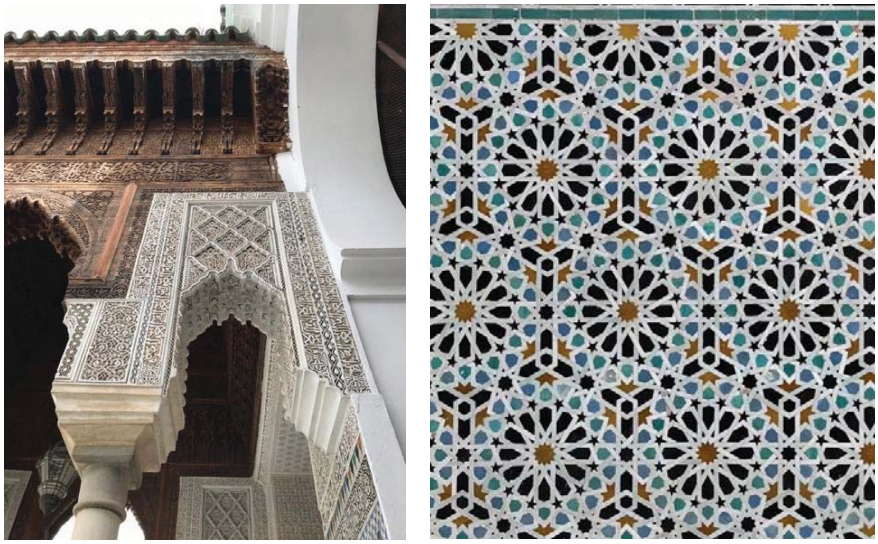


Figure 11. Ornamentation details from Al-Attarin Madrasa, Fez —left: carved wood and stucco; right: geometric zellij tile mosaic (photographs by the author)

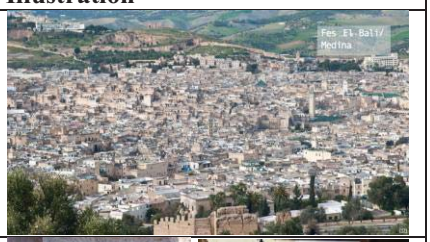
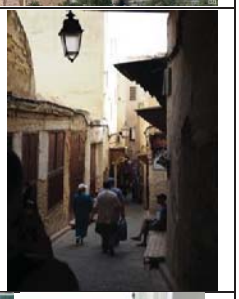
Thus, the spatial composition of Fez is not merely a pragmatic response to environmental conditions but a spiritual order that manifests the unity of existence. The experiential journey through Fez—from labyrinthine streets to serene courtyards—represents the human passage from multiplicity to unity, from the outward to the inward, from matter to meaning.

Through these characteristics, Fez exemplifies Turgut Cansever's conception of architecture as a moral act and a manifestation of tawḥīd in space. It demonstrates that architecture can be understood not only as functional or aesthetic but also as an ethical and spiritual system. For this reason, Fez provides an ideal case for observing, in tangible form, the metaphysical and moral dimensions of Islamic architecture as envisioned by Cansever.

5. COMPARATIVE INTERPRETATION: CANSEVER'S PRINCIPLES AND THE SPATIAL REALITY OF FEZ

Turgut Cansever's architectural philosophy approaches Islamic architecture not merely as a formal or typological phenomenon, but as a moral and metaphysical discipline. This section interprets his nine fundamental principles—*Tawḥīd* (Unity), *Iʿtidāl* (Moderation), *Iḥsān* (Aesthetic Virtue), *Amānah* (Responsibility), *Tafakkur* (Contemplation), *Maḥramiyyah* (Privacy), *Traditional Continuity*, *Spiritual Space*, and *Urban and Social Consciousness*—through the spatial reality of Fez. The purpose is to reveal how these principles are embodied in the urban fabric of the Islamic city and to interpret Fez as a living manifestation of Cansever's notion of "architecture within moral integrity."

Fez, as a city shaped by centuries of religious, social, and environmental consciousness, aligns closely with Cansever's vision of architecture as trust (*amānah*), worship (*ʿibādah*), and a manifestation of divine unity (*tawḥīd*). The following table (Table 1) summarizes the correspondence between Cansever's principles and their spatial reflections in Fez, supported by visual examples.

Cansever's Principle	Spatial Manifestation in Fez	Illustration
Tawḥīd (Unity)	The integration of mosque, market, and dwelling within the same neighborhood structure. Fez unites spaces of worship, production, and domestic life into a single holistic system that expresses the divine unity of existence.	
Iʿtidāl (Moderation)	Modest façades, balanced masses, and shaded streets. Simplicity and restraint reflect the ethical harmony of humility and elegance—tranquility on the exterior, refinement within.	 
Iḥsān (Aesthetic Virtue)	The fine craftsmanship seen in *zellij* tiles, carved wood, and stucco ornamentation. Beauty is not pursued for decoration but performed as an act of sincere devotion; artisanal work becomes a moral expression.	 
Amānah (Responsibility)	The use of local materials and climate-responsive construction techniques. Fez's sustainable material culture reflects humanity's ethical responsibility toward nature and the ecological dimension of architecture.	
Tafakkur (Contemplation)	Courtyards, the interplay of light and water, and the silence of interior spaces invite spiritual reflection and awareness of the Divine. Architecture becomes a medium of contemplation.	
Maḥramiyyah (Privacy and Dignity)	Enclosed streets, introverted domestic layouts, and controlled visual access. Boundaries between public and private are carefully mediated to protect human dignity.	

Traditional Continuity	The enduring neighborhood structure, artisanal culture, and typological coherence sustained for centuries. Fez draws from the continuity of values rather than imitation of forms, embodying Cansever's "innovation within continuity."	
Spiritual Space	Mosque courtyards, madrasas, and domestic riads function as spiritual centers where light, water, and proportion establish a state of inner balance and serenity. Space becomes a medium of sacred experience.	
Urban and Social Consciousness	The neighborhood-based social network organized around the mosque, market, and home. Fez represents the spatial embodiment of social justice and communal solidarity, continuously regenerating balance between the individual and society.	

Table 1. Correspondence between Cansever's Principles and Their Spatial Manifestations in Fez

This synthesis reveals that the moral–spatial order of Fez corresponds directly to the ethical vision formulated by Cansever. The city's integrated morphology reflects *tawḥīd*; its restrained façade language and balanced urban form express *iʿtidāl*; the mastery of craftsmanship exemplifies *iḥsān*; and the environmentally conscious building practices embody *amānah*. Likewise, the contemplative nature of courtyards manifests *tafakkur*; the introverted urban texture ensures *maḥramiyyah*; the persistence of its typological and social structures ensures *traditional continuity*; and its sacred atmospheres illustrate *spiritual space*. Finally, the neighborhood-based organization—where spiritual, economic, and social life intertwine—represents *urban and social consciousness*.

Through these interrelations, Fez transforms the ethical idea of architecture proposed by Cansever into a living urban system. Every street, courtyard, and façade becomes a tangible expression of a spiritual and moral code. In this sense, Fez embodies the unity of form and faith, the integration of ethics and environment, and the synthesis of the physical and metaphysical realms.

Fez thus exemplifies what Cansever envisioned as the true purpose of Islamic architecture: not merely to construct spaces, but to sustain moral equilibrium within them. The medina's morphology demonstrates how architecture can translate spiritual principles into lived experience, preserving balance between individuality and community, humility and beauty, functionality and contemplation.

6. DISCUSSION AND CONCLUSION

The comparative analysis between Turgut Cansever's architectural philosophy and the historic urban fabric of Fez reveals that Islamic architecture, at its essence, is not so much a matter of formal

aesthetics as it is a moral and metaphysical discipline. Through its labyrinthine urban texture, introverted domestic typologies, and balanced aesthetic language, Fez exemplifies how faith, ethics, and daily life can coexist as an integrated whole.

Cansever's nine foundational principles—*Tawḥīd* (Unity), *Iḥsān* (Aesthetic Virtue), *Iʿtidāl* (Moderation), *Amānah* (Responsibility), *Tafakkur* (Contemplation), *Maḥramiyyah* (Privacy), *Traditional Continuity*, *Spiritual Space*, and *Urban and Social Consciousness*—are not abstract philosophical notions but lived ethical values manifested both spatially and socially. Fez materializes each of these values within its urban fabric:

- The unity of religious and social functions embodies *tawḥīd*;
- The measured material language and spatial simplicity express *iʿtidāl*;
- The refined craftsmanship and aesthetic sincerity represent *iḥsān*;
- The adaptation to local materials and climate illustrates *amānah*;
- The courtyard system and the orchestration of light and shadow embody *tafakkur* and *maḥramiyyah*;
- The preservation of its historic morphology demonstrates *traditional continuity*;
- The spiritually resonant design of its architectural spaces reflects *spiritual space*;
- And its neighborhood-based organization symbolizes *urban and social consciousness*.

These findings situate Cansever as a unique figure among modern Muslim thinkers. While figures such as Hassan Fathy, Nader Ardalan, or Ismail Serageldin focus respectively on environmental adaptation, symbolic cosmology, or socio-economic dimensions, Cansever grounds architectural design in an ontological and ethical foundation derived from the unity of existence (*tawḥīd*). His perspective allows us to interpret cities like Fez not merely as historical artifacts but as living embodiments of a spiritual and moral order sustained through everyday spatial practice.

Cansever's vision offers a profound ethical lens through which to interpret the challenges of contemporary urbanization. In an era marked by environmental degradation and identity loss, he reminds us that sustainability cannot be achieved through technical efficiency alone, but through moral equilibrium. His conception of architecture as a moral act situates design within the broader framework of responsibility, moderation, and spiritual awareness.

Fez, as a city that harmonizes beauty, faith, and responsibility, embodies this equilibrium. Its urban structure demonstrates that the preservation of heritage should not aim to fossilize the past but to sustain living moral systems that shape human conduct and community life. The city's labyrinthine form, use of local materials, and passive climatic adaptations are not merely historical artifacts—they are manifestations of a timeless ecological ethic that continues to inform contemporary ideas of resilience and balance.

This alignment between Cansever's ethical thought and Fez's urban morphology provides a valuable paradigm for modern sustainability frameworks. Principles such as *amānah* (responsibility) and *iʿtidāl* (moderation) offer a moral foundation for contemporary discourses on climate adaptation,

ecological resilience, and circular heritage. In this sense, Fez's moral–spatial order resonates with global approaches such as UNESCO's Historic Urban Landscape (HUL) recommendation, the ICOMOS *Heritage and the Sustainable Development Goals* policy framework (ICOMOS, 2021), and bioclimatic design principles (Radoine, 2021; Salama, 2022). These frameworks collectively emphasize that heritage conservation is not merely a matter of technical preservation but an act of ethical stewardship—one that sustains moral values, cultural identity, and human well-being through spatial continuity. In Fez, adaptive reuse practices, such as the transformation of riads into guesthouses, thus represent more than economic revitalization; they embody processes of moral continuity that keep the ethical essence of architecture alive.

Ultimately, as Cansever states, "architecture is the art of establishing balance"—between human and nature, individual and community, matter and spirit. The medina of Fez continues to uphold this principle as a living truth, reminding us that the moral structure of space is the most visible expression of faith.

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Preserving Heritage in a Changing Climate: A Comparative Study of Climate Change Impacts on Urban and Natural Tourism Sites in Malaysia and the UK

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ABSTRACT

Climate change poses immediate and significant threats to tangible and intangible heritage worldwide. Extreme weather changes, rising sea levels, and excessive urbanisation have made heritage sites and ecosystems increasingly fragile. UNESCO recognises the profound impacts of climate change on cultural and natural sites, which has led to an urgent emphasis on integrating climate change policies with heritage conservation and tourism planning. Particularly in Malaysia, there are alarming gaps between climate change, tourism, and city development policies, and no specific areas address climate change impacts on heritage sites. To investigate this issue urgently, this research proposes a cross-over learning between Penang and Liverpool to examine the impacts of climate change on heritage and culture. Each city has initiatives and plans to conserve heritage sites and mitigate climate change, though not yet as integrated strategies. The findings from the research are expected to urgently find a way forward in addressing this gap.

Keywords: cultural heritage, climate change, tourism, Malaysia, UK

1. INTRODUCTION

This project aims to examine the impacts of climate change on heritage sites in two unique harbour towns, Penang, Malaysia and Liverpool, UK. Penang includes heritage sites on the island of George Town (a World Heritage Site) and Seberang Perai (mainland), while Liverpool consists of the Liverpool Maritime Mercantile City (formerly a World Heritage Site), Festival Garden and Stanley Park. The choice of these cities is informed by the need to understand how climate change affects these sites differently and how threats are mitigated in Asia and Europe. The investigation will focus on built and natural heritage affected by climate change by examining the effects of climate change on heritage tourism and highlighting the risks and impacts to tourism activities. Learning from both cities, this project aims to bridge the gap between climate actions and heritage conservation and investigate the roles of various agencies and stakeholders.

2. CHALLENGES OF TWO HERITAGE SITES: PENANG AND LIVERPOOL

Penang is a state located in Peninsular Malaysia. It is divided into two parts: the island where George Town is located, and the mainland, Seberang Perai. In a Report on Climate Change Impacts in Penang (Othman et al., 2021), Penang Green Council stated that Malaysia has seen the occurrence of extreme weather events within the past two decades. High temperatures, high rainfall, and prolonged dry spells can cause direct and indirect impacts on the environment, people, and resources, as well as loss of biodiversity, and have implications on the socio-economy (Penang Green Council, 2020). Important tourist sites in low-lying areas such as George Town could be affected by future extreme floods and impact the local economy. Within the last seven years, the historical sea walls of George Town Esplanade had to be rebuilt due to the deterioration of the structure and extensive cavities that resulted from the incessant waves (Think City, 2022). Strengthening the sea wall was crucial for the public realm and conserving the historic esplanade and adjacent Fort Cornwallis.

Figure 1. Fort Cornwallis, a star-shaped fort built by the East India Company facing the shore of George Town

In June 2020, the Penang Green Agenda 2030 reported that the Penang State and Local Government need to recognise Penang's rich biodiversity and prioritise ecotourism in areas with important ecosystems. In April 2023, the Penang Green Council found that low-lying areas of Seberang Perai could be underwater by 2100 because of the rising sea level at a rate of 3.3 mm to 5 mm per year, temperature rise and increase in rainwater intensity. A study by Universiti Sains Malaysia found that many coastal paddy planting areas could be affected. This scenario could impact Penang's agricultural activities, food security, and cultural landscape (Yang et al., 2020). The rising sea levels could impact the mangrove zones, which are crucial to the biodiversity of the coastal ecosystem and ecotourism. Similarly, for George Town, the changes in rainfall patterns would make heritage sites and buildings vulnerable to floods, heat stress and extreme weather events. Changes in environmental parameters can affect the conservation and durability of materials, causing deformation, decay and, consequently,

loss of cultural value (Sesana et al., 2020). A study by Urban Nature Atlas (UNA, 2023) for Penang proposed nature- based solutions such as blue-green corridors to reduce climate change impacts, increase social resilience and build institutional capacity for communities vulnerable to climate change impacts. This research builds further from UNA's existing work by focusing on the impacts of climate change on heritage sites in Penang, which was not covered in detail in the study. The George Town UNESCO World Heritage Site Special Area Plan (2022) has outlined the guidelines for heritage building in supporting climate change impact reduction. However, the plan does not yet address other types of heritage sites, such as natural heritage and the public realm.

Figure 2. From port city to World Heritage site: case study of George Town (Malaysia)

Penang's ongoing initiatives to sustain George Town's World Heritage Status have been continuous alongside meeting the city's urban development needs. In recent years, growing attention has been paid to addressing the impacts of climate change in Penang. This is where Penang can learn from the 2030 Net Zero Liverpool Action Plan, particularly in city sustainability and ecology. Liverpool is a city in Northwest England. From the 18th to the 20th centuries, it was an important trade and migration harbour. In 2004, the Liverpool Maritime Mercantile City was inscribed as a UNESCO World Heritage Site. The port city was an exceptional reflection of mercantile culture. It influenced the demographic change through its trans-Atlantic slave trade and waves of European migration to the New World (LWH, 2021). The city attracted new visitors and development (Alsalloum & Brown, 2010), but the standardisation and branding of cities, including Liverpool, have caused a lot of pressure due to globalisation (Lehtimáki 2006). The excessive new constructions, however, around the UNESCO heritage buffer zone transformed Liverpool into a strange mix of heritage and contemporary buildings.

In nearly 50 years, Liverpool is only the third place to lose its UNESCO heritage status due to the continuous development of the Victorian Docks. Similar to Penang, urban expansion is inevitable; however, heritage communities' current and future needs must be considered. This is where Liverpool could learn from Penang on how to sustain the city's heritage zones. Without integrated and resilient strategies, these developments will continuously impact the city and cause an urban heat island effect, flood and erosion, given the maritime locations of both cities. Liverpool City Region (LCR) has some of the highest levels of air pollution, where stagnant air and extreme heat increase the amount of ozone and particulate pollution (UCAR, 2024), accelerating the deterioration of building materials and leading to high maintenance costs and the loss of heritage. Despite LCR reaching carbon neutrality by 2040, the city and the region face ecological challenges that can alter the natural sites, vegetation, and soil composition, thus impacting the visual qualities of the cultural heritage site's landscape. This project's findings aim to identify strategies to mitigate the impacts of climate change and propose alternative modes for safeguarding heritage sites in Penang and Liverpool.

2. AIMS & OBJECTIVES

The study aims to examine the impact of climate change on built and natural heritage sites in the harbour cities of Penang and Liverpool.

The objectives are:

1. To assess the current state of vulnerability of the heritage sites
2. To analyse the effectiveness of the current heritage conservation and climate change policies in addressing climate change impacts towards heritage sites
3. To map the affected heritage sites in Penang and Liverpool

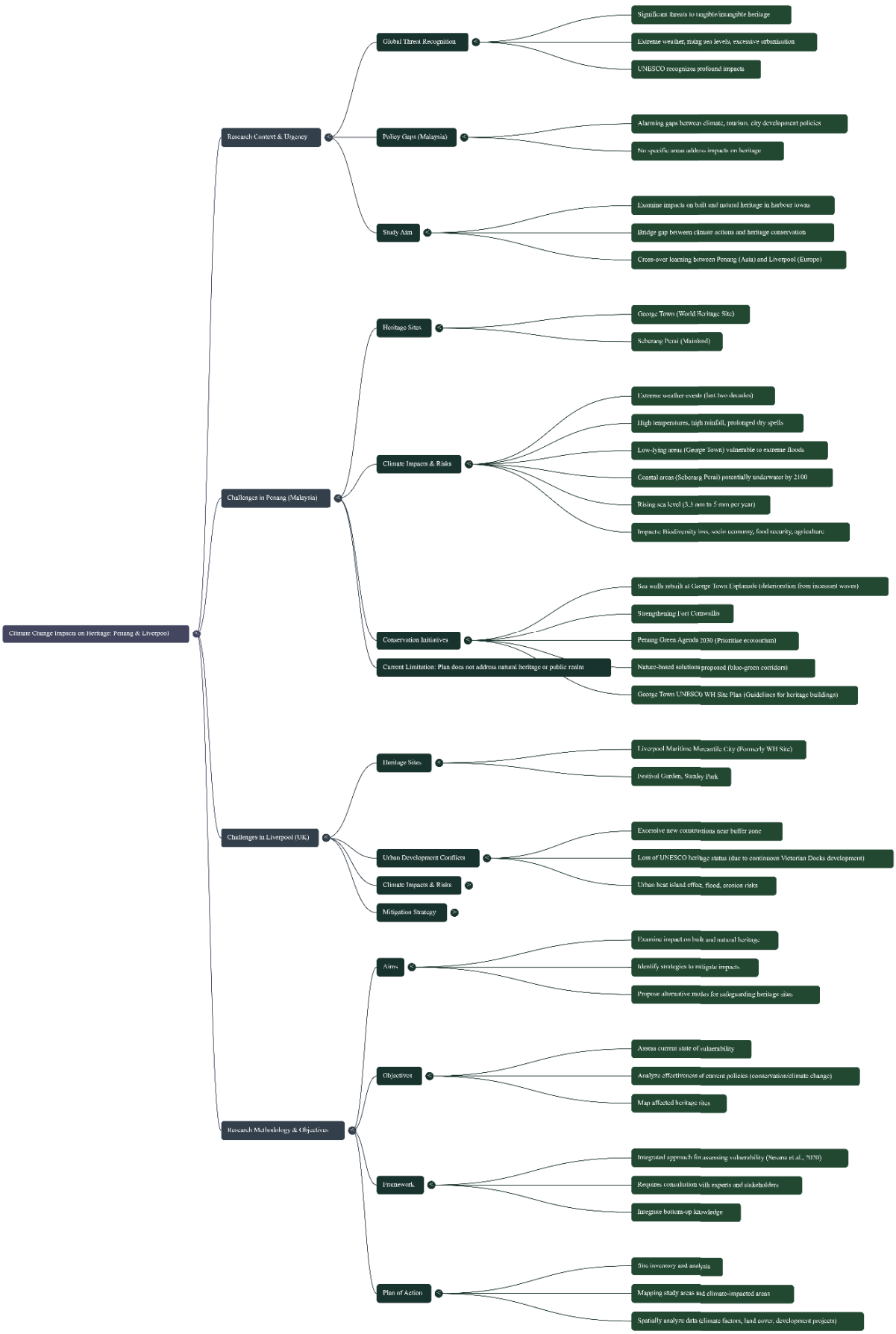

Figure 1. Research Project Frameworks and Complex

3. REVIEW OF POLICY INTEGRATION AND CLIMATE VULNERABILITY GAPS

The framework for this research will be based on an integrated approach in assessing the vulnerability of WHSs to the impacts of climate change. According to Sesana, Gagnon, Bonazza & Hughes (2020), the approach requires consultations with experts, managers, coordinators, and stakeholders working at the heritage sites to assess the sites' sensitivity and adaptive capacity. This approach shall integrate bottom-up knowledge in determining the factors contributed by climate change which impact the sites, the existing measures being undertaken, and the suitable strategies to safeguard the heritage from extreme climate change impacts in the future. We shall also incorporate site inventory and analysis in mapping the study areas and climate change-impacted areas of Penang and Liverpool. Mapping will allow data that comes from interviews to be spatially analyzed to determine the relationship between climate factors, built sites, and natural sites among other elements within the cities -- including land cover, built-up areas, industries, and proposed or future development projects.

Global Context and Policy Imperatives

Climate change is dramatically altering the global landscape of heritage conservation, affecting both tangible and intangible cultural assets. These are most readily seen through rising sea levels, more extreme weather patterns, and urbanization spilling into protected zones. Sesana et al. (2021) say climate-related hazards increasingly degrade the structural integrity of heritage buildings in addition to ecosystems and communities surrounding them. UNESCO has called for better linkage between climate action and heritage preservation since 2016, but national and sub-national action continues to be inconsistent.

A global review of vulnerability studies showed that there is usually a lack of robust, climate-informed frameworks for conservation at the majority of heritage sites in most coastal or maritime cities (Leissner et al., 2015; Fatorić & Seekamp, 2017). Heritage protection in many developing countries still works in isolation from environmental planning or climate resilience agendas. The gap that has to be filled is growing every day.

Policy Gaps in Malaysia

Malaysia embodies this set of disjunctions. For example, while the National Heritage Act of 2005 provides for legislative protection at listed sites, it makes no mention of climate risk or environmental degradation (Malaysian National Heritage Department, 2020). In Penang, the Special Area Plan of George Town has guidelines for preserving built heritage but as yet does not deal with natural heritage and public spaces, which are very important in terms of cultural identity and ecotourism.

Recent research reveals that Malaysian policymakers still fail to sufficiently incorporate climate science into the urban heritage framework, especially in regard to sea-level rise, hydrological stress, or thermal decay. Such a policy lag may undermine long-established conservation efforts, especially in heritage-rich urban environments such as George Town and its surrounding districts. Comparative Value: Penang and Liverpool This research shall, therefore, respond to such multi-scalar challenges through a comparative study between Penang and Liverpool, two harbour cities with diverging heritage trajectories but shared exposure to climate risk. Both cities offer important lessons on how

to balance growth with conservation. From Penang, with its ecological fragility and lack of integrated climate-heritage policy, to Liverpool, with its overreach in development policies, leading to the loss of its UNESCO status (Alsalloum & Brown, 2010), studying both cities would allow a reciprocal learning across cities and cross-geographic insight into adaptive strategies, institutional resilience, and stakeholder coordination in the face of escalating climate pressures.

4. CASE STUDY ANALYSIS: CLIMATE CHANGE IMPACTS ON PENANG, MALAYSIA

Observed Climate Trends and Projected Risks

During the last two decades, an escalation of climate-related events such as serious and prolonged dry spells, extreme rainfall, and episodic flooding has been experienced in Penang. These changes have already had implications on both human and ecological systems and have posed direct challenges to heritage preservation. The low-lying urban heritage zone, such as George Town, is directly prone to tidal surges and sea-level rise by as much as 3.3 mm to 5 mm per year until 2100. The agricultural hinterlands of Seberang Perai are also threatened. Yang et al. (2020) found that the rice paddies along the coast of Penang are under threat from salinisation and submergence under future sea-level rise scenarios. This degradation not only threatens food security but also endangers cultural landscapes shaped by centuries of agroecological practice.

Vulnerability Built Heritage

George Town's infrastructure from colonial times is made of lime plaster, timber, and unreinforced masonry, which is very vulnerable to moisture ingress, salt crystallisation, and temperature fluctuations. According to Sesana et al. (2021), humidity and thermal shock act as highly active environmental stressors that accelerate material decay and weaken building envelopes, thereby causing significant cultural and economic losses.

Physical interventions have been necessary in recent years. Think City, 2022, documented the reconstruction of the Esplanade Sea wall, where wave action had created extensive cavities and structural weakening. Vegetated buffer zones and permeable streetscapes are some of the nature-based solutions proposed in the Urban Nature Atlas 2023 to mitigate flood impacts and enhance community resilience.

Policy Inertia and Adaptive Gaps

In spite of the George Town Special Area Plan's guidelines of preservation (2022), policy implementation is not well considered. Natural heritage and ecosystem-based assets, such as mangrove zones that are very important for biodiversity and tourism, are not comprehensively included. Furthermore, there is limited coordination between municipal conservation departments and climate science agencies, which leads to disjointed adaptive strategies (Othman & Sidek, 2025).5. Case Study Analysis: Urbanisation and Climate Pressures in Liverpool, UK

Historical Significance and Recent Decline

Liverpool's historic status as a trans-Atlantic port city shaped its built form and cultural memory. The city was granted UNESCO World Heritage status in 2004 under the Liverpool Maritime Mercantile City designation, reflecting its role in global trade, migration, and industrial architecture (UNESCO, 2012). However, the very forces that revitalised Liverpool’s economy—namely real estate-driven urban regeneration—led to the site’s delisting in 2021 (UNESCO, 2021). Alsalloum and Brown

(2010) argue that Liverpool's loss was not due to development per se, but to a lack of integration between heritage planning and urban growth. Large-scale developments, such as Liverpool Waters, disrupted the historical skyline, leading to a fragmented urban narrative where heritage structures were overshadowed by high-rise architecture.

Climate Risks and Material Degradation

Although Liverpool is part of the UK's Net Zero 2040 ambition, the city faces substantial environmental stressors, including increased flooding, coastal erosion, and the urban heat island effect. Coastal cities like Liverpool are especially vulnerable to salt-laden air and rising humidity, both of which accelerate material decay (Sesana et al., 2021). Historic buildings in the city, made of sandstone, brick, and cast iron, require frequent maintenance due to these compounded environmental pressures.

Air pollution further exacerbates material deterioration. Data from the University Corporation for Atmospheric Research (UCAR, 2024) confirms that the Liverpool City Region has among the UK's highest levels of particulate matter. These pollutants, when mixed with moisture, form acidic compounds that chemically erode building façades, particularly those in maritime exposure zones.

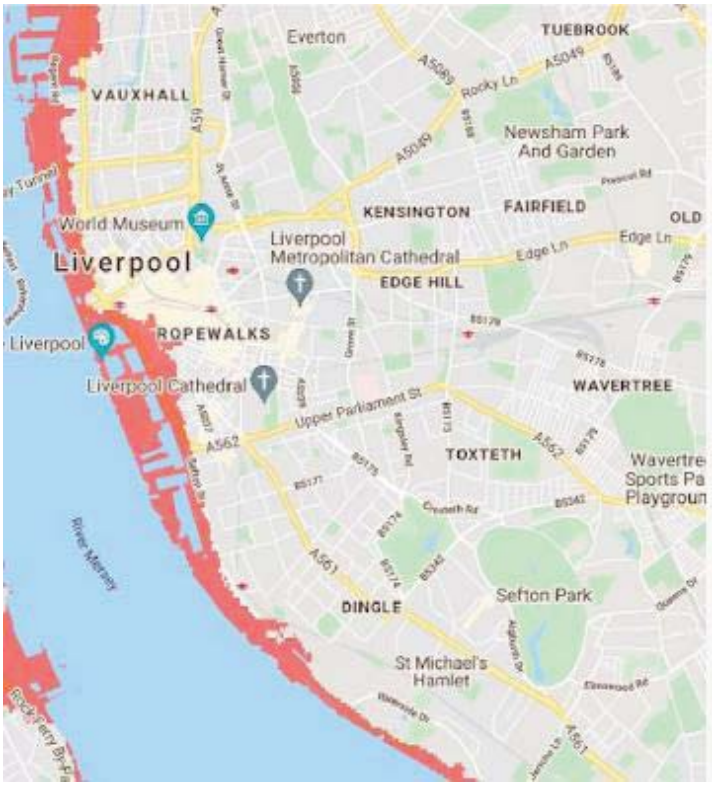

Figure 3. Liverpool's docklands could be under water in 10 years time

Learning Opportunities and Regenerative Pathways

Liverpool's case highlights the consequences of policy misalignment between heritage and urban development. Yet, there is still opportunity for regenerative learning. The city's Net Zero 2040 strategy includes sustainability and green infrastructure targets that could inform heritage-sensitive climate actions (Liverpool City Council, 2022). Meanwhile, Penang offers a contrasting case: where heritage remains central to development vision, albeit lacking formal climate integration. Through

this comparative lens, both cities have much to learn. Penang may adopt Liverpool's decarbonisation and urban resilience strategies, while Liverpool could recalibrate heritage values as central, not peripheral, to future development. This mutual exchange frames the foundation of this study's contribution.

6. THE DELISTING OF LIVERPOOL'S WORLD HERITAGE SITE: DEVELOPMENT PRESSURES AND HERITAGE RISK

Liverpool's designation as a UNESCO World Heritage Site in 2004 recognised the city's significance as a maritime mercantile hub and its contribution to global migration, trade, and architecture (UNESCO, 2021). However, in July 2021, Liverpool became only the third site in the world to be removed from the World Heritage list. The delisting was prompted by ongoing large-scale developments—most notably, the Liverpool Waters regeneration project by the Peel Group—that UNESCO deemed to have caused "irreversible loss of attributes" which justified its Outstanding Universal Value (OUV) (Jones, 2023).

Figure 4. Liverpool has been removed from UNESCO's World Heritage List by the World Heritage Committee. (Image: Unsplash/Conor Samuel)

6.1 Urban Regeneration vs. Heritage Protection

The *Liverpool Waters* project was conceptualised as a £5 billion redevelopment scheme stretching across the city's northern docklands. Although it aimed to revitalise post-industrial zones and stimulate economic growth, critics—including UNESCO and heritage bodies—argued that the scale, height, and density of proposed buildings conflicted with the historic waterfront's character (Hole & Alsalloum, 2024).

According to Jones (2023), the regeneration embodied a trend where "global investment and economic opportunity" were prioritised over heritage conservation, creating an imbalanced urban narrative. Urban visual cohesion and historic skylines were compromised by high-rise buildings, despite local planning authorities insisting on design modifications.

6.2 Impacts on Cultural Tourism and Climate Resilience

The delisting of Liverpool raised immediate concerns about the city's cultural tourism economy. While the city council downplayed UNESCO's decision, local and international heritage experts warned of diminished attractiveness to culturally driven tourists (Newisar, 2023). The incident also spotlights the broader issue of urban developments ignoring climate resilience principles, including the risk of intensifying the urban heat island effect or undermining coastal resilience. Boland et al. (2024) argue that Liverpool's case demonstrates how planning agendas that lack integration with heritage protection and climate adaptation can lead to long-term ecological and cultural vulnerabilities. For example, extensive waterfront development has altered land use and local microclimates, potentially aggravating stormwater runoff and erosion risks—issues particularly acute in maritime cities.

Figure 5. Liverpool's Albert Dock could be destroyed by rising sea waters due to climate change. (Image: Project Solar UK)

6.3 Planning Lessons for Comparative Cities

The tensions observed in Liverpool serve as a cautionary tale for similar cities like Penang, which is also pursuing rapid urbanisation within a fragile heritage setting. While economic growth is essential, Liverpool's experience underscores the necessity for integrated planning strategies that value heritage, sustainability, and resilience simultaneously.

This research thus situates Liverpool's delisting not just as a heritage governance failure but as an emblematic case where development pressures, climate risks, and tourism potential collided in policy silos.

7. CONCLUSION

This paper has examined the multifaceted impacts of climate change on both cultural and natural heritage within two historically significant harbour cities: Penang, Malaysia and Liverpool, United Kingdom. Through an interdisciplinary approach integrating climate science, urban planning, and heritage conservation, the study reveals how built and natural heritage sites in both locations are increasingly vulnerable to rising sea levels, extreme weather events, and unsustainable development trajectories.

In Penang, while conservation efforts in George Town and beyond are ongoing, gaps remain in integrating climate adaptation within heritage planning, particularly for natural and intangible heritage. Conversely, Liverpool's experience highlights the consequences of prioritising large-scale economic development over heritage values, culminating in its unprecedented delisting from the UNESCO World Heritage List. This loss demonstrates the critical need for a more balanced planning approach that accounts not only for economic growth and tourism, but also for long-term cultural resilience and environmental sustainability.

Importantly, this comparative study underscores that although both cities operate under distinct regional, institutional, and governance frameworks, they share common challenges at the intersection of climate change, urbanisation, and heritage protection. These challenges call for integrated, place-based strategies that combine nature-based solutions, adaptive policy frameworks, and inclusive stakeholder participation.

The findings advocate for a reimagining of heritage not as a passive recipient of climate impacts, but as an active contributor to resilient and sustainable urban futures. By fostering cross-regional learning between cities such as Penang and Liverpool, this research supports the development of policy interventions and conservation strategies that are both culturally sensitive and climate-resilient. Future research should further investigate how heritage can act as a lens for climate justice, especially in regions where socio-cultural identities are deeply embedded in vulnerable coastal and historical landscapes.

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Architecture As Poetry: Investigation Of The Ronda Process The Case Of "Merdiven" Poem

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ABSTRACT

This paper explores the intersection between architecture and poetry as two interrelated art forms, focusing on the Ronda design method practiced at Ciudad Abierta, located on the Ritoque coast in Valparaíso, Chile, is an experimental architectural and artistic community founded in 1970 by poets, architects, and artists from the Pontificia Universidad Católica de Valparaíso.

While architecture and poetry share structural and symbolic affinities, real-world examples of their integration in practice remain rare. This study investigates Ronda as a methodological and experiential design approach where poetic acts initiate and guide architectural creation through collective, improvisational, and site-specific sketching and building. To expand the inquiry beyond theoretical analysis, the paper includes a design case study conducted with architecture students from Fatih Sultan Mehmet Vakıf University (FSMVU). In this project, students engaged with a transitional garden space between the university's historic Ottoman-era campus Yenikapı Mevlevihanesi (a Mevlevihane is an Islamic lodge or monastery used by the Mevlevi order, a Sufi sect rooted in Islamic mysticism, founded by followers of the 13th-century poet and mystic Rumi, known for their whirling dervish ceremonies. In English, it is often translated as a "Mevlevi lodge" or "Islamic Dervish monastery.") and its newly established technical campus. Using the Ronda method and beginning with a poetic act rooted in Ahmet Haşim's poem "Merdiven", students created a series of sketches that interpreted the poem's spatial atmosphere and symbolic richness, proposing pavilion and landscape interventions.

This study additionally frames the Ronda process within a sustainability lens: environmentally through sensitivity to site and material use; socially through collective authorship and community engagement; and pedagogically through slow, reflective learning that cultivates long-term stewardship of place.

Through this methodology, the research addresses the following questions:

1. How does architecture and poetry intersect through the Ronda process?

2. In what ways does Ronda differ from conventional architectural workflows?

3. What inspirations can contemporary architectural education draw from it?

The paper concludes that the Ronda method offers a clear, adaptable, and deeply poetic alternative to traditional design approaches, one that invites slowness, reflection, and a renewed sensitivity to language, place, and human presence in architectural practice.

Keywords: Architecture, Poetry, Ronda, Design process, Ciudad Abierta

1. INTRODUCTION

This research investigates the rare but profound intersection between architecture and poetry as two forms of artistic creation, focusing on the Ronda design method practiced at Ciudad Abierta (Open City), a living architectural experiment initiated by the School of Architecture and Design at Pontificia Universidad Católica de Valparaíso (PUCV). While architecture and poetry have long shared mutual principles (such as rhythm, structure, atmosphere, and symbolism) their actual integration as process and methodology remains limited and often unexplored in practice. This paper addresses that gap by analyzing a unique model in which poetic thinking is not simply an inspiration or metaphor, but a central force driving the act of architectural making.

