**Solid and Void in Dialogue: Tracing the Morphological Evolution of Aleppo’s Mosques**

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**Abstract**

This study explores the evolution of solid and void relationships in the mosque architecture of Aleppo, one of the world’s oldest continuously inhabited cities. The study examines five significant mosques from the Umayyad period to contemporary times, exploring how spatial arrangements—especially the function of courtyards—have evolved throughout history. Using architectural analysis, spatial mapping, and comparative interpretation, the findings reveal a shift from inward-oriented, courtyard-centered designs to more externally focused forms in the Ottoman and modern periods. This transition has diminished the social, spiritual, and environmental functions historically provided by courtyards. The study highlights the need to reintegrate traditional spatial strategies in contemporary mosque design to restore environmental comfort and community engagement, offering insights for heritage preservation and future architectural practice.

**Keywords:** Mosque Architecture, Solid and Void, Morphology, Aleppo, Courtyard Design, Heritage Preservation.

# **Introduction**

Aleppo, recognized as one of the oldest cities with continuous habitation in the world, boasts a profound heritage of Islamic architecture, particularly showcased through its ancient mosques that trace their origins to the 7th century (Alafandi and Abdul Rahim, 2014). Among these, the Umayyad Mosque emerges as a significant edifice, constructed in the 8th century and acknowledged as one of the most ancient and expansive mosques within the Islamic realm (Kuban, 1974). Its architectural composition features a spacious courtyard adorned with marble columns and intricate mosaics(al-Jamīlah, 1999), exemplifying the sophisticated balance between solid and void spaces that characterize Islamic design. Other significant examples include the Al-Halawiyya Mosque, dating to the 12th century with its elegant courtyard and gardens(Guidetti, 2016, Neglia, 2020) , and the Al-Adiliyah Mosque from the 13th century, renowned for its detailed stonework and decorative tile patterns(Bonner and Bonner, 2017).

Throughout its historical timeline, Aleppo has been the site of the establishment of a multitude of mosques that embody the architectural legacies of the Umayyad, Ayyubid, Mamluk, and Ottoman epochs, alongside contemporary interpretations that encapsulate modern design philosophies(Al-razik and Mohamed, 2020). Regrettably, a significant number of these mosques have experienced considerable damage or complete obliteration due to the ramifications of Syria’s recent armed conflict. Nevertheless, ongoing restoration efforts seek to revive their cultural and architectural value for future generations(Ibold, 2020, Noaime, 2023, Noaime and Alnaim, 2023b).

The diversity and continuity of these historical mosques confirm Aleppo’s role as a living archive of Islamic architectural evolution(El-Hakim, 2021). These edifices function not solely as sites for religious observance but also as significant cultural, social, and historical markers that have profoundly influenced the urban character of the city(Noaime et al., 2020, Noaime and Alnaim, 2023b). Studying these mosques is therefore crucial for three main reasons. First, it provides insight into the stylistic and technological developments of Islamic architecture across centuries, illustrating how local and external influences—from Umayyad to Ottoman—shaped architectural expressions in Aleppo(Gokalp and Uguz, 2018). Second, it supports heritage preservation efforts, providing a documented architectural record that can guide restoration and reconstruction initiatives(Militello, 2018). Third, it offers valuable lessons for contemporary mosque design, allowing architects to draw inspiration from traditional spatial principles while integrating modern materials and technologies(Petruccioli and Pirani, 2013).

A distinctive feature of Aleppo's mosques is their masterful interplay of solid and void elements, a design strategy that balances enclosure with openness, light with shade, and private spiritual functions with communal social engagement (Miroğlu, 2005, Noaime, 2016, Noaime and Alnaim, 2023a). This spatial relationship—most visibly represented by the integration of courtyards and arcades—is not only an architectural choice but a social and environmental strategy that enhances user experience. Despite its architectural and cultural importance, limited scholarly attention has been given to the specific role of solid and void spaces in shaping the spatial, social, and environmental qualities of Aleppo’s mosques.

