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ANALYSIS OF FUNCTIONAL DESIGN IN EGYPT’S CONTEMPORARY MOSQUES: TRADITION, INNOVATION AND ENVIRONMENTAL RESILIENCE

MISIR’IN ÇAĞDAŞ CAMİ MİMARİSİNDE İŞLEVSEL TASARIMIN İNCELENMESİ: GELENEK, YENİLİK VE ÇEVRESEL UYUM

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Abstract

This study examines the architectural evolution of mosques, tracing their development from purely liturgical spaces to multifunctional community centers that embody regional identities across the Islamic world. The research investigates the impact of socioeconomic transformations, from the Industrial Revolution to Modernism and Postmodernism, on mosque architecture, elucidating a nuanced interplay between architectural heritage and contextual adaptation. It specifically addresses the challenges facing modern Egyptian mosque architecture as it seeks to preserve traditional elements from the Prophet’s Medina prototype while responding to current environmental, technological, and societal demands.

Utilizing a mixed-methods framework that includes qualitative spatial analysis, field-based case studies, and environmental performance evaluations, all informed by a critical review, the study integrates insights from semi-structured interviews with architects and congregants to deepen the understanding of community engagement and the experiences of mosque users. Findings suggest

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that a performance-driven design paradigm, rooted in cultural continuity yet adaptable to local needs, can effectively reconcile the tensions between historic architectural typologies and modern imperatives.

The paper concludes with evidence-based design guidelines tailored to Egypt's unique context, advocating for solutions that reconcile aesthetic heritage with sustainability, thermal comfort, and inclusivity. By situating these findings within broader discourses on Islamic architectural innovation, this research contributes to interdisciplinary debates on culturally grounded design in an era of accelerated urban and climatic change.

Keywords: Mosque architecture, Functional Design, Tradition and Innovation, Environmental Resilience, Egypt.

Öz

Bu araştırma, İslam dünyasında camilerin, salt ibadet mekânı olma işlevinden sıyrılarak bölgesel kimlikleri temsil eden toplumsal merkezlerle dönüşüm sürecindeki mimari evrimi incelemektedir. Bu bağlamda, Sanayi Devrimi'nden Modernizm ve Postmodernizm'e uzanan sosyoekonomik dönüşümlerin Mısır cami mimarisini nasıl şekillendirdiği ve bu süreçte kültürel süreklilik ile bağlamsal uyum arasında nasıl bir etkileşim olduğu irdelenmektedir. Çağdaş Mısır camilerinin, Hz. Peygamber'in Medine'deki Camisinden türeyen geleneksel cami prototipinden miras aldığı unsurları korurken, aynı zamanda güncel çevresel, teknolojik ve toplumsal ihtiyaçlara yanıt vermekte karşılaştığı ikilemler analiz edilmektedir.

Araştırmada, niteliksel mekânsal analiz, saha çalışmalarına dayalı vaka incelemeleri ve çevresel performans değerlendirmelerini, eleştirel bir literatür taraması ile birleştiren karma bir yöntem benimsenmiştir. Bu çerçeveyi güçlendirmek amacıyla, mimarlar, akademisyenler ve cami cemaati üyeleriyle yapılan yarı yapılandırılmış mülakatlardan elde edilen nitel veriler entegre edilmiş; böylece toplumsal katılım ve kullanıcı deneyimlerinin daha derinlemesine anlaşılması hedeflenmiştir.

Araştırma bulguları, kültürel sürekliliğe kök salmış, aynı zamanda yerel ihtiyaçlara uyarlanabilen ve performans odaklı bir tasarım yaklaşımının, tarihi mimari tipler ile modern gereklilikler arasındaki gerilimi etkili bir şekilde uzlaştırabileceğine işaret etmektedir. Bu bağlamda, bulgulardan yola çıkılarak, Mısır'ın kendine özgü koşullarına uygun bir dizi kanıta dayalı tasarım ilkesi önerilmektedir. Bu ilkeler, estetik miras, sürdürülebilirlik, termal konfor ve sosyal kapsayıcılık gibi temel parametrelerle uyumlu mimari çözümler ortaya koymaktadır.