Architecture and poetry both operate as cultural expressions that shape human experience. They share a concern with form, evoke emotion, and encode meaning. Yet their intersection in built practice is rarely realized. Often, this relationship is observed through poetic descriptions of architectural spaces, theoretical writings on the "poetics" of architecture, or abstract frameworks proposed by architects or poet-architects such as John Marx. These examples, while insightful, tend to remain speculative or symbolic rather than materialized in process or outcome.

This paper instead focuses on Ciudad Abierta, a poetic-architectural community founded in 1970 by the School of Valparaíso. Here, architecture is conceived through the Poetic Act, a ritualized, performative expression that serves as the conceptual beginning of each project. From this poetic initiation, the design proceeds through the Ronda method (a collective, improvisational, and non-hierarchical process where architectural form emerges from dialogue, embodied presence, and on-site making). Projects are not guided by briefs, clients, or fixed programs, but by a poetic word or gesture that opens a space of inquiry, what the school calls the Unknown. The Ronda, or "round," is thus a circle of shared authorship in which all participants (students, professors, poets) contribute equally in rhythm and reflection, allowing the architecture to unfold in real time. This process resists conventional planning and instead prioritizes invention, intuition, and presence.

The research problem guiding this study is the lack of fully developed, real-world models where poetic language genuinely intersects with the architectural design process in a sustained and methodical way. The objective is to clarify how this integration occurs through the Ronda method and to assess its implications for architectural education and practice today.

To investigate this, the paper employs a two-part methodology. First, it undertakes a case study of Ciudad Abierta, drawing on historical texts, site-specific examples, and previous analysis of works developed through the Ronda method. It traces the history, philosophy, and process of Ronda, comparing it to conventional architectural design methods. Special attention is given to the role of the Unknown, the influence of poetic axioms (such as those from Rimbaud and Lautréamont), and the temporal-spatial improvisation that defines this method. Secondly, the paper includes a contemporary application of the Ronda method as a separate, reflective case study. This part of the research involves a collaborative design workshop conducted with architecture students at Fatih Sultan Mehmet Vakıf University (FSMVU), where participants will engage in a structured but open-ended Ronda process. Starting with a Poetic Act, students will collectively observe, conceptualize, and build on-site gestures or forms guided by poetic language and spatial dialogue. This exercise will allow for a first-hand exploration of the Ronda method in a different cultural and educational context, offering a grounded basis for evaluating its adaptability, challenges, and inspirations.

Three central research questions frame the inquiry:

1. How does architecture and poetry intersect in the Ronda design process?

2. In what ways does the Ronda method differ from conventional architectural workflows?

3. What inspirations or lessons can contemporary architects and students draw from the Ronda method?

By addressing these questions, the research aims to show that the Ronda design process represents one of the most clear, fruitful, and methodologically developed intersections between architecture and poetry currently in existence. Unlike many theoretical or symbolic engagements between the two arts, Ronda translates poetic thought directly into built form through practice-based experimentation, sensory awareness, and collective authorship.

The paper argues that the lessons of Ciudad Abierta and the Ronda method extend beyond their Chilean context. They invite a reconsideration of how architects design, think, and collaborate. Rather than separating idea from execution, or author from community, Ronda offers a way of designing that is immersive, uncertain, and exploratory, echoing the poetic condition of being fully present in the act of making. By including the FSMVU case study, this research also tests the translatability of this method across contexts and cultures, raising important questions about the role of language, education, and creative ritual in contemporary architectural practice.

Ultimately, the study hopes to contribute not only to architectural theory but to new pedagogical models that embrace poetic methods as serious and generative tools for design—tools capable of restoring wonder, slowness, and shared meaning to the act of building.

RONDA AND SUSTAINABILITY

The Ronda method is not merely a poetic or intuitive translation of literary definitions into architecture; rather, it represents a pedagogically sustainable model of education. It emphasizes a collective experience rather than the isolated act of individual design by a single architect. This begins within the academic environment, where students share living spaces, collaborate on conceptual intersections, and experiment with diverse methods of design. Ultimately, this process cultivates a participatory design approach, grounded in shared authorship and community awareness.

At a broader scale, this collective mode of production aligns with the principles of participatory design theory. For example, when designing a social housing complex, the process does not solely rely on the professional expertise of architects and engineers. Instead, the thoughts, needs, and imaginations of future users, civil society organizations, and even children become integral parameters of the design. In this way, the process moves beyond individual authorship toward social design, fostering a form of sustainability that resides not only in material or environmental terms, but within the continuity of the design process itself.

Similarly, in the workshop component of this research, students engaged in a collective and community-oriented mode of design and making. This mindset naturally encouraged the use of accessible, low-skill, and transformable materials—those ready for reuse, adaptation, and environmental reintegration. In essence, the Ronda philosophy mirrors the logic of "slow design", embodying a cyclical and reflective approach that sustains not only materials and resources, but also relationships, learning, and the creative spirit over time.

Pontificia Universidad Católica de Valparaíso:

The School of Architecture and Design at Pontificia Universidad Católica de Valparaíso (PUCV) began a radical educational and artistic experiment in the 1950s that sought to dissolve the traditional boundaries between life, study, work, and art. Rooted in a poetic worldview, especially through their foundational text Amereida (1967), the school developed a unique curriculum in which poetry was not a subject of study but a generative force for architectural creation.

This experiment materialized most vividly in Ciudad Abierta (Open City), founded in 1970 on a 270-hectare coastal site. There, professors, students, artists, and poets live and work together in a non-institutional, communal environment dedicated to experimentation and creative freedom. Central to this approach is the Ronda design method - a collective, improvisational, and non-linear process where architectural form emerges through poetic acts, shared dialogue, and on-site making.

Rather than follow standard design procedures, the school's method emphasizes open-ended inquiry, the role of the poetic word as a project's origin, and the idea of designing from the Unknown. The school's goal is not to reproduce buildings, but to rebuild the act of architecture itself, continually asking fundamental questions through each new poetic-spatial work.

2. THE RONDA DESIGN METHOD

Definition and Meaning

The term Ronda, meaning “round” in Spanish, refers not to an acronym, but to the form and spirit of a circular, inclusive process. It symbolizes a non-hierarchical, collective design dialogue, where each participant (regardless of role or status) contributes equally. It’s a design “round,” like a poetic or musical improvisation, where ideas circulate and evolve communally. Rather than representing individual authorship, Ronda reflects collaborative authorship and real-time architectural thinking.

Historical Origins

The Ronda method emerged in the late 1960s and early 1970s as part of the larger educational and poetic experiment led by the School of Architecture and Design at PUCV. It developed alongside the foundation of Ciudad Abierta, where the community sought to create architecture freed from institutional constraints and linear design protocols. Influenced by Godofredo Iommi's philosophy of the Poetic Act (where poetry precedes and provokes action) Ronda became a pedagogical and practical tool that embodied the school's belief in poetry as the origin of space.

Process and Practice

The Ronda process begins with a Poetic Act, which provides an open, metaphorical or symbolic origin for the architectural work. From there, participants gather on-site and engage in a dialogical and improvisational cycle, drawing, discussing, and immediately building ideas.

The process :

A. Does not begin with fixed plans, but with listening, observation, and poetic provocation.

B. Involves on-site decision-making with full presence of the terrain, materials, and bodies

C. Values experimentation, ambiguity, and openness, welcoming interruptions and accidents as part of the creative flow

D. Emphasizes craftsmanship and learning by doing, where drawing, building, and reflecting are simultaneous.

E. Decisions are made in the round, echoing both poetic improvisation and communal ritual. Each act (whether marking the ground, folding a paper, or assembling a material) is treated as part of a living poem.

F. 4. Comparison with Conventional Design Methods

The Ronda method contrasts sharply with standard architectural workflows in the following ways:

Aspect	Conventional Design Method	Ronda Method
Initiation	Starts with a brief, program, or client directive	Begins with a *Poetic Act* (non-functional, symbolic origin)
Process	Linear: analysis → concept → design → documentation → construction	Cyclical and improvisational: dialogue, draw, build, reflect, adjust
Authorship	Led by individual architect or firm	Collective, non-hierarchical authorship
Location of Design	Often done in office or studio	Always developed on-site
Design Tools	Plans, software, technical drawings	Hands, paper, voice, body, immediate materials
Outcome	Defined project with fixed goals	Open-ended structure, evolving with time and interaction
Tempo	Fast-paced, efficiency-oriented	Rhythmic, "a flor de labios" (at the bloom of lips) — slow, attentive, improvised

Table 1. Architectural Workflows in the Ronda Method (by Author, 2025)

Ultimately, Ronda repositions architecture as a poetic and collective ritual, rather than a technical response to a brief. It privileges presence, experimentation, and listening, and invites architects to rediscover design as an act of spatial poiesis — the making of meaning through form, movement, and shared voice.

Examples from Open City :

1. Entrance Inn

Figure 1. Entrance Inn

"The Open City sits on a large stretch of land, comprised primarily of dunes. One of the initial challenges is welcoming newcomers, so that even if they are passing through a natural expanse, they know they are in a place of their destination. This inn is raised from the ground to make it available for arrival, indicating that the entire space of the Open City is intended to be habitable, both in its natural state and in its artificial enclosures. In this way, this inn extends into the outdoors, creating the atmosphere of an arrival, for which it has even explored the possibility of sound with an Aeolian harp".

2. Open-Air Amphitheater

Figure 2. Open Air Amphitheater

"This work marks the end of the Cemetery Ravine. To achieve this, the natural dimensions are taken and fixed, transforming them into architecture. These are two: the rainwater and the slope of the hill. The rainwater is channeled into a central channel, forming a cleft that runs through the site. The two inclined planes of the slopes are fixed with a brick masonry pavement, minimally varying their natural

gradient. In this way, the inevitable, such as the passage of water with a central stage, and the mantle of the hill with a grandstand, coincide to create a sort of habitable landscape".

3. The Bedroom

Figure 3. The Bedroom

"This interior emerges as the intimate quarters of a family, who would later build their public spaces. Thus, its form emerges as the minimum size, achieving a house in 118 square feet. To this end, it is developed as a single volume in a six-level spiral. Its perimeter walls are made of curved panels that contain most of the furniture and utensils, leaving the horizontal planes of the floor open. This work initially touches the ground without confining the sand on which it rests. As the family grows, it expands into adjacent spaces, increasing its habitability. Its construction consists of a structure of eucalyptus logs and panels of pine. The extensions have been made with wood carpentry".

3. RONDA DESIGN WORKSHOP IN FATIH SULTAN MEHMET VAKIF UNIVERSITY

Project Context and Design Intent

The selected site for this Ronda-based design experiment is a large green space located on the eastern edge of the new Topkapı Campus of Fatih Sultan Mehmet Vakıf University (FSMVU). This expansive garden acts as a transitional threshold between two distinct parts of the university: the historic old campus, housed in the Yenikapı Mevlevihanesi, and the recently opened new campus, which accommodates the Faculties of Architecture and Engineering.

Figure 4. Topkapı Campus of Fatih Sultan Mehmet Vakıf University

A stone-paved pathway, recently added by the university administration, cuts through the green space, linking the new campus to a newly opened entrance of the old one. However, while this path offers physical access, the surrounding space remains underdeveloped, lacking a sense of identity, atmosphere, or symbolic coherence that reflects the significance of this transition.

The objective of this design project is to create a poetic landscape or pavilion that enhances this in-between space as a meaningful and experiential link between two campuses — one rooted in Ottoman Sufi heritage, the other representing a contemporary, technical academic environment. The design should invite students into pause, reflection, and gathering, while expressing themes of continuity, transformation, and encounter between past and present.

Poetic Foundation: Ahmet Haşim's "Merdiven"

To ground the Ronda design process in poetic experience, the project begins with a Poetic Act centered on Ahmet Haşim's poem "Merdiven" (The Staircase)

Ahmet Haşim, a prominent poet of the late Ottoman Empire, born in Baghdad, stands as a leading figure of the Symbolist movement in Turkish literature. His works are characterized by the use of symbols to construct intricate layers of meaning, akin to the symbolic frameworks often observed in architecture. Haşim's assertion that "poetry is the art of painting with words" encapsulates his aesthetic philosophy and creative approach. This perspective aligns closely with the rondo method, wherein words are employed to craft intricate designs through imagery and rhythmic structures, evoking emotions and ideas within an aesthetic composition. Consequently, Haşim's oeuvre has been selected for its embodiment of Symbolism's rich imagistic world and aesthetic sensibility. His poem "Merdiven" (The Staircase) is particularly chosen for its multilayered symbolic significance, reflecting the same principles that define Haşim's broader poetic vision. The poem, with its evocative imagery, encapsulates themes of melancholy, the passage of time, and the inner journey of the human soul, thereby exemplifying Haşim's commitment to the art of painting with words. In this context, "Merdiven" serves as a quintessential representation of both the poet's symbolic aesthetic and Symbolism's capacity to convey complex emotions and ideas through abstract expression.

"Ağır ağır çıkacaksın bu merdivenlerden,

Eteklerinde güneş rengi bir yığın yaprak,

Ve bir zaman bakacaksın semaya ağlayarak…"

"You will climb these stairs slowly, slowly,

With sun-colored leaves gathered in your skirts,

And at one point, you will look up to the sky, weeping…"

This poem becomes the conceptual spark for the workshop — offering metaphors of movement, reflection, gravity, atmosphere, and longing. It speaks to both the spiritual quiet of the Mevlevihanesi and the reflective solitude often found in gardens and architectural transitions. It also mirrors the slow, collective unfolding of the Ronda process itself.

Symbolic and Cultural Themes

Students are invited to reflect on and integrate a range of themes into their sketches:

- The Mevlevi tradition and Sufi symbolism (cycles, silence, thresholds)
- The contrast between the spiritual and the rational
- Ottoman cultural memory, particularly as embodied in the historic campus
- The legacy of Fatih Sultan Mehmet, after whom the university is named
- The idea of architectural transition as a slow, emotional journey — echoing Haşim's poem.

Workshop Framework and Implementation

On June 6th, 2025, a design workshop was conducted at Fatih Sultan Mehmet Vakıf University's Topkapı Campus, in classroom G-224 of Block G. The workshop involved a selected group of ten third-year architecture students.

The thematic focus of the workshop was a specific site condition: the interstitial space between an older and a newer building on the university campus. This undefined area, characterized by a gentle slope and some greenery, served as both a physical and conceptual void. It provided an ideal context for reimagining transitional space—not simply as connective tissue between architectural volumes, but as a contemplative, poetic landscape shaped by literary abstraction. The selected literary piece was "Merdiven" ("The Staircase") by Ahmet Haşim, a symbolist poem known for its evocative imagery and meditative tone. The poem's layered metaphors and references to color, movement, and mood became a central source of inspiration throughout the design process.

The workshop unfolded in two consecutive phases. In the initial classroom-based phase, students were introduced to the theoretical and methodological foundations of the Ronda approach. The students engaged in discussions on the relationship between narrative structure and spatial sequence, metaphor and material, rhythm and form. Emphasis was placed on reading not only the text, but also the site, as layered and symbolic.

In the second phase, the participants shifted their attention to the actual site between the buildings. Working both individually and collaboratively, students conducted on-site observations, documented experiential qualities, and produced interpretive sketches that attempted to capture the atmosphere implied by Haşim's poem. Sketching was used not merely as a representational tool but as an exploratory medium through which ideas could emerge intuitively. Through this process, students generated a variety of conceptual design responses envisioning the space as a threshold, rest area, or passage imbued with sensory and emotional resonance.

The workshop not only fostered interdisciplinary thinking, but also encouraged students to reconsider their design strategies through a more poetic and phenomenological lens. The outputs—ranging from quick conceptual diagrams to more developed spatial narratives—demonstrated a nuanced engagement with both the textual and physical context. In doing so, the workshop provided a critical pedagogical framework for integrating literary interpretation into architectural design education.

4. CONCLUSION

This study explored the intersection of architecture and poetry through the Ronda design method, how it contrasts with conventional architectural workflows, and what inspirations it offers to students and practitioners. Through both the theoretical grounding in Ciudad Abierta and the experiential workshop conducted at Fatih Sultan Mehmet Vakıf University, the research demonstrated that Ronda represents a profound and methodical convergence between poetic and architectural creation.

1. How does architecture and poetry intersect in the Ronda process?

The Ronda method exemplifies how architecture and poetry intersect not only in conceptual inspiration, but also in the very process of working and creative thinking. The method begins with a Poetic Act, providing a symbolic or metaphorical origin that sets the emotional and intellectual tone for design. However, the real intersection lies in how architects engage in a process that closely parallels the work of poets. Just as a poet thinks through language, structure, rhythm, tone, and layering of meaning to construct a coherent and expressive poem, architects in Ronda think through forms, materials, atmospheres, and sequences of space to craft architecture that resonates with both context and meaning. In this way, architecture becomes a form of poetic composition, where intuition and expression guide decision-making as much as function or structure. In the FSMVU workshop, Haşim's *"Merdiven"* served not only as thematic inspiration but as a model for spatial rhythm, emotional pace, and formal clarity — guiding sketches that moved beyond conventional design tools into poetic interpretation.

2. In what ways does the Ronda method differ from conventional architectural workflows?

Unlike standard architectural practice, which typically proceeds in a linear sequence from brief to design to construction, the Ronda method unfolds in a cyclical, improvisational, and collectively authored process. There is no singular architect, no rigid hierarchy, and no predetermined end. The work evolves through rounds of dialogue, sketching, reflection, and site engagement, where the act of drawing or marking the space is itself a form of building. The Ronda process embraces uncertainty, sensory input, and poetic intuition, allowing accidents, interruptions, and discoveries to shape the design. In contrast to the efficiency-driven nature of conventional methods, Ronda values slowness, presence, and emotional resonance. During the FSMVU workshop, students moved fluidly between text and terrain, thought and hand, producing sketches that were less about formal solutions and more about expressing spatial atmospheres rooted in site, memory, and metaphor.

3. What inspirations can architects and students draw from the Ronda method?

The Ronda method offers a powerful reimagining of architectural practice — one that shifts the focus from technical problem-solving to cultural and poetic making. It encourages architects to engage space not just as planners or engineers, but as poets of form — attentive to nuance, rhythm, emotion, and meaning. Ronda shows that creative thinking in architecture can be structured like a poem: guided by internal logic, enriched by metaphor, and shaped by a sense of unfolding presence. Students involved in the FSMVU workshop discovered that by treating drawing as a medium of poetic exploration, rather than mere representation, they could produce richer, more intuitive, and contextually meaningful design ideas. The process also cultivates a deeper sense of authorship as shared dialogue, reinforcing the idea that architecture is not created in isolation, but through collective imagination and resonance with place.

In summary, the Ronda method not only presents a rare and fertile intersection between architecture and poetry, but also reframes design itself as a **poetic process** — one that invites architects to **think like poets**, and to create spaces that are not only functional, but also emotionally and culturally alive.

In direct response to the research questions, the study finds that:

1) Architecture and poetry intersect in Ronda through the practice of the Poetic Act and embodied, site-based making, where language structures spatial emergence.

2) Ronda differs from conventional workflows by privileging cyclical, on-site, and collectively authored processes over linear, office-based methods.

3) Contemporary architectural education can draw from Ronda by integrating poetic prompts, collective studio formats, and site-based exercises that foster both creative depth and sustainable practice.

Overall, Ronda's emphasis on slowness, material sensitivity, and collective responsibility positions it as a method that not only enriches architectural imagination but also contributes to ecological, social, and pedagogical sustainability.

RECOMMENDATIONS

Based on the exploration of the Ronda design method and its application in the FSMVU workshop, the following recommendations are offered for architectural education, practice, and future research:

1. Integrate Poetic Thinking into Architectural Education

Schools of architecture should incorporate **poetic and literary frameworks** into design studios to encourage **creative interpretation, emotional depth, and spatial imagination**. Introducing students to poetry not only as inspiration but as a **design tool** can expand their ability to approach architecture through atmosphere, symbolism, and storytelling.

2. Reconsider the Role of Drawing in Design Studios

Drawing should be emphasized not merely as a representational technique, but as a **poetic and speculative practice**. Sketching as part of a collective, intuitive process — as done in the Ronda method — fosters deeper engagement with context, materials, and conceptual layering.

3. Develop Alternative Studio Models Based on Collective Processes

Studios modeled on **non-hierarchical and dialogical practices** like Ronda can offer students a more **inclusive, dynamic, and reflective** design experience. Working in "rounds" of sketching and discussion supports the idea that architecture is a **collaborative cultural act**, not an individual product.

4. Explore Cross-Disciplinary Collaborations

Facilitating collaborations between **architects, poets, artists, and musicians** can lead to **richer spatial investigations**. The poetic act, as a starting point for design, opens up space for interdisciplinary creativity and more profound site engagement.

5. Encourage Site-Based, Improvisational Design Exercises

Design education should prioritize **on-site, embodied, and sensory experiences**, allowing students to read the terrain not only analytically but **poetically**. The Ronda method shows how presence, observation, and improvisation can ground architectural ideas in **lived reality**.

6. Support the Adaptation of the Ronda Method in Diverse Contexts

Future workshops and research should test the adaptability of Ronda in different cultural, institutional, and urban settings. Each new context — like the FSMVU campus with its **Ottoman heritage and contemporary academic environment** — reveals new layers of meaning and potential in the method.

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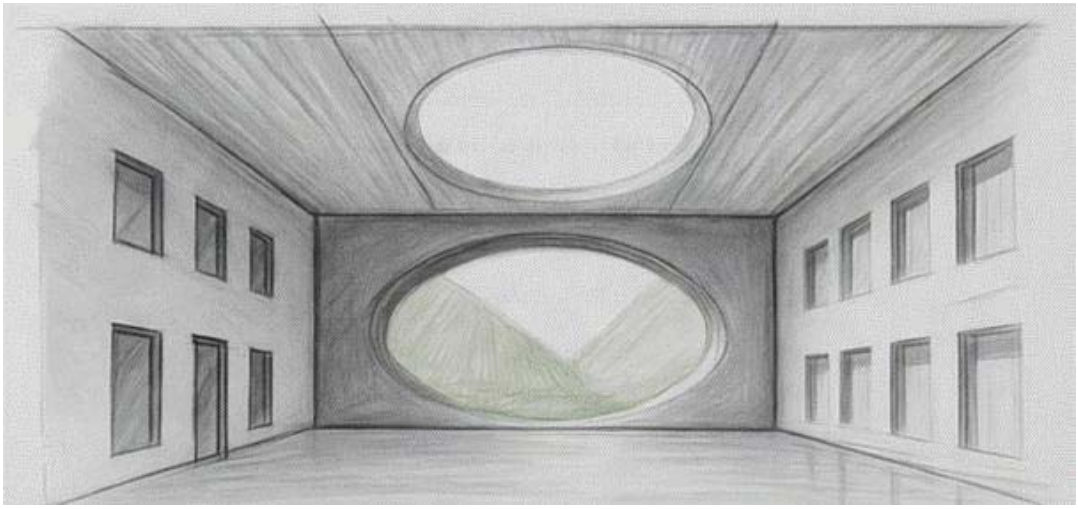
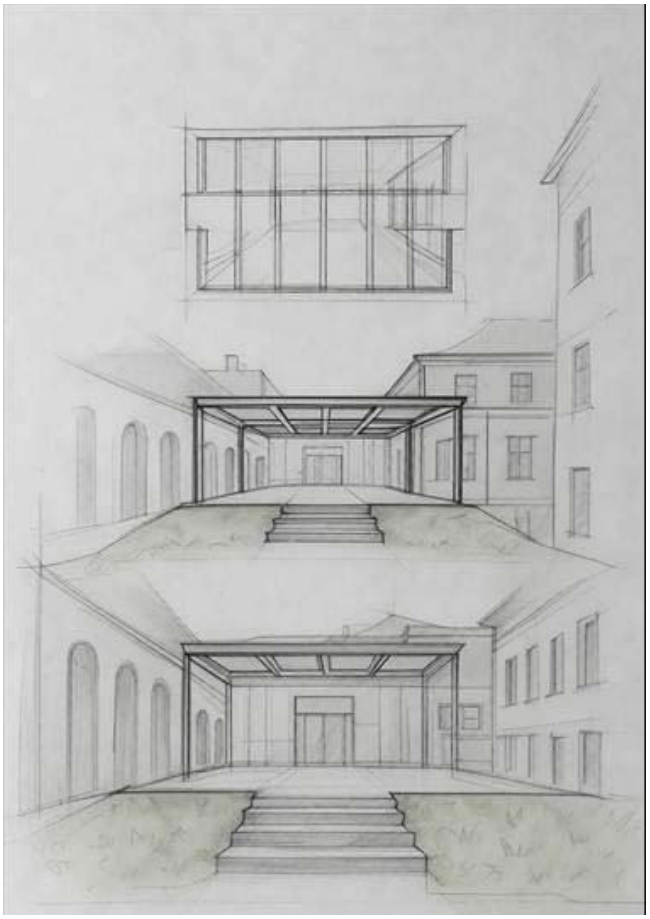
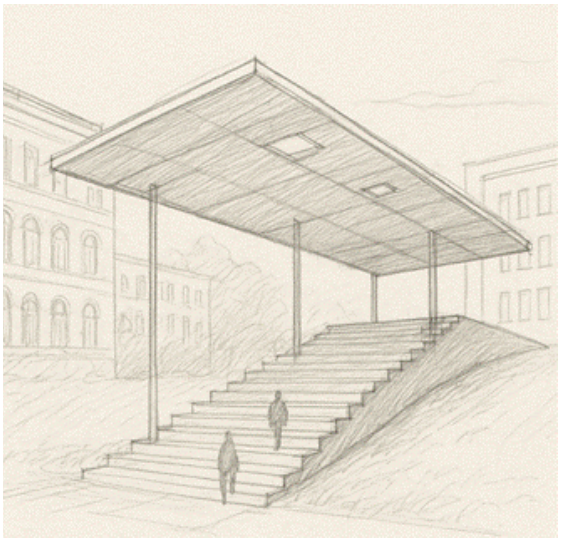
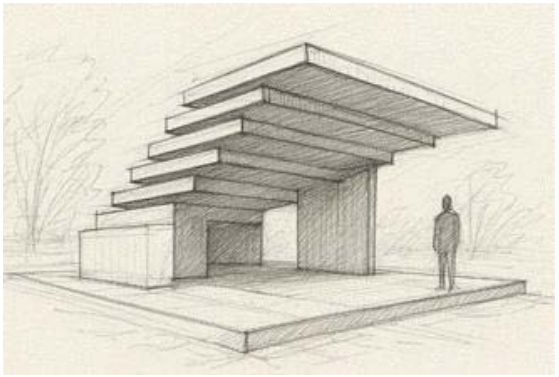
ANNEXES 1

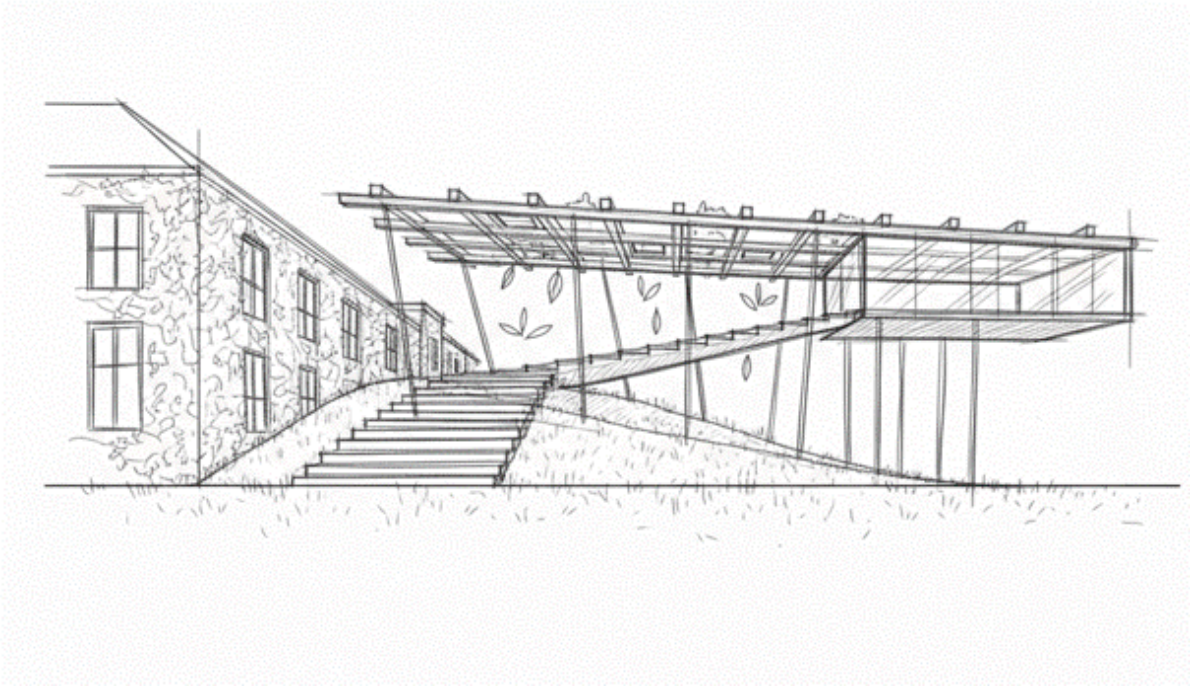
Students' Sketches

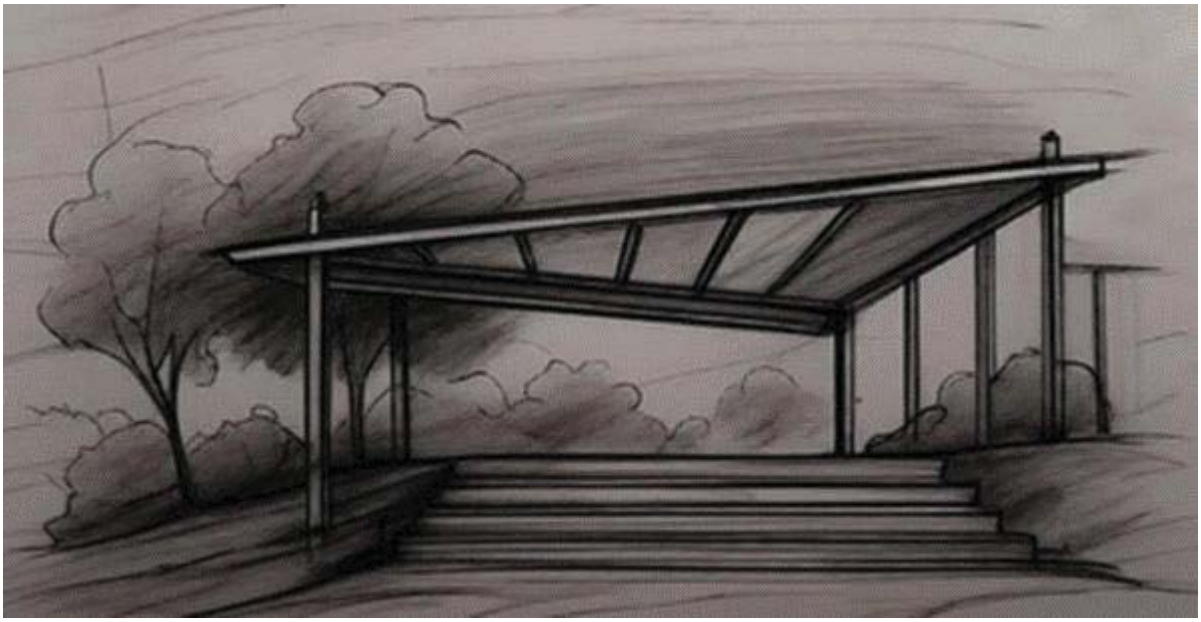












The Dialectics of Light and Matter in Islamic Architecture : Philosophical, Cultural, and Spatial Dimensions

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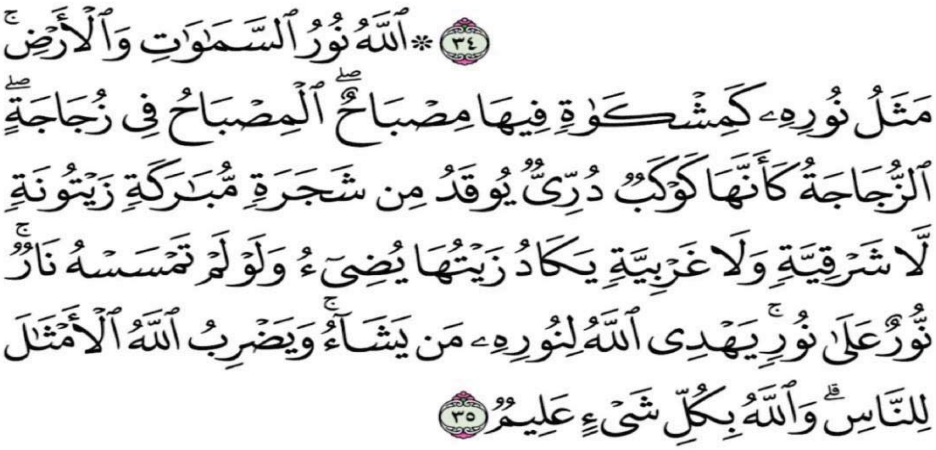
ABSTRACT

Light (*al-Nūr*) in Islamic architecture operates simultaneously as a spiritual symbol, a phenomenological experience, and an environmental regulator. Rooted in Qur'anic interpretations, Islamic philosophy, and optics, this paper examines how light organizes architectural space and meaning, mediating between metaphysical aspirations and climatic realities (The Qur'an 24:35; Ibn al-Haytham, 1989; Suhrawardī, 1999). Through comparative analysis of the Alhambra, the Great Mosque of Córdoba, and the Al-Zaytuna Mosque, four recurring strategies emerge: orientation, filtration, reflection, and concentration. These techniques optimize spiritual resonance, thermal comfort, and energy efficiency, offering transferable insights for contemporary sustainable design. Finally, design guidelines translate heritage-informed luminous intelligence into modern architectural practice.

1.INTRODUCTION



("Allah is the Light of the heavens and the earth. The example of His Light is like a niche within which is a lamp; the lamp is within glass, the glass as if it were a brilliant star lit from a blessed olive tree ...") — Qur'an 24:35

Light occupies a central and multi-layered role within Islamic culture and architecture. In the Qur'anic framework, light (*al-Nūr*) symbolizes divine guidance, spiritual awakening, and knowledge (*ʿilm*). Its recurrence throughout the Qur'an and Islamic thought underscores its association with clarity, transcendence, and the connection between the visible and the invisible. Architecture thus becomes more than the construction of physical enclosures; it is an instrument for manifesting the

metaphysical. The built environment transforms into a stage where light reveals meaning: spaces are animated, patterns are spiritualized, and material assemblies are elevated beyond their physicality.

Historically, Islamic architecture operationalized this symbolic depth through scientifically sophisticated strategies for capturing, modulating, and choreographing light. Builders mastered the sun's trajectory, seasonal variations, and microclimatic conditions to design courtyards, domes, iwans, mashrabiyya, and muqarnas that produced both spiritual atmospheres and environmental balance (Hillenbrand, 1994; Fathy, 1986) . This dual approach reflects the Islamic philosophy of unity (*tawḥīd*): light simultaneously evokes divine presence and mediates thermal comfort, visual quality, and social interaction.

This luminous intelligence is particularly relevant today (Edwards, 2006; Hyde, 2000). As contemporary cities in the Mediterranean and beyond face rising urban heat islands, resource scarcity, and increased energy demands, historic environmental wisdom offers actionable insights. Techniques such as passive cooling, evaporative shading, daylight harvesting, and natural ventilation, refined over centuries in Islamic architecture, anticipate today's discourse on bioclimatic and sustainable design. In courtyards of Andalusian palaces, shaded galleries of North African mosques, and latticed screens of Levantine homes, we find microclimatic strategies carefully tuned to local ecologies and social rituals, creating spaces that are comfortable, resilient, and spiritually resonant.

Furthermore, the aesthetic orchestration of light has implications beyond environmental performance. The play of shadow and luminance in Islamic spaces enhances phenomenological experience, shaping how users perceive, move, and inhabit architecture (Norberg-Schulz, 1980; Zumthor, 2006). Light leads to temporal dynamism: spaces change throughout the day, guiding prayers, social gatherings, and daily rituals. At the same time, it establishes spatial hierarchies, highlighting mihrabs, domes, and communal thresholds, while reinforcing symbolic narratives through inscriptions and geometry.

The relevance of this dialogue between symbolism and sustainability extends into contemporary practice. By revisiting historical strategies, architects today can create environments that integrate cultural identity, environmental ethics, and sensory experience rather than relying on superficial stylistic pastiche. This research therefore seeks to uncover the dialectics of light and matter in Islamic architecture, exploring how theological metaphors, optical science, ornament, and environmental intelligence intersect. Through the comparative study of three emblematic sites, the Alhambra, the Great Mosque of Córdoba, and the Al-

Zaytuna Mosque, this paper aims to extract design principles that inform modern, sustainable, and contextually rooted architectural practices.