While existing studies have addressed the historical significance, stylistic features, and cultural value of Aleppo’s mosques, little attention has been given to the morphological analysis of spatial relationships, particularly the dynamic interplay between solid and void elements across different architectural periods. Most architectural research on Aleppo tends to focus on individual monuments or stylistic classifications, without tracing how spatial configurations evolved in response to changing cultural, environmental, and political contexts. This study distinguishes itself by offering a diachronic, comparative analysis that not only documents these transformations but also critically evaluates their impact on environmental performance, social interaction, and urban identity. By positioning the courtyard as both a spatial and functional mediator between built form and communal life, this research brings forward an underexplored dimension of mosque architecture that holds significant implications for both heritage conservation and contemporary mosque design.

Accordingly, the central research question guiding this study is:

* How has the relationship between solid and void evolved in the architecture of Aleppo’s mosques from the Umayyad period to the modern era, and what are the spatial, social, and environmental implications of these changes?

By positioning the courtyard as both a spatial and functional mediator between built form and communal life, this research brings forward an underexplored dimension of mosque architecture that holds significant implications for both heritage conservation and contemporary mosque design.

This study seeks to fill this gap by systematically analyzing how the relationship between solid and void has evolved from the Umayyad to the modern era in Aleppo's mosque architecture. It further examines how these spatial configurations influence social interactions, cultural continuity, and environmental performance. By revisiting these traditional design strategies, the study aims to inform contemporary mosque design and urban planning practices, contributing to the preservation and revitalization of Aleppo's rich architectural heritage. Ultimately, this scholarly investigation seeks to enhance the comprehension of the manner in which architectural form may promote social cohesion, cultural identity, and environmental welfare, in both historical and contemporary contexts.

# **Research Design and Methodology:**

This study adopts a sequential mixed-method research design that integrates architectural documentation analysis, spatial mapping, and critical comparative interpretation. The primary objective of this approach is to trace the evolution of solid and void relationships in the mosques of Aleppo, with particular attention to how these spatial dynamics have influenced the social, environmental, and cultural roles of these structures over time.

The research began by defining its geographical and historical scope, focusing on Aleppo’s historic core. Five mosques were deliberately chosen to exemplify significant epochs in the architectural evolution of the city, spanning from the Umayyad period to contemporary times. The selection was based on three essential criteria. Firstly, each mosque needed to demonstrate historical significance, offering a representative example of its architectural period. Secondly, the presence of dependable architectural information, encompassing building schematics, photographic documentation, and historical narratives, was imperative to guarantee the precision of the analysis. Thirdly, the selected mosques had to hold cultural and urban importance, reflecting their lasting role in Aleppo’s social and architectural identity. These criteria ensured the study covered a wide temporal spectrum while remaining grounded in accessible, verifiable data sources.

Following the identification and selection of the relevant case studies, the research progressed to the methodical collection and categorization of architectural data. This phase involved gathering historical records, architectural surveys, and photographic archives, particularly those provided by the Aleppo Heritage Project. Additional data were obtained through on-site documentation conducted by the author between 2008 and 2010. Complementing these primary sources were published architectural studies and scholarly works on Islamic architecture, which provided theoretical and contextual depth. To facilitate spatial analysis, the gathered architectural plans were digitized and transformed into two-dimensional models using AutoCAD and Photoshop. This modeling process enabled the precise identification and mapping of the solid and void relationships characterizing each mosque.

With the architectural models prepared, the study advanced to the spatial and morphogenetic analysis phase. This analysis traced the evolution of spatial configurations over the various historical periods represented by the selected mosques. A considerable focus was directed towards the arrangement and metamorphosis of courtyards, the equilibrium between sheltered and exposed areas, as well as the architectural methodologies utilized to enhance environmental variables including natural illumination and airflow. These spatial analyses provided the architectural foundation necessary to compare the mosques across different eras and to interpret the changing role of courtyards in relation to social and environmental functions.