Araştırmanın; kentsel ve iklimsel değişimin hızlandığı bir çağda, İslam mimarisinde kimlik ve yenilik üzerine yürütülen daha geniş tartışmalara ve kültür odaklı tasarım konusundaki disiplinlerarası diyaloglara katkı sağlayacağı değerlendirilmektedir.

Anahtar Kelimeler: Cami mimarisi, işlevsel tasarım, gelenek ve yenilik, çevresel direnç, Mısır.

1. Introduction

The architecture of mosques in Egypt holds considerable significance, as it represents both religious and social centrality. This architectural heritage is a vital part of Egypt's cultural legacy, with modern designs increasingly focusing on user needs while harmoniously blending traditional styles with contemporary.¹

The initially modest and functionally driven form of the mosque inherited from the earliest structure in El-Madinah, established by the Prophet Muhammad (Peace Be Upon Him), including the precise orientation toward the qibla -the direction of Mecca- has evolved into a richly varied architectural typology, reflecting regional identities and local traditions while

¹ Elhefnawya- Mohammed 2024, 74.

maintaining its core religious purpose.² Additionally, the mosque's flexible layout allows for modifications that do not adversely impact the surrounding environment.³

Globally, several trends have emerged in contemporary mosque design based on an inductive review of existing examples.⁴ This review highlights the importance of integrating tradition, innovation, and sustainability, while also emphasizing the mosque's relationship with its local environment, community identity, and lived experiences.⁵

Various traditional components have been employed in mosque architecture to address local climatic conditions effectively⁶ while prioritizing materials that minimize environmental impact, optimizing the use of natural light, and enhancing energy efficiency.⁷ Minarets, for example, may serve as light towers that elegantly diffuse illumination throughout the mosque's interior or as wind towers that facilitate natural ventilation within the space.⁸

Hassan Fathy emphasizes the significance of vernacular architecture, encapsulated in the concept of sustainable architecture that harmonizes with its environment, leverages local resources, and addresses the needs of the community it serves.⁹

Despite the rich architectural heritage, these inherited architectural typologies have often been replicated with limited critical reassessment of their historical or contextual origins, leading to a degree of formal stereotyping in contemporary mosque design, where form has become dissociated from function and is frequently driven by historical precedent and cultural expectation rather than contextual or practical relevance.¹⁰

However, this tendency reveals a significant disjunction: a growing gap between the evolving demands of contemporary society -shaped by advances in technology, shifts in philosophical and scientific thought, and changing communal needs- and the persistent replication of inherited architectural stereotypes.¹¹ This phenomenon raises important questions about the extent to which contemporary mosque design reflects the lived realities and identities of the communities it serves, rather than merely reproducing inherited formal tropes.¹²

Mosque architecture exemplifies the distinctive characteristics of diverse societies, shaped by a complex interplay of historical, colonial, environmental, political, and external cultural influences.¹³ As the semiotic meanings embedded in mosque design differ across geographical and cultural contexts, they directly inform the physical configuration of the buildings, thus reflecting localized interpretations of religious identity, power structures, and socio-political dynamics.¹⁴

This paper analyzes the integration of functional design in contemporary Egyptian mosques while respecting tradition and addressing environmental challenges, focusing on the

² Taib-Rasdi 2012, 295.

³ Utaberta-Hamzah 2016, 58.

⁴ Haraty-Utaberta 2018, 529.

⁵ Bahauddin 2021, 3.

⁶ Croome 1991, 125-126.

⁷ Abass et al 2016, 2561.

⁸ Najmul Imam 2003, 746.

⁹ Ezzlou 2020, 37.

¹⁰ Hoteit 2015, 13548.

¹¹ El-Husseiny 2022, 29.

¹² Sekhri et al 2023, 17.

¹³ Sujak et al 2021, 206.