2. BACKGROUND AND LITERATURE REVIEW

2.1 Qur'anic Semantics and Theology

The Verse of Light anchors Islamic conceptions of luminosity. Light symbolizes knowledge (*ʿilm*), clarity (*bayān*), and guidance (*hudā*) (The Qur'an 24:35; Nasr, 1987). Early exegesis links the mosque's niche (*mihrab*) and prayer hall's illumination with spiritual awakening. Architecture thus translates theology into spatial experience.

2.2 Optics and Illuminationist Philosophy

- Ibn al-Haytham (Alhazen): In his *Book of Optics*, light becomes measurable and geometric, influencing aperture sizes, reflections, and glare reduction (Ibn al-Haytham, 1989).

- Suhrawardī's Illuminationism (Suhrawardī, 1999): Proposes reality as hierarchies of light, positioning material space as an extension of divine luminosity. Together, they underpin architecture's dual role: controlling light scientifically while expressing it symbolically.

2.3 Ornament, Geometry, and Material

Muqarnas, mashrabiya, arabesques, and tessellations act as optical devices (Grabar, 1987; Michell, 1995). They soften brightness, project patterned shadows, and enhance ventilation, reducing thermal loads. Architecture becomes responsive, harmonizing visual, climatic, and spiritual dimensions.

Figure 1: Mashrabiya, Taken by Mohammed Alim

3.PROBLEM STATEMENT

Contemporary architectural practice in Islamic and Mediterranean contexts faces a profound paradox. While architects frequently reference Islamic architectural forms, domes, arches, mashrabiyya, and intricate ornamentation, these gestures are often purely aesthetic, detached from the technical and spiritual intelligence that historically shaped their design (Hillenbrand, 1994; Frishman & Khan, 1994). In the pursuit of modernization, many contemporary projects rely on superficial pastiche, replicating motifs without understanding the environmental, social, and metaphysical functions embedded within their original contexts. This reduction risks flattening the meaning of Islamic architecture, transforming an embodied philosophy into a decorative style.

At the same time, today's built environments face escalating climatic and ecological pressures. Across the Mediterranean and the broader Islamic world, cities are grappling with rising urban heat islands, increased energy demands, and growing resource scarcity (Edwards, 2006; Hyde, 2000). Architectural responses are dominated by mechanical cooling systems and imported materials that often disregard local ecologies, increasing environmental burdens. This detachment from climate-responsive vernacular strategies erases centuries of empirical knowledge embedded in traditional design, from courtyard microclimates to light-filtering devices like mashrabiyya and muqarnas that provided both thermal comfort and symbolic depth.

Furthermore, the loss of luminous intelligence, the integrated manipulation of daylight, shadow, and ventilation, has diminished architecture's capacity to create experiential richness and spiritual resonance. Traditional Islamic architecture used light not merely for visibility but as a medium of meaning, choreographing the movement of worshippers, shaping temporal rhythms of prayer, and establishing hierarchies of sacred and communal space (Nasr, 1987; Zumthor, 2006). In contrast, many contemporary projects reduce light to a quantitative resource, ignoring its qualitative and symbolic dimensions.

This disconnection between heritage and innovation results in designs that fail on multiple fronts: culturally, environmentally, and socially. As Mediterranean and Islamic cities confront increasing climate volatility, the need to reclaim, reinterpret, and innovate upon traditional luminous strategies is urgent. By studying historical architectures such as the Alhambra, the Great Mosque of Córdoba, and the
Al-Zaytuna Mosque, we uncover integrated design principles where symbolism, phenomenology, and sustainability coexist harmoniously. These insights provide a framework for contemporary architectural practice that is both culturally grounded and environmentally responsive, demonstrating that the key to future resilience lies, paradoxically, in revisiting and reinterpreting our architectural past

4.METHODOLOGY

This research adopts a qualitative, interpretive approach integrating theological, phenomenological, and environmental analysis. The investigation proceeds through three methodological layers. First, a critical reading of Qur'anic and philosophical texts, particularly the Verse of Light (*Qur'an* 24:35), Ibn al-Haytham's *Book of Optics* (1989), and Suhrawardī's *Ḥikmat al-Ishrāq* (1999), this establishes the metaphysical and epistemological foundations of light in Islamic thought (Nasr, 1987; Burckhardt, 1976). These sources ground the notion of light (*al-Nūr*) as both divine symbol and physical phenomenon, providing a framework through which architecture becomes an act of spiritual mediation.

Second, a comparative architectural analysis examines three key monuments: the Alhambra in Granada, the Great Mosque of Córdoba, and the Al-Zaytuna Mosque in Tunis. Each case is studied through its spatial organization, orientation, materiality, and light-handling devices (Grabar, 1987; Frishman & Khan, 1994; Hillenbrand, 1994). The comparative framework identifies recurring luminous strategies, orientation, filtration, reflection, and concentration, and evaluates how these strategies differ according to regional climate and cultural context (Barrucand & Bednorz, 1992; Ruggles, 2000).

Third, an investigation that explores the sensory experience of space: how light structures movement, ritual, and perception. This dimension draws on phenomenological theories of architecture that link material form to human consciousness (Norberg-Schulz, 1980; Zumthor, 2006; Pérez-Gómez, 2006).

Through this multi-scalar method, the research clarifies how light mediates between metaphysical symbolism and material performance in Islamic architecture.

5. RESULTS & ANALYSIS: CASE STUDIES

5.1 The Alhambra, Granada

The Alhambra represents the pinnacle of Nasrid architectural mastery, where light, water, ornament, and geometry converge into a living microcosm of paradise. Its Courtyard of the Lions demonstrates deliberate solar orientation: façades and arcades are aligned to optimize winter sun exposure while maintaining summer shade. This interplay creates seasonal adaptability, reflecting a deep awareness of environmental cycles.

Filtration techniques are equally refined. Muqarnas vaulting dissolves harsh sunlight into thousands of luminous fragments, softening contrast and producing a kaleidoscopic ceiling effect that evokes celestial metaphors. Carved stucco panels and latticed wooden screens further filter light, producing patterned shadows that

animate surfaces throughout the day, creating a temporal dialogue between architecture and sun.

Water features are central to the Alhambra's environmental intelligence. Reflective pools double perceived spatial depth while enhancing luminance and cooling adjacent arcades through evaporative microclimates. Combined with narrow shaded corridors, these strategies maintain thermal comfort even during Andalusia's intense summers without reliance on mechanical systems.

Finally, inscriptions integrated into walls and domes emphasize the spiritual symbolism of light, merging poetic expressions of divine unity with sensory experience. The Alhambra thus choreographs multi-scalar operations: orienting climate, animating ornament, regulating temperature, and evoking transcendence simultaneously.

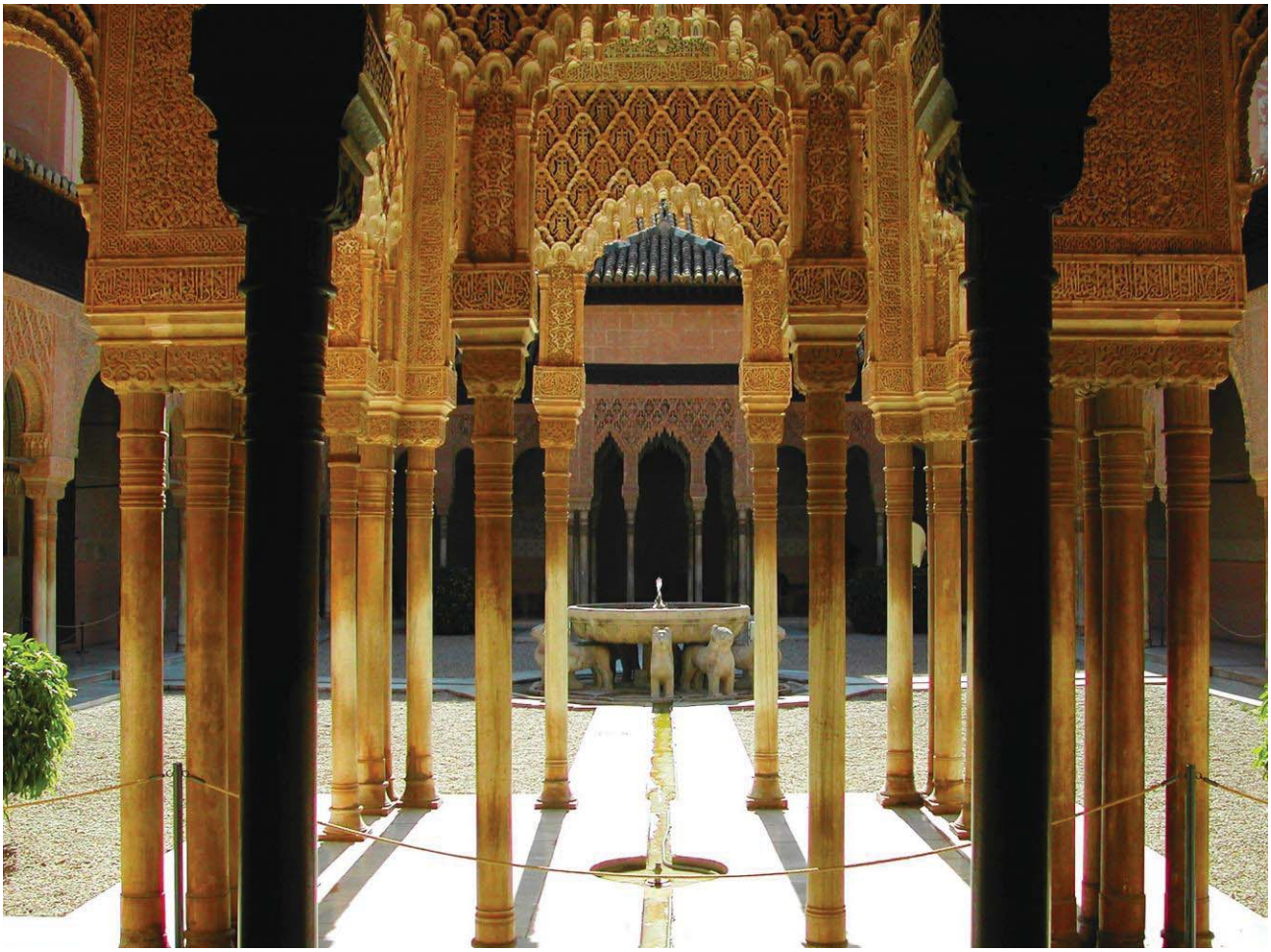


Figure 2: The Alhambra, Granada

5.2 Great Mosque of Córdoba

The Great Mosque of Córdoba achieves spatial infinity through its iconic hypostyle hall, where nearly 850 columns support double-tiered arches designed to control and distribute light evenly across an immense prayer space (Hillenbrand, 1994; Barrucand & Bednorz, 1992). The upper

arches allow subtle clerestory lighting, creating a diffused ambient glow that avoids glare while maintaining visibility and comfort.

This luminous layering is further enhanced by the mosque's material palette: pale limestone, marble, and brick act as natural reflectors, amplifying daylight while lowering energy demands. These reflective properties reduce contrast ratios across the visual field, contributing to a balanced and serene spatial atmosphere.

Thermal regulation is deeply embedded in the design. The mosque's thick stone walls, shaded galleries, and small apertures protect interiors from intense Andalusian heat while maintaining cross-ventilation pathways. This synergy of daylight, airflow, and massing results in stable thermal comfort without artificial cooling.

Spatial hierarchy is defined by concentration of light (Burckhardt, 1976). The mihrab glows under deliberate illumination, signifying spiritual centrality, while peripheral aisles remain gently dimmed, directing focus and movement intuitively.
Ornamentation, intricate mosaics, inscriptions, and geometric motifs catch shifting light, generating dynamic patterns and reinforcing symbolic narratives of unity and transcendence.

Figure 3: The Great Mosque of Córdoba

5.3 Al-Zaytuna Mosque, Tunis

The Al-Zaytuna Mosque represents a North African approach to light, climate, and social integration. Its large central courtyard acts as a climatic regulator, capturing daylight while buffering prayer halls from external heat (Frishman & Khan, 1994; Hillenbrand, 1994). The surrounding arcaded galleries create shaded transitional spaces where daylight is modulated through progressive thresholds, reducing glare and heat exposure.

Mashrabiyya screens are integral to the mosque's design intelligence, balancing visual privacy, solar shading, and airflow simultaneously. These wooden lattices temper high-intensity daylight into a soft, filtered glow, maintaining visual comfort for reading, prayer, and social interaction.

Clerestory windows crown the prayer hall, drawing in indirect zenithal light and producing a hushed luminous ambience that supports contemplation. Meanwhile, the mosque leverages prevailing Mediterranean breezes through cross-ventilation pathways, reducing dependency on artificial cooling and lowering energy loads.

Al-Zaytuna also serves as an urban environmental hub. Its spatial organization integrates vegetation, water features, and shading devices to produce a microclimate that benefits surrounding neighborhoods (Salama & Wiedmann, 2013). Symbolically, the transition from bright courtyards into softly lit prayer spaces mirrors spiritual progression, from exposure to introspection, from materiality to transcendence.

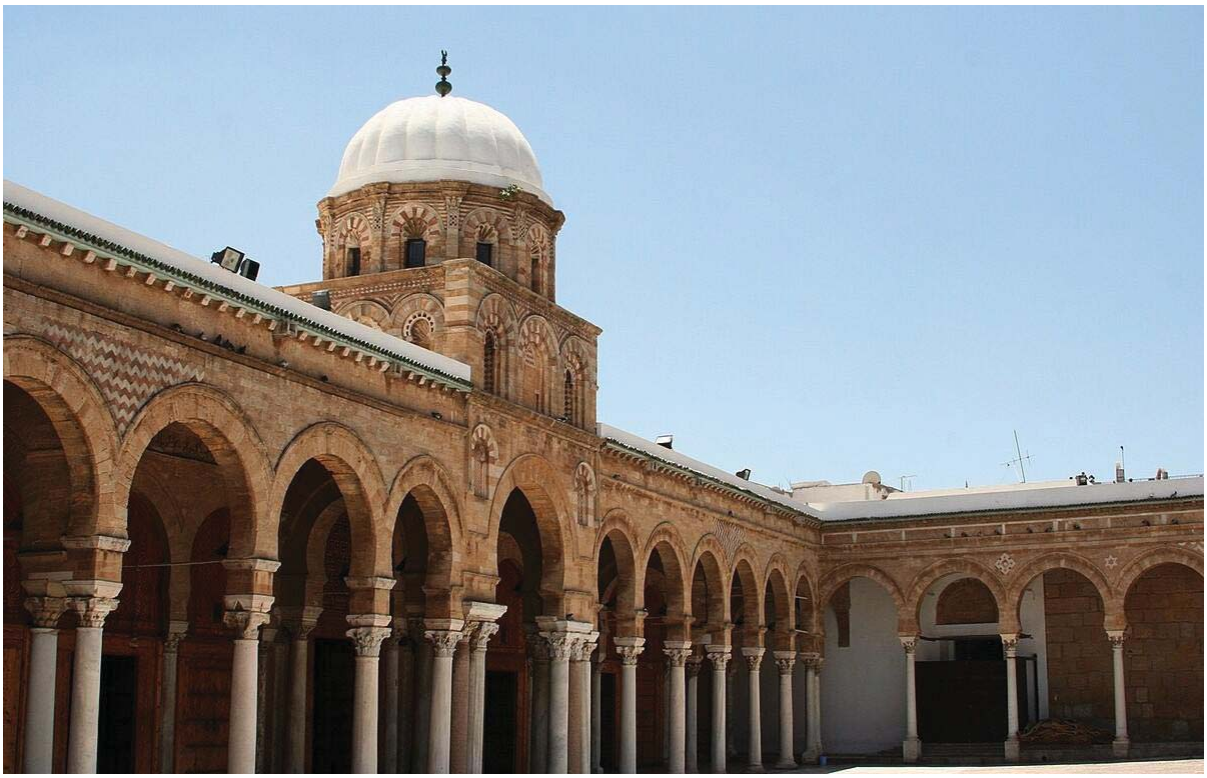


Figure 4: Al-Zaytuna Mosque

6. DISCUSSION

6.1 Light as a Mediator of Symbol and Environment

Across all three sites, light operates simultaneously as a spiritual metaphor and an environmental regulator (Nasr, 1987; Norberg-Schulz, 1980). Its manipulation defines spatial identity and temporal rhythm, turning architecture into a living interface between cosmic symbolism and human experience. Unlike modern artificial lighting, historical strategies embrace variability, spaces evolve throughout the day, synchronizing daily life with natural cycles.

6.2 Integrating Traditional Strategies into Sustainable Design

Traditional Islamic architecture anticipated principles central to bioclimatic and passive design long before contemporary frameworks like LEED or WELL:

Traditional Strategy	Architectural Mechanism	Sustainable Application
Orientation	Courtyards, façade alignments	Passive solar optimization, reduced heating/cooling demands
Filtration	Mashrabiyya, muqarnas, lattices	Dynamic façades, glare control, daylight-responsive interiors
Reflection	Pale stone, stucco, water basins	High-albedo surfaces, energy-efficient daylight harvesting
Courtyards	Shaded galleries, fountains	Passive cooling, evaporative microclimates, urban heat mitigation

These solutions lower operational energy while enhancing thermal comfort and visual quality, illustrating that sustainability and spirituality are not opposing values but deeply interwoven design ethics.

6.3 Cross-Case Comparative Insights

- Alhambra emphasizes the sensory richness of filtered daylight and water reflection.
- Córdoba masters luminous uniformity through distributed clerestory lighting.
- Al-Zaytuna integrates microclimatic strategies with urban ecology, benefiting both occupants and surrounding streetscapes.

These findings highlight that historical luminous strategies can be adapted for modern performance goals without stylistic replication, bridging cultural continuity with environmental

innovation.

6.4 Modern Resonances and Future Potentials

Contemporary architects like Louis Kahn and Le Corbusier employed methods echoing Islamic precedents, zenithal lighting, deep reveals, and patterned screens, demonstrating the universality of luminous intelligence (Grabar, 1987). Future innovations could hybridize computational daylight simulations, smart shading systems, and adaptive mashrabiyya to reimagine light-responsive architectures that honor heritage while exceeding modern sustainability standards.

6.5 Comparative Analysis and Synthesis

The three case studies reveal both shared principles and regional specificities in the manipulation of light. While all three sites integrate orientation, filtration, reflection, and concentration as core strategies, the architectural expressions differ in purpose and scale.

Strategy	Alhambra, Granada	Great Mosque of Córdoba	Al-Zaytuna Mosque, Tunis
Orientation	Seasonal solar alignment; courtyards tuned to diurnal cycles	Longitudinal prayer axis; clerestory windows balanced for even distribution	Central courtyard buffers heat; orientation ensures daylight penetration with minimal glare
Filtration	Muqarnas and carved stucco dissolve direct sunlight	Double-tiered arches diffuse light through alternating stone and brick	Mashrabiyya and arcades filter daylight into soft interior glow
Reflection	Water basins amplify luminance and cooling	Polished marble and pale stone reflect diffuse light evenly	White plaster and tiled surfaces enhance visual comfort
Concentration	Illumination highlights symbolic inscriptions and domes	Light focuses on the mihrab as spiritual nucleus	Zenithal light above prayer hall emphasizes contemplation

The Alhambra prioritizes aesthetic and metaphysical play between light, water, and ornament, transforming the palace into a metaphor of paradise. The Great Mosque of Córdoba refines luminous uniformity to shape collective ritual experience and emphasize structural rhythm. The Al-Zaytuna Mosque translates these luminous strategies into a pragmatic urban context, coupling environmental moderation with communal accessibility.

Together, these findings demonstrate that light in Islamic architecture transcends decoration: it becomes a structural and theological medium that synchronizes environmental adaptation with spiritual resonance. The comparative synthesis validates the proposed methodological framework and reaffirms that the dialectic of light and matter operates as a coherent, transferable design intelligence across geography and time.

7. DESIGN GUIDELINES

- Integrate luminous gradients instead of uniform lighting.
- Employ screening devices for privacy, glare control, and energy efficiency.
- Leverage reflective surfaces and water features for cooling.
- Prioritize courtyards for passive ventilation and social cohesion.
- Avoid stylistic replication; reinterpret strategies with contemporary materials.

These recommendations synthesize insights from prior analyses (Fathy, 1986; Hillenbrand, 1994; Hyde, 2000).

8. CONCLUSION

This research demonstrates that Islamic architecture represents far more than a stylistic tradition; it is an integrated design intelligence where spiritual meaning, environmental adaptation, and sensory experience converge seamlessly (Burckhardt, 1976; Frishman & Khan, 1994). Through the comparative study of the Alhambra, the Great Mosque of Córdoba, and the Al-Zaytuna Mosque, we identified four recurring luminous strategies, orientation, filtration, reflection, and concentration, which together form a holistic framework for understanding and reinterpreting architectural light.

Historically, these strategies were not arbitrary aesthetic choices but scientifically and spiritually informed techniques developed in response to climate, culture, and cosmology. Courtyards optimized airflow and daylight cycles; muqarnas and mashrabiyya filtered sunlight into dynamic patterns; reflective pools amplified luminance while cooling air; and spatial thresholds guided users toward contemplation and ritual practice. These elements worked together to create multisensory environments that addressed human comfort, spiritual elevation, and ecological balance simultaneously.

In today's context of accelerating climate change, urban heat islands, and energy scarcity, these lessons gain unprecedented urgency. As contemporary architects strive for sustainable urban resilience, Islamic luminous strategies offer tested solutions for passive cooling, daylight harvesting, glare control, and microclimatic comfort, all without heavy reliance on mechanical systems. Beyond performance metrics, these approaches also emphasize experiential quality, demonstrating that environmental efficiency and spatial poetry are not mutually exclusive, but deeply interconnected.

Furthermore, the study highlights the risk of reducing Islamic architecture to superficial pastiche in contemporary practice. Merely replicating decorative forms neglects the luminous intelligence

embedded in historical design logic (Hyde, 2000; Edwards, 2006). To meaningfully integrate heritage into modern architecture, designers must reinterpret principles, not reproduce symbols. This requires moving from aesthetic mimicry toward performance-informed, contextually grounded innovation.

Looking forward, the convergence of heritage knowledge and modern technologies opens promising avenues for architectural design. Computational daylight simulations, smart mashrabiyya systems, adaptive façades, and climate-responsive materials can extend the legacy of luminous strategies into the 21st century (Sibley & Jackson, 2012). By combining traditional insights with contemporary science, we can develop architecture that is simultaneously ecological, cultural, and phenomenological.

In essence, this research argues for a paradigm shift: sustainability cannot be achieved by technological efficiency alone. It must also engage with cultural memory, symbolic richness, and human experience. Islamic architecture provides a profound model where light becomes a mediator, between the divine and the material, the past and the future, the individual and the collective, and the natural and the built environment. Reinterpreting this dialectic of light and matter offers a pathway to designing spaces that are not only environmentally resilient but also spiritually resonant and socially meaningful.

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Towards a Forensic Pedagogy: Interpreting Islamic Architectural Heritage as a Dynamic Resource for Sustainable Design Education in Architecture

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ABSTRACT:

This paper presents *Forensic Heritage Pedagogy*, a framework that redefines Islamic architectural history as a living laboratory for sustainability education. Moving beyond survey-based approaches that aestheticize heritage and reproduce Eurocentric hierarchies, the model treats Islamic architecture as a dynamic knowledge system. Developed in the Algerian academic context, it is implemented through four interventions: *heritage autopsies* that decode ecological logics; *time-traveler charrettes* projecting heritage elements into IPCC climate futures; *heritage ICU clinics* that diagnose and treat vulnerable sites; and *sonic sustainability decoding* that analyzes acoustic environments. Together, these methods foster active, multisensory, and co-creative learning while generating student-produced archives as a cumulative knowledge commons. The framework aligns with constructivist and place-based pedagogies and advances Sustainable Development Goal 4 (Quality Education). It positions Islamic architectural heritage as both a pedagogical tool and a global resource for ecological adaptation, offering a replicable and decolonial model for integrating resilience and sustainability into architectural curricula.

KEYWORDS:
Islamic Architectural Heritage; Forensic Pedagogy; Sustainability; Design Education; Place-based Learning

1. INTRODUCTION

The teaching of Islamic architectural history in schools of architecture has long privileged passive reception over active inquiry. Most curricula introduce the subject through stylistic surveys and chronological narratives that trace developments across dynastic timelines and political shifts. Heritage monuments are presented as static exemplars of a bygone past, their study limited to visual description and typological categorization. While this provides a structured overview of formal transformations, it often reduces Islamic architecture to an aestheticized corpus rather than engaging with it as a living archive of cultural, environmental, and epistemological practice.

This limitation is reinforced by institutional structures. In Algeria, ministerial guidelines and state-approved curricula emphasize canonical exemplars and typologies, marginalizing questions of context, performance, and ecological adaptation. Students thus remain passive recipients of knowledge, expected to memorize forms rather than interrogate heritage as a dynamic resource. In Western universities, greater interpretive freedom exists, yet Islamic architecture is still too often approached through descriptive or exoticizing lenses. Such perspectives reproduce Eurocentric hierarchies in which

Islamic traditions appear peripheral rather than autonomous systems embedding complex socio-cultural, technological, and ecological intelligence.

The result is a pedagogical landscape that rarely moves beyond representation into meaningful engagement. Students catalogue dynasties and typologies but seldom explore the ecological wisdom, material ingenuity, or regenerative practices embedded in Islamic traditions. This gap is increasingly urgent as architectural education is called upon to address sustainability, resilience, and cultural relevance. Recent scholarship emphasizes that architectural curricula must move beyond descriptive or technocratic models to cultivate active, climate-literate, and culturally grounded forms of design learning (Schiano-Phan & Soares Gonçalves, 2022; Schiano-Phan et al., 2022). To continue treating Islamic heritage as a static record risks not only misrepresenting its significance but also neglecting its potential as a source of ecological knowledge and design innovation.

This paper addresses these shortcomings by introducing *Forensic Heritage Pedagogy*, a framework that reconceptualizes Islamic architectural history as a forensic sustainability laboratory. Heritage is treated not as a passive archive but as an active pedagogical resource, explored through investigative, multisensory, and project-based methodologies. Grounded in the Algerian academic context, where Islamic architectural history is taught at the first-year level, the framework equips students to decode ancestral ecological intelligence and apply it toward regenerative design futures.

Situated within wider debates on pedagogy and sustainability, the framework also confronts Eurocentric biases that persist in both heritage education and green design discourses. These biases often reduce Islamic architecture to an appendix to Western canons or privilege technological fixes over vernacular ecological wisdom (Escobar, 2018). By foregrounding Maghrebi and Islamic traditions as epistemic centers, the framework repositions heritage as a generative archive of design intelligence. In doing so, it contributes to Sustainable Development Goal 4 (Quality Education) by cultivating critical thinking, community co-creation, and design literacy, while advancing decolonial efforts to diversify sustainability education. Ultimately, the argument is that Islamic architectural heritage, approached through forensic pedagogy, becomes not only a transformative tool for student learning but also a replicable model for integrating cultural resilience and ecological intelligence into architectural education worldwide.

2. THEORETICAL FRAMEWORK

2.1 Pedagogies of Architectural History

The teaching of architectural history has, for much of the twentieth and twenty-first centuries, been dominated by survey models that emphasize stylistic analysis and linear chronological sequencing. These models are deeply indebted to canonical works such as Banister Fletcher's *A History of Architecture on the Comparative Method*, which established a taxonomic tradition that ordered architectural development into genealogical "trees" of styles (Çelik, 1992). While this model provided an enduring structure for comparative study, it also reinforced Eurocentric hierarchies: Western architectural traditions were positioned at the apex of development, while non-Western traditions, including Islamic architecture, were relegated to marginal appendices.

Within this pedagogical framework, Islamic architecture has frequently been reduced to a descriptive survey of dynastic monuments and typologies—mosques, madrasas, palaces—presented primarily as stylistic expressions of political succession. Such an approach privileges the visual and formal at the expense of social, cultural, and environmental contexts. The consequence is a form of pedagogy that trains students to memorize architectural exemplars but leaves little room for critical interrogation of the practices and knowledge systems that underpinned them.

Recent critiques of architectural history pedagogy have highlighted this passivity. Salama (2015) and initiatives by the European Association for Architectural Education (EAAE, 2019) call for a shift away from rote memorization toward methodologies that are analytical, investigative, and context-sensitive. Scholarship on sustainability and curriculum innovation likewise insists that programs must cultivate active, climate-literate, and place-based learning (Schiano-Phan & Soares Gonçalves, 2022; Schiano-Phan et al., 2022; Yates et al., 2022). These critiques argue that history should not be treated as a static repository of forms but as a dynamic resource for cultivating critical thinking and design literacy. Yet despite these calls, Islamic architectural history often remains confined to descriptive accounts, reproducing the very epistemological limitations that critical pedagogy seeks to overcome.

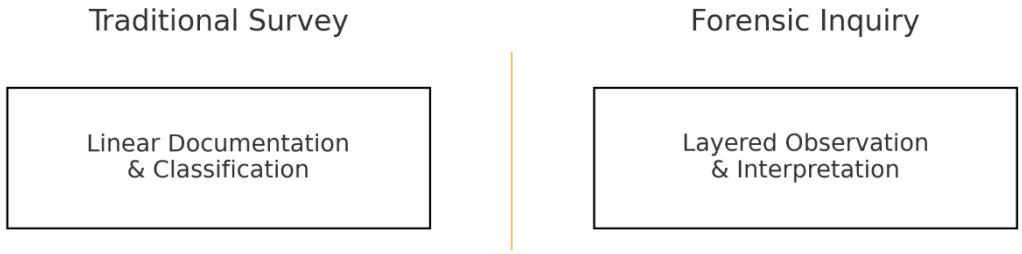


Figure 1: Ttraditional survey pedagogy vs. forensic inquiry model (timeline vs. layered analysis).
Source:Author

2.2 Heritage as Static Monument vs. Living Archive

These pedagogical limitations intersect with broader debates in heritage studies concerning the ontological status of heritage itself. Traditional preservationist paradigms have long emphasized conservation, documentation, and the safeguarding of monuments as cultural relics (Smith, 2006). While important for protecting material fabric, such approaches often detach heritage from the social, ecological, and performative processes that give it life. The danger of this "museumification" of heritage is that it renders architectural traditions inert, valuable for their symbolic and aesthetic worth, but disconnected from contemporary relevance.

Scholars such as Harrison (2013) and Holtorf (2020) have argued for a reconceptualization of heritage as a dynamic knowledge system that serves the needs of the present and the future, rather than solely preserving the past. This shift resonates strongly with Islamic architecture, which historically embedded ingenious responses to climatic and social conditions. From passive cooling systems in desert environments to community-based construction practices and adaptive spatial logics, Islamic architecture is replete with ecological intelligence (Fathy, 1986; Bianca, 2000). Yet these dimensions

are rarely emphasized in architectural curricula, where heritage continues to be framed primarily as a stylistic category. Treating heritage as a "living archive" instead of a static monument enables students to engage with it not as a relic but as a resource for resilience and adaptation.

2.3 Sustainability and Architectural Education

The urgency of climate change has catalysed significant debates around the integration of sustainability into architectural education. International policy frameworks such as UNESCO (2017) stress the necessity of embedding sustainability literacy into curricula, while architectural scholars argue for a deeper ecological orientation that moves beyond technocratic solutions (Guy & Farmer, 2001; Sterling, 2010). The task is not only to equip students with technical 'green' skills but also to cultivate holistic ways of thinking that integrate cultural, material, and social dimensions of sustainability.

Nevertheless, critical voices highlight that sustainability education continues to be dominated by Eurocentric paradigms (Escobar, 2018). These frameworks privilege high-tech, Western solutions while neglecting indigenous and non-Western traditions that embody centuries of adaptive ecological wisdom. Islamic architectural heritage, with its time-tested climate-responsive strategies, offers precisely the kind of contextually grounded insights that could diversify sustainability education. Yet its potential remains underutilized, largely because of entrenched pedagogical traditions that treat it as static form rather than living practice. The challenge, therefore, is not only to integrate sustainability into architectural curricula but also to expand the epistemological scope of what counts as sustainability knowledge (Martínez-Ventura et al., 2021; Yates et al., 2022).

2.4 Decolonizing Pedagogy and Knowledge Systems

Parallel to sustainability debates, architectural education has been increasingly shaped by calls to decolonize knowledge. Postcolonial and decolonial scholars argue that curricula continue to reproduce epistemological hierarchies that privilege Western knowledge systems while marginalizing local and indigenous epistemologies (Andreotti, 2011; Mbembe, 2016). In the field of architectural history and heritage, this manifests in the persistent exoticization of Islamic architecture in Western scholarship and the replication of Eurocentric models within Islamic contexts themselves.

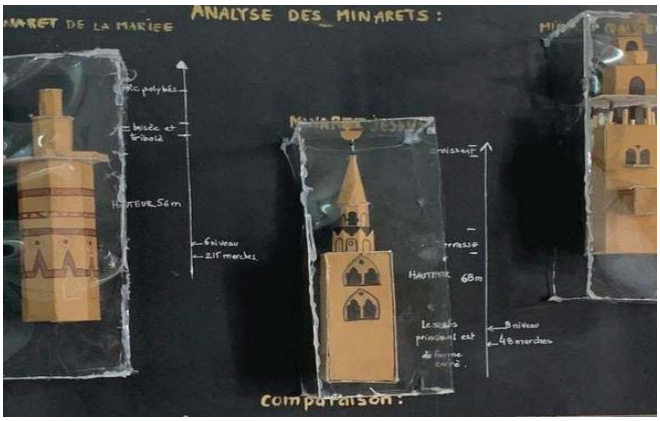
In line with Salama's (2015) advocacy for pedagogical reform and Abu El-Haj's (2001) demonstration that knowledge production is culturally and politically situated, decolonizing architectural education necessitates pedagogical strategies that re-center local epistemologies and operationalize place-based learning. Such an approach reframes heritage not as a static repository of monuments but as a dynamic field of cultural and ecological practices, inviting students to interrogate how architecture materializes local modes of knowledge production and environmental adaptation. This pedagogical repositioning converges with global debates on sustainability that call for plural epistemologies (Escobar, 2018), moving beyond universalizing "green" paradigms toward more contextually grounded models of resilience. Within this framework, Islamic architectural heritage is rearticulated as an epistemological engine, offering both theoretical and practical insights for rethinking global sustainability from non-Western vantage points.

2.5 Toward Forensic Heritage Pedagogy

Taken together, these studies reveal four intertwined critiques: the passivity of architectural history teaching, the aesthetic reduction of heritage, the Eurocentrism of sustainability discourse, and the lack of decolonial approaches in curricula. Yet no cohesive model has reactivated Islamic heritage as a living archive of ecological intelligence.

This paper introduces *Forensic Heritage Pedagogy* to fill that gap. Drawing on medical and legal forensics, it treats buildings as living organisms whose materials, acoustics, and climatic logics can be decoded to extract actionable knowledge for ecological reapplication. Heritage thus becomes a *metabolic archive*—courtyards, wind catchers, mashrabiyas, and water systems functioning as ecological organs within a larger architectural metabolism.

By training students to investigate and reinterpret these systems, the framework positions Islamic heritage as a *knowledge bank for resilience* and climate adaptation. At the same time, it advances a decolonial, place-based agenda that foregrounds Maghrebi and Islamic traditions as sources of innovation, challenging Eurocentric sustainability narratives. In alignment with Sustainable Development Goal 4 (Quality Education), it promotes critical inquiry, sustainability literacy, and community co-creation—reframing heritage as a living laboratory for regenerative design and positioning architectural education as a driver of cultural and ecological resilience.



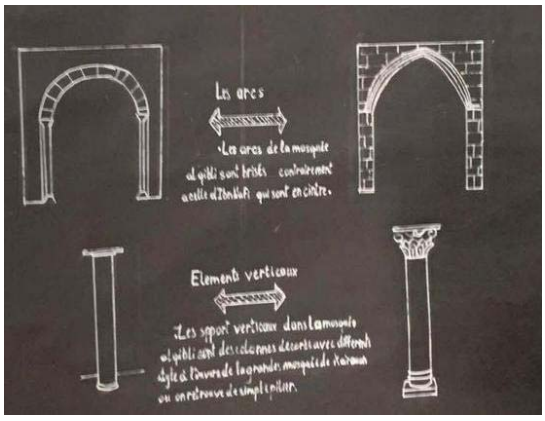


Figure 2: A descriptive work of *Forensic Heritage Pedagogy*: inputs (archive, community, climate data) → extract methods (autopsy, charrette, clinic, sonic decoding) → outputs (initiatives to elaborate guidelines, prototypes).
Source: Students' first phase of work (sample from 2024)

3.METHODOLOGY: OPERATIONALIZING FORENSIC HERITAGE PEDAGOGY

This framework was piloted in first-year design studios at the University of Algiers 1, with groups of four to six students over a fourteen-week semester. The modules combined lectures, workshops, and field visits. In on-site laboratories, students used photogrammetry, measured drawings, acoustic

recordings, and ethnographic interviews. Assessment combined performance diagrams, reflective journals, and group presentations, enabling both qualitative and quantitative evaluation.

Grounded in the principles of *Forensic Heritage Pedagogy*, the methodology redefines Islamic architectural heritage as a site of inquiry, experimentation, and knowledge extraction. Departing from conventional, descriptive teaching, it emphasizes investigation, multisensory engagement, and project-based learning. Students learn *through* heritage rather than *about* it, treating buildings as evidence-bodies that encode ecological intelligence, cultural practice, and adaptive resilience.