In parallel with the spatial analysis, the study incorporated qualitative data derived from field observations conducted before the outbreak of conflict in 2011. These observations offered insights into user behavior, including patterns of movement and social interaction within mosque courtyards and prayer spaces. Furthermore, the ecological efficacy of these environments, especially their ability to facilitate shading, promote ventilation, and ensure thermal comfort, was subject to a qualitative evaluation. Although these observations were limited to pre-conflict conditions, they added significant depth to the architectural analysis by providing evidence of how these spaces functioned in practice.

To further strengthen the findings, the study employed a comparative interpretation framework, situating Aleppo’s mosque typologies within a broader architectural context. Comparative analysis was conducted with regional examples from cities such as Cairo, Istanbul, and Cordoba. This process highlighted both the shared patterns and the unique adaptations present in Aleppo, particularly the influence of Ottoman architectural models, which introduced the practice of externalizing courtyards inspired by Byzantine precedents. By positioning Aleppo’s mosques within this wider architectural discourse, the study was able to draw more generalizable conclusions about the evolution of mosque architecture.

In the process of investigation, triangulation served to back up the results. This involved cross-referencing data from architectural plans, historical documents, photographs, field observations, and scholarly literature. The interpretations derived from the spatial analysis were further tested against established architectural theories and regional studies to ensure their robustness and to minimize the risk of bias or misinterpretation.

Finally, the research synthesized the architectural, social, and environmental findings into a comprehensive narrative that documents the historical transformation of mosque architecture in Aleppo. This synthesis not only enhances our understanding of how solid and void relationships have shaped the evolution of mosque design but also identifies practical lessons that are relevant for contemporary architectural practice and urban planning. By reconnecting traditional spatial strategies with modern design needs, the study offers insights that can contribute to both heritage preservation and the development of socially and environmentally responsive mosque architecture in the future. See figure 1

A diagram of a process of research

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Figure 1. flowchart research design and methodology

# **Historical background of Aleppo**

Aleppo, encompassing an expanse of 190 square kilometers, serves as the most prominent city in Syria and ranks among the oldest urban locales that have been continuously inhabited throughout history(Mohamed et al., 2020, TOPAL). Strategically located in northwestern Syria on a plateau 680 meters above sea level and approximately fifty kilometers from the Turkish border, Aleppo has long held a prominent position due to its geographical, historical, and cultural significance. Its architectural landscape reflects a unique synthesis of ancient Eastern traditions and modern Western influences, making it an exceptional case study for architectural and urban heritage. See figure 2

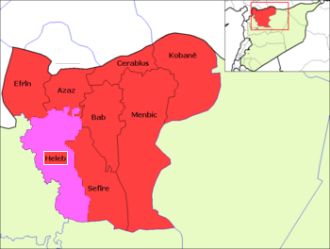
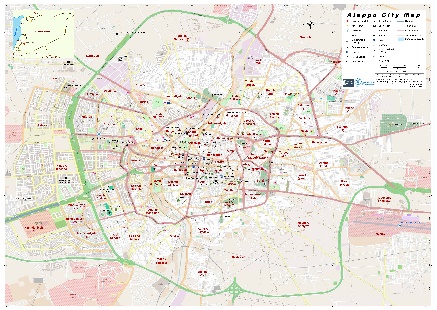
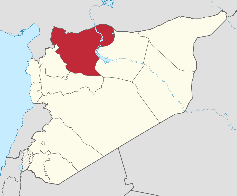


Figure 2. Aleppo region location and administrative boundaries. Source: Aleppo Municipality.