¹⁴ Adi-Puspitasari 2016, 35.

extent to which architectural form and spatial organization effectively support the diverse religious, social, and communal needs of users.¹⁵

The paper concludes by proposing conceptual guidelines that encourage architects to view mosque design as a set of dynamic cultural expressions anchored in their societal contexts, rather than merely reproductions of traditional formal elements that have diminished in their original significance.

2. Methodology

This section presents an analytical examination of contemporary mosque design in Egypt, emphasizing architects' responses to contemporary challenges. The study adopts a methodology centered on a critical review of selected case studies, systematically examining each mosque against established criteria and prioritizing high-quality projects recognized by the architectural community.

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The analysis identifies recurring factors across the selected mosque case studies to inform a new theoretical approach for contemporary mosque design that addresses present-day needs. The three case studies -Ezbit El Nakhl' Great Mosque, Basuna Mosque, and New Gournia Village (Luxor, Egypt)- demonstrate modern strategies for engaging with inherited elements and treatments within mosque architecture.

Four analytical approaches, distilled from prior research discussions, are illustrated in the graphic that follows (Tab. 1).¹⁶ The study applies four historically significant positions: valorization of tradition (generalization), sense of belonging as a primary motivational principle, functional performance, and environmental resilience, for a detailed examination of the three selected case studies. These examples were selected on the basis of their acknowledgment through two prominent architectural awards: the Aga Khan Award for Architecture and the Al-Fozan Mosque Architecture Award (Third Cycle 2017–2020) (nominated mosques), which underscore creative approaches in mosque design across diverse contexts.

Table 1: The Comprehensive Evaluation of Choosing Examples.

Tradition (stereotyping) vs Innovation	Cultural Identity Manifestation
<ul style="list-style-type: none"> - The dome - Minbar - Minaret - Indication (function) - Construction 	<ul style="list-style-type: none"> - Community involvement in celebrations and events contributes to the maintenance of the mosque. - A feeling of affiliation
Historical Relevance	

¹⁵ Wirakusumah et al 2021, 382.

¹⁶ El-Husseiny 2022, 32; Aziz et al 2022, 3.

- Geometry of the structure Spirituality (interaction of light).

Environmental Resilience
- Form - Façade - Setting - Scale - Structural elements and material usage - Space (Spatial organization)

The first two case studies were shortlisted for the Al-Fozan Mosque Award, which seeks to advance contemporary mosque design by blending heritage with modernity during its third cycle from 2017 to 2021.¹⁷ Notably, the Basuna Mosque was awarded the Al-Fozan Mosque Award in 2021 during this cycle.

The New Gournia Village Mosque received the prestigious Aga Khan Award for Architecture in the 1980 cycle, recognizing its contributions to improving local community living conditions through affordable and sustainable building solutions that incorporate traditional materials and construction methods. Every three years, the Aga Khan Trust for Culture oversees the prestigious Aga Khan Award, which was founded in 1977.¹⁸

These elements serve as indicators through which the interplay between tradition and innovation can be analyzed. Specifically, the reinterpretation of formal components such as the minbar, dome, and minaret, and the architectural expression through material choices are examined.

Historical relevance is assessed through spatial attributes, including the geometric organization of plans and spatial hierarchy. Cultural identity is investigated through the mosque's role as a socio-cultural hub.

Environmental resilience in mosque design comprises two fundamental components: form and spatial organization. These overarching elements encompass aspects such as scale, arrangement of spaces, and environmental treatment, as well as structural form and material expression.¹⁹

The official Aga Khan and Al-Fozan Mosque Award publications and archives provide the primary data for the selected examples (Tab. 2).

Table 2: Provides essential technical details pertinent to the three chosen examples: The Aga Khan Development Network's website (<https://www.akdn.org>) and the Al-Fozan Award's website (<https://alfozanaward.org>).

¹⁷ Allahham 2019, 206.

¹⁸ Serageldin 2007, 85.