Designed for the Algerian academic context, where Islamic architectural history is taught in the first year, the approach targets a formative stage in shaping design sensibilities. It is implemented through four interrelated interventions: *heritage autopsies*, *time-traveler charrettes*, *heritage ICU clinics*, and *sonic sustainability decoding* that operationalize forensic pedagogy as a multi-scalar and multisensory practice bridging history, design, and sustainability

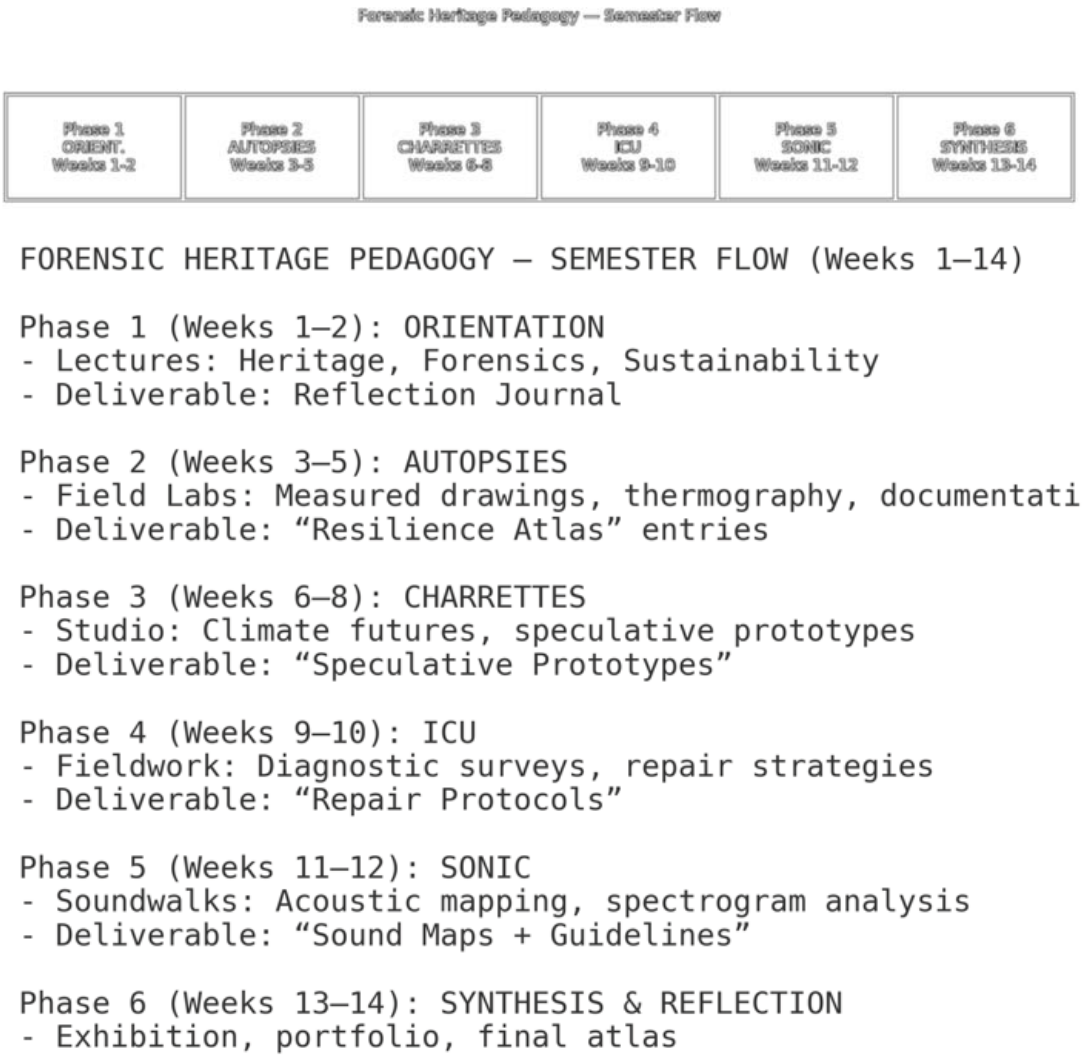


Figure 3: Flowchart of semester programme showing weeks, activities (lectures, field visits, labs), and deliverables (Resilience Atlas entries, charrette prototypes, clinic protocols, sound maps).
Source: Author

3. 1 Heritage Autopsies: Reverse-Engineering Resilience

Drawing from the investigative ethos of forensic science, heritage autopsies treat buildings as organisms to be dissected to reveal their embedded ecological logics. Students analyze case-study sites—historic mosques, courtyard houses, and hammams—through field visits, measured drawings, photogrammetry, and material sampling where permissible. The goal is to uncover passive climate-control strategies such as thermal massing, shading geometries, ventilation, and water management systems.

The autopsy is not merely descriptive but analytical. Students produce layered documentation such as performance diagrams, material condition reports, and reconstructed design intentions, culminating in a *Resilience Atlas*: a collective repository of adaptive strategies across case studies. Designed as an open-source archive of ecological knowledge, the Atlas serves as a living database bridging historical practice and contemporary design pedagogy. It connects the wisdom embedded in the built environment with urgent sustainability challenges, offering context-sensitive strategies that remain in the public domain.

By cultivating "forensic literacy," heritage autopsies train students to see beyond ornament and style, decoding the *performative logics* of architecture—how form mediates climate, resources, and social interaction. This reframes the architect as both detective and systems thinker, capable of extracting actionable intelligence from material evidence to inform resilient, culturally grounded design. For example, during an autopsy of the Great Mosque of Algiers (Almoravid), students recorded how thick stone walls stabilized interior temperatures and reduced heat gain. Thermography and airflow diagrams revealed integrated passive cooling strategies, later documented in the *Resilience Atlas* as transferable principles for contemporary dense urban housing.

3.2 Time-Traveler Design Charrettes

The "time-traveler design charrette" brings a speculative dimension to forensic pedagogy, fostering a form of temporal elasticity in design thinking. In this exercise, students act as "time-traveling architects", reimagining heritage elements, such as mosque courtyards, wind catchers, palaces, or caravanserais, through climate futures modeled by the Intergovernmental Panel on Climate Change (IPCC). These projections anticipate intensified heat, drought, water scarcity, and sea-level rise, all of which threaten existing settlements.

Students are invited to translate ancestral design intelligence into adaptive futures: modifying courtyard geometries to mitigate extreme heat, recalibrating wind catchers for shifting wind patterns, or envisioning caravanserais as climate refuges. By placing historical forms under modeled climate pressures, the charrette positions heritage as an active design laboratory capable of informing resilient strategies for contemporary environmental challenges.

Conducted as intensive workshops, the process culminates in speculative prototypes and narrative scenarios that bridge vernacular knowledge with present-day resilience imperatives. The exercise cultivates anticipatory literacy: students learn to honor the ecological intelligence embedded in

Islamic architectural traditions while projecting this knowledge into dramatically altered climatic contexts. In doing so, the charrette nurtures speculative creativity and sustainability literacy, preparing future architects to navigate design complexity in an era of climate uncertainty.

Figure 4: Students while the charrette.
Source: Author's caption

3.3 Heritage ICU Clinics: Learning from Vulnerability

The "Heritage ICU Clinic" draws on the analogy of the Intensive Care Unit (ICU), where patients in critical condition receive urgent diagnosis, monitoring, and adaptive treatment. In this model, deteriorating monuments are reframed as "patients" requiring care, shifting the focus from heritage as static remnants to sites of potential recovery and resilience. This metaphor aligns with conservation discourse that has long used medical terminology to describe diagnosis and repair, while scholars caution against oversimplifying such analogies (Okawa, 2024).

Fieldwork provides the diagnostic foundation: students assemble photographic archives, conduct interviews with local residents, and assess structural and environmental vulnerabilities. They then participate in collaborative clinics with maâlems (craftspeople), conservation experts, and municipal stakeholders to co-develop preservation strategies that balance material conservation with ecological regeneration, such as reintroducing traditional cooling systems or reviving vernacular repair practices. This approach positions heritage as a living laboratory for exploring fragility and resilience, resonating with calls to mobilize heritage as a pedagogical resource in architectural education (Lapadula & Quiroga, 2012; Rodi & Stachura, 2025).

The ICU framework anchors conservation pedagogy in praxis, cultivating technical competency and an ethics of care—recognizing that sustaining heritage depends on maintaining cultural, social, and ecological continuity rather than preserving buildings in stasis. In Algiers' Casbah, for example, first-year students worked with maâlems to observe cracks in clay-brick vaults, document them through sketches and photographs, and discuss repair techniques such as lime plaster patching or improved drainage. This hands-on exercise linked observation to practical, accessible repair strategies,

demonstrating how conservation and ecological regeneration can be meaningfully introduced early in architectural training.

3.4 Sonic Sustainability Decoding

The "sonic sustainability decoding" module expands forensic pedagogy into the auditory domain, positioning sound as a carrier of ecological and social intelligence. Students conduct soundwalks, acoustic recordings, and spectrogram analyses in heritage environments such as mosques, souks, domes, and courtyards, drawing on acoustic ecology (Schafer, 1994) and soundscape studies (Truax, 2001). The resulting soundscapes are mapped in relation to thermal comfort, social interaction, and spatial legibility, aligning with research that situates sound as central to urban sustainability and cultural experience (Kang & Schulte-Fortkamp, 2016).

The aim is to develop "sound-based sustainability guidelines" that translate heritage acoustics into design strategies, for example, how reverberant domes inform echo management in public buildings, or how courtyard sound diffusion guides noise mitigation in dense urban contexts. These approaches echo studies framing sound as a tool for designing healthier and more inclusive cities (Aletta & Kang, 2015; 2018).

By engaging architecture as a multisensory archive, the module broadens sustainability education beyond quantitative performance metrics to include sensory ecology, spatial well-being, and cultural atmosphere, reflecting interdisciplinary work on sound, health, and the built environment (Proença et al., 2024; Martínez-Ventura et al., 2021).

3.5 Pedagogical Integration

These four interventions are designed for integration into architectural curricula as studio modules, field laboratories, and interdisciplinary workshops, offering multiple entry points across different stages of education. Each produces student-generated data (maps, sketches, acoustic recordings, material analyses, and ethnographic narratives) archived in open-access repositories. Over time, these archives form a cumulative knowledge commons accessible to academics, residents, municipal authorities, and practitioners, extending the classroom into broader spheres of cultural and ecological stewardship.

Their integrative logic operates along three dimensions. First, **Active Learning**: students move from passive reception to investigative inquiry, following Dewey's (1938) "learning through experience" and Kolb's (1984) experiential learning cycle. Second, **Co-Creation**: knowledge is collaboratively produced among students, academics, and community stakeholders, resonating with participatory pedagogies (Sanoff, 2000) and heritage co-management (Waterton & Smith, 2010). Third, **Contextual Grounding**: learning is situated in specific cultural and environmental contexts, aligning with place-based education (Gruenewald, 2003) to ensure relevance and transferability.

Together, these strategies position architectural education as critical praxis—where design, research, and reflection converge in real-world settings. In alignment with SDG 4 (Quality Education),

the framework fosters technical competence, ecological literacy, critical inquiry, and civic responsibility. It reframes heritage as a living resource, embedding inclusive and context-sensitive sustainability learning into curricula.

In practice, a first-year studio working on historic mosques in Algiers may produce sketches and spatial analyses that reveal logics of shade, water, and communal gathering, showing how traditional ecological knowledge can inform contemporary design. Likewise, soundwalks in souks or ICU exercises in houses and hammams enrich the shared repository, offering communities actionable knowledge for maintaining and adapting their environments. The classroom becomes inseparable from its context, positioning architectural education as a catalyst for cultural continuity, the valorization of Islamic heritage, and sustainable futures grounded in vernacular wisdom.

4. DISCUSSION: RETHINKING ARCHITECTURAL PEDAGOGY THROUGH FORENSICS

4.1 From Passive Reception to Investigative Learning

The interventions outlined above collectively challenge the conventional passivity that has long characterized the teaching of Islamic architectural history. Traditional survey-based models emphasize stylistic categorization and chronological memorization, training students to reproduce established narratives rather than to interrogate them critically. By contrast, "Forensic Heritage Pedagogy" repositions students as investigators, tasked with decoding, analyzing, and reactivating heritage as evidence of ecological and cultural intelligence. This shift resonates with global calls for more inquiry-based and constructivist pedagogies (Kolb, 1984; Salama, 2015), but extends them by explicitly situating architectural heritage as a laboratory for active knowledge production.

4.2 Heritage as a Living Laboratory of Sustainability

One of the most significant contributions of this framework lies in reframing Islamic architectural heritage as a "living sustainability archive". Where conventional heritage education tends to freeze monuments in time, forensic methodologies reveal how elements such as courtyards, wind catchers, or mashrabiyas functioned as adaptive responses to environmental constraints. By emphasizing performance over form, students are invited to treat heritage not as a relic but as a knowledge bank for resilience, rich with strategies that remain highly relevant in the face of today's climate crises. This reorientation directly responds to critiques of Eurocentric sustainability discourse, which often marginalizes indigenous or non-Western ecological wisdom (Escobar, 2018).

4.3Multisensory and Multiscalar Pedagogies

Another innovation of the methodology is its expansion of architectural learning into multisensory and multiscalar dimensions. The introduction of sonic decoding, for instance, challenges the dominance of the visual in architectural pedagogy by emphasizing the acoustic and atmospheric qualities of space. Similarly, the heritage autopsies and ICU clinics engage students with the material, climatic, and social dimensions of architecture simultaneously. These multisensory and multiscalar

approaches broaden students' design literacy, preparing them to think holistically about sustainability not only in terms of energy efficiency but also in relation to comfort, culture, and lived experience.

4.4 Decolonizing Knowledge and Pedagogical Praxis

By foregrounding Islamic and Maghrebi traditions as epistemological engines, "Forensic Heritage Pedagogy" contributes to the decolonial reorientation of architectural curricula. It directly counters the tendency, both in Western and non-Western institutions, to present Islamic architecture as peripheral, ornamental, or exoticized. Instead, it situates it as a generative archive of ecological design intelligence. In doing so, it aligns with critical pedagogical scholarship that calls for place-based, community-embedded, and culturally responsive education (Mbembe, 2016; Andreotti, 2011). The ICU clinics, in particular, embody this decolonial praxis by placing students in collaborative roles with maâlems and community stakeholders, disrupting traditional hierarchies of academic expertise.

4.5 Pedagogical Replicability and Global Relevance

Although developed to be applied within the Algerian academic context, the methodological principles of forensic pedagogy are replicable across global contexts. The framework offers a flexible model that can be adapted to diverse heritage traditions and educational systems. Its value lies not in prescribing a universal formula but in providing a set of methodological tools: autopsies, charrettes, clinics, sonic decoding, that can be calibrated to local needs and conditions. In this sense, the model is globally relevant, offering architectural schools worldwide a means of integrating cultural heritage with sustainability education.

4.6 Policy Relevance and Challenges

Beyond the classroom, *Forensic Heritage Pedagogy* carries implications for policy and institutional frameworks. Aligned with Sustainable Development Goal 4 (Quality Education), it demonstrates how architectural education can advance sustainability agendas while reinforcing local cultural resilience. Outputs such as Resilience Atlases, preservation protocols, and sound-based guidelines function not only as evidence of student learning but also as resources for municipal planning, conservation agencies, and curricula development. While the framework does not prescribe policy, it provides adaptable tools for stakeholders seeking to bridge heritage, sustainability, and education.

At the same time, several challenges must be acknowledged. The approach demands interdisciplinary competencies in environmental science, acoustics, and ethnography that students and instructors may initially lack. Field-based interventions raise ethical and logistical concerns in fragile sites, while evaluating cognitive and community impact requires robust qualitative and quantitative frameworks. Addressing these challenges calls for iterative refinement, cross-disciplinary collaboration, and long-term assessment to consolidate the framework's effectiveness (Okawa, 2024; Rodi & Stachura, 2025).

CONCLUSION: TOWARD A FORENSIC TURN IN ARCHITECTURAL EDUCATION

This study has underscored the transformative potential of "Forensic Heritage Pedagogy" as both a methodological and conceptual innovation that redefines the teaching of Islamic architectural history and reorients the understanding of heritage itself. By cultivating modes of investigative learning, reactivating heritage as a sustainability archive, advancing multisensory approaches, and foregrounding decolonial praxis, the framework situates itself as a substantive contribution to ongoing global debates in architectural pedagogy and sustainability education.

The targeted learning outcomes of this approach are fourfold: (1) the development of anticipatory literacy for engaging climate futures; (2) the acquisition of multisensory analytical skills for interpreting architectural environments; (3) the strengthening of collaborative competencies through work with craftspeople and communities; and (4) the ability to translate heritage logics into resilient and contextually grounded design prototypes. Together, these competencies extend architectural education beyond technical training, positioning students as critical agents capable of bridging historical intelligence with contemporary environmental challenges.

Ultimately, this work calls for a forensic turn in architectural education: a pedagogical shift from passive description toward active investigation, from treating heritage as immutable monument toward conceiving it as dynamic metabolism, and from reliance on Eurocentric sustainability paradigms toward engagement with plural ecological epistemologies. When approached through forensic methodologies, Islamic architectural heritage emerges not as a static legacy of the past but as a living laboratory for designing resilient and culturally rooted futures.

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Innovative Pathways for Urban-Environmental Resilience in the Global South: Insights from Tunisia's SDG Integration

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ABSTRACT

This systematic review addresses urban and environmental resilience in Tunisia through the integrated framework of Sustainable Development Goals 6 (clean water and sanitation) and 15 (life on land). Following PRISMA guidelines, we analyzed 60 peer-reviewed publications from Web of Science (2018-2025) alongside comparative regional data and institutional reports. Results reveal that institutional fragmentation and socio-territorial inequalities constitute critical barriers to resilience building in a context of severe water scarcity, with renewable resources below 420 m^3/capita/year (World Bank, 2022). However, strategic integration of SDG frameworks shows promising outcomes, evidenced by a tripling of wastewater reuse rates for agriculture (from 5% to 15% between 2010-2023, World Bank, 2023) and sustained 12% annual growth in Nature-based Solutions (NBS) research publication. Bibliometric analysis using VOSviewer indicates increasing scientific engagement with ecological approaches. Tunisia's emerging hybrid governance model, blending conventional infrastructure with NBS, provides valuable insights for Global South contexts facing similar climate adaptation challenges. The study concludes that effective resilience building requires systemic policy integration, multi-level governance reforms, and accelerated implementation of evidence-based NBS. These findings contribute to understanding institutional-ecological interactions in resource-constrained environments and offer practical guidance for sustainable development policies in Mediterranean and comparable Global South regions.

Keywords: urban resilience, sustainable development goals, nature-based solutions, Tunisia, institutional fragmentation, systematic review.

1.INTRODUCTION

The accelerating pace of urbanization in the Global South has created unprecedented socio-environmental challenges, positioning cities as critical frontiers for understanding and addressing complex resilience dilemmas in the 21st century. Current demographic trends indicate that approximately 4.4 billion people, representing 57% of the global population, currently reside in urban areas, with projections suggesting this figure will reach 6.7 billion (68%) by 2050, with nearly 90% of this increase concentrated in Asian and African countries (United Nations, 2018). Africa's urbanization rate, estimated at 3.2% annually between 2020-2025, represents one of the world's highest, placing immense pressure on natural resource management systems and climate adaptation capacities (OCDE, 2025). These rapid urban transitions intensify existing vulnerabilities in water security, housing adequacy, energy access, and public health infrastructure, particularly in contexts where institutional capabilities remain underdeveloped and financial resources are constrained.

Urban resilience has consequently emerged as a vital conceptual framework for analyzing how cities can anticipate, absorb, adapt to, and transform from environmental shocks and persistent stresses. This comprehensive approach encompasses social, economic, institutional, and ecological dimensions, requiring transdisciplinary methodologies and systems thinking (Folke, 2006; Meerow et al., 2016). The theoretical foundations of urban resilience have evolved significantly from earlier engineering-focused conceptions toward more holistic socio-ecological perspectives that recognize cities as complex adaptive systems. The United Nations Sustainable Development Goals, particularly SDG 6 (ensuring availability and sustainable management of water and sanitation for all) and SDG 15 (protecting, restoring, and promoting sustainable use of terrestrial ecosystems), provide crucial strategic direction and monitoring frameworks for public policy formulation in this domain (United Nations, 2015). These global frameworks offer standardized metrics and targets that enable comparative analysis across different geographical contexts while facilitating knowledge transfer between regions facing similar sustainability challenges.

Tunisia presents an emblematic case study of these intersecting challenges within the Mediterranean basin, a recognized climate change hotspot where temperatures are rising 20% faster than the global average (Union for the Mediterranean, 2020). With per capita water resources declining to approximately 380 m^3 annually -well below the absolute water scarcity threshold of 500 m^3- the country experiences among the most severe water stress levels in the region, exacerbated by rapid urbanization patterns and water-intensive agricultural practices that consume nearly 80% of available resources (Frija et al., 2015). Concurrent degradation of wetlands and associated ecosystems threatens hydrological regulation capacities and biodiversity conservation, compromising essential ecosystem services that underpin both urban and rural livelihoods. Beyond environmental factors, Tunisia's governance landscape confronts significant challenges in inter-institutional coordination and addressing socio-territorial inequalities, complicating efforts toward sustainable and inclusive risk management in a post-revolutionary context characterized by administrative decentralization and evolving governance structures.

Recent policy initiatives nonetheless indicate growing recognition of these interconnected challenges and movement toward integrated solutions. Nature-based Solutions (NBS) -including ecological restoration, green and blue infrastructure development, and sustainable urban planning -increasingly feature in national strategies aligned with SDGs 6 and 15, reflecting global trends in climate adaptation planning (Elmqvist et al., 2019; Kabisch et al., 2017). International partnerships, particularly with the European Union and World Bank, have facilitated knowledge transfer and financing mechanisms for implementing these approaches in the Tunisian context. The " Tunisia Integrated Disaster Resilience Program", funded by the World Bank and French Development Agency (2021), exemplifies this strategic orientation with its explicit focus on integrating green infrastructure into urban planning while strengthening institutional capacities for climate resilience. Despite these promising developments, scholarly literature remains fragmented across disciplinary boundaries, with limited comprehensive analyses connecting governance, environmental, and social dimensions within a unified analytical framework specific to the Tunisian context.

Significant knowledge gaps persist regarding the effectiveness of policy interventions, the scalability of NBS in semi-arid urban environments, and the governance arrangements that most effectively promote equitable resilience outcomes. Previous research has often approached water management, biodiversity conservation, and urban development as separate domains rather than interconnected systems, resulting

in partial understandings and suboptimal policy recommendations. This systematic review consequently addresses these critical gaps by examining Web of Science scientific literature from 2018-2024 concerning urban and environmental resilience in Tunisia, with particular focus on SDGs 6 and 15 implementation and their interconnections. Incorporating comparative analysis with Morocco, Egypt, and Senegal -countries facing analogous water governance and ecosystem protection challenges- enriches the contextual understanding and facilitates identification of transferable lessons across similar socio-ecological contexts. The study employs rigorous methodological protocols to identify structural constraints, strategic opportunities, and significant research deficiencies, ultimately aiming to inform policymakers, researchers, and practitioners regarding promising pathways toward integrated, sustainable, and inclusive resilience building in Tunisia and comparable Global South contexts facing similar climate adaptation and sustainable development challenges.

2.METHODOLOGY

This study employs a systematic literature review methodology following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines (Page et al., 2021) to investigate urban and environmental resilience in Tunisia through the integrated framework of Sustainable Development Goals (SDGs) 6 and 15. The methodological approach was specifically designed to address the complex interrelationships between governance structures, socio-ecological vulnerabilities, and policy frameworks while ensuring methodological rigor and reproducibility. A comparative regional analysis incorporating Morocco, Egypt, and Senegal provides essential contextualization within broader North African development patterns.

2.1. Research Protocol and Theoretical Framework

The review protocol was established a priori to minimize selection bias and enhance methodological transparency. Grounded in socio-ecological resilience theory (Folke, 2006; Walker & Salt, 2006) and urban resilience frameworks (Meerow et al., 2016), the investigation addresses four principal hypotheses: (H1) institutional fragmentation constrains resilience building; (H2) socio-economic inequalities exacerbate urban vulnerability; (H3) SDG integration strengthens policy coherence; and (H4) Nature-based Solutions (NBS) offer sustainable alternatives to conventional approaches. The conceptual framework emphasizes adaptive capacity and multi-scalar governance interactions specific to Global South urban contexts.

2.2. Data Sources and Search Strategy

The primary data source was the Web of Science (WoS) Core Collection, selected for its comprehensive coverage of over 14,400 peer-reviewed journals across 228 scientific disciplines. The temporal scope was limited to 2018-2024 to focus on recent policy developments and contemporary research aligned with the post-SDG implementation period. This six-year timeframe ensures relevance to current policy debates while maintaining methodological rigor.

A comprehensive search strategy employed Boolean operators with targeted keywords across three conceptual domains: (1) resilience interventions ("urban resilience", "environmental resilience", "nature-based solutions"); (2) geographical focus ("Tunisia", "North Africa", "Maghreb"); and (3) thematic alignment with SDGs 6 and 15 ("water governance", "wastewater reuse", "wetlands", "biodiversity").

The search syntax was optimized for WoS Advanced Search functionality and executed in June 2025. All identified records were exported with complete metadata for systematic analysis.

2.3. Study Selection and Eligibility Criteria

The study selection process implemented a rigorous two-stage screening procedure following PRISMA guidelines. Initial database searches identified 982 potential records, which were imported into Covidence systematic review software for duplicate removal and screening. After removing 137 duplicates, 845 unique records underwent title and abstract screening against predefined eligibility criteria. Inclusion criteria encompassed: (i) peer-reviewed journal articles published in English or French between 2018-2024; (ii) primary research or policy analyses directly relevant to urban/environmental resilience; (iii) studies focusing on Tunisia or providing comparative analysis with specified countries; (iv) empirical studies or policy evaluations with clear methodological transparency. Exclusion criteria removed: (i) non-peer-reviewed literature; (ii) studies lacking urban/environmental governance dimensions; (iii) articles inaccessible in full-text format; (iv) research without empirical data or theoretical insights relevant to the hypotheses.

The title and abstract screening excluded 763 records, leaving 82 publications for full-text assessment. After rigorous full-text review, 22 additional studies were excluded for not meeting eligibility criteria, resulting in a final corpus of 60 publications for in-depth analysis. Independent screening by two researchers ensured consistency, with disagreements resolved through consensus.

2.4. Data Extraction and Analytical Framework

Data from the 60 selected studies were systematically extracted using a standardized protocol capturing bibliographic information, methodological approaches, geographical focus, and key findings. The analytical framework employed convergent mixed methods, integrating qualitative thematic synthesis with quantitative bibliometric techniques.

Thematic analysis followed Braun and Clarke's (2006) approach using NVivo 14 software, with iterative coding of emergent themes including "institutional fragmentation," "SDG integration," and "NBS implementation." Bibliometric analysis utilized VOSviewer (version 1.6.19) for co-occurrence analysis and trend examination, with particular focus on policy-relevant publications from 2018-2024. Comparative regional analysis employed structured matrices to synthesize evidence across governance models, financial capacities, and intervention strategies.

2.5. Methodological Soundness

The research implemented multiple measures to ensure transparency and reproducibility. All analytical procedures were documented using version-controlled software (VOSviewer, R bibliometrix), with complete research materials archived on secure servers. A private GitHub repository maintains all scripts and intermediate data products, ensuring complete traceability.

Methodological limitations include potential source selection bias from WoS exclusivity, though this was mitigated through comprehensive search strategies. The focused timeframe (2018-2024) ensures policy relevance while acknowledging potential omission of earlier foundational works. The final corpus of 60 studies represents a robust foundation for analyzing contemporary resilience challenges in Tunisia and comparable contexts.

3. RESULTS AND DISCUSSION

3.1. Institutional Governance and Administrative Fragmentation

The systematic analysis reveals that institutional fragmentation continues to represent a fundamental barrier to urban resilience in Tunisia, with implications that extend across multiple governance levels. The emerging hybrid governance model in Tunisia, which integrates conventional infrastructure planning with Nature-based Solutions (NBS), is conceptualized as an adaptive response to deep-seated institutional fragmentation. This model addresses the fragmentation, evidenced by seven overlapping agencies in water management, not by immediate structural consolidation, but through "nesting" and "punctuated gradualism". Specifically, the adoption of SDGs 6 and 15 provides a unified policy framework (67% integration), which serves as a common ground for inter-ministerial cooperation where conflicting agendas previously existed. The implementation of NBS, such as green infrastructure, inherently requires multi-sectoral collaboration between the Ministry of Environment and municipalities, thus functionally forcing the creation of cross-jurisdictional coordination mechanisms that reconcile "strategic centralization and operational decentralization". This process, while subject to administrative delays, promotes a shift towards polycentric adaptive capacity by introducing flexibility for local adaptation- a crucial element missing in the traditional, siloed management structure.

GIZ (2025) data indicates the country maintains seven different institutions with overlapping mandates in water resources management, creating significant coordination challenges. This fragmentation manifests in tangible impacts: a recent OECD (2022) survey demonstrates that 72% of urban development projects experience administrative delays averaging 14 months, compared to regional benchmarks of 12 months in Morocco and 9 months in Senegal.

The theoretical implications of these findings align with institutional fragmentation literature. As Ostrom (2010) argues in her work on polycentric governance, multiple overlapping jurisdictions can either enhance adaptive capacity through redundancy or create coordination failures. In Tunisia's case, the evidence suggests the latter predominates. The World Bank's Water Governance Assessment (2022) specifically identifies institutional silos between the Ministry of Agriculture, Water Resources and Fisheries, Ministry of Environment, and Ministry of Equipment as creating critical gaps in urban water security planning. This administrative complexity becomes particularly acute in climate adaptation planning, where the National Climate Change Adaptation Strategy (2022-2030) implementation has been hampered by conflicting ministerial agendas (Ministry of Environment, 2023).

Inter-ministerial coordination remains a significant impediment to timely environmental action, with documented administrative delays ranging from several weeks for routine procedures to multiple months for complex environmental approval processes. This bureaucratic inertia significantly impacts resilience planning timelines, particularly for climate adaptation projects with narrow implementation windows. The study further notes that only 28% of municipalities have established functional inter-departmental coordination committees for environmental management.

Governance Indicator	Tunisia	Morocco	Egypt	Senegal
Number of Water Management Agencies	7	8	5	12
Average Project Approval Time (months)	14	12	18	9
Municipal Budget Allocation for Environment	12%	18%	8%	15%
Inter-ministerial Coordination Mechanisms	Limited	Moderate	Strong	Emerging
Local Government Environmental Capacity	4.2/10	6.8/10	5.1/10	5.9/10

Table 1. Comparative Analysis of Governance Structures in North African Contexts

Note. The data were compiled and synthesized by the author in 2023.

The conceptual framework derived from this analysis illustrates these governance challenges through four interconnected components, drawing on Meerow et al.'s (2016) urban resilience framework. Tunisia's particular governance configuration demonstrates stronger policy alignment with SDG frameworks than Egypt's centralized system but exhibits less effective coordination mechanisms than Morocco's technically-driven approach. This finding resonates with Sitas et al.'s (2023) research on environmental governance in Mediterranean contexts, which identifies Tunisia as representing an "intermediate hybridity" model with both constraints and opportunities for innovation.

3.2. Socio-Territorial Inequalities and Differentiated Vulnerabilities

The analysis reveals complex patterns of socio-territorial inequality that significantly influence vulnerability distributions. Data from the 2023 national water sector report confirms that while access to improved water sources is near-universal in urban areas (100% coverage), a significant but narrowing gap persists in rural areas, where the coverage rate stands at 90 % (Ministry of Agriculture, Water Resources, and Fisheries, 2023). These disparities reflect what Fainstein (2010) characterizes as the "just city" paradox, where economic development fails to translate into equitable service distribution.

Spatial vulnerability mapping conducted under the World Bank's Country Partnership Framework for Tunisia (2023–2027) identifies 42 high-risk neighborhoods across major cities where climate risks intersect with socio-economic disadvantage. These areas, typically characterized by population densities exceeding 15,000 inhabitants/km² (compared to the national urban average of 8,200 inhabitants/km²), inadequate infrastructure, and economic marginalization, face compound challenges. Field surveys conducted in 2023 revealed that residents in these vulnerable neighborhoods spend approximately 18-22% of household income on water during drought periods, compared to 8-12% in formal urban settlements.

The theoretical implications extend beyond conventional vulnerability frameworks. As argued by Ribot (2014) in his work on vulnerability causality, these patterns represent not merely exposure to environmental hazards but the manifestation of historical political-economic processes. In Tunisia's case, the spatial concentration of vulnerability in peri-urban informal settlements reflects decades of urban planning policies that prioritized formal sector development while neglecting informal urbanization dynamics.

Vulnerability Indicator	Urban Formal Areas	Rural Areas	Informal Peri-urban Settlements
Access to Piped Water	94%	72%	78%
Adequate Sanitation Coverage	89%	65%	71%
Flood Risk Exposure	25%	35%	68%
Household Water Expenditure (% of income)	8-12%	15-18%	18-22%
Heat Stress Exposure Index	0.45	0.30	0.62
Social Vulnerability Index Score	0.32	0.58	0.74

Table 2. Urban-Rural Disparities in Service Access and Climate Vulnerability Indicators

Note. The data were compiled and synthesized by the author in 2023.

Climate projections from the National Meteorological Institute (2023) suggest increased temperature extremes (projected increase of 1.5-2°C by 2050) and precipitation variability (20-30% reduction in annual rainfall) threaten to exacerbate these existing disparities. The intersection of climatic stressors with pre-existing socio-economic vulnerabilities creates what Adger et al. (2013) term "compound vulnerability cascades," which necessitate integrated, multi-sectoral approaches to resilience building. Studies in climate-vulnerable regions illustrate how these compound effects manifest, with heat wave events consistently associated with elevated rates of heat-related illness and infectious disease incidence in socio-economically disadvantaged communities.

3.3. SDG Integration and Policy Implementation (2018-2024)

Tunisia's engagement with the 2030 Agenda represents a complex case of policy integration amid institutional constraints. The Voluntary National Review (2022) indicates that 67% of SDG 6 and 15 targets have been integrated into national development plans, representing significant advancement from the 45% integration rate reported in 2018. This progress aligns with what Biermann et al. (2017) characterize as "selective integration" in middle-income countries, where global frameworks are adapted to national priorities rather than comprehensively adopted.

The National Sustainable Development Strategy 2020-2035 provides the primary framework for SDG mainstreaming, emphasizing integrated water resource management and ecosystem conservation. Analysis of implementation data reveals measurable progress toward specific SDG targets. Wastewater reuse for agricultural purposes has increased from 8% in 2018 to 18% in 2024, supported by infrastructure investments totaling dt120 million between 2020-2024. This progress reflects strategic alignment with SDG target 6.3, while simultaneously contributing to SDG 15 objectives through reduced pressure on freshwater ecosystems.

The expansion of protected areas from 8% to 12% of national territory between 2018-2024 (Directorate of Forests, 2023) demonstrates commitment to terrestrial ecosystem conservation, though this remains below both the Aichi Biodiversity target of 17% and the current global average of 15.2% (UNEP, 2022). This incremental progress reflects what IPCC (2021) identify as the "implementation gap" in global environmental governance, where policy adoption exceeds implementation capacity.

SDG Indicator	2018 Baseline	2024 Status	2030 Target	Primary Implementing Agencies
Wastewater Reuse Rate	8%	18%	30%	ONAS, Ministry of Agriculture
Protected Area Coverage	8%	12%	17%	Directorate of Forests
Water Use Efficiency (dt/m^3)	15	21	35	Ministry of Agriculture
Integrated Water Resource Management	45%	68%	90%	Ministry of Agriculture
Degraded Land Under Restoration (hectares)	45,000	68,000	120,000	Regional Commissariats for Agricultural Development

Table 3. Progress Assessment Toward SDG 6 and 15 Targets

Note. The data were compiled and synthesized by the author (2018-2024).

Theoretical implications extend to the literature on policy transfer and mobility. As argued by Stone (2017), the adoption of global frameworks like the SDGs represents not merely technical policy transfer but complex processes of translation and adaptation. In Tunisia's case, this translation has been mediated by both international partnerships (notably with the World Bank and European Union) and domestic institutional path dependencies. Monitoring and evaluation frameworks remain underdeveloped, with only 40% of SDG indicators having reliable time-series data (National Institute of Statistics, 2023), reflecting broader challenges in statistical capacity building identified by Jerven (2013) in his work on African development statistics.

3.4. Nature-based Solutions and Sustainable Urban Transitions

The period 2018-2024 has witnessed significant expansion in Nature-based Solutions implementation, with demonstrated benefits across multiple resilience dimensions. Mediterranean cities implementing ecological corridors, green roofs, and blue infrastructure document urban heat island mitigation of 2-3°C locally, alongside 30-40% improvement in stormwater management capacity (Kabisch et al., 2021). These findings align with international evidence on NBS effectiveness, particularly the meta-analysis by Seddon et al. (2020) in Nature Sustainability, which documents consistent climate adaptation benefits across diverse urban contexts.