Throughout history, Aleppo’s strategic location at the northern edge of the Fertile Crescent has positioned it as a crossroads of civilizations and a vital trading hub since Roman times(Asslan et al., 2022, TOPAL). Over centuries past, the city has seen a chain of conquests and governances, prominently by the Arabs in the 7th century, the Seljuk Turks in the 11th century, and the Crusaders as well. It was subsequently reasserted by the Mamluks in 1260 and later integrated into the Ottoman Empire in 1516, remaining under its jurisdiction until the conclusion of World War I. Following the war, Aleppo fell under French administration until Syria achieved its sovereignty in 1946(Spagnolo, 1969). More recently, the city has endured significant destruction due to the ongoing conflict since 2011, suffering extensive damage to its infrastructure and heritage. Nevertheless, Aleppo persists as one of the most dynamic urban centers within Syria, housing an abundance of historical monuments that perpetually shape its cultural identity.

Founded in the 3rd millennium BCE, Aleppo boasts a rich architectural legacy, with some of its earliest surviving structures dating back to the 1st century CE(Matthiae and Lamberg-Karlovsky, 2003). Among its most iconic landmarks is the Citadel of Aleppo, a monumental fortified palace constructed on the remains of an ancient Assyrian fortification. Other significant instances encompass the Great Mosque of Aleppo, constructed during the 8th century CE, as well as the Souq al-Madina, a covered market from the 13th century that is recognized as one of the most expansive and historically pertinent bazaars in the Middle East. Despite repeated invasions and urban transformations, Aleppo’s architectural heritage has remarkably endured, earning the Old City recognition as a UNESCO World Heritage Site(Al Azm, 2015, Vincent, 2004).

Climatically, Aleppo experiences hot, dry summers and cool, wet winters. The mean temperature attains an approximate value of 26°C during the month of July, while it declines to roughly 6°C in January. The region receives most of its annual precipitation, averaging 600 mm, between October and May(Paine and Lieutier, 2016). Positioned in a semi-arid zone, Aleppo benefits from its proximity to an oasis, which has historically supported agriculture and urban green spaces despite the low rainfall. The city’s moderate humidity levels and generally temperate climate have contributed to the development of architectural strategies that respond to environmental conditions, including the prominent use of courtyards and shaded spaces to enhance thermal comfort.

# **Solid and void in Islamic architecture: literature review.**

The relationship between solid and void is recognized as a defining characteristic of Islamic architectural expression, shaping both the aesthetic identity and functional performance of built environments(Alami, 2013, Shahlaei and Mohajeri, 2015). Solid elements in Islamic architecture traditionally convey notions of privacy, security, and enclosure. These enclosed spaces—such as prayer niches, private chambers, and meditation areas—are typically defined by thick walls, limited openings, and small windows designed to protect users from external disturbances while fostering inward-focused experiences(Lehrman, 1980, Bollnow, 1961).

In contrast, void spaces serve as mediators between architecture and the natural environment. Characterized by open courtyards, expansive halls, large windows, and transitional zones, voids facilitate light penetration, natural ventilation, and social interaction(Nejad et al., 2016, Albarazy, 2022). These spaces often function as communal gathering areas, enhancing the spatial and social connectivity of the building with its surrounding context. The tension between these two spatial conditions—solid and void—not only generates architectural rhythm and spatial hierarchy but also supports diverse functional and climatic performances(Shahlaei and Mohajeri, 2015).

This interplay is particularly evident in mosque architecture, where the integration of enclosed prayer halls with open courtyards exemplifies the balance between spiritual intimacy and communal engagement(Amin, 2019, Ismail, 2008). While individual prayer spaces are typically located within smaller, more secluded zones to enhance personal reflection(Hamilton and Shepley, 2010), larger congregational areas are designed as open halls that promote visibility, unity, and collective worship(Gobe, 2010). Similar spatial principles are observed in residential and palatial architecture, where enclosed living quarters are juxtaposed with open courtyards, gardens, and terraces to facilitate environmental comfort and social interaction.

Beyond their functional role, solid and void elements carry symbolic meaning in Islamic architectural philosophy. Solid walls are often interpreted as representations of protection, permanence, and the stability of faith and community. Conversely, voids symbolize openness, transparency, and the dynamic interaction between the built environment and the natural world(Baharudin and Ismail, 2014). Together, these contrasting elements establish a spatial dialogue that captures the complexity, richness, and spiritual depth of Islamic culture.