¹⁹ Aziz et al 2022, 3.

	Basuna Mosque	New Gourni Village Mosque	Ezbit El Nakhl' Great Mosque
Architect	Waleed Arafa	Hassan Fathy	Osama Muhammad Ali Farag
Location	Basuna, Egypt	Luxor, Egypt	Cairo, Egypt
Size	450 m ² m ²	nine thousand m ² (although, the accessible building space was limited to only 2,700 m ²)
Completion	2019	1946 to 1948	2017
Distinguished Addition	The mosque used local materials and traditional construction techniques in a modern form.	Historical relevance is manifested in the unique mud brick and limestone.	It adopts a postmodernist approach for design with many Ottoman features.

2.1. The Basuna Mosque

The Basuna Mosque serves as an exemplary illustration of the integration between traditional identity and contemporary architectural principle. The mosque seamlessly integrates inherited local cultural elements, such as the dome, minbar, minaret, and structural columns, with innovative design strategies, resulting in a harmonious traditional-contemporary manifestation of Islamic architecture that is profoundly interconnected with its surrounding environment.²⁰

This observation underscores the significance of Arabic calligraphy, particularly the term “*Tholoth*,” and the deconstruction of stalactite motifs, which are instrumental in the development of Islamic architectural styles.²¹

Within the Islamic tradition, the 99 components that constitute the Mihrab's cantilevered form symbolize the names of Allah. Furthermore, this dome introduces a dynamic variability, revealing a structure composed of light sand bricks that enhances the interplay of light and spatial perception, aimed at establishing a spiritual connection with the heavens, while casting shifting shadows produced by the projections of the sand-brick materials.²²

The solid facades of the Basuna Mosque exemplify a minimalistic approach to Islamic design, appropriately responding to the hot, arid climate of the region. This architectural approach fosters a profound sense of connection among individuals within their local

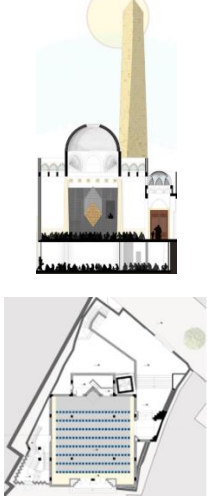


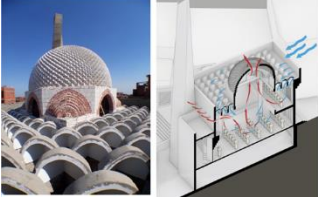


²⁰ Sabry- Shaker 2025, 173.

²¹ Dariyadi et al 2025, 1.

²² Ali 2021, 52.

environment.²³ The table below (Tab. 3) provides a more comprehensive examination of the mosque, expanding upon the points discussed previously.

Table 3: Analysis of Basuna Mosque.

Tradition and Contemporary thinking	Historical Significance	Manifestation of Cultural Identification	Environmental resilience
 <p>The design reinterprets conventional components, like the minaret, minbar, and dome, with an introspective expression that enriches the spatial experience.</p>	 <p>The dome is designed to express the concept of transition in two distinct ways: structurally and symbolically.</p> <p>Skylights serve as a source of natural illumination within a space.</p>	 <p>In addition to literacy training, the mosque offers facilities for temporary hospitals and extracurricular educational programs.</p> 	<p>Passive sustainability elements like effective ventilation and natural lighting, utilizing mashrabiyas.</p> <p>Form: Façade</p> <p>Two distinctive domes, a perforated ceiling, and 108 pendentives, which create a naturally illuminated space for prayer.</p>  <p>Multi-Functional Spaces: Multi-purpose halls in the basement for classes, clinics, and events. The ground floor features the main prayer hall.</p> 

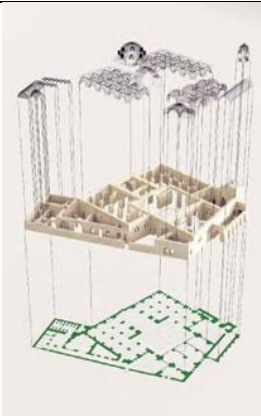
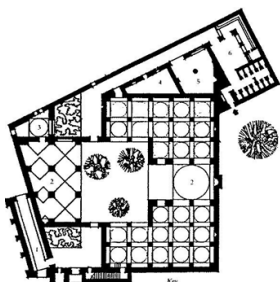



²³ Ali 2021, 54.