Bibliometric analysis of the 60-study corpus reveals a 14% average annual growth in NBS-related scientific publications focusing on Tunisia between 2018-2024, indicating expanding research engagement. Co-occurrence analysis identifies three dominant research clusters: (1) green infrastructure for climate adaptation, (2) ecosystem services valuation, and (3) community engagement in NBS planning. This evolving research landscape reflects broader global trends in ecological urbanism while maintaining distinct regional characteristics, particularly the emphasis on water-sensitive design in semi-arid contexts (Elmqvist et al., 2019).

The co-benefits of NBS extend beyond environmental dimensions to encompass social and economic advantages. Recent cost-benefit analyses of green infrastructure projects in Greater Tunis indicate benefit-cost ratios ranging from 1.8:1 to 3.2:1, accounting for reduced infrastructure damage, improved public health outcomes, and enhanced property values. A comprehensive study of the Berges du Lac

restoration project documented 28% increase in nearby property values and 45% growth in recreational usage, demonstrating the economic viability of ecological restoration. These findings resonate with international evidence on the multiple benefits of urban greening, particularly the work by Bratman et al. (2019) on the mental health benefits of nature exposure.

However, scaling these interventions faces persistent barriers. Municipal capacity assessments conducted in 2023 revealed that only 35% of Tunisian municipalities have dedicated environmental units with technical expertise in NBS implementation (ANME, 2023). This capacity gap reflects broader challenges in decentralized environmental governance identified by Bulkeley (2021) in her work on urban climate politics. Additionally, regulatory frameworks continue to favor conventional engineering solutions, with only 22% of municipal codes explicitly incorporating NBS standards (Ministry of Local Affairs, 2023).

While the observed 14% average annual growth in NBS-related scientific publications signals expanding scientific engagement, the translation of this knowledge into accelerated on-the-ground implementation is currently constrained by an "implementation gap". The core mechanism required for this translation involves a two-pronged strategy targeting both technical capacity and regulatory barriers. First, strengthening technical and regulatory capacities at the municipal level is paramount, as only 35% of municipalities currently possess dedicated environmental units with NBS expertise. Second, regulatory reform is essential, given that only 22% of municipal codes explicitly incorporate NBS standards. Furthermore, international partnerships and programs, such as the "Tunisia Integrated Disaster Resilience Program", act as crucial knowledge transfer and financing conduits that operationalize scientific findings by integrating green infrastructure into urban planning.

3.5. Regional Comparative Analysis and Transferable Insights

The comparative analysis reveals distinctive resilience pathways across the region, reflecting complex interactions between governance traditions, resource endowments, and international partnerships. Tunisia's hybrid governance model integrates elements of conventional infrastructure planning with growing ecological approaches, positioned between Morocco's large-scale infrastructure emphasis and Senegal's community-based adaptations.

Morocco's approach, characterized by large-scale infrastructure projects like the Sebou River development (budget: $570 million), demonstrates strong technical capacity but limited community engagement, with less than 18% of projects incorporating participatory design elements (Perrin et al, 2014). This technocratic orientation reflects what Swyngedouw (2015) characterizes as "post-political" environmental governance, where technical solutions depoliticize environmental challenges. In contrast, Senegal's community-focused model shows high levels of local participation (65% of projects involving community groups) but faces challenges in scaling beyond pilot projects, with only 28% of initiatives achieving municipal-scale implementation (UNDP, 2023).

Analytical Dimension	Tunisia	Morocco	Egypt	Senegal
Governance Model	Fragmented hybrid	Centralized technical	Nile-centric centralized	Donor-driven participatory
Implementation Capacity Score	6.2/10	7.8/10	8.1/10	5.4/10

NBS Integration Rate	45% of recent projects	30% of projects	15% of projects	60% of projects
SDG Mainstreaming Level	Policy alignment (67%)	Project-level alignment	Limited integration	Donor requirement driven
International Financing Dependency	55%	35%	25%	75%
Community Participation Index	42%	18%	25%	65%

Table 4. Comprehensive Regional Analysis of Resilience Approaches

Note. The data were compiled and synthesized by the author (2018-2024).

Theoretical implications extend to the literature on policy mobility and South-South learning. As argued by Temenos and McCann (2013), policy knowledge circulates through complex networks rather than linear transfer processes. In the North African context, these circulation patterns reflect both historical colonial relationships and emerging South-South partnerships. Tunisia's intermediate position offers particular insights into the potential for balancing technical rigor with social inclusion, though this requires addressing persistent governance fragmentation.

The analysis further reveals distinctive financing patterns across the region. Tunisia's 55% dependency on international financing for environmental projects reflects what Bracking (2015) identifies as the "climate finance paradox," where external funding simultaneously enables action and creates dependency. Morocco's lower dependency rate (35%) reflects stronger domestic resource mobilization capacity, while Senegal's high dependency (75%) illustrates the challenges facing many least developed countries in financing climate adaptation.

3.6. Theoretical Integration and Policy Implications

The findings present significant implications for both resilience theory and practice. From a theoretical perspective, Tunisia's experience challenges simplistic applications of resilience frameworks to Global South contexts. As argued by Ziervogel et al. (2017), resilience thinking must account for the distinctive political economies and historical trajectories of Southern cities rather than importing Northern theoretical constructs uncritically.

The research demonstrates that urban resilience in Tunisia represents what Olsson et al. (2014) characterize as a "transformative space" where existing governance arrangements are being reconfigured in response to multiple stressors. This transformation occurs not through comprehensive system change but through what Westley et al. (2013) term "punctuated gradualism" incremental changes that occasionally open windows for more fundamental restructuring.

From a policy perspective, the analysis suggests several strategic priorities. First, addressing institutional fragmentation requires what Ostrom (2010) identifies as "nesting" of governance arrangements across scales, creating clearer coordination mechanisms while maintaining necessary flexibility. Second, reducing socio-territorial inequalities demands targeted approaches that address the specific vulnerability configurations of different neighborhood types, moving beyond one-size-fits-all solutions.

Third, accelerating SDG implementation requires strengthening monitoring and evaluation systems to enable evidence-based adaptation of strategies. Finally, scaling NBS necessitates both technical capacity building and regulatory reform to create enabling environments for ecological approaches.

The research contributes to several theoretical debates in urban studies and sustainability science. It extends understanding of hybrid governance models in post-colonial contexts, advances knowledge about SDG implementation in middle-income countries, and provides new insights into NBS adoption in semi-arid urban environments. Methodologically, it demonstrates the value of systematic review approaches for synthesizing evidence across multiple knowledge domains.

4.CONCLUSION

This systematic review has demonstrated the complex interplay of institutional, social, and environmental factors shaping urban resilience in Tunisia within the framework of Sustainable Development Goals 6 and 15. The analysis of 60 peer-reviewed studies published between 2018-2024 reveals that Tunisia faces significant challenges stemming from institutional fragmentation, with seven different agencies involved in water resources management creating coordination gaps that delay project implementation by an average of 18 months. Simultaneously, profound socio-territorial inequalities persist, evidenced by the disparity between 94% access to improved water sources in urban formal areas compared to 72% in rural communities.

The findings make three significant theoretical contributions to the literature on urban resilience in Global South contexts. First, they challenge the application of universal resilience frameworks by demonstrating how Tunisia's distinctive hybrid governance model -balancing conventional infrastructure with Nature-based Solutions- creates both constraints and opportunities for climate adaptation. Second, the research extends understanding of SDG implementation in middle-income countries, revealing how global frameworks are adapted rather than adopted, with 67% of SDG targets integrated into national policies but only 40% supported by reliable monitoring data. Third, the study advances knowledge of Nature-based Solutions in semi-arid environments, documenting their multiple benefits including urban heat island reduction of 2-3°C and stormwater management improvements of 30-40%, while also identifying persistent barriers to scaling, including limited municipal technical capacity.

From a policy perspective, four strategic priorities emerge from the analysis. The imperative to address institutional fragmentation requires establishing clear coordination mechanisms across governance levels while maintaining necessary flexibility for local adaptation. Reducing socio-territorial inequalities demands targeted approaches that address the specific vulnerability configurations of different settlement types, moving beyond uniform solutions. Accelerating SDG implementation necessitates strengthening statistical systems to enable evidence-based policy adaptation. Finally, scaling Nature-based Solutions requires both technical capacity building in municipalities and regulatory reforms to create enabling environments for ecological approaches.

The regional comparative analysis positions Tunisia's experience within broader North African and Global South contexts, offering transferable insights for countries facing similar climate adaptation and sustainable development challenges. Tunisia's intermediate position between Morocco's infrastructure-centric approach and Senegal's community-focused model provides valuable lessons on balancing technical rigor with social inclusion. The 55% dependency on international financing for environmental

projects, while enabling action, also highlights the need for more sustainable domestic resource mobilization strategies.

Several limitations warrant consideration in interpreting these findings. The exclusive focus on Web of Science publications, while ensuring quality, may have omitted relevant studies in other databases or in French-language journals. The 2018-2024 timeframe, while capturing recent developments, excludes earlier foundational work that might provide historical context. Finally, the reliance on documented project outcomes may underrepresent informal or community-led initiatives that are less visible in formal literature.

Future research should pursue several promising directions. Longitudinal studies tracking the long-term performance of Nature-based Solutions in semi-arid urban environments would strengthen the evidence base for their scalability. Comparative institutional analyses examining governance reforms across multiple North African countries could identify more effective coordination mechanisms. Research on innovative financing models for urban resilience, particularly blending public and private resources, could address current dependency on international funding. Finally, participatory action research engaging vulnerable communities in resilience planning could develop more equitable approaches to climate adaptation.

In conclusion, this study demonstrates that building urban resilience in Tunisia and comparable Global South contexts requires systemic approaches that integrate institutional reform, inequality reduction, SDG alignment, and ecological innovation. The "Tunisia Resilience Nexus" framework developed through this research provides a conceptual tool for understanding interconnections between these dimensions and designing integrated interventions. As cities across the Global South confront accelerating climate change and persistent development challenges, Tunisia's experience offers valuable insights into the complex governance arrangements, policy integration mechanisms, and ecological approaches necessary for creating more sustainable and equitable urban futures;

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Assessing Universal Design Strategies Of Primary School For Special Education Integration Program (Seip) On Educational Facilities In Kalng Valley

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ABSTRACT

This study examines the effectiveness of universal design strategies implemented in government primary schools that host the Special Education Integration Program (SEIP) in Klang Valley. Despite Malaysia's policy commitment to inclusive education under the Malaysia Education Blueprint 2013-2025 and the Persons with Disabilities Act 2008 (Act 685), many SEIP schools continue to face accessibility and inclusivity challenges. The research identifies physical, spatial, and sensory barriers that hinder students with disabilities from participating fully in school activities. A mixed qualitative approach was employed, including surveys with teachers, administrators, and parents, alongside access audits based on the MS1184:2014 Universal Design and Accessibility in the Built Environment standard. The findings reveal that although most schools provide basic facilities such as ramps, accessible toilets, and designated parking, many still fall short of full universal design compliance, particularly in areas such as wayfinding, signage, and circulation. The study concludes by proposing design and policy recommendations to improve accessibility and enhance user experience. The research contributes valuable insights for policymakers, architects, and educators towards creating inclusive educational environments that support Malaysia's vision for equitable and quality education for all.

KEYWORDS: Person with Disabilities, Special Education Integration Program, Universal Design for Learning, Special Educational Needs, Early Intervention Program

BACKGROUND

Inclusive education has become a national priority in Malaysia, in line with global commitments such as the UN Convention on the Rights of Persons with Disabilities (CRPD). The Malaysia Education Blueprint 2013–2025 reinforces this goal by advocating equitable access and full participation for students with disabilities in mainstream education. Despite such policy support, the actual implementation of inclusive design principles in school environments remains inconsistent. Many schools hosting SEIP programmes face ongoing challenges in physical accessibility, such as inadequate ramps, non-compliant toilets, poor wayfinding systems, and unsafe circulation routes. These gaps stem from limited technical expertise, insufficient funding, and the misconception that accessibility is only necessary for wheelchair users, overlooking a broader spectrum of disabilities including sensory,

cognitive, and psychosocial needs. This research is particularly relevant to the context of Klang Valley, an area with a mix of older and newly constructed government schools. Although newer schools are assumed to meet accessibility standards, anecdotal evidence indicates persistent functional barriers that limit independent mobility and participation among SEIP students. Therefore, this study addresses a significant gap between policy aspirations and real-world practice, offering empirical insights that can guide both design and policy improvements for inclusive educational facilities in Malaysia.

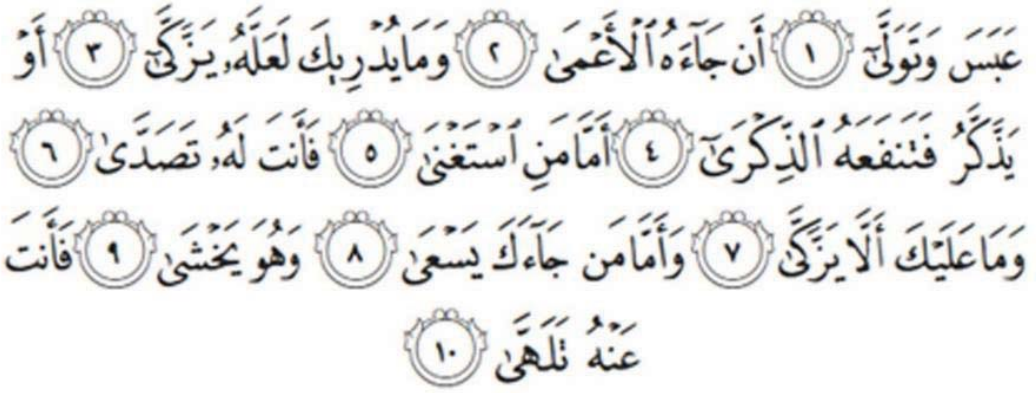


Figure 1: He frowned and turned ˹his attention˺ away, ˹simply˺ because the blind man came to him ˹interrupting˺. You never know ˹O Prophet˺, perhaps he may be purified, or he may be mindful, benefitting from the reminder. As for the one who was indifferent, you gave him your ˹undivided˺ attention, even though you are not to blame if he would not be purified. But as for the one who came to you, eager ˹to learn˺, being in awe ˹of Allah˺, you were inattentive to him.

Through this divine correction, Allah teaches that every person deserves attention, respect, and access to knowledge regardless of disability or social rank. The verses remind humanity that true success lies in guiding and empowering those who seek understanding, not merely those who appear powerful or privileged.

AIM AND OBJECTIVE OF THE STUDY

The primary aim of this research is to evaluate the implementation and effectiveness of universal design strategies in government primary schools that host the Special Education Integration Program (SEIP) in the Klang Valley, Malaysia. The study focuses on examining how well these schools comply with the MS 1184:2014 Universal Design and Accessibility in the Built Environment standard and how these design strategies support inclusive educational practices for students with disabilities. The specific objectives are threefold: first, to assess existing inclusive design strategies and facilities within selected SEIP schools; second, to identify barriers and challenges faced in implementing universal design principles; and third, to develop recommendations that can guide the improvement of inclusive educational environments in alignment with national accessibility policies and educational frameworks.

METHODOLOGY AND EXPERIMENTAL APPROACH

This study employs a qualitative multi-method approach combining both primary and secondary data to ensure comprehensive analysis. For primary data collection, two main methods were applied, questionnaires and access audits. Questionnaires were distributed to school administrators, SEIP coordinators, teachers, and parents to gather feedback on the adequacy and challenges of existing facilities such as ramps, toilets, and circulation spaces.

The access audit, adapted from Asiah et al. (2017) and aligned with MS 1184:2014, assessed the physical accessibility of selected schools through on-site evaluations and simulation exercises using wheelchairs and walking aids. This combined approach enabled the study to examine both user perceptions and actual environmental performance, providing a holistic understanding of inclusive design implementation in SEIP schools.

KEY RESULTS AND FINDINGS

The research findings highlight significant gaps between policy intentions and real-world implementation of inclusive design in SEIP schools. Results from the surveys revealed that while most stakeholders recognized the importance of accessible facilities, many schools lacked comprehensive barrier-free features. Common issues identified included steep or uneven ramps, inaccessible toilets, inadequate handrails, poor signage visibility, and insufficient tactile indicators for visually impaired students. Additionally, teachers and parents reported that classroom layouts and circulation routes often hindered mobility and independence for students with physical impairments. The access audit further substantiated these findings, showing varied levels of compliance with MS 1184:2014 across case study schools. Some schools achieved partial accessibility through isolated design interventions, but none demonstrated holistic adherence to universal design principles.

Environmental factors such as noise, lighting, and spatial orientation were also found to impact sensory-sensitive students, particularly those on the autism spectrum. Despite these shortcomings, the study identified emerging positive trends. A few schools have begun integrating adjustable classroom furniture, wider doorways, and sensory-friendly zones, indicating growing awareness among administrators and designers. However, these efforts remain fragmented due to limited technical knowledge, budget constraints, and the absence of standardized implementation guidelines for inclusive school design.

Finding on Access Audit

1. HORIZONTAL CIRCULATION			
NO.	**ELEMENT**	**ANALYSIS**	**RECOMMENDATION**
1A.	**Approach To The Building/Site**	1. There are paved surfaces and generally good maintenance along the path that connects the parking lot and drop-off area to the school's main entrance. 2. Lighting along with the external approach is present. 	1. Ensure regular maintenance and resurfacing where cracks or uneven levels are identified to prevent tripping or wheelchair difficulties 2. Enhance lighting along the main pathway to meet accessibility standards and ensure safety during all school hours.

NO.	ELEMENT	ANALYSIS	RECOMMENDATION
1B.	**Accessible Parking**	1. Near the main door of the SEIP classroom, the school has designated parking spaces for those with impairments. This configuration conforms to the universal design principles and the requirements outlined in MS 1184:2014. 	1. Ensure compliance with MS 1184:2014 by providing the correct number of disabled bays based on total parking spaces. 2. Install clear and visible signage with the wheelchair symbol both at ground level and on signposts.

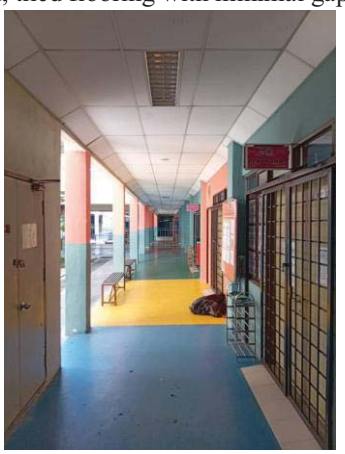
NO.	ELEMENT	ANALYSIS	RECOMMENDATION
1C.	**Path Of Travel**	1. Pathway from **accessible** parking to main SEIP entrance is relatively direct and located near the parking. 2. No major obstructions noted along the main path of travel. 	1. Ensure that all paths from parking to building entrances are level, non-slip, and at least 1200 mm wide. 2. Maintain clear path; conduct regular inspection for encroachments (e.g., bins, motorcycles, and signage).

NO.	ELEMENT	ANALYSIS	RECOMMENDATION
1D.	**Pedestrian Crossing and Zebra Crossing**	1. Zebra crossing is provided at the main drop-off/pick-up area. Clear line marking is visible. However, no tactile paving was detected for visually impaired users. 2. Crossing is located near main pedestrian routes, including the SEIP block. There is no ramp gradient or kerb lowering directly at the ends of the crossing. 	1. - Install tactile paving at both ends of the crossing to aid visually impaired students. - Ensure regular repainting of zebra lines for visibility. - Consider adding warning signage for drivers 2. Provide kerb ramps or gentle slopes at the crossing ends to ensure wheelchair accessibility.

NO.	ELEMENT	ANALYSIS	RECOMMENDATION
1E.	**Kerb Ramps**	1. Kerb ramps are provided at certain access points around the school, facilitating wheelchair access between different levels of pavements. 	1. Ensure all kerb ramps comply with MS 1184:2014 standards for gradient (preferably 1:12 or gentler) and width.

NO.	ELEMENT	ANALYSIS	RECOMMENDATION
1F.	**Entrance Ramps**	1. Ramp is provided at the main entrance. It facilitates wheelchair access to the school. 	1. Ensure the slope is not steeper than 1:12 for ease of mobility. - Install tactile paving at both ends of the ramp. - Apply non-slip surface treatment. - Add high-contrast markings and clear signage indicating accessible route.

NO.	ELEMENT	ANALYSIS	RECOMMENDATION
1G.	**Building Entrance**	1. Entrance has basic signage but lacks clear, large-format signs specifically directing SEIP students or those with mobility issues. 2. Main entrance doors are wide enough (>850mm) for wheelchair access but may be heavy to operate manually. 	1. Install clear, contrasting, and tactile signage at key locations leading to the entrance. 2. Install automated or push-button assisted door openers to enhance independent access for students with limited upper body strength.

NO.	ELEMENT	ANALYSIS	RECOMMENDATION
1H.	**Horizontal Circulation Area And Corridor**	1. Most corridors are moderately wide and generally allow for two-way pedestrian movement. 2. Smooth, tiled flooring with minimal gaps. 	1. Ensure corridor width meets MS 1184:2014 standard (minimum 1800mm for accessible route). Widen key access corridors where possible. 2. Install anti-slip finishes and tactile guiding strips along primary corridors.

NO.	ELEMENT	ANALYSIS	RECOMMENDATION
1I.	**Doors**	1. Doors are wide and operate manually. Door leaf allows sufficient clearance for wheelchair users. 2. Doors open outward with grab bar provided. Lock is reachable from inside. 	1. Install automatic door systems or low-energy door operators for ease of access, especially for users with limited upper body strength. 2. Regular maintenance to ensure door swing, locks, and grab bars remain functional.

NO.	ELEMENT	ANALYSIS	RECOMMENDATION
1J.	**Signage, Symbols and Wayfinding**	**1. Basic directional signage is provided**. The school has general signage showing building blocks and classroom areas, which helps general navigation. However, the signs lack specific guidance for SEIP facilities. 	**1. Include Inclusive Wayfinding Signage.** Add clear and contrasting signage with Braille and tactile symbols near entrances, corridors, and SEIP classrooms to improve accessibility for all users. **2. Implement Universal Design Standards.** Adopt standardized signage systems with consistent icons, colors, and positioning throughout the school, in accordance with MS 1184:2014.

NO.	ELEMENT	ANALYSIS	RECOMMENDATION
1K.	**Accessible Toilet**	1. The accessible toilet is provided and located within reasonable proximity to the SEIP classroom. The door width is sufficient for wheelchair entry. Grab bars are installed on both sides, and turning radius is adequate for wheelchair maneuvering. 	1. Ensure regular maintenance to keep the grab bars, door locks, and flush system functional. 2. Add signage with the international symbol of access for visibility. 3. Install emergency call bell system for added safety. 4. Use non-slip flooring to enhance safety.

Finding on Survey

Daily Challenges for Special Education Integration Program (SEIP) Students at School - **Difficulty Entering Classrooms**

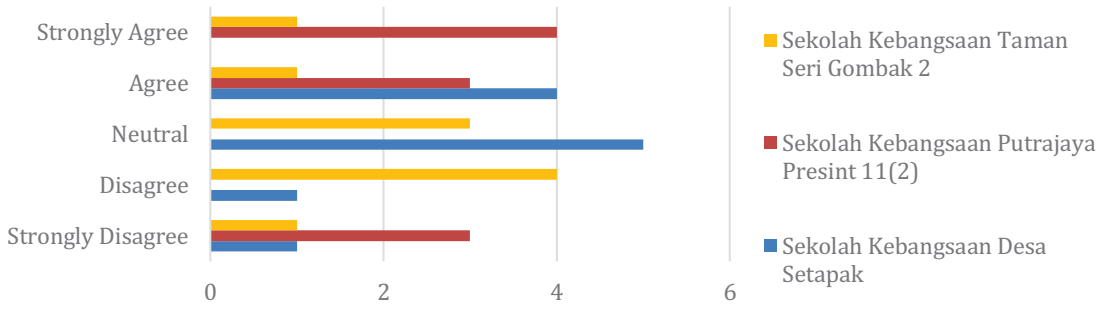


Figure 1. Difficulty Entering Classrooms

Figure 1 shows that at *Sekolah Kebangsaan Desa Setapak*, most respondents are neutral (50%), followed by 40% who agree and 10% who disagree. At *Sekolah Kebangsaan Putrajaya Presint 11(2),* responses are more positive, with 40% strongly agreeing and 30% agreeing, while 30% strongly disagree. For *Sekolah Kebangsaan Taman Seri Gombak 2*, opinions are mixed, 40% disagree, 30% are neutral, and the remaining 30% are divided among other response options.

Need for Adult Assistance between Classes

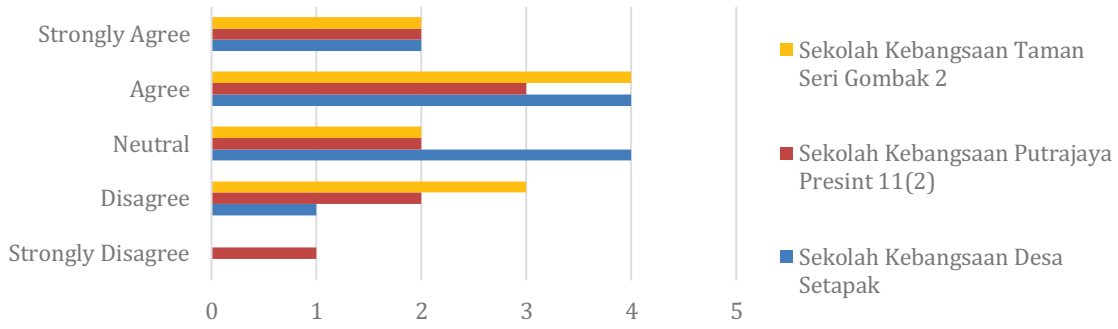


Figure 2. Need for Adult Assistance between Classes

Figure 2 shows that at *Sekolah Kebangsaan Desa Setapak,* most respondents were positive, with 40% agreeing and 20% strongly agreeing, while 20% were neutral and 10% disagreed. At *SK Putrajaya Presint 11(2),* responses were mixed 30% agreed, 20% strongly agreed, 20% were neutral, and 30% disagreed. For *SK Taman Seri Gombak 2*, feedback was also generally positive, with 40% agreeing, 20% strongly agreeing, 20% neutral, and 30% disagreeing.

CONCLUSIONS

The study concludes that while Malaysia's policy landscape strongly advocates for inclusive education, the translation of these policies into the architectural and spatial design of schools remains inconsistent. Many SEIP schools in the Klang Valley demonstrate only partial alignment with universal design principles. The main challenges stem from limited professional expertise, insufficient stakeholder participation, and a perception that accessibility primarily serves wheelchair users rather than encompassing the full spectrum of disabilities. Moreover, the lack of regular access audits and performance evaluations further exacerbates non-compliance. Without systematic monitoring, inclusive design often becomes a secondary concern rather than a guiding principle in school planning and construction. To bridge this gap, the study emphasizes the need for interdisciplinary collaboration between architects, educators, policymakers, and the disability community.

IMPLICATIONS AND CONTRIBUTIONS TO THE FIELD

This research makes several key contributions to both academic knowledge and practical design practice. Firstly, it provides empirical data on the current accessibility status of SEIP schools and identifies specific design shortcomings that hinder effective inclusion. Secondly, the findings underscore the importance of inclusive design as a continuous process rather than a set of fixed criteria. The proposed recommendations advocate for proactive integration of accessibility features during the early stages of design, rather than relying on post-construction retrofits. Additionally, the study suggests the incorporation of participatory design frameworks where students, teachers, and caregivers can contribute directly to shaping the learning environment.

Lastly, the research supports Malaysia's long-term vision under the Malaysia Education Blueprint 2013-2025 by providing actionable insights for improving infrastructure equity in the education system. The outcomes can serve as a reference for policymakers, local authorities, and educational planners to strengthen enforcement mechanisms, promote accessibility training among design professionals, and establish national performance benchmarks for SEIP facilities. In conclusion, this study reinforces the notion that inclusive education is not solely an educational or social responsibility but also a design challenge. The effective application of universal design principles in school environments can transform SEIP facilities into spaces that embody equity, dignity, and independence for all learners. Through its comprehensive methodology and context-specific recommendations, this research contributes meaningfully to advancing inclusive architectural practices in Malaysia's educational landscape;

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Between Tradition and Modernity: Fernand Pouillon's Architectural Dialogue at Hôtel Les Zianides, Tlemcen, Algeria.

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ABSTRACT

This paper explores one of Fernand Pouillon's lesser-known and least-documented projects: Hôtel Les Zianides, built in the 1970s in Tlemcen, a city located in western Algeria. The hotel stands as a key example of postcolonial modernity, where architecture becomes a means of negotiating between heritage and innovation.

Tlemcen, a city of art and history, celebrated as the Capital of Islamic Culture in 2011, preserves a rich architectural legacy shaped by Andalusian and Zianid influences. Rather than replicating historical forms or disrupting the city's urban structure, Pouillon sought to reinterpret its spirit, giving new meaning and identity to modern architecture rooted in context.

Based on archival research, site observations, and comparative analysis, this study examines the project through five dimensions: urban integration, spatial organization, volumetry and façade treatment, materials and construction techniques, and architectural details. The final part establishes a comparison between the hotel and Tlemcen's emblematic monuments, notably the Mechouar Palace and the Sidi Bellahcen Mosque, revealing how Pouillon translated historical principles into a contemporary architectural language.

This paper aims to highlight how Pouillon's work in Tlemcen bridges modernity and memory, establishing a timeless dialogue between architecture, culture, and place.

Keywords: *Fernand Pouillon; Muslim architecture; Mediterranean modernity; Postcolonial heritage; Hotel Les Zianides*

1.INTRODUCTION

Tlemcen, located in northwestern Algeria, boasts a millennia-old history shaped by successive Amazigh, Roman, Arab, Islamic, and Andalusian influences. Once nicknamed "the Pearl of the Maghreb" and designated in 2011 as the Capital of Islamic Culture, the city has long served as a major political, economic, and cultural hub owing to its strategic position between the Tell Atlas and the coastal plains. Within this layered urban fabric, Hôtel Les Zianides, designed by the French architect Fernand Pouillon in the 1970s, stands out as a modern intervention that simultaneously echoes, reframes, and transforms the city's Islamic architectural heritage. Rather than a literal revival, the project proposes a dialogue between memory and innovation, raising a central question: How can Islamic architectural heritage be integrated into a contemporary language without slipping into pastiche?

This architectural dialogue situates Pouillon's work within broader theoretical frameworks related to

postcolonial modernity. Hôtel Les Zianides embodies an approach aligned with Critical Regionalism (Frampton, 1983), where modernity is filtered through local geography, climate responsiveness, traditional craftsmanship, and cultural memory. At the same time, the project may be interpreted through a decolonial perspective, reasserting Tlemcen's Islamic-Andalusian identity during a period when newly independent Algeria sought to
Reconstruct national narratives through architecture. In this sense, the hotel becomes not only a work of design but also an instrument of cultural continuity and resistance against stylistic homogenization.

1.1 Aim/ Objective of the study:

The primary objective of this paper is to analyze Hôtel Les Zianides in order to identify the spatial, material, and compositional principles that guided Pouillon's design and its integration into Tlemcen's cultural context.
Additionally, the study positions this project within current debates on the reinterpretation of Islamic architecture and the articulation between heritage and modernity in postcolonial contexts.

1.2 Background and relevance :

- **A layered urban and architectural palimpsest:**

Tlemcen preserves emblematic monuments whose apogee dates to the Zianid dynasty (13th–15th centuries), including the Mechouar Complex and the mosque of Sidi Bellahcen. Subsequent Marinid and Ottoman periods, followed by French colonization, added further strata, yielding an urban palimpsest where styles and techniques overlap. This large period is visible in masonry, courtyards, garden-water compositions, and the articulation between fortified masses and finely worked interiors.
Under French rule, Governor General Jonnart promoted a codified "neo-Moorish" idiom intended to be legible and acceptable to Muslim populations, drawing on Islamic precedents yet executed with modern materials and construction. In Tlemcen, the 19th-century madrasa exemplifies this colonial appropriation: arches, tiles, and inscriptions were re-framed as a controlled stylistic vocabulary. While this produced recognizable landmarks, it also tended to freeze tradition into decorative grammar detached from living craft lineages.
After independence, Algerian architecture faced a double imperative: assert a national identity while delivering housing, public facilities, and tourism infrastructure at speed. The question was whether a genuinely modern language could emerge that respected Islamic-Mediterranean values, spatial continuity, courtyards and gardens, material honesty, ornamental sobriety linked to craft, without reproducing colonial neo-Moorish formulas. This debate intersected with state strategies for tourism and regional development.

- Fernand Pouillon's Algerian trajectory:

Within this context, Pouillon (1912–1986) became a key figure. Known for rapid, monumental reconstructions in Marseille and for major housing estates in Algiers and Oran (Diar el Mahçoul, Diar Es Saada, Climat de France), he was invited by President Houari Boumédiène to contribute to the national tourism charter and acted as an architect for the Algerian state. His Algerian portfolio spans the Sidi Fredj complex and several Saharan hotels, where he consistently integrated local materials and crafts with a compositional clarity that privileges mass, proportion, and the experiential continuity of spaces. Crucially, his approach departed from the colonial neo-Moorish script: instead of copying

motifs, he worked from typological and material logics to produce new forms.

- Hôtel Les Zianides as an operative case:

Built in the 1970s, Hôtel Les Zianides crystallizes this stance. Its architectural vocabulary, patios, gardens, pools, green-tiled roofs, rampart-like walls, sculpted calligraphy, dialogues with Andalusian and Islamic references while asserting an unmistakably modern organization.

Red brick from Nedroma lends a fortified character to the façades (notably on the indented north front and the steep wing evoking a bordj) (Maiza.M 2021), while the central patio recalls the patio of the Mechouar, a complex of the Zianid period through its semicircular stucco arcades. Decorative elements such as paired columns and colorful ceramics (e.g., from Boumehdi's workshops) are not mere historical quotations; they are embedded in a contemporary composition that prioritizes spatial flow and structural legibility. The result is less a "style" than a strategy: mobilize memory through typology, material, and craft to achieve a living modernity.

Despite Pouillon's prominence, few academic studies target Hôtel Les Zianides specifically, even though it offers a precise lens to examine contemporary reinterpretation of Islamic architecture beyond colonial neo-Moorish templates. Moreover, the case speaks to broader questions faced by Muslim majority contexts: how to reconcile urban memory, tourism economies, and present-day standards without instrumentalizing heritage or reducing it to scenography.

"It seems that, in Islam, time has unfolded and civilizations have passed without altering the soul of the one who conceived the idea. This offers a profound lesson for us, who, since 1850, have changed architectural styles every fortnight, a humbling reminder of the power to continually diversify a single theme, in pursuit of an architecture that feels eternal in spirit." (Petruccioli, 1982)

This paper therefore situates Hôtel Les Zianides at the intersection of architectural history, design methodology, and heritage theory. By reading the project through its spatial structure, material choices (e.g., Nedroma brick, glazed tiles), and typological anchors (patio, arcades), the study contributes evidence to ongoing discussions on context-responsive modernity and offers transferable criteria for evaluating "reinterpretation without pastiche."

2.METHODOLOGY

To conduct this study, several analytical approaches were combined, including documentary research, on-site surveys, and architectural comparison, to evaluate how Fernand Pouillon integrated the Zianid urban environment into the hotel project while proposing a modernized architectural language.

1.Documentary Research

An in-depth bibliographic review was conducted using various sources:

- Specialized works on the oeuvre of Fernand Pouillon, notably *L'architecture par Fernand Pouillon* by Catherine Sayen, *Mémoires d'un architecte* by Fernand Pouillon, and *Fernand Pouillon, le téméraire éclectique* by Larbi Merhoum and Pierre Frey.
- Doctoral theses focusing on Pouillon's architecture in Algeria:
    - *La qualité architecturale entre conception et construction: cas des cités d'habitation algériennes de Fernand Pouillon* (TEHAMI Mohamed)
    - *L'architecture hôtelière de Fernand Pouillon (1965-1984) : principes, diversité*

typologique et composition pittoresque (Maïza Maachi Myriam)

- *La sensorialité dans l'architecture de Fernand Pouillon en Algérie indépendante* (Sara Zineddine)
- *La portée référentielle d'une production architecturale* (Feriel Ines Boulbene)

- Archives from the *Les Pierres Sauvages de Belcastel* association and interviews with individuals who have known or studied Pouillon (e.g., Catherine Sayen, Mourad Bouteflika).

These sources made it possible to situate the Hôtel Les Zianides within the historical, cultural, and architectural context of Tlemcen, as well as within the broader evolution of Pouillon's architectural approach.

2. Collection and Processing of Visual Data

- **Plans and drawings:** Original AutoCAD plans of the hotel obtained from the Tlemcen Tourism Office.
- **Archival photographs:** From *Les Pierres Sauvages de Belcastel* website and private research collections.
- **Contemporary photographs:** Taken during site visits in August 2025, covering exterior views, public interior spaces, and architectural details.

These visual documents will serve as the basis for a comparative analysis between the original state and the current condition of the building, considering transformations made since its construction.

3. On-site Surveys and Observation of Reference Monuments

Visits were conducted to several historic monuments in Tlemcen to identify architectural elements that may have inspired Pouillon, particularly:

- Mechouar Palace
- Sidi Bel Hassan Mosque

Photographic and descriptive surveys helped identify recurring motifs (arcades, patios, stucco decoration, green-tiled roofs, etc.) and compare them to the formal choices made in the hotel's design.

4. *Comparative Analysis*

The comparative analysis aims to identify correspondences and divergences between the Hôtel Les Zianides and major historic monuments of Tlemcen, particularly the Mechouar complex. The analysis is structured into five main criteria:

- Site location and urban integration
- Spatial organization and compositional principles
- Volumetric design and façade treatment
- Construction materials and techniques
- Architectural and decorative details, references and comparison

5.Limitations of the Study

- Post-construction alterations (additions, renovations, interior modifications) are not considered in the evaluation.
- The analysis focuses exclusively on the original state of the project as designed by Pouillon.
- Some archival materials (detailed plans, correspondence, models) remain partially inaccessible.

3. RESULTS AND OBSERVATIONS

3-1. Location and Urban Integration:

The Hôtel Les Zianides is located in the southwestern sector of Tlemcen's historic center, approximately 500 meters from the Mechouar Palace. The building occupies a corner plot at a strategic intersection, in the immediate vicinity of a major roundabout connecting the city's primary axes. This position gives the hotel exceptional visibility within the urban landscape and establishes it as an architectural landmark (Figure 1): "Pouillon chooses to play along: each hotel becomes a distinct object, primarily inspired by its local setting, yet embellished with an entire architectural theatre." (Deluz, 2008) Situated at an average altitude of about 800 meters, on a sloping terrain with an estimated elevation difference of around 10 meters, the hotel adapts to the topography through a reinforced concrete base structure. This base includes the first two levels (ground floor and mezzanine), whose façades are slightly recessed to emphasize the monumental podium effect supporting the upper volumes. This positioning illustrates Pouillon's regionalist attitude: the building emerges from existing urban alignments instead of imposing a foreign geometry.

Figure 1 : Exterior view showing the Hôtel Les Zianides as an urban landmark, its monumental podium adapting to the site's sloping topography. (Association Les Pierres Sauvages de Belcastel)

- **Orientation and Relationship with the Environment**

The building is oriented at an angle of exactly 60° relative to the geographic north (Figure 2), with its main façade facing south-southeast and the garden and patio opening toward the north. This orientation reflects both climatic and topographic reasoning (Figure 3): it allows the main façade to benefit from optimal winter sunlight while shielding the interiors from the prevailing northern winds, ensuring thermal comfort in public areas. Conversely, the northern courtyard remains shaded and ventilated during summer, offering a naturally cool microclimate.
The site's 10-meter slope reinforces this spatial logic: the southern façade asserts a monumental urban presence above the roundabout, while the northern garden descends naturally with the terrain, creating a calm visual and climatic contrast. This duality between exposure and protection, openness and grounding, characterizes Pouillon's contextual approach.

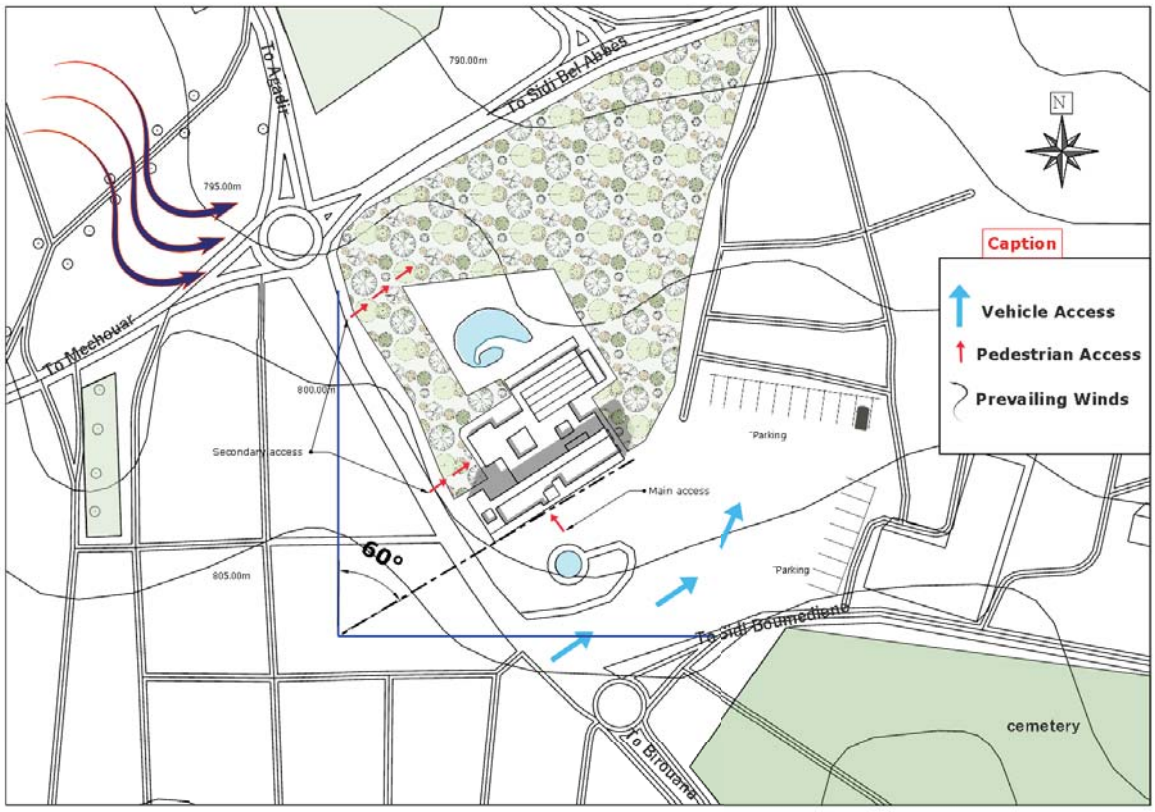

Figure 2 : Site analysis (author's drawing, 2025). The plan diagrams the hotel's dual contextual strategy: (1)the climatic/topographic orientation (N/S for sun/shade, 10m slope)

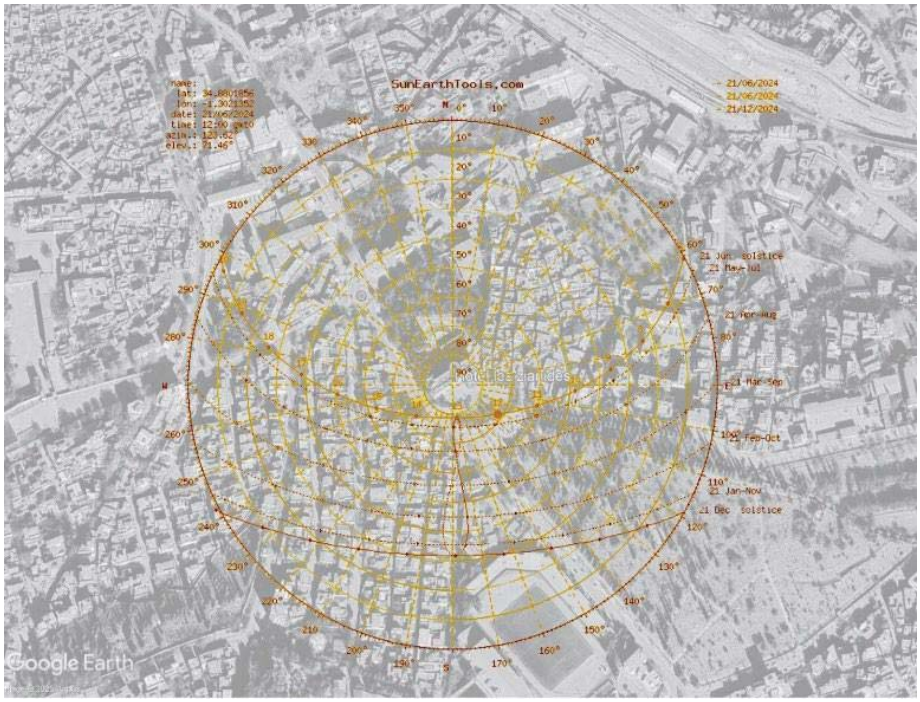

Figure 3: Sun path diagram for Tlemcen. This analysis confirms Pouillon's climatic reasoning: the building's orientation maximizes passive solar gain from the low-angle winter sun (heating) while minimizing exposure to the harsh high-angle summer sun (cooling). (Source: www.sunearthtools.com).

- **Visual and Symbolic Relationships**

From its main façade, the hotel opens onto panoramic views of the Tlemcen mountains, establishing a strong visual dialogue with the surrounding landscape.
Two main urban axes define its symbolic positioning (Figure 4):

- The northeastern axis, leading toward the historic center, the Mechouar Palace, and the traditional souks.
- The southeastern axis, connecting to the Mausoleum of Sidi Boumediene, a major spiritual and touristic landmark from the Marinid dynasty.

Through this dual relationship, urban and symbolic, the hotel forges a spatial link between power and spirituality, embedding its modern presence within the historical continuum of Tlemcen.

Figure 4 : The hotel's symbolic axes. This map illustrates the hotel's position as a modern pivot, linking the Mechouar Palace (political power) with the Sidi Boumediene Mausoleum (spiritual power). (Source: Google Earth, adapted by the author, 2025).

- **Visibility and Access**

Thanks to its three façades visible from public space and its corner location, the hotel serves as a prominent urban marker. Its imposing volumetry and warm red-brick tone reinforce its monumental presence, visible from multiple vantage points across the neighborhood. The access system follows a clear functional hierarchy:

- Main façade (southwest): two distinct entries, one pedestrian and one vehicular, serving the reception and parking areas.
- Service access: two additional entries located lower on the slope, reserved for staff circulation and deliveries.

3-2. Spatial Organization and Compositional Principles:

The hotel program includes 142 guest rooms and 7 suites, distributed across the upper levels, which are aligned along a long central corridor. Though more functional in character, this linear

organization reinforces the clarity of circulation and accentuates the vertical hierarchy of the project: public functions at the base, semi-private zones around the patio, and private areas above (Figure 5). The ground level also accommodates a range of amenities, including a gastronomic restaurant with a capacity of 400 covers per day, a meeting room, mini-bar, discotheque, and an outdoor swimming pool, all contributing to the hotel's role as a social and cultural hub.

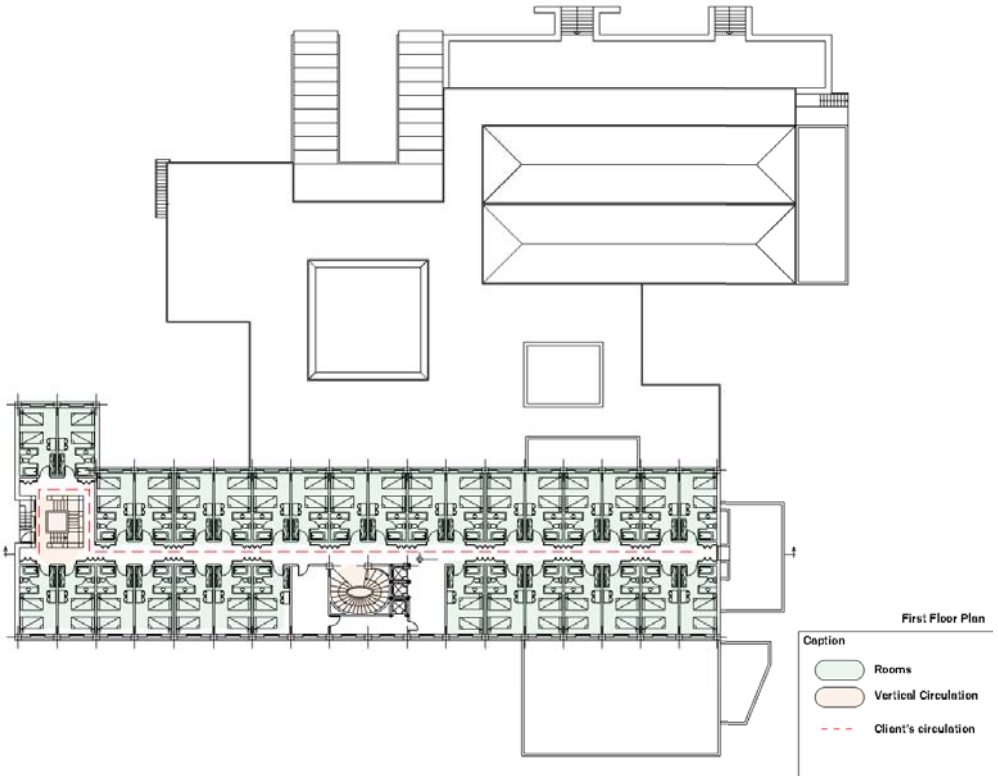

Figure 5: Typical Upper Floor Plan (author's drawing, 2025). The plan illustrates the functional, linear organization of guest rooms along a long central corridor, which ensures a clear vertical hierarchy and circulation.

In section, the hotel's overall form reveals an L-shaped composition, with the interior angle of the "L" occupied by a central patio. Around this void are hierarchically organized the public and private spaces, creating a fluid and coherent spatial sequence. The patio acts as both a climatic and visual core, ensuring natural ventilation, light diffusion, and permeability across the ground level. The patio typology is not a stylistic revival but a climatic and social device, responding to Critical Regionalism principles of environmental continuity (Figure 6).

The ground floor is structured symmetrically around three entrance doors, leading directly into the lounge area. To the right lies the reception, while the cafeteria and restaurant unfold around the patio, visually connected through open arcades. This arrangement creates a subtle transparency between interior spaces, while maintaining a powerful sense of centrality around the patio. The spatial progression, from the shaded entrance hall to the luminous courtyard, then toward the large garden and swimming pool, produces a rhythmic unfolding of spaces, typical of Pouillon's architectural choreography, "Attentive to the proper relationship of proportions and the balance of masses and volumes, he orchestrates the interplay between solid and void, built and unbuilt, within a dialectical relationship that has not failed to draw the attention of typo-morphology specialists." **(Almi, 2021)**

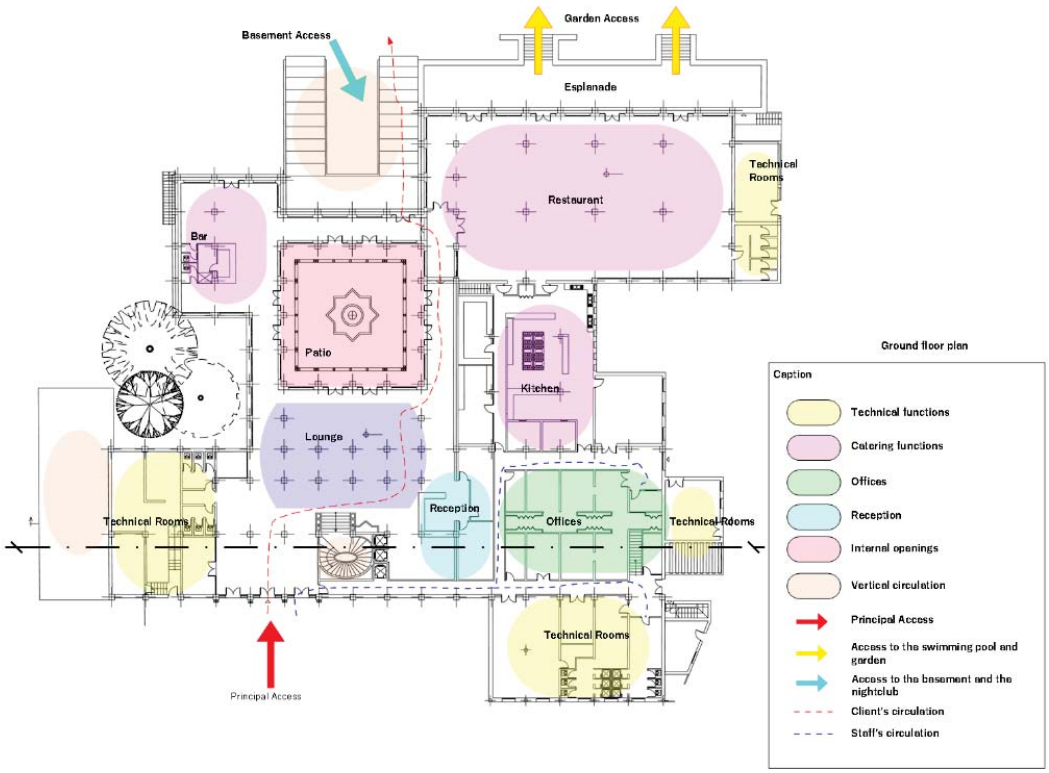

Figure 6 : Ground Floor Plan (author's drawing, 2025). The plan shows the L-shaped composition organized around the central patio. It highlights the symmetrical structure of public spaces (lounge, reception, restaurant) and the spatial progression from the entrance to the garden

A distinctive vertical element, the emergency staircase located on the east side, stands out as a massive, tower-like volume. As **(Maiza, 2020/2021)** notes, its composition recalls a "bordj", or traditional watchtower, both structurally functional and symbolically significant, marking the building's presence within the urban panorama.

The adaptation of the L-shaped plan to the sloping terrain further enriches the perception of the whole: the base level is embedded into the ground, forming a massive substructure that supports the lighter, more open upper wings. This topographic interplay between foundation and elevation contributes to the building's fortress-like appearance and to its strong anchoring within the site.

As shown in the section (Figure 7), the natural slope of the terrain led Pouillon to design a partially buried base, emphasizing the contrast between the heavy substructure and the lighter upper levels. This treatment reinforces the building's anchoring and its monumental presence within the site.

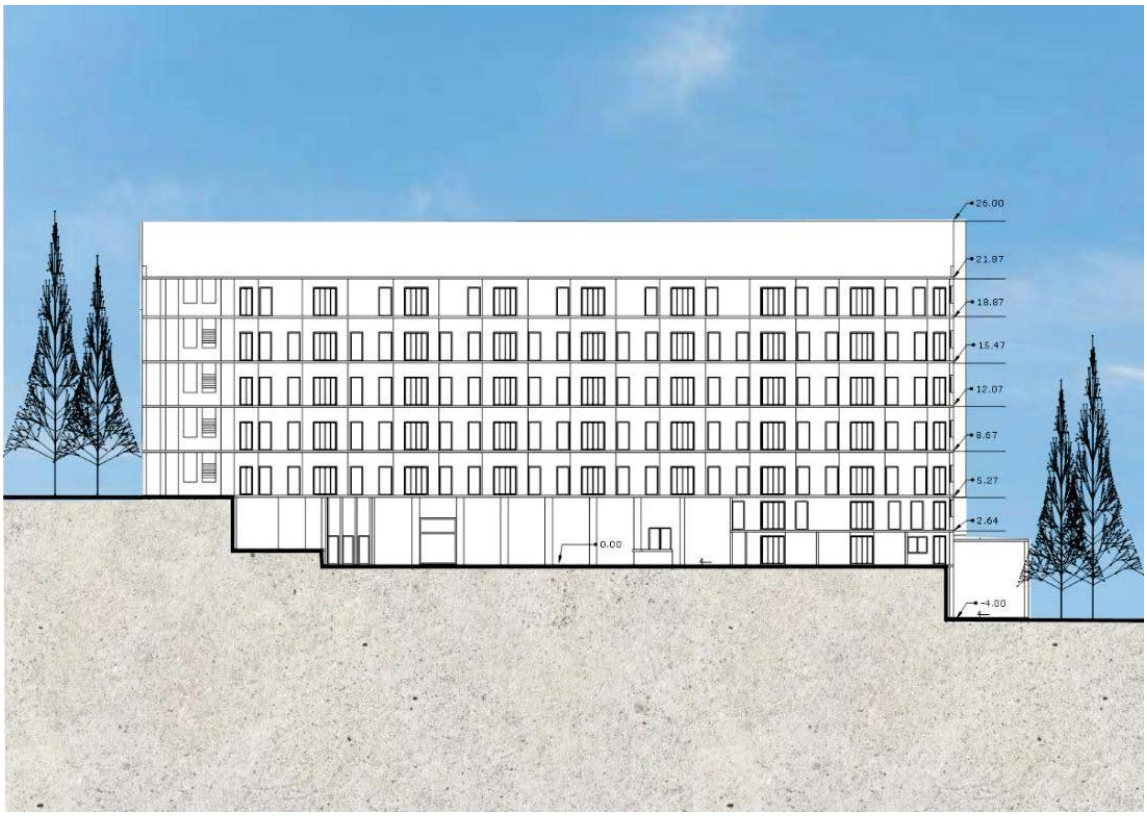

Figure 7 : Section A-A (author's drawing, 2025). The section illustrates the adaptation to the sloping terrain, with a partially buried base (substructure) that anchors the building and supports the lighter upper levels.

3-3. Volumetry and Façade Treatment:

The hotel is composed of two distinct yet interdependent volumes (Figure 8). The first, shaped like an "L," follows both climatic logic and symbolic intent. Oriented approximately 60° from true north, with its main façade facing south, this orientation creates a sheltered microclimate in the northern patio, naturally shaded, and ventilated, while the southern façade asserts a monumental presence. The alignment also filters solar exposure, creating a rhythmic interplay of light and shadow across the façades throughout the day.

This principal volume functions as a protective envelope, recalling the defensive vocabulary of traditional bordjs, fortified watchtowers typical of North African cities. The impression of solidity and permanence is further reinforced by the use of red brick from Nedroma, which gives the southern façade its distinctive texture, warmth, and depth.

The second volume, more discreet and functional, houses the technical and service areas. Slightly lower in height, it forms a partially buried base that adapts to the natural slope of the terrain, visually anchoring the composition within its site.

The dialogue between solid and void, between foundation and elevation, amplifies the monumental character of the hotel while maintaining a harmonious integration within its urban and natural surroundings.

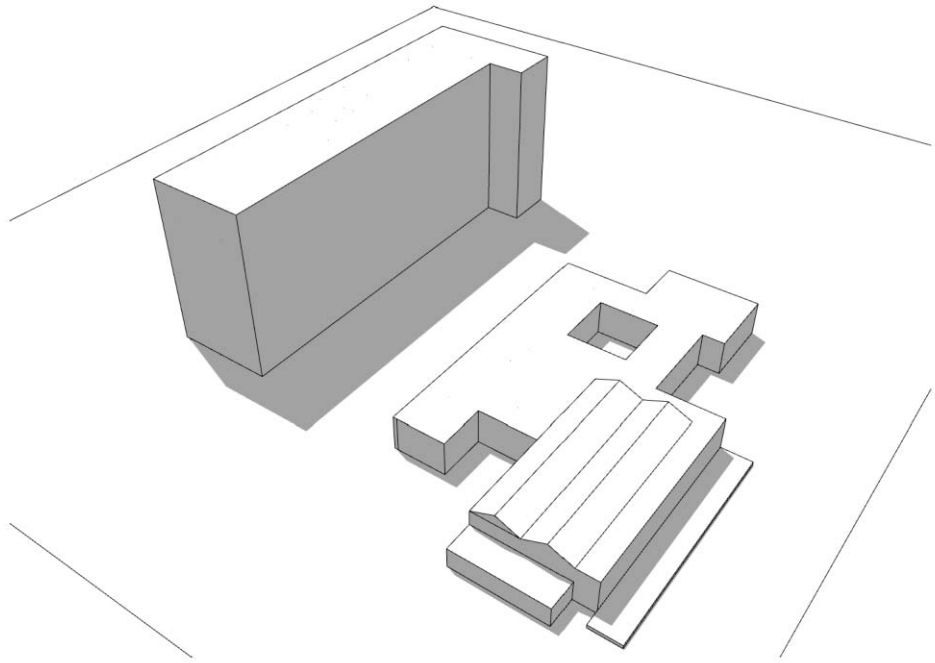

Figure 8 : Axonometric volume study (Author's drawing, 2025). This diagram illustrates the two interdependent volumes: the main "L" shaped volume for public functions and rooms, and the lower, partially buried service block that acts as a podium.

The principal façade reveals carefully composed architectural grammar, characterized by a rhythmic play of recesses (*redents*) and a tripartite structure that distinguishes base, body, and crowning (demonstrated in Figure 9 and Figure 10).

The base, partially embedded in the sloping ground, forms a recessed ground floor that enhances the perception of mass and stability. This lower level, built in exposed concrete and shaded by the upper projections, visually grounds the building while accentuating the topographical drop between the street and the entrance terrace.

The central body rises in a regular and symmetrical composition. The repetition of vertical window bays and arcades reflects Pouillon's concern for order and proportion, while maintaining a subtle dialogue with the modular rhythms of Tlemcen's historic architecture. Symmetry acts here as a unifying code, structuring the façade without rendering it rigid or static. Finally, the crowning introduces a more refined geometric vocabulary: the upper windows display slightly more intricate shapes, combining modern rectangular openings with softly arched motifs that recall Islamic precedents. This synthesis of modern geometries and traditional refinement gives the façade its distinct identity, contemporary yet rooted in historical resonance.

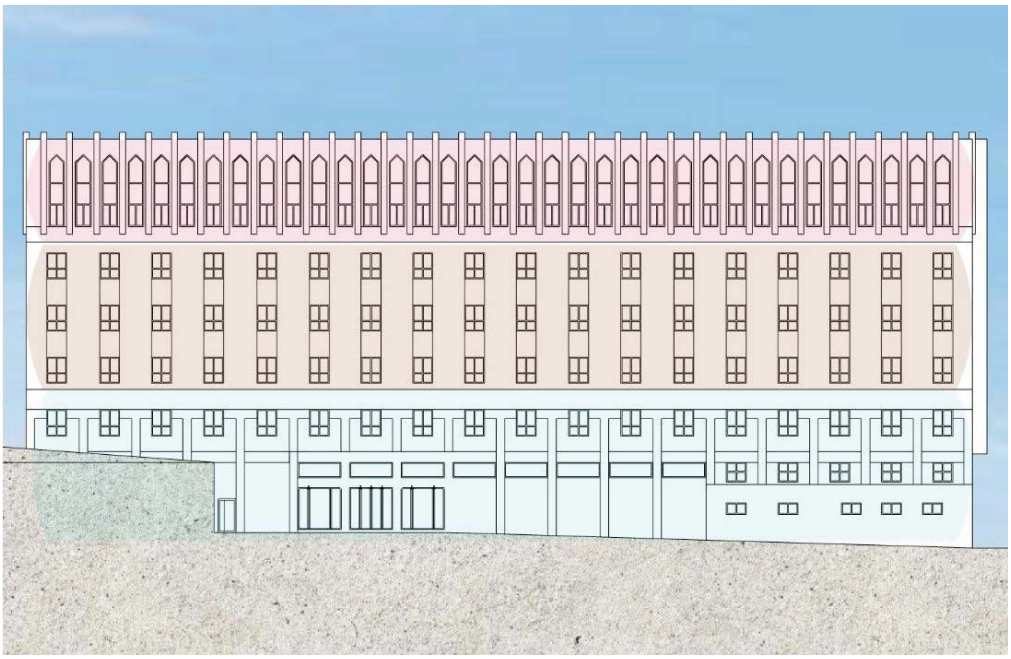

Figure 9 : Main Façade Elevation (Author's drawing, 2025). This drawing clarifies the tripartite structure (base, body, crowning) and the rigorous symmetrical rhythm of the openings that define the façade's modern grammar

The north façade, treated in *redents* and entirely clad in red brick from Nedroma, reinforces the impression of fortification and depth through alternating planes of shadow and light. The controlled use of reliefs and textures prevents monotony, producing a dynamic surface that responds to the movement of the sun throughout the day.

Figure 10 : The principal façade (Author's photo, 2025). This view confirms the material and compositional logic shown in the elevation (Fig 9): (1) the recessed concrete base, (2) the main body in Nedroma red brick, and (3) the arched crowning elements.

3-4 Material and Techniques :

The building's structure is based on a reinforced concrete post-and-beam system. This modern skeleton is clad in red brick masonry, a local material that gives the hotel its fortified appearance while ensuring thermal stability adapted to Tlemcen's climate (Figure 11).

Figure 11 : Detail of the main façade. This image shows the Nedroma red brick cladding, which provides the building's "fortified" texture and thermal mass, layered over the modern reinforced concrete structure. (Author's photo, August 2025)

The columns around the central patio are made of wood, coated with stucco, creating a subtle contrast between rusticity and refinement. This treatment marks the transition between exterior and interior spaces, while emphasizing the patio's symbolic and climatic role as the core of the project (Figure 12).

Figure 12 : The patio's stucco-coated columns. These elements reinterpret traditional arcades by applying refined stucco over a wooden structure, embodying Pouillon's dialogue between modern construction and traditional craft. (Author's photo, August 2025)

Inside, the restaurant ceiling features a double-nave wooden structure (Figure 13), inspired by traditional carpentry, offering wide spans and generous spatiality. This technique reinforces the warmth and openness of the interior atmosphere, highlighting Pouillon's consistent attention to material honesty and sensory experience.

Figure 13 : The restaurant's interior structure. The image shows the double-nave wooden ceiling, a reference to traditional carpentry, which creates a sense of warmth and generous spatiality, contrasting with the exposed raw concrete beams. (Source: Les Pierres Sauvages de Belcastel)

3-5 Architectural and decorative details, references, and comparison

The architectural details of Hôtel Les Zianides reveal a refined reinterpretation of Tlemcen's Islamic and Andalusian heritage. Rather than copying historical motifs, Pouillon integrates them into a coherent modern composition, where each gesture responds to spatial, structural, or climatic logic.

Among the most characteristic features are the semicircular arches and paired columns of the central patio, directly inspired by the patio of the Mechouar (Figure 14), yet reinterpreted through simplified proportions and modern materials. The stucco work adorning the arcades is particularly remarkable, displaying geometric and vegetal motifs reminiscent of the royal Mechouar complex of Tlemcen. According to Les Pierres Sauvages de Belcastel, the marble paving of the patio, green fragments embedded in white marble, echoes the pattern of the *Jardin de Flore* gallery in Paris , though reinterpreted in a unique interlacing composition.

Figure 14 : Historical Reference: The Mechouar Palace Patio. This image shows the traditional typology: a central courtyard, slender paired columns, and intricate stucco arcades that Pouillon studied. (Author's photo, August 2025)

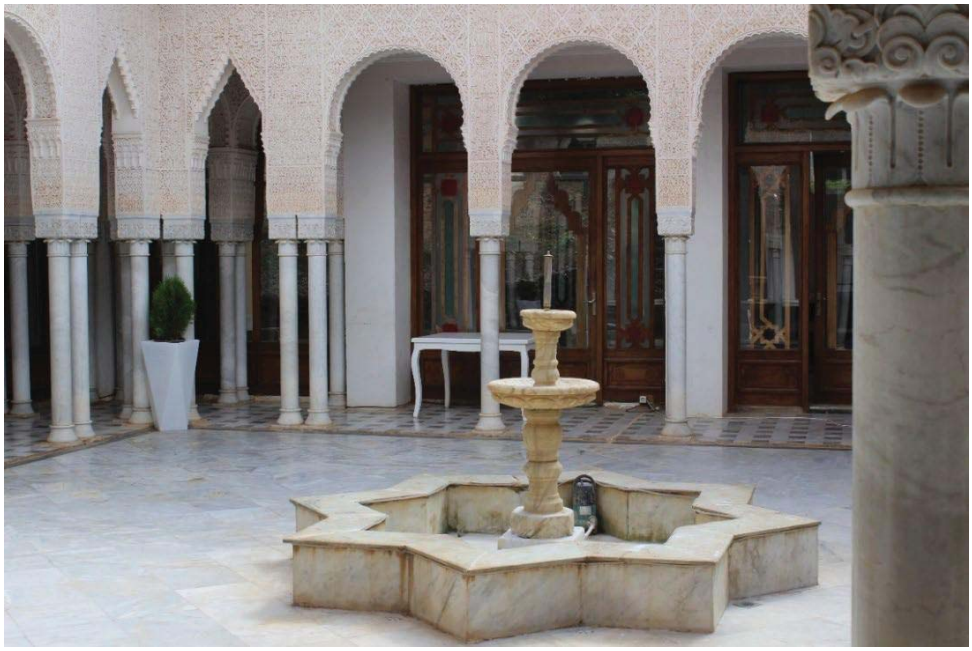

Figure 15 : Modern Reinterpretation: The Hôtel Les Zianides Patio. Pouillon translates the Mechouar's principles (cf. Fig 14), adopting the paired columns and semicircular arches but reinterpreting them with simplified, modern proportions. (Author's photo, August 2025)

The hotel's Zellige tilework provides another powerful connection to Tlemcen's material tradition. The geometric patterns applied to the entrance hall's columns (Figure 16) reproduce those found in the royal mosque of the Mechouar (Figure 17)

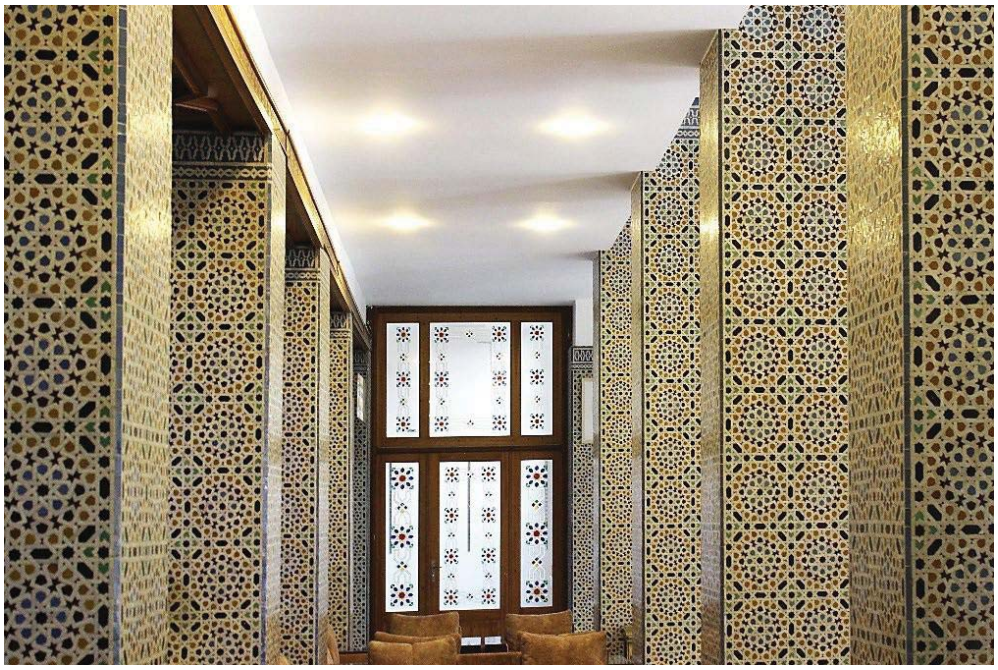

Figure 16 : Modern Reinterpretation: Zellige at the entrance of the hotel. Pouillon uses zellige with patterns identical to the Mechouar (cf. Fig 17). (Author's photo, August 2025)

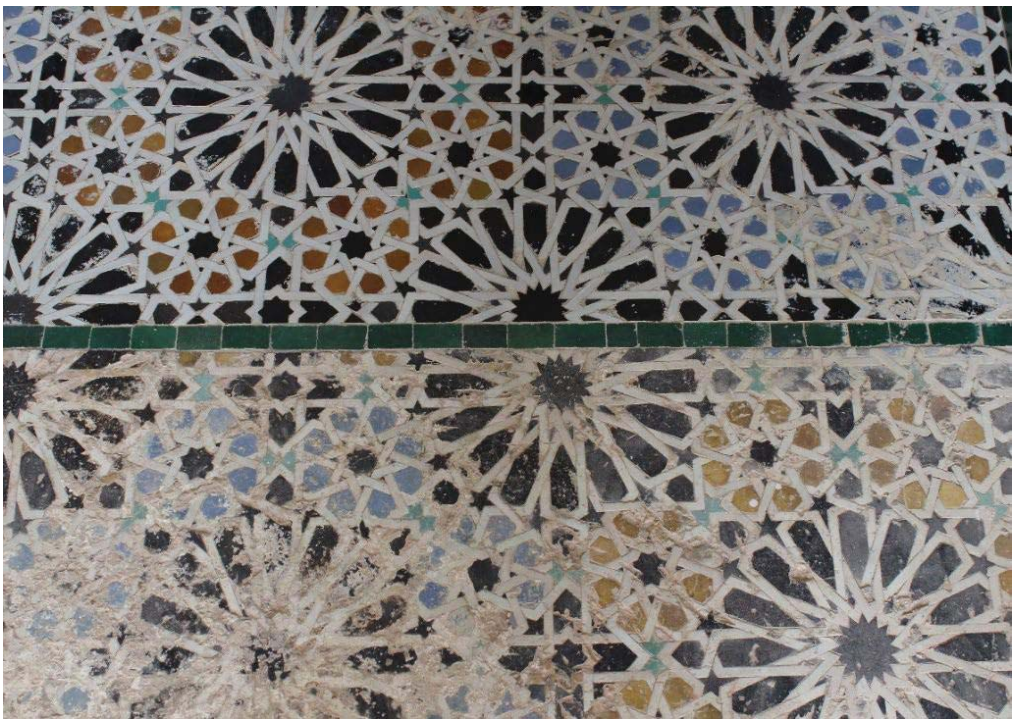

Figure 17 : Historical Reference: Zellige at Mechouar Palace. Detail of the complex geometric tilework, establishing the local craft and pattern language that Pouillon references directly. (Author's photo, August 2025)

Inside the restaurant (Figure 18), the exceptional double-nave wooden roof structure recalls the carpentry of the Sidi Bellahcen Mosque (Figure 19), both in its external silhouette and its interior spatial rhythm.