2.2. New Gournia Village Mosque

The mosque constitutes a key example of regionally contextualized modernism, employing traditional construction techniques with mud brick walls and limestone, structurally supported by arches and wooden slabs. It emphasizes affordability and sustainability over dependence on imported Western materials, such as concrete and steel, while concurrently incorporating environmentally conscious building practices. The structure embodies the architectural heritage of Upper Egypt and Nubia while addressing the social and environmental conditions of postcolonial rural communities.²⁴

The mosque and the adjacent madrasa exhibit a dual courtyard configuration and are constructed with limestone and fired brick, resulting in a cohesive scale and visually appealing massing. Fathy's mosque integrated modernist principles, including functional zoning and participatory design, while simultaneously expressing regional identity.²⁵ According to Pyla (2009), there was local opposition to the use of Nubian domes, which were perceived as appropriate solely for sacred structures such as mosques and mausoleums.²⁶ Table 4 provides a more comprehensive analysis of the mosque, expanding upon the points discussed above.

Table 4: Analysis of New Gournia Village Mosque.

Tradition Innovation	Historical Relevance	Cultural identity	Environmental resilience
 <p>Reinterprets traditional elements like the minaret, inspired by the Nubian staircase, along with the minbar and dome.</p>	 <p>The plan features an external staircase, mudbrick domes, trapezoidal iwans, and a courtyard configuration influenced by early Islamic and Nubian architectural styles.</p>	 <p>This mosque incorporates a madyafa (guest house), ablution facilities, and meditation areas that reflect local social customs.</p>  	<p>Its efficient ventilation systems, thick mudbrick walls, and vaulted arcades provide natural insulation, reducing reliance on artificial cooling and thereby maintaining a comfortable environment for worshippers.</p> <p>Form: The mosque is characterized</p>

²⁴ Tawab 2018, 147.

²⁵ El-Shorbagy 2006, 116.

²⁶ Pyla 2009, 720-721.

			<p>by a quadripartite iwan courtyard, which includes three domed iwans and a central dome (baked brick) positioned above the qibla.</p> <p>Façade: The earth-toned mudbrick façade complements the design.</p> <p>Setting and Scale:</p> <p>Located in New Gurna village, the mosque serves as a vital social and spiritual hub within the community.</p> <p>Spatial Organization:</p> <p>It features functional zoning with separate areas for prayer, ablution, social gatherings, and meditation.</p>
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2.3. Ezbit El Nakhl' Great Mosque

The Ezbit El Nakhl Great Mosque represents a notable instance of postmodern reinterpretation, integrating Ottoman architectural features through the reimagining of historical elements, including a central dome with semi-domes, arches, pencil-shaped minarets, and a hierarchical spatial configuration within a contemporary architectural framework.²⁷ Critics contend that this design constitutes a “deformed replica” or “pseudo-Ottoman style,” implying that aesthetic emulation supersedes genuine cultural significance. Furthermore, the abstract palm tree columns are perceived primarily as ornamental elements rather than as substantive cultural symbols.²⁸

The mosque's design strategically integrates planning, lighting, insulation, and ventilation techniques while addressing five principal challenges: the heterogeneous needs of stakeholders, its geographical context, the necessity for adaptability, elements aimed at historical revival, and aesthetic considerations, such as arches derived from equilateral triangles and influenced by Mamluk proportional systems. Situated in a densely populated informal settlement near a metro station and adjacent bustling marketplaces on Cairo's periphery, the mosque encounters challenges such as noise pollution, environmental degradation, and spatial constraints.²⁹

The structure employs passive design strategies to enhance ventilation and natural lighting, incorporating east-west oriented courtyards to facilitate cross-ventilation and minarets to direct airflow into the prayer hall. Transparent domes allow abundant natural light, thereby reducing reliance on artificial illumination. Additionally, the elevated configuration of the prayer hall and the minimization of street-facing openings contribute to the mitigation of urban noise.³⁰ The table below (Tab. 5) presents a more detailed analysis of the mosque, expanding upon the points discussed previously.