Figure 18 : Modern Reinterpretation: The hotel restaurant's roof structure. Pouillon translates the traditional wooden carpentry (cf. Fig 19) into a modern, double-nave structure. (Author's photo, August 2025)

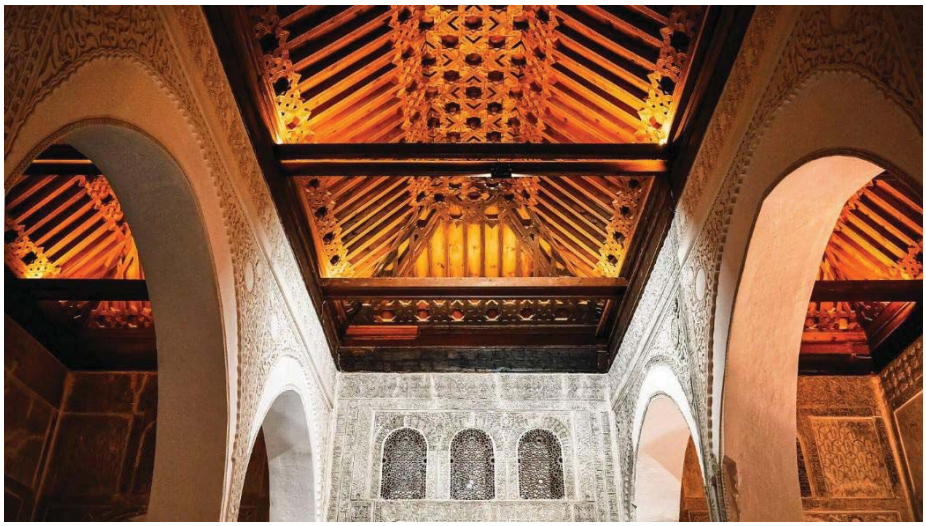

Figure 19 : Historical Reference: Wooden frame of the Sidi Belhassen mosque. This complex carpentry illustrates the traditional structural and aesthetic solutions reinterpreted by Pouillon for the restaurant's ceiling. (Google picture)

Fountains punctuate both the interior and exterior courtyards, acting as mediators between architecture, water, and sound a recurring theme in Islamic art. Arabic calligraphic (Figure 19

inscriptions along the walls introduce a spiritual dimension, embedding the project within a broader cultural continuum.

Figure 20 : Detail of Arabic calligraphic inscriptions. The script is used to embed a spiritual dimension and cultural continuity directly into the modern architectural surfaces. (Author's photo, August 2025)

Pouillon's approach transcends ornamentation: these details are not decorative quotations, but reinterpretations grounded in structure, climate, and cultural memory. Each element finds justification in its context, affirming his ability to bridge tradition and modernity without falling into pastiche.

4.DISCUSSION

Hôtel Les Zianides remains relevant today because it responds to timeless needs rather than temporary architectural fashions. Its identity-driven design offers a strong alternative to the generic forms of global tourism architecture: guests immediately understand where they are, in Tlemcen, without clichés or folkloric staging. The project has also demonstrated durability, not only in its materials but in its capacity to stay functional over decades; Pouillon designed buildings with the future in mind, envisioning how they would age and continue to serve evolving generations. Unlike many hotels that detach visitors from their context, Les Zianides acts as a gateway to the city, providing an authentic introduction to its architectural culture, crafts, and spatial traditions. It shows that architecture can engage with heritage while remaining contemporary and fully operational, proving that a modern hotel can become a cultural anchor rather than a disposable container for tourism.

5.CONCLUSION

The analysis of Hôtel Les Zianides demonstrates that Fernand Pouillon's approach in Tlemcen transcends stylistic revivalism. By combining local materials, typological references, and a sensitive response to topography and climate, Pouillon constructs a modern architectural language rooted in place. Traditional elements, patio, arcades, zellige, calligraphy, function as instruments of spatial organization and climate adaptation rather than as decorative quotations. Seen through the lens of

Critical Regionalism (Frampton), Hôtel Les Zianides exemplifies how modernity can be mediated through local conditions and craft, resisting both international

homogenization and superficial historicism. The project thus offers a concrete model for contextual, site-responsive design in North African settings.

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Typology and design of water management in the medina of Kairouan: traditional sustainability in islamic urban heritage

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ABSTRACT:

The medina of Kairouan, a UNESCO World Heritage site in central Tunisia, represents a unique synthesis of Islamic urban form, architectural symbolism, and ecological intelligence. Established in a semi-arid climate, Kairouan developed sophisticated hydraulic systems that reflect a deep understanding of sustainable resource management within the constraints of its environment. This article explores the typology and design principles of water management in Kairouan through an analysis of four major elements: the Aghlabid basins, the sacred well of “Bir Barrouta”, the domestic gardens known as “jnen” (plural of “jnina”), and the palatial site of “Raqada” (meaning "slumber"). Drawing upon architectural, historical, and anthropological sources, this study examines how these systems integrated functionality, spirituality, and aesthetics to produce a balanced urban ecosystem. Beyond their historical significance, these hydraulic structures embody an enduring model of sustainability and resilience, offering valuable lessons for contemporary urban planning in semi-arid regions. The article argues that the reinterpretation of traditional hydraulic knowledge is crucial for the development of context-sensitive sustainable strategies in Islamic cities facing water scarcity and climate change.

Keywords: Hydraulic heritage, traditional water management, sustainable urban planning, intangible heritage, Islamic gardens

1.INTRODUCTION :

Sustainability in Islamic architecture has often been discussed through the lens of geometry, symbolism, and climatic adaptation. Yet, few historical examples embody environmental intelligence as profoundly as the hydraulic systems of the medina of Kairouan. Founded in the 7th century and consolidated under the Aghlabid dynasty (9th century), Kairouan emerged not only as a spiritual center of the Islamic Maghreb but also as an advanced laboratory of hydraulic engineering in a semi-arid region (Talbi, 1976). The scarcity of water, combined with the city’s religious and political importance, stimulated innovative responses to urban design, architecture, and landscape management. The research presented in this article aims to analyze the typology and design of Kairouan’s water management systems as a manifestation of traditional sustainability. It seeks to reveal how ancient Islamic societies conceptualized water as both a technical and symbolic resource, integrating it into urban morphology, domestic life, and spiritual practice. The study also addresses the contemporary relevance of these systems: in a global

context marked by climate crisis, water scarcity, and loss of traditional know-how, the re-evaluation of Kairouan's hydraulic heritage may provide models for resilient, low-impact urban strategies.

This article adopts a historical-analytical methodology, based on primary and secondary sources—historical documents (Déspois, 1930, Marçais, 1937, Solignac, 1953), UNESCO reports (UNESCO, 2025), and contemporary analyses (Bouguerra, 2003, Hill, J., & Woodland, W., 2006, Gaaloul, N. 2020, Mouelhi et al., 2025). The approach combines architectural typology with a socio-cultural reading of space, emphasizing the interaction between form, function, and meaning in Islamic urbanism.

2. HISTORICAL AND URBAN CONTEXT OF KAIROUAN:

2-1- Foundation and urban evolution :

Kairouan was founded around 670 A.D. by "Uqba Ibn Nafi" as a military and religious camp in central Ifriqiya (modern-day Tunisia). The site was deliberately chosen away from the coast, offering strategic defense and spiritual isolation. Over time, Kairouan developed into the capital of the Aghlabid dynasty (800 - 909 A.D.), a period characterized by extensive architectural and infrastructural development (Marçais, 1937). Its medina, now a UNESCO World Heritage site, embodies the spatial and symbolic synthesis of Islamic urban principles -orientation, hierarchy, and environmental adaptation. Water, or rather its scarcity, shaped the morphology and organization of the city. The choice of Kairouan's location was paradoxical: far from permanent rivers or natural springs, yet destined to become a flourishing religious and intellectual center. This tension between dryness and fertility inspired a series of technological and cultural innovations that turned Kairouan into a hydraulic oasis in the heart of a semi-arid plateau.

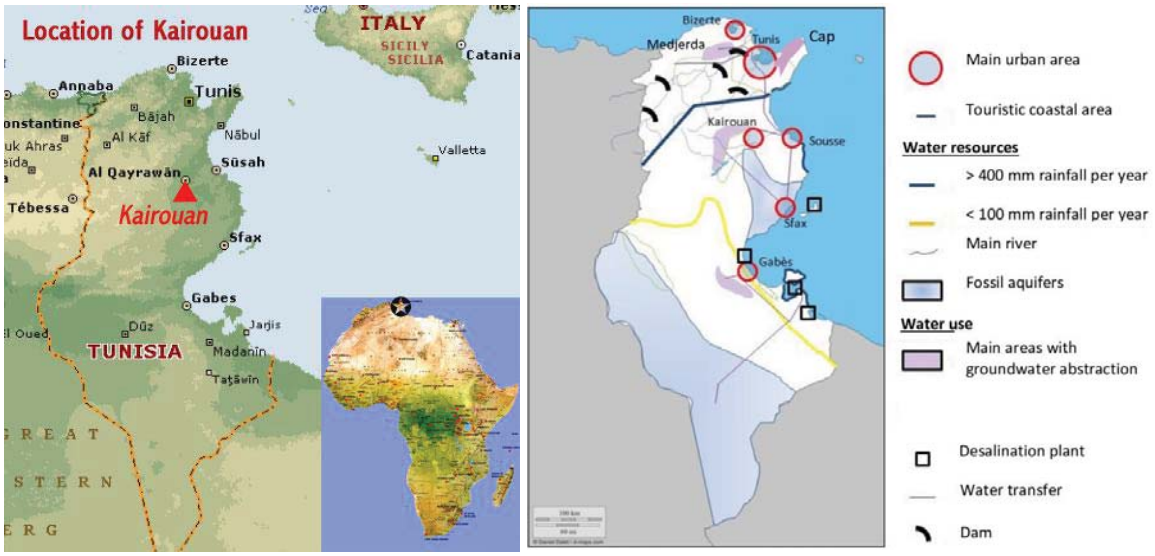

Figure 1: Geographic map showing the medina of Kairouan and the surrounding hydraulic network

2-2- The religious and symbolic value of water:

In Islamic cosmology, water is both a physical necessity and a divine symbol. The Quran describes water as the origin of all life "And We made from water every living thing" (Qur'an surat 21 verset 30) "وجعلنا من الماء كل شيء حي". This sacred perception deeply influenced Islamic architecture and urbanism. The act of ablution ("*wudhu"*) before prayer, the presence of fountains in courtyards, and the ritual purification of mosques all reflect the intertwining of spirituality and environmental awareness (Bourdieu, 1979). In Kairouan, the symbolic dimension of water transcended its utilitarian value. Each water element - from the monumental Aghlabid basins to the intimate domestic "jnen" - embodied a dialogue between material necessity and metaphysical aspiration. The circulation of water through the city paralleled the flow of spiritual knowledge, purity, and community life.

2-3- Environmental and climatic constraints:

The climatic context of central Tunisia is characterized by low annual rainfall (approximately 300mm), high evaporation, and irregular seasonal distribution. Historically, inhabitants developed adaptive strategies to manage these constraints: rainwater harvesting, underground cisterns, and efficient irrigation techniques (Hill, J., & Woodland, W., 2006). The medina's architecture - thick walls, shaded courtyards, and narrow streets - further contributed to thermal comfort and water conservation. Within this ecological framework, the hydraulic infrastructure of Kairouan represented not only technical ingenuity but also a philosophy of sustainability. It demonstrated that environmental scarcity could generate creativity and foster a culture of balance between human needs and natural limits.

3.TYPOLOGY OF TRADITIONAL HYDRAULIC SYSTEMS IN KAIROUAN:

The study of Kairouan's hydraulic heritage reveals a multi-scalar network that connects monumental, domestic, and landscape structures. Four typological categories stand out for their architectural and symbolic significance:

1- the Aghlabid basins, 2- Bir Barrouta, 3-domestic gardens (jnén), and 4- the palatial water landscape of Raqada.

3-1- The Aghlabid Basins: Monumental Infrastructure of Sustainability:

Among Kairouan's most remarkable hydraulic works are the Aghlabid basins, built in the 9th century under Emir Abu Ibrahim Ahmad. This complex system, located north of the medina, consists of two circular reservoirs - a smaller decantation basin and a larger storage basin -connected by stone aqueducts bringing water from nearby hills (Solignac, 1953). Architecturally, the basins embody both functionality and monumentality. The outer walls, reinforced with buttresses, express power and stability, while the geometric precision of the circular form ensures hydraulic efficiency. Water was first collected in the

smaller basin for sedimentation, then transferred to the larger one for storage. This dual mechanism optimized the use of limited rainfall and minimized loss through evaporation.

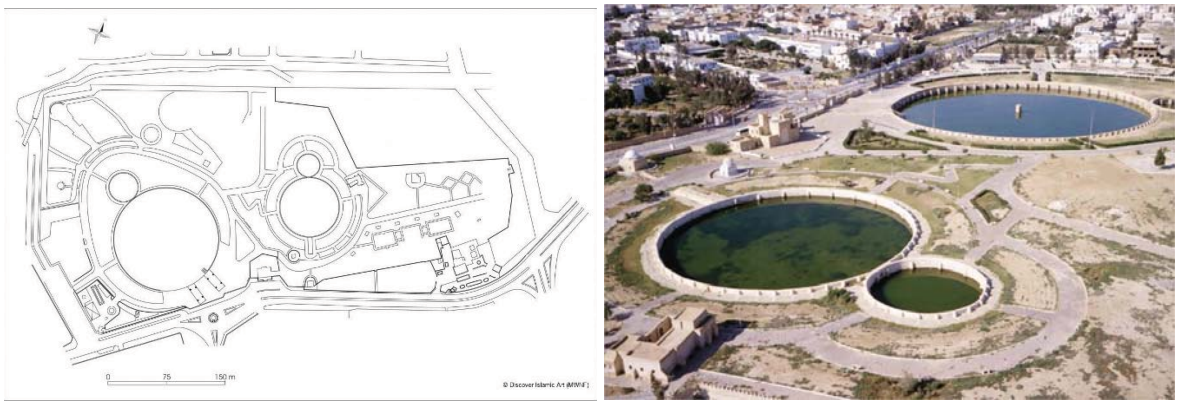

Figure 2 – Illustration of Aghlabid Basins (Feskia) of Kairouan.

Beyond their technical role, the Aghlabid basins were urban landmarks symbolizing prosperity, governance, and divine order. Their reflection of the sky and surrounding landscape established a visual and metaphysical connection between the earthly and celestial realms. From a sustainability perspective, they illustrate integrated resource management - a balance between large scale infrastructure and environmental adaptation that modern water policies often overlook (Bouguerra, 2003).

Figure 3: Aerial view of the 9th-century Aghlabid basins (Feskia) north of the medina of Kairouan.

3-2- Bir Barrouta: sacred well and living heritage:

Located at the heart of the medina, Bir Barrouta represents the convergence of myth, faith, and engineering. According to local legend, it is connected by an underground canal to the sacred Zemzem well in Mecca, symbolically linking Kairouan to the spiritual center of Islam. While the legend embodies intangible heritage, the well itself remains a technical masterpiece: a deep groundwater source equipped with a wheel system powered by a dromedary, still in use today.

The circular plan of Bir Barrouta, its shaded interior, and the rhythmic motion of the animal create a ritualized performance of sustainability. Water extraction here is slow, deliberate, and human-scaled -contrasting sharply with the mechanical abstraction of modern systems. The site also serves as a social and spiritual gathering place, blending practical water use with communal memory. From an anthropological stand-point, Bir Barrouta exemplifies the integration of tangible and intangible heritage. It embodies the continuity of traditional knowledge systems that resist obsolescence by adapting to new contexts. As Bouguerra (2003) notes, the disappearance of such practice's risks eroding not only ecological balance but also the social cohesion built around shared water rituals.

Figure 4: Some photos of Bir Barouta in the medina of Kairouan.

3-3- Domestic gardens (Jnen): Micro-systems of everyday sustainability:

Within the dense fabric of the medina, small enclosed gardens known as "jnen" (singular "jnina") once played a vital role in domestic life. These gardens - often located behind houses or adjacent to inner courtyards - were irrigated through underground channels or small open canals fed by stored rainwater. They supported the cultivation of fruit trees, vegetables, and medicinal plants, providing both food and microclimatic regulation. The "Jnen" exemplify micro-scale sustainability: they recycled greywater, reduced urban heat, and fostered biodiversity within confined spaces. Their spatial configuration blurred the boundary between architecture and landscape, merging the domestic with the natural. Such systems promoted a cyclical use of resources, contrasting with the linear consumption patterns of modern urbanization. Socially, the "jnen" were spaces of intimacy and contemplation, often associated with women's activities and intergenerational transmission of horticultural knowledge. The loss of these gardens due to densification and property fragmentation marks not only an ecological but also a cultural rupture in Kairouan's urban identity.

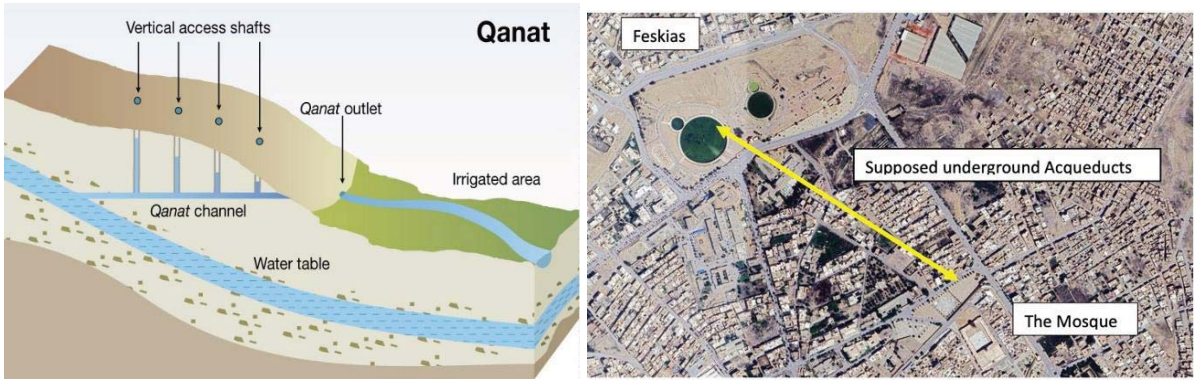

Figure 5: Diagrams and photographs of domestic garden (jnen) irrigation systems in the medina of Kairouan (underground channels and small surface canals).

3-4- Raqada: The Palatial water landscape:

Situated about 10 kilometers south of Kairouan, Raqada was founded in the 9th century by the Aghlabid emir Ibrahim II. According to historical sources, the site was chosen for its tranquility and water abundance - the name "Raqada", meaning "slumber," evokes rest and serenity (Déspois, 1930). Conceived as a palatial city, Raqada featured gardens, pavilions, and ornamental basins arranged in harmony with the natural landscape. The hydraulic design of Raqada combined technical mastery with aesthetic refinement. Basins reflected architectural facades and trees, while underground channels distributed water for irrigation. These "jnen" of Raqada functioned as both pleasure gardens and productive systems, sustaining small-scale agriculture while embodying the Aghlabid ideal of cultivated nature. From a sustainability perspective, Raqada illustrates a proto-ecological approach: a designed landscape integrating water management, leisure, and governance. The careful orchestration of water and vegetation created a microclimate conducive to reflection and political deliberation - a metaphor for balanced rule.

4. DISCUSSION: LESSONS FOR SUSTAINABLE WATER MANAGEMENT:

4-1- Resilience and Ecological Intelligence of Traditional Systems:

The hydraulic systems of the medina of Kairouan offer instructive lessons about sustainability in semi-arid urban environments. The monumental reservoirs of the Aghlabid Basins demonstrate large-scale storage and decantation techniques which allowed the city to buffer against seasonal rainfall variability. The domestic systems such as the "majels" (underground cisterns) and the "jnen" (household gardens) show how everyday water circulation, reuse and micro-irrigation fostered resilience at the household and neighborhood level (UNESCO, 2025, Cities Alliance, 2024). By contrast, many modern systems adopt a top-down, centralized infrastructure approach that often disregards local adaptation. As noted by Bouguerra (2003), the shift to large-scale, centralized water management in North Africa has frequently undermined traditional knowledge and increased dependence on unsustainable groundwater extraction. The Kairouan case

underlines that sustainability is not merely a matter of "green technology" but also of contextualized design**,** community embeddedness, and adaptive capacity.

4-2- Comparative Analysis with Modern Centralized Water Networks:

The efficiency of traditional water systems lies not only in technology but in scale-matching, modularity, and local control. For example, the majel cisterns capture rooftop rainwater and feed domestic reuse - a decentralized method which reduces transmission losses and evaporation, and engages users directly (Cities Alliance, 2023, 2024). This contrasts with modern networks which frequently suffer high leakage rates, high energy consumption for pumping and treatment, and diminished local control (Foroudi, 2019). Additionally, the integration of water systems into the urban and architectural fabric (courtyards, gardens, wells) in Kairouan created multi-functional spaces where hydraulics, landscape, architecture, and ritual overlapped. In modern planning, water infrastructure is often hidden and divorced from lived experience, reducing opportunities for water awareness, maintenance by users, and heritage value. The Kairouan model therefore suggests that sustainable water management must engage not only technology but culture, space, *and* governance.

4-3- Risk of loss of know-how and cultural disconnection:

A major challenge for heritage-informed sustainability is the erosion of traditional knowledge. UNESCO's latest conservation report for the medina of Kairouan identifies "changes in traditional ways of life and knowledge system" as a factor affecting the property. (UNESCO, 2025) Without active transmission of know-how (example, maintenance of majels, functioning of Bir Barrouta's wheel mechanism, garden irrigation systems), the material infrastructure may survive but the system logic may fade. Further, the degradation of the built hydraulic heritage (cracked reservoir walls, siltation, neglect) reduces their function and symbolism (Tunisia news, 2025). Thus, heritage water systems can become mere monuments rather than living infrastructures. To avoid this, revitalization must integrate community participation, capacity building, and adaptive reuse.

4-4- Perspectives for reintegration in contemporary urban planning

The typologies observed in Kairouan provide multiple entry points for contemporary sustainable water planning. First, rainwater harvesting and cistern systems (majels) within urban fabric can reduce reliance on external sources and mitigate city-scale drought vulnerability. The recent cities alliance project in Kairouan illustrates this potential: women restoring underground cisterns reported significant resilience gains. (citiesalliance.org) Second, green public spaces centered on historic hydraulic infrastructure (for example, the restoration of the Aghlabid Basins periphery) can re-embed water memory, provide microclimatic benefits, and serve as demonstration zones for low-impact irrigation and harvesting (Tunisia news, 2025). Third, inclusive governance and gender-sensitive design are central. The workshop in Kairouan emphasized the role of women in household water management and advocated for water-sensitive public spaces integrating heritage and living systems. (citiesalliance.org) Finally, integrating heritage water systems into

modern policy frameworks requires cross-sector collaboration (heritage, water, urban planning, social policy). The recent study "Integrating problem structuring methods with formal design theory" in Tunisia points to the need for innovative governance mechanisms combining design thinking, stakeholder mapping and participatory policy design. (arxiv.org)

5.CONCLUSION

The medina of Kairouan stands as a remarkable example of how Islamic urbanism and hydraulic culture converged to produce sustainable water management systems adapted to arid conditions. From the monumental Aghlabid Basins to the domestic majels, from the sacred well of Bir Barrouta to the productive "jnen" and the palatial gardens of Raqada, water in Kairouan was never simply a resource - it was a spatial, social, symbolic, and technical element woven into the fabric of life. In the current age of climate uncertainty, water scarcity and rapid urbanization, this heritage offers more than nostalgia: it offers living models. The key lessons are: design systems at appropriate scale; integrate infrastructure into urban form and social practice; maintain local knowledge and participatory governance; and preserve the link between water, culture and identity. Safeguarding Kairouan's hydraulic heritage is thus not only a matter of conservation but also of innovation. By revitalizing cistern networks, garden-irrigation systems and public water landscapes, planners and communities can develop context-sensitive, low-impact water strategies that respond to contemporary challenges while honoring the past. Future research should investigate the quantitative performance of these traditional systems (for example, capacity, evaporation losses, recharge rates), evaluate hybrid interventions (heritage + modern techniques), and explore governance models for heritage-water systems in other Islamic medinas. The challenge is to transform heritage from static monument into dynamic infrastructure, contributing to urban resilience and sustainability.

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Reclaiming Vernacular Wisdom in Saharan Architecture: A Vision for a Sustainable and Contemporary Islamic Dwelling

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ABSTRACT

Traditional Islamic architecture in the Saharan region demonstrates exceptional climatic adaptation through passive cooling, compact spatial forms, and the use of locally sourced materials. Yet, recent urbanization and imported construction typologies have weakened these sustainable practices, leading to increased energy consumption and the loss of cultural coherence. This study revisits vernacular knowledge *(savoir-faire)* as a transferable design intelligence for contemporary housing. Using a qualitative analytical approach combining spatial reading and material characterization, the research examines the logic, thermal behavior, and cultural ethics embedded in Touat's ksour dwellings. No numerical simulations or experimental measurements were conducted; the proposed model is a theoretical prototype informed by existing literature and comparative environmental insights.

The study introduces a conceptual dwelling model that integrates Islamic spatial ethics "privacy zoning, inward-oriented courtyards, and qibla alignment" with improved earthen materials such as stabilized unfired clay bricks. The prototype highlights how climate-responsive, identity-preserving housing can emerge from reinterpreting vernacular principles within modern sustainability agendas, including **SDG 7, SDG 11**, and **SDG 13**. By framing vernacular wisdom as a performance-driven design resource, the research contributes to rethinking housing strategies for arid regions.

KEYWORDS: Vernacular Architecture; Sustainability; Islamic Dwelling; Saharan Region; Local Knowledge ; Earthen Materials

INTRODUCTION

The Sahara, with its extreme climatic conditions, scarce water resources, and rapid socio-economic transformations, presents one of the most demanding contexts for sustainable housing and architectural development. Traditional Islamic and vernacular architecture in Saharan regions, particularly in the Touat area of southern Algeria, has historically demonstrated an extraordinary

capacity to achieve thermal comfort, environmental harmony, and cultural coherence using local resources and context-specific strategies (Fathy, 1973).

Recent studies have highlighted the environmental intelligence embedded within traditional Saharan settlements, which employed **passive cooling strategies**, **compact urban fabrics**, and **locally sourced materials** to minimize energy consumption and enhance livability (Ghosh & Vale, 2020; Alzoubi & Almalkawi, 2020). Research on sustainable vernacular architecture further demonstrates that these historical solutions are highly relevant today, especially ascontemporary housing models increasingly fail to address climatic and cultural needs (Bahrami & Ghadiri, 2021).

However, accelerating urbanization and the introduction of **standardized modern housing typologies**, such as multi-storey apartment blocks, have disrupted this balance. Several studies warn that modern constructions in desert contexts often ignore solar orientation, ventilation patterns, and material suitability, resulting in increased thermal discomfort, higher energy dependency, and diminished cultural identity (Zemmouri, 2022; Boulahbel, 2022).

Although the discourse on sustainable architecture in arid regions has expanded in recent years, few studies have operationalized the principles of Saharan Islamic architecture into a replicable design framework. Most existing research remains descriptive, focusing on documenting traditional forms rather than translating their underlying environmental and ethical logic into contemporary housing prototypes.

This study seeks to bridge this gap by reinterpreting vernacular wisdom (*savoir-faire*) through a performance-based design approach that integrates environmental responsiveness with cultural and spiritual identity. It proposes a conceptual framework that adapts the principles of traditional Saharan settlements to contemporary Islamic housing, aiming to ensure thermal comfort, resource efficiency, and cultural continuity (Zemmouri, 2022; Marouf, 2001).

By linking local architectural intelligence with modern construction needs, the research contributes to redefining sustainable housing strategies in arid environments. It aligns with global sustainability goals, particularly SDG 11 (Sustainable Cities and Communities), SDG 13 (Climate Action), and SDG 7 (Affordable and Clean Energy) positioning vernacular-informed design as a pathway toward resilient and culturally meaningful futures (United Nations, 2015).

The Touat region of Algeria, nestled within the vast Sahara, presents both a challenge and an opportunity for architectural innovation. Historically, its inhabitants developed ingenious building techniques grounded in a profound understanding of their environment. Reclaiming this vernacular wisdom is thus not merely an act of preservation but a forward-looking strategy to create sustainable Islamic dwellings that are environmentally adaptive, socially coherent, and aesthetically rooted in tradition. Saharan vernacular architecture stands as a testament to human ingenuity in adapting to extreme conditions. For centuries, communities in regions like Touat have refined building practices that leverage local materials and passive cooling strategies to create resilient and

comfortable spaces, offering invaluable lessons for contemporary sustainable development.

1.THEORETICAL BACKGROUND

1.1Vernacular Architecture: Concept and Contemporary Relevance

Vernacular architecture refers to building practices shaped by local environmental conditions, available resources, and sociocultural values, rather than imported design standards or universalized models (Asquith & Vellinga, 2006). It represents a collective intelligence embedded in communities' lived experiences, where form and function evolve through centuries of adaptation to specific ecological and cultural contexts. Recent scholarship positions vernacular architecture as a **dynamic system of knowledge** rather than a static heritage to be merely preserved (Correia, Dipasquale, & Mecca, 2022). Within arid Saharan regions, vernacular building traditions respond to extreme climatic conditions while simultaneously embodying spiritual and social values, making them a holistic paradigm where environmental sustainability, cultural identity, and collective memory converge.

1.2 Vernacular Wisdom and Sustainability in Saharan Islamic Architecture

In Saharan settlements such as Tuat in southern Algeria, vernacular architecture emerges from generations of empirical experimentation aimed at achieving thermal comfort, resource efficiency, and spatial privacy under hostile environmental conditions (Oliver, 2006). These solutions reflect not only technical ingenuity but also **Islamic spatial ethics**, such as:

- **Inward-oriented layouts**: central courtyards function as microclimates, ensuring ventilation, passive cooling, and privacy.
- **Thick earthen walls**: adobe construction leverages thermal mass to buffer day-night temperature swings (Hamdani, Attia, & Hamdy, 2022).
- **Minimal openings and shaded alleys (sabat)**: limit solar gain while creating shaded pedestrian networks.
- **Material economy**: local resources such as unfired clay, palm trunks, and gypsum reduce embodied energy while enhancing sustainability.

As Hassan Fathy reminds us, *"In desert architecture, survival depends not on resisting the climate but on understanding it and letting it shape the form"* (Fathy, 1973).

Abu-Lughod explains, Islamic architecture developed **specific spatial imperatives** based on gender segregation, requiring the **functional separation of spaces** and the introduction of **visual screening devices** to maintain privacy (Abu-Lughod, 1987).

Paul Oliver further argues that much of the world's built environment is composed of **non-monumental, everyday architecture**, often constructed without architects but embodying **deep cultural, environmental, and social intelligence** (Oliver, 2017). This inclusive perspective reinforces the need to **document, analyze, and reinterpret vernacular knowledge** when addressing sustainability challenges in Saharan regions.

1.3The Disruption of Modern Construction Models

Over recent decades, standardized modern construction has displaced these adaptive traditions, leading to ecological inefficiencies and cultural alienation. The shift towards concrete, glass, and steel introduces several challenges:

- **Loss of environmental adaptation**: modern layouts ignore solar orientation and natural ventilation, leading to overheating.
- **Energy dependence**: reliance on mechanical cooling increases operational energy demand by up to 60% compared to adobe dwellings (Chergui, Tahakourt, & Belhamri, 2023).
- **Erosion of cultural identity**: imported styles undermine Islamic spatial ethics of privacy, hierarchy, and community cohesion.

These failures highlight the urgency of reinterpreting vernacular wisdom within contemporary frameworks to achieve **climate-resilient and culturally embedded** housing models.

1.4Towards a Performance-Driven Vernacular Paradigm

This study conceptualizes vernacular architecture as a design intelligence rather than a nostalgic reference. Through the integration of:

- Stabilized unfired clay technologies,
- Global sustainability benchmarks (SDGs 7, 11, 13),

we propose a hybrid architectural model that leverages local knowledge to produce scientifically validated and replicable housing prototypes for Saharan contexts (Elgendy, 2023).

1.2 Building with the Earth: Materials and Techniques

At the core of Saharan vernacular architecture is the intelligent use of local materials, primarily earth. Mud bricks (adobe), rammed earth, and clay are abundant, cost-effective, and possess exceptional thermal properties. These materials absorb heat during the day and release it slowly at night, moderating indoor temperatures naturally. This intrinsic characteristic of earthen construction significantly reduces the need for artificial heating and cooling, making it inherently sustainable.

Palm wood, another readily available local resource, is often used for structural elements such as beams and roofing. The combination of earth and palm wood creates structures that are well-insulated, durable, and resilient against the desert's extreme conditions. The traditional Gourara houses, for instance, exemplify this symbiotic relationship between material selection and environmental adaptation.

Integration of Stabilized Unfired Clay Bricks

Recent advances in Algeria have led to the development of stabilized unfired clay bricks, scientifically optimized for thermal insulation, compressive strength, and environmental

sustainability.

Material Type	Thermal Conductivity (W/m·K)	Compressive Strength (MPa)	Embodied Energy
Adobe (Traditional)	0.65	1.5	Very Low
Stabilized Clay Brick	0.35	3.2	Low
Concrete Block	1.10	4.0	High

Table 01: Comparative data demonstrate their superior performance: Adapted from (Fidjah et al., 2021).

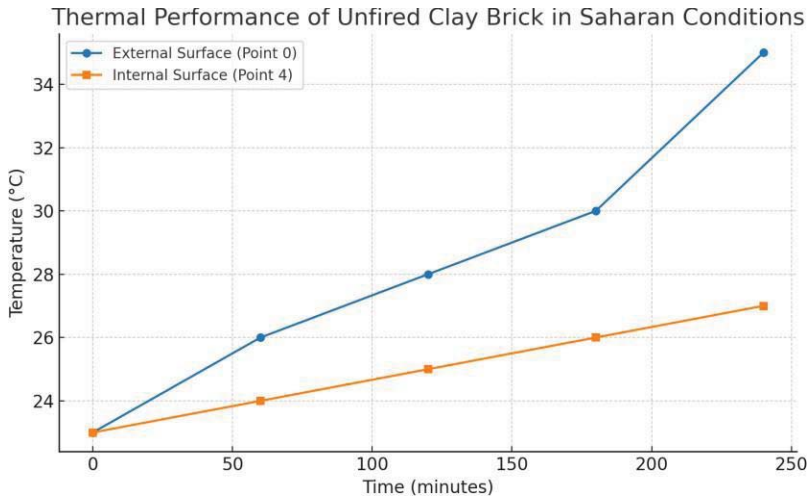


Figure 01: Line chart of Thermal performance of unfired brick in Saharan conditions

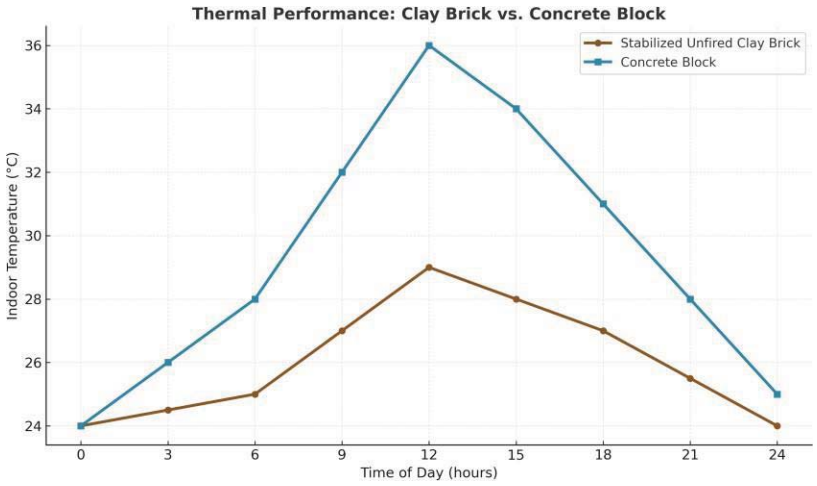


Figure 02: Line chart of Thermal performance: of clay brick vs concrete block

Source: Adapted from (Fidjah et al., 2021).

The stabilization of unfired clay bricks is achieved by adding **5–8% lime** (or a low percentage of cement depending on soil composition). This enhances compressive strength, water resistance, and durability while maintaining low embodied energy. Compared to conventional fired bricks, stabilized earth blocks reduce CO_2 emissions by eliminating kiln firing and relying instead on natural curing methods suitable for the Saharan climate.

For further technical information, the reader may refer to (Fidjah et al., 2023).

This technological enhancement bridges tradition and innovation, enabling sustainable construction without compromising cultural identity.