Table 5: Analysis of Ezbit El Nakhl' Great Mosque.

Tradition Innovation	Historical Relevance	Cultural identity	Environmental resilience
	 The mosque's spatial organization reflects that of Mamluk madrasas.	The palm tree motif on the columns symbolizes the area's historical identity as “the land of palm trees,” though the abstraction of these motifs diminishes	Form: It features a six-story vertical structure with irregular massing that addresses spatial constraints and urban density. The façade:

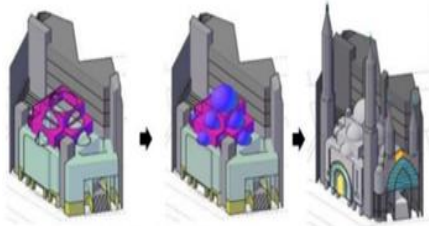
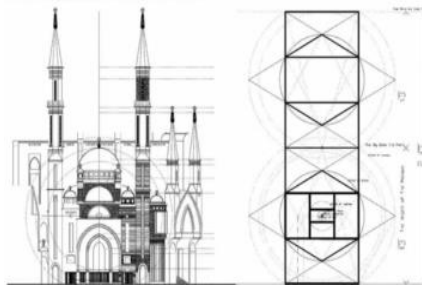
²⁷ Ali 2021, 41.

²⁸ Ali 2021, 45.

²⁹ Ali 2021, 38.

³⁰ Ali 2021, 44.

The central dome is surrounded by semi-domes and pencil-shaped minarets, and the main entrance is designed as a bent entrance, reminiscent of Mamluk architectural examples.



their cultural significance.

It is enveloped in hashma stone, which offers a robust and traditionally aesthetic exterior.

Setting and Scale:

The mosque, located in a densely populated area, is designed to accommodate 5,000 worshippers. It's a compact 2,700 m² plot but achieves a built area of 9,000 m² through vertical expansion.

Space (Spatial Organization):

The design features a flexible layout with a rectangular prayer hall and a multifunctional ground floor, which includes separate ablution facilities for men and women. The medical facility is situated

			behind the prayer hall.
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3. Functional Design in Egypt's Contemporary Mosques between Tradition, Innovation, and Environmental Resilience

The preceding qualitative analysis clarifies the impact of integrating traditional mosque architectural identity with contemporary requirements, ambitions, and values in modern architectural practice. This reinterpretation cultivates deeper layers of meaning within the mosques examined, closely associated with community engagement, spiritual experiences, metaphorical significance, and the interplay of light.

The functional design of contemporary mosques in Egypt focuses on effective spatial organization, incorporating prayer halls, ablution areas, and community spaces that allow for flexible, multi-functional use, including education and social services.³¹ Aesthetic and symbolic continuity is maintained through geometric patterns, calligraphy, and traditional materials, while modern interpretations of elements such as domes, arches, and minarets are utilized.³² Innovative structural solutions, such as lightweight materials, modular designs, and adaptive reuse, strengthen both functionality and sustainability.³³

Successful mosque architecture is viewed as a cultural product that addresses community needs and aspirations, reflecting their values and lifestyles for deeper significance. This aligns with Amos Rappaport's view of architecture as emerging from the communities it serves.³⁴ A comparative table (Tab. 6), based on three analyzed case studies, illustrates various meanings and values, highlighting differences and similarities among them. This analysis is essential for balancing innovation with modern sensibilities while enhancing the mosque's spirituality and community value. Ultimately, the goal is to boost user engagement, foster a sense of belonging, and advance environmental resilience.