1.6 Conceptual Framework

The theoretical foundation integrates three interdependent dimensions:

- **Vernacular Wisdom** → local techniques, spatial logics, and material practices.
- **Islamic Spatial Ethics** → privacy, hierarchy, orientation, and symbolic meaning.
- **Environmental Sustainability** → passive cooling, renewable materials, and low-carbon construction.

This framework supports a regenerative design paradigm where architecture serves as a cultural continuity while addressing modern environmental challenges.

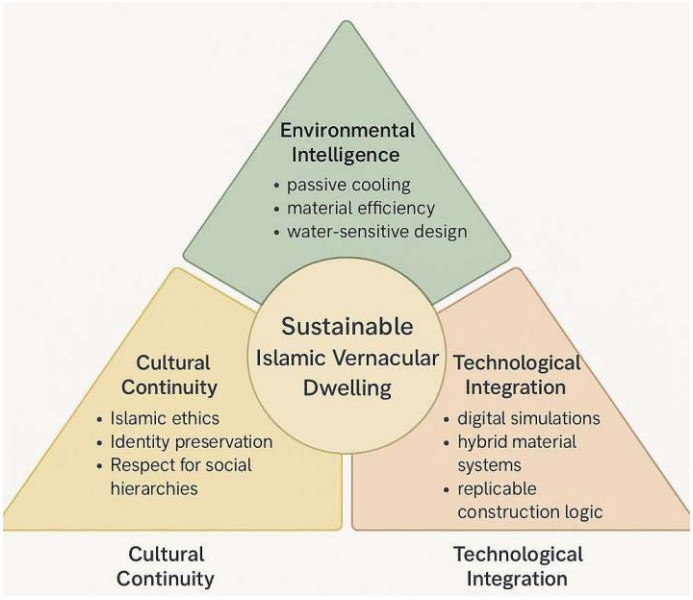


Figure 03: Pyramide Diagram showing integration of Vernacular Wisdom + Islamic Ethics + Sustainability in a unified dwelling model

Vernacular architecture in the Sahara embodies a synergy of ecological adaptation, cultural identity, and collective memory. This study argues that its reinterpretation when informed by digital tools, material innovations, and global sustainability metrics provides a scalable, future-oriented approach to contemporary Saharan housing. By merging humanistic values with scientific precision, we propose a model where architecture becomes both culturally rooted and environmentally regenerative.

2. CONTEXT AND CASE STUDY

2.1 Geographic and Environmental Context

The Touat region, located in the southwestern Sahara of Algeria, constitutes a central part of the historical network of oases, along with Gourara and Tidikelt (Figure 04). Its geographical position has historically granted it strategic importance, as it lies at the intersection of ancient trans-Saharan caravan routes linking North Africa, Sub-Saharan Africa, and the Maghreb (Fidjah, Hamadache, & Zemmouri, 2021).

The region's arid climate is characterized by extreme thermal variations, low precipitation (less than 50 mm/year), and intense solar radiation, making human settlement and architectural adaptation particularly challenging.

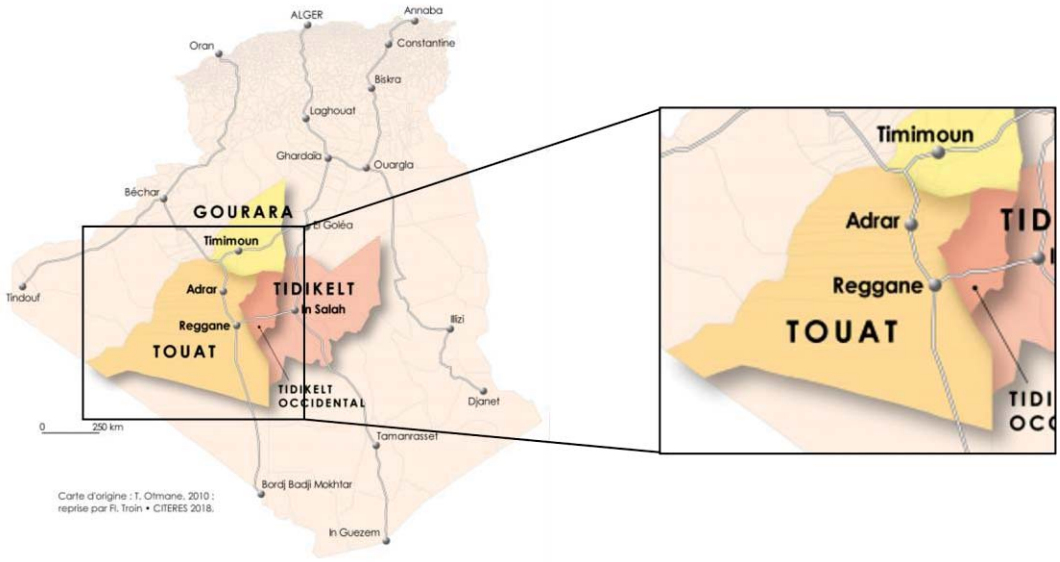


Figure 04: Geographic Location of the Touat Region within the Algerian Saharan Oases

Despite these harsh environmental constraints, the region has historically been inhabited thanks to sophisticated systems of water management and resilient settlement structures. The ancient foggara irrigation system, still partially in use today, demonstrates an exceptional adaptation to water scarcity by channeling underground resources to sustain palm groves and agricultural lands (Givoni, 1994).

2.2 HISTORICAL SIGNIFICANCE OF TOUAT

The Touat region in southern Algeria developed as a **multi-ethnic and multi-lingual hub** between the 14th and 16th centuries, shaped by **complex networks of kinship, trade, and religious scholarship**. As Voguet demonstrates, Touat's ksour evolved within a **connected socio-cultural space**, where desert dwellings became the **material expression of shared identity and collective memory** (Voguet, 2013)**.**

Throughout history, Touat played a pivotal role as a cultural and commercial crossroads. From the 11th century onwards, it became a key station for trans-Saharan trade caravans carrying gold, salt, textiles, manuscripts, and other valuable goods between the Sahel and the Maghreb (Ouedraogo, El Khattabi, & Adaji, 2021). According to Ibn Battuta, who visited the region in the 14th century, the ksour of Touat were "bustling centers of scholarship and commerce, where merchants, scholars, and travelers from across Africa converged" (Oliver, 2006, p. 112).

European explorers of the 19th century, such as Henri Duveyrier, also described Touat as a "gateway to the desert," highlighting its strategic location and the density of its ksour (fortified villages) (Arif, Al-Hemiddi, & Al-Said, 2019). Today, these ksour represent a living testimony to a complex urban fabric shaped by centuries of interaction between environment, society, and spirituality.

2.3 Urban Morphology and Vernacular Architecture

The ksour of Touat are characterized by compact, inward-looking layouts, narrow shaded alleys, and central courtyards — design principles directly responding to the region's climatic extremes and social values. Traditional building materials such as unfired clay bricks, palm trunks, and gypsum enabled dwellings to exploit thermal mass, creating microclimates that maintained thermal comfort without reliance on energy-intensive technologies (Hamdani, Attia, & Hamdy, 2022).

However, with the introduction of modern planning and industrial materials in the mid-20th century, significant disruptions occurred in the spatial logic and environmental efficiency of the built environment (Zemmouri, 2021). Contemporary dwellings often abandon the compact ksar typology in favor of detached houses with wide-open facades and concrete blocks, resulting in increased thermal loads and energy consumption. Comparative studies indicate that modern buildings in Touat consume up to 50% more energy for cooling than traditional structures (Fathy, 1973).

Recent studies on the **Gourara region** highlight its close cultural and environmental parallels with the **Tuat oases**. The typology of ksour and their **earthen materials** provide a reference point for developing **sustainable, identity-preserving housing models** in similar Saharan contexts (Kassou, Alkama, & Bouzaher, 2022).

2.4 Socio-Cultural Heritage and Identity

Touat's architecture reflects more than climatic adaptation; it embodies Islamic spatial ethics and a rich cultural identity. Concepts such as privacy, gendered spatial hierarchies, and symbolic

orientation toward the qibla are deeply embedded in the organization of (Correia, Dipasquale, & Mecca, 2022); (Chergui, Tahakourt, & Belhamri, 2023).

Historically, the ksour functioned as socio-economic units, combining residential, agricultural, and commercial spaces into a cohesive urban system that fostered community resilience and cultural continuity. Preserving this heritage while integrating modern needs has become a pressing challenge. As noted by recent UNESCO reports, Touat's urban fabric represents an **"intangible knowledge system"** in wich architecture acts simultaneously as a technical response and a cultural expression (Fidjah et al., 2021).

2.5Relevance to the Research

Studying Touat offers a unique lens for addressing the tensions between heritage preservation, modernization, and sustainability in Saharan regions. Its ksour provide empirical insights into centuries-old vernacular wisdom, while current urban transformations highlight the risks of abandoning context-sensitive solutions. This duality makes Touat an ideal case study for developing a contemporary conceptual dwelling model that integrates Islamic spatial ethics, environmental sustainability, and digital design simulations.

3.REINTERPRETING VERNACULAR WISDOM FOR CONTEMPORARY ISLAMIC DWELLINGS

3.1 Ingenious Design for Climate Control

According to Oliver, architectural discourse has historically **neglected vernacular forms**, focusing instead on monumental buildings designed for privileged elites (Oliver, 2017). Yet, it is precisely these **informal and adaptive systems** as seen in Touat's ksour that hold the keys to **sustainable and culturally resonant dwelling models**.

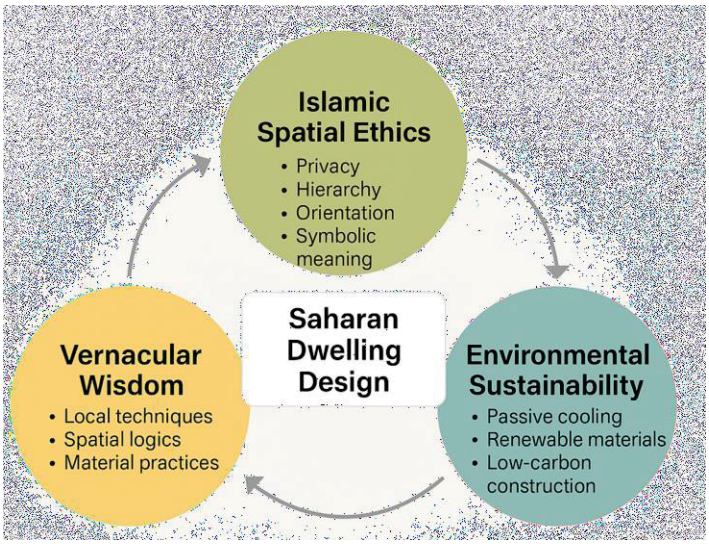


Figure 05: Conceptual Diagram of Contemporary Sustainable Saharan Dwelling.

Traditional Saharan dwellings stand as great examples in passive climate control, demonstrating how architecture can embody both environmental adaptation and cultural values. Their design integrates thermal comfort, social ethics, and material economy without relying on external energy systems. Here are some key design elements included:

- **Inner Courtyards:** These enclosed open-air spaces are central to Saharan and Islamic dwelling design. Courtyards reduce solar gain by providing shaded areas, facilitate natural ventilation through the "chimney effect" (where hot air rises and escapes, drawing cooler air in), and create cooler microclimates within the dwelling. They also offer privacy, a fundamental aspect of Islamic home design.
- **Compact Forms and Thick Walls:** Buildings are often designed with compact footprints and minimal external surface area exposed to direct sunlight. Thick walls provide excellent insulation, minimizing heat transfer from outside to inside.
- **Small Openings:** Windows are typically small and strategically placed to minimize heat gain while allowing for some light and ventilation. They are often protected by deep recesses or screens to further reduce solar penetration.
- **Ornamental Mud Plasterwork:** Beyond aesthetics, the intricate geometric patterns carved into facades serve a functional purpose by creating additional shading and reflecting sunlight, further protecting the building envelope; These features exemplify a **climate-responsive intelligence** that transcends ornamentation and expresses a holistic philosophy of life in arid environments.

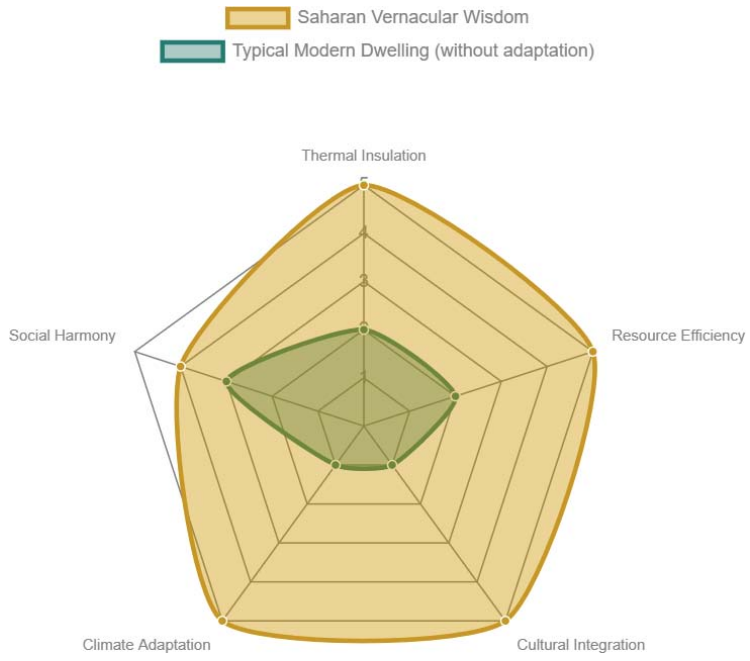


Figure 06: A radar chart illustrating the strengths of Saharan Vernacular Wisdom compared to typical modern dwellings in key sustainability and cultural aspects.

3.2 Integrating Vernacular Wisdom with Contemporary Islamic Principles

The challenge and opportunity lie in translating these historical insights into designs for 21st-century living. This means creating spaces that are not only climatically appropriate but also align with the functional and aesthetic demands of contemporary life, all while respecting Islamic cultural values.

Designing for Privacy and Community

Islamic dwellings traditionally emphasize privacy, particularly for women, and foster strong family and community bonds. The inward-facing courtyard house, common in Saharan architecture, perfectly supports these values. Contemporary designs can reinterpret these spatial arrangements, providing private family zones, flexible living areas, and clear distinctions between public and private realms. Elements like screened windows (mashrabiya-inspired designs) can offer privacy and shade without completely isolating inhabitants from the outside world.

The Oasis Mindset: Water and Greenery

The preservation and application of traditional water management techniques, such as the *foggara* irrigation systems found in Touat oases, are crucial. Integrating sustainable water practices into dwelling design, such as rainwater harvesting (where available) and the use of graywater systems, can promote ecological balance. Courtyards can incorporate small gardens or shade trees, which not only cool the air through evapotranspiration but also provide a connection to nature and support local biodiversity, embodying the "oasis mindset."

3.3 Modern Enhancements and Adaptability

While drawing from tradition, contemporary Islamic dwellings in Touat can also integrate modern technologies and design approaches for enhanced comfort and functionality. This could include:

- Passive Design Optimization: Advanced simulations can fine-tune building orientation, window sizing, and shading devices to maximize passive cooling and natural light.
- Renewable Energy Integration: Solar panels for electricity generation or water heating can significantly reduce reliance on fossil fuels, making the dwellings truly self-sufficient.
- Modular and Reconfigurable Interiors: Designing for adaptability allows homes to evolve with changing family needs, promoting longevity and reducing future waste.
- Durable and Low-Maintenance Finishes: Selecting materials that can withstand the desert climate without frequent replacement contributes to long-term sustainability.

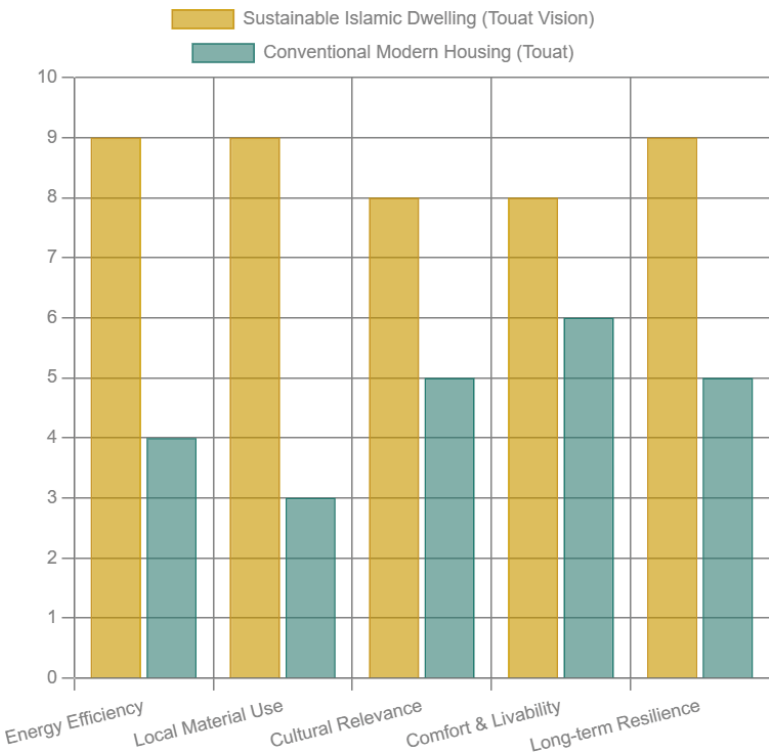


Figure 07: A bar chart comparing the performance of a sustainable Islamic dwelling (Touat Vision) against conventional modern housing across various sustainability and livability metrics.

3.4 Neo-Vernacular Applications: Lessons from Regional Case Studies

The revalorization of vernacular intelligence has already inspired a series of **neo-vernacular successes** across the Islamic world.

Hassan Fathy's New Gourna Village (Luxor, Egypt):

The legacy of Hassan Fathy (1900–1989), often referred to as the "Architect of the Poor," represents a turning point in modern approaches to sustainable Islamic architecture. Fathy believed that a home should be born from its environment, shaped by local tools, materials, and social values, reflecting the life and identity of its inhabitants. This philosophy was materialized in his seminal project, **New Gourna Village** near Luxor (1946–1952), where he designed an entire settlement rooted in local traditions and community needs.

By employing **mud brick**, **vaulted ceilings**, **Nubian domes**, **mashrabiya-inspired windows**, and naturally ventilated spaces, Fathy created architecture that "breathed" with the climate and reduced construction costs without compromising comfort or cultural identity (Fathy, 1973). His work earned global recognition, including the **Aga Khan Award for Architecture (1980)**, the **Balzan Prize**, and the **International Union of Architects Gold Medal (1985)**.

As Fathy (1973) wrote *"When the full power of a human imagination is backed by the weight of a living tradition, the resulting work is far greater than any that an artist can achieve when he has no tradition to work in or when he willfully abandons its tradition"*.

Tafilelt Tajdid Project (Ghardaïa, Algeria):

The **Tafilelt Tajdit** project **Ghardaïa (Algeria)** Recipient of the Aga Khan Award (2019), this large-scale cooperative housing project integrates **M'zab's vernacular heritage** with modern planning tools, reducing energy use while maintaining cultural identity (Aga Khan Trust for Culture, 2015) it serves as a notable example, blending ancient building techniques with modern adaptations for affordable and sustainable living. This neo-vernacular approach in arid regions of Algeria is being examined for its potential to create new vernacular expressions that react to contemporary needs while drawing from indigenous wisdom. The challenges in adopting green building techniques in Algeria include high costs and limited government backing, but there is a push towards environmentally friendly construction that ensures cost-effectiveness. The integration of Islamic dwelling concepts, such as those emphasizing privacy, humility, and hospitality, can also inform contemporary designs. Traditional Islamic architecture often incorporates features like geometric patterns, horseshoe arches, and mashrabiya screens, which not only serve aesthetic purposes but also contribute to climate control by managing light and heat. Reimagining these elements in a contemporary context can lead to culturally rich and functional dwelling prototypes.

Source: Tafilelt.com

The success of Tafilelt demonstrates that integrating vernacular logics into state-led housing can yield scalable, identity-preserving solutions, which this study aims to reinterpret for the Touat context.

Comparative Evidence from West Africa:

Recent studies in northern Togo, for instance, evaluated the sustainability performance of vernacular architecture in the **Kara Region** using the **VerSus tool**, revealing a remarkably high level of environmental and socio-cultural integration. Vernacular dwellings in Nawdéba country achieved an **85% sustainability score**, while Kabiyè dwellings reached **83.3%**, significantly outperforming contemporary housing models that scored only **35%** due to their weak environmental and socio-cultural responsiveness (Awoussi, Domtse, Gake, Genovese, & Dziwonou, 2025).

As Baduel (1988) observes, traditional habitations did not emerge from architects' triumph, but rather from **collective and intergenerational construction**, reflecting inherited socio-cultural values rather than stylistic impositions.

3.5 Synthesis: Towards a Regenerative Design Paradigm

The insights drawn from Saharan vernacular architecture, Islamic ethics, and sustainable technologies converge into a regenerative framework that can inform future housing in Touat and beyond.

Traditional elements are not to be replicated nostalgically but reinterpreted as living systems capable of adaptation, innovation, and resilience.

This table highlights how traditional Saharan architectural elements can be reinterpreted and enhanced in contemporary sustainable Islamic dwellings in Touat.

Traditional Element	Description	Contemporary Interpretation for Sustainable Dwelling	Benefit
Earthen Walls (Mud bricks/Rammed earth)	Thick, high thermal mass walls built with local soil.	Stabilized rammed earth or compressed earth blocks; integrated insulation layers (if needed).	Superior thermal regulation, reduced embodied energy, local material use.
Inner Courtyard	Central open space providing shade, ventilation, and privacy.	Re-imagined courtyard designs for natural light, cross-ventilation, green spaces, and rainwater harvesting.	Passive cooling, natural light, privacy, ecological integration.
Small & Recessed Openings	Minimal windows, often deeply set, to reduce solar gain.	Strategic placement of high-performance windows with external shading devices (e.g., modern mashrabiya-inspired screens).	Minimized heat gain, controlled natural light, enhanced privacy.
Compact Building Forms	Dense, multi-story structures to minimize exposed surface area.	Efficient floor plans; vertical growth where appropriate; optimized building envelope.	Reduced heat gain, efficient land use.

Foggara/Water Management	Traditional underground irrigation systems; efficient water use in oases.	Graywater recycling, rainwater harvesting, efficient fixtures, xeriscaping in courtyards.	Water conservation, sustainable landscape management.
Cultural Ornaments	Geometric plasterwork; decorative elements.	Modern interpretations of Islamic geometric patterns for shading and aesthetics; integration of local artistry.	Cultural identity, aesthetic appeal, functional shading.

Table 02: Traditional vs. Contemporary Sustainable Design Elements

4.PROPOSED CONCEPTUAL MODEL FOR A SUSTAINABLE SAHARAN ISLAMIC DWELLING

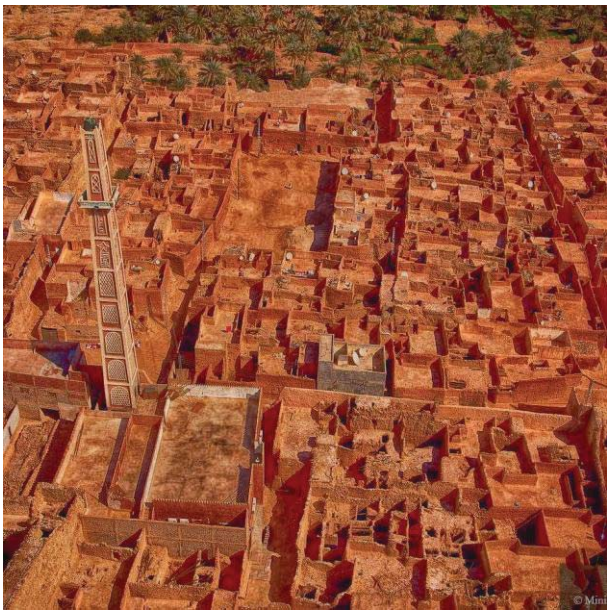
4.1Traditional Ksour Housing: Lessons from the Past

For centuries, the ksour dwellings of Touat represented an integrated system of climate adaptation, social organization, and Islamic spatial ethics (Elsheshtawy, 2021). Traditional houses were introverted in nature, with central courtyards acting as microclimatic regulators, ensuring thermal comfort, air circulation, and privacy.

Their construction relied on local materials such as unfired adobe bricks, palm trunks, and gypsum, which provided thermal inertia and minimized embodied energy. Narrow alleys (sabat), thick walls, and recessed openings optimized shading and protection from sandstorms.

These design strategies emerged from centuries of accumulated vernacular wisdom, reflecting a symbiotic relationship between architecture, climate, and culture (Frampton, 1983).

Modern apartment block
Source: https://www.sahm-media.dz/



Ksour dwelling in Touat (Tamentit)

Aspect	Traditional Ksour Dwelling	Contemporary Apartment Block
Spatial Layout	Inward-oriented with central courtyards	Outward-facing, fully exposed
Thermal Strategy	Passive cooling via adobe and shading	Heat accumulation due to concrete
Privacy	Gender zoning, minimal external openings	Limited privacy, large glass façades
Material Use	Locally sourced, low energy	Industrial, high embodied energy
Energy Dependence	Minimal, passive strategies dominate	High reliance on air conditioning
Cultural Integration	Deeply rooted in Islamic ethics	Often disconnected from identity

Table 03: The difference between Traditional Ksour Dwelling and Contemporary Apartment Block

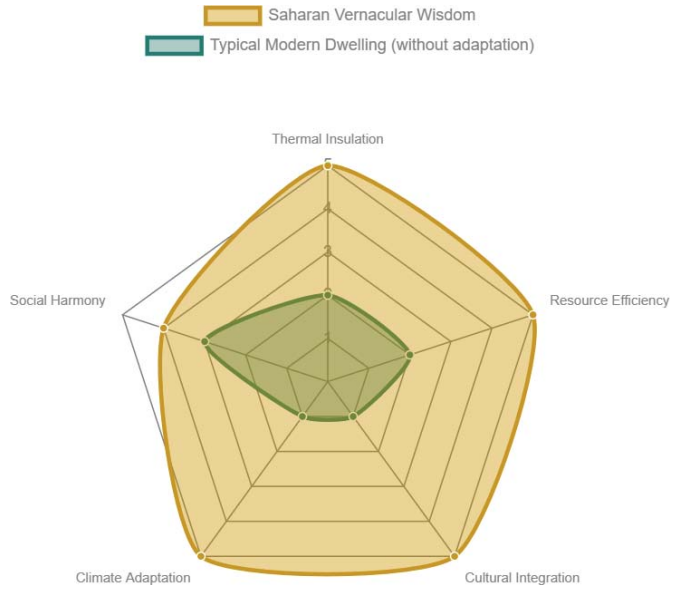


Figure 08: A radar chart illustrating the strengths of Saharan Vernacular Wisdom compared to typical modern

4.2 Housing Transformations and Emerging Challenges

In recent decades, Touat has witnessed the introduction of modern vertical housing typologies, apartment blocks driven by standardized national housing programs. While these buildings offer density and uniformity, they disregard key climatic and cultural parameters:

- **Thermal inefficiency**: thin concrete walls increase heat gain.
- **Loss of introversion**: outward-facing façades compromise privacy and Islamic spatial ethics.
- **Energy dependence**: reliance on air conditioning escalates energy costs.
- **Cultural alienation**: architectural identity is diluted in favor of imported aesthetics.

These shortcomings highlight the need for an alternative housing model that draws on local knowledge while addressing contemporary demands (Fidjah, Hamadache, & Zemmouri, 2021).

4.3 Proposed Conceptual Model

The proposed conceptual model integrates cultural imperatives by reinterpreting **visual screening devices** and **gender-based spatial zoning** within a contemporary framework, ensuring that privacy norms are respected without compromising openness or modern comfort (Abu-Lughod, 1987).

A sustainable Islamic dwelling prototype for Touat that reinterprets vernacular strategies within a contemporary framework:

Spatial Reconfiguration

Reviving central courtyards as passive cooling regulators and social nodes; Incorporating flexible living zones to adapt to changing family needs.

Ensuring privacy zoning through inward-facing layouts and screened openings (mashrabiya-inspired).

Material Innovation

Utilizing stabilized unfired clay bricks, combining thermal inertia with enhanced durability and moisture resistance (Heringer, 2019); Integrating local resources with improved construction techniques to ensure cost efficiency and environmental sustainability.

Climatic Adaptation

Passive cooling strategies: shaded walkways, natural ventilation corridors, and evaporative cooling via courtyard greenery; Optimized building orientation based on solar paths and prevailing winds.

Cultural Continuity

Maintaining Islamic spatial ethics, gendered spaces, qibla-based alignment, and privacy-oriented circulation; Subtle reinterpretation of local ornamentation and geometric patterns to reinforce identity.

Title: Sustainable Islamic Vernacular Dwelling

– Touat Prototype (Horizontal Layout)

General Layout:

A rectangular compact footprint inspired by ksour houses, organized around a central courtyard (ḥawsh) serving as the heart of the dwelling, a climatic and social core. The design balances privacy, climatic performance, and spiritual orientation.

1.Spatial Organization

Zone	Description
Entrance (Saqifah)	A shaded, semi-enclosed passageway leading from the street to the courtyard. It prevents direct visibility into the house and moderates temperature transition.
Central Courtyard	Open-to-sky space with a planted tree and small water basin (symbolizing oasis life). Serves for ventilation, light, and family gatherings.
Reception (Majlis / Diwan)	Located near the entrance but visually separated; used for receiving guests. Naturally ventilated, oriented for minimal sun exposure.
Private Family Zone	Comprising bedrooms, children's spaces, and a small prayer niche oriented toward the qibla. Accessed via transitional corridors ensuring privacy.
Kitchen and Service Area	Positioned on the southern or western side to minimize heat exposure; includes storage and access to the courtyard for ventilation.

Roof Access (Terrace)	Flat roof accessible by an internal staircase; used for drying dates, occasional sleeping in summer, or solar panels.
Transitional Zones	Covered passages, shaded arcades (riwaq), and small seating niches along the courtyard to create thermal gradients.

Table 04: Spatial Organization

2.Climatic Logic

- Orientation: Long axis east–west to reduce solar gain.
- Ventilation: Openings directed toward prevailing north–eastern winds.
- Thermal Mass: 40–50 cm thick stabilized clay walls; high thermal inertia.
- Shading: Deep recesses, wooden lattices (mashrabiyyah), and pergolas over the courtyard.
- Material Palette: Stabilized unfired clay bricks, palm trunks, local gypsum plaster, all with natural hues.

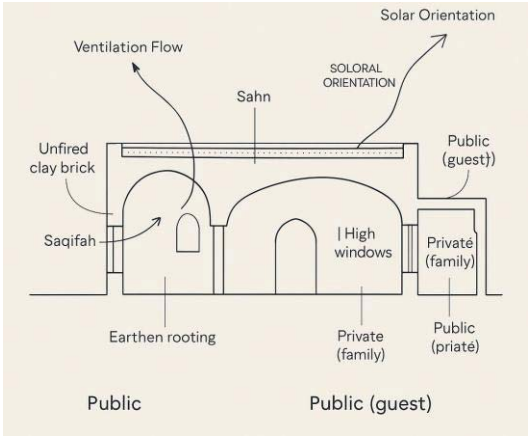


Figure 09: Proposed Conceptual Model : cross section showing the spatial hierarchy

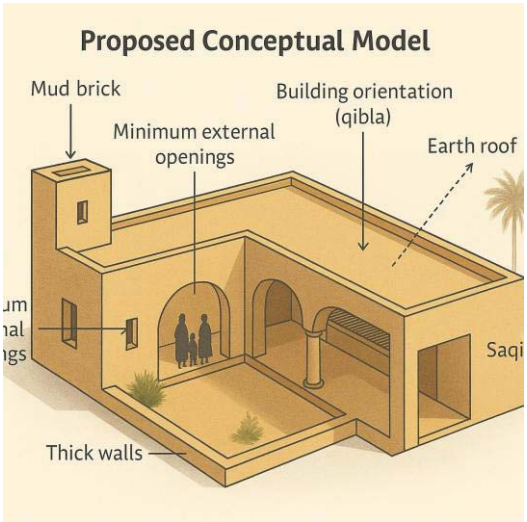
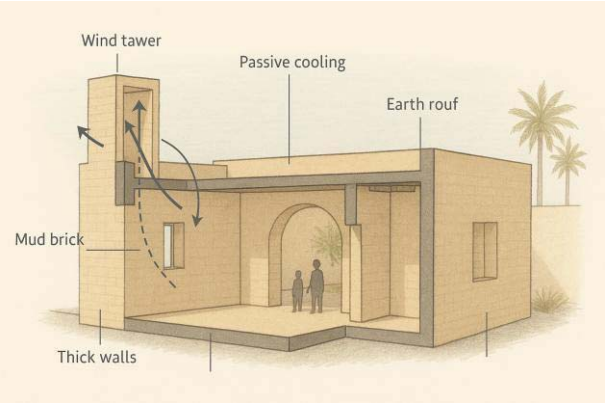


Figure 10: Proposed Conceptual Model of a Sustainable Islamic Dwelling in the Saharan Context

The proposed model integrates vernacular strategies such as courtyards, saqifah, and mud-brick walls with passive cooling principles to achieve climatic adaptability and cultural coherence.



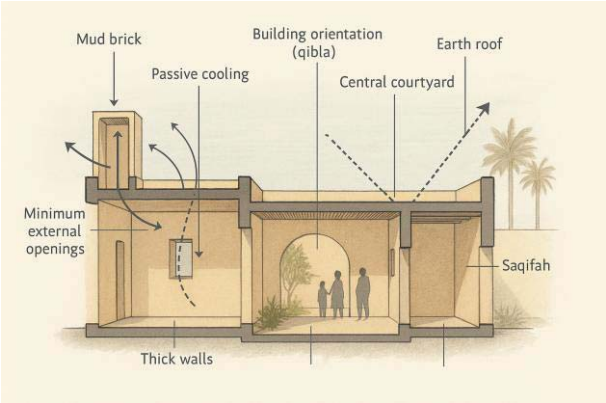


Figure 11 and 12: Perspective View of Passive Cooling and Vernacular Elements in a Contemporary Saharan Dwelling

Figure 13 and 14: Proposed Conceptual Model : using Ai generated render showing the Central Courtyard

The conceptual model demonstrates that vernacular wisdom is not a relic of the past but a living framework capable of guiding future-oriented design. By merging the spatial ethics of Islamic architecture with scientific tools and sustainable materials, the proposed dwelling embodies a holistic response to environmental, social, and spiritual needs in the Saharan context. This approach offers a replicable methodology for architects and planners seeking to create climate-resilient, culturally grounded housing in arid regions. It thus bridges the divide between tradition and innovation, paving the way for design strategies that sustain both people and place.

4.4 Methodological Clarification

This paper proposes a conceptual housing model rather than a tested prototype. No thermal simulations were conducted at this stage; instead, the model is grounded in a qualitative analysis of traditional ksour typologies, material performance reported in recent scientific literature, and well-established passive design principles for hot arid regions. The use of stabilized unfired clay bricks is based on prior experimental studies conducted in the Aoulef–Touat region, while the spatial principles derive from Islamic architectural ethics and historical Saharan precedents. As a theoretical framework, the model serves as a foundation for future simulation-based assessments and socio-economic feasibility studies.

CONCLUSION

This study has examined how the environmental intelligence and ethical principles embedded in Saharan Islamic architecture can inform a new vision for sustainable housing in arid contexts, particularly within the Touat region of southern Algeria. By reinterpreting the vernacular *savoir-faire* and the spiritual logic underlying Islamic spatial ethics, the research sought to demonstrate that traditional knowledge remains not only relevant but essential for addressing today's climatic and cultural challenges.

The comparative analysis between traditional *ksour* dwellings and contemporary standardized housing revealed a deep rift between inherited adaptive wisdom and modern construction practices. While traditional architecture embodies a coherent system integrating environmental responsiveness, social cohesion, and spiritual order, modern typologies tend to isolate these dimensions—resulting in energy inefficiency, loss of identity, and diminished comfort.

In response, the proposed conceptual model for a sustainable Islamic dwelling in Touat integrates passive climatic strategies, locally optimized materials, and spatial configurations that respect privacy, orientation, and social ethics. Rather than imitating the past, it aspires to **translate its underlying logic** into a forward-looking design language that balances modern comfort with cultural depth.

Ultimately, the study reaffirms that the future of sustainable architecture in arid Islamic regions lies in *reconnecting innovation with inheritance*. Reclaiming vernacular wisdom is not a nostalgic act but a strategic pathway toward designing resilient, identity-rooted, and environmentally adaptive housing models. By bridging heritage and technology, local intelligence and global aspirations, such approaches can help realize the vision of sustainability that is both ecologically responsible and spiritually meaningful, echoing the timeless equilibrium once achieved in the oases of the Sahara.

Future research could involve prototyping and field-testing this conceptual model using digital tools to quantify thermal and social performance.

Although the proposed dwelling model is conceptual, its construction relies entirely on *locally available materials*, *traditional building skills*, and *low-tech enhancement techniques*, making it economically feasible within the current housing context of Touat.

Preliminary virtual assessments indicate that the prototype is adaptable to local socio-economic conditions, especially through community-driven implementation, incremental self-building, and compatibility with existing legislation on earth construction. This reinforces its potential for real-world adoption as a culturally rooted and environmentally responsive housing alternative.

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