Table 6: Cross analysis of the three chosen examples concerning the established criteria.

		Basuna Mosque	New Mosque	Qourna	Ezbit El Nakhl'
Historical	Relevance	Integrating Traditional and Contemporary Architectural Elements	Vernacular	Archi-	Intentional but superficial
Form		Robust Exterior Envelope with Parallels in Key Features	Vernacular Architecture and Stemming from Structure		a pragmatic vertical structure and unprecedented dome treatment

³¹ Khamis- Tantawy 2021, 42.

³² Fouad et al 2021, 7.

³³ De Gregorio et al 2020, 2.

³⁴ Rapoport 2005, 2-10.

Expression	Traditional Contemporary	Traditional and contextual	Minimalist, traditional, contextual
Spirituality	Achieved through the integration of philosophical Islamic ideologies and the interplay of light within the Dome Eye	Connection through communal traditions and directional light.	Formalistic natural light.
Tradition Vs Innovation	Re-interpretation of Traditional Elements	Reinterpretation of Nubian elements in a contemporary context	The traditional elements are copied without deep cultural or functional justification.
Community Participation	Serves as a hub for community activities.	promote social interaction	Present (based on Charitable Foundation).
Environmental Resilience	Focusing on its sustainable design features	Passive sustainability	Passive strategies with less sustainability

4. Discussion: A Novel Interpretation of Mosque Architecture in Egypt

The theoretical discourse, supplemented by case study analysis and cross-referencing, demonstrates that the typology of mosques derives its significance, sustainability, and influence from the deep spiritual meanings they hold for Muslim communities.³⁵ More than mere places of worship, mosques represent the “house of God” on Earth and serve as spiritual conduits with the divine. Additionally, they act as vital social hubs that foster connection and unity within their communities.³⁶

The challenges faced by contemporary mosques are evident in the tension between the preservation and revival of historic forms and architectural elements -despite their potential lack of core significance or necessity- and the opportunity to reinterpret historicism in a manner that produces meanings, values, and usage patterns that better align with the needs of modern communities.³⁷

There is a growing necessity to redefine mosque architecture by embracing research and innovative designs. Such a redefinition would enhance user experience, enrich the historical narrative of mosques, and promote the phenomenological evolution of this architectural

³⁵ Fireza et al 2025, 122.

³⁶ El-Husseiny 2022, 39.

³⁷ Serageldin 1990, 12.

typology. This mobilization is significant, as it has the potential to embody and reinforce sacred values for a large global community of users.³⁸

5. Conclusions

This study aimed to clarify the transition of mosque architecture, language, and functional design from traditional repetitions to a focus on quality, environmental appropriateness, and technological innovation. The data have been established through a methodical analysis of various viewpoints regarding the origins, significance, and characteristics of mosque design. Subsequently, three prominent case studies were qualitatively examined to identify factors pertinent to modern mosque architecture in Egypt. The following is a summary of the lessons extracted from each of the three chosen examples:

- Basuna Mosque distinguishes itself in philosophical interpretations of heritage meanings, generating innovative concepts that transcend conventional representations of mosque architecture.
- New Gurna Mosque: Residents collaborating to enhance the significance of vernacular architecture and its role in preserving local cultural traditions.
- The Great Mosque of Ezbit El Nakhl prioritizes monumental form and functionality; however, its postmodern reinterpretation lacks sufficient cultural depth.

The research highlights the importance of approaching mosque architecture with greater significance, particularly in relation to elements that enhance its visual representation of Muslim identity. Furthermore, it emphasizes the importance of recognizing the mosque as a cultural artifact that reflects the communities it serves. Finally, the design of mosques must also prioritize environmental balance.

The analytical criteria and the framework established in this study can be applied to other case studies to explore whether these new additions convey an insightful message or simply represent a further appropriation of tradition within mosque architectural design.

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³⁸ Helmy 2022, 300-301.

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