In conclusion, the dynamic interplay between solid and void is not merely a formal or functional strategy but a deeply rooted cultural expression that shapes the spatial, environmental, and social dimensions of Islamic architecture(Bell, 2019). Grasping this interrelation yields significant knowledge for modern architectural endeavors, especially concerning the formulation of environments that aspire to harmonize privacy, transparency, and ecological adaptability.

# **Results and discussion**

# **5.1 Case studies: Morphological Evolution of Mosques in Aleppo**

To investigate the evolution of solid and void relationships in mosque architecture, five case studies were selected, each representing a distinct historical period in Aleppo’s urban and architectural development. Among these structures lies the Great Umayyad Mosque, a notable feat of design from the Umayyad period, the Halawiyya Mosque, which showcases the design trends that flourished during the Zengid and Ayyubid eras, the Al-Utrush Mosque, symbolizing the distinct architectural traits of the Mamluk time, the Al-Adiliyya Mosque, embodying the architectural customs of the Ottoman era, and the Al-Tawheed Mosque, representing a modern take on Syrian mosque architecture. Together, these cases offer a diachronic perspective on the architectural transformation of mosque layouts, particularly in relation to the spatial interplay of enclosed (solid) and open (void) elements.

The Great Umayyad Mosque of Aleppo, dating back to the 8th century, stands as one of the most significant religious and cultural landmarks in Syria(HALABI). Situated in the central area of Aleppo’s historical district, the mosque encompasses an area of roughly 12,000 square meters(ABDULHADI, 2020). It features a prominent central courtyard framed by arcades and decorated with intricate inscriptions and ornamental details. Erected in the 11th century, the mosque's minaret reaches a remarkable height of 45 meters and is one of its standout attributes(Fangi, 2019). In its lengthy journey, the mosque has been a significant place for Islamic research and collective engagement. Despite severe damage during the recent conflict, restoration efforts are underway to preserve this architectural masterpiece(Cytryn-Silverman, 2009).

The Al-Halawiyya Mosque, built in the 12th century during the Zengid dynasty, exemplifies the integration of large courtyards and domed prayer spaces(Allen, 1986, Gaube and Wirth, 1984). Its spatial organization features a central courtyard with a fountain, surrounded by several domed prayer halls supported by monumental columns. The mosque underwent significant restorations in the 16th and 18th centuries, yet it suffered major damage during the Syrian Civil War, particularly in 2013(Knost, 2010, Van Berchem et al., 1903). Current efforts are focused on the conservation and rehabilitation of this key example of Aleppo’s Islamic architectural heritage.

The Al-Utrush Mosque, commissioned in 1399 by the Mamluk ruler Aqbugha al-Utrush, presents a rich example of Mamluk architectural expression. Characterized by its rectangular layout, the mosque integrates a central courtyard surrounded by arcades and a prayer hall with arched openings(Gaube and Wirth, 1984). The west-facing façade is notable for its elaborate decorative portal and windows, while the domed mausoleum situated at the northwest corner adds a commemorative dimension to the complex(Al-Ghazzi, 1926). Like other heritage mosques, Al-Utrush has experienced damage during recent conflicts, yet remains a significant case for understanding Mamluk spatial organization and ornamentation.

The Al-Adiliyya Mosque, built between 1551 and 1553 under the patronage of Mohammed Pasha Dukakinzade, marks a transition toward Ottoman architectural influences in Aleppo. Named after its proximity to the House of Justice (Dar al-‘Adl), the mosque features a hemispherical dome covering a square prayer hall preceded by a double portico(Al-Ghazzi, 1926, Gaube and Wirth, 1984). The portal combines Ottoman stylistic elements with local masonry traditions, exemplified by its muqarnas hood and richly articulated entrance niche(Van Berchem et al., 1903). This mosque represents the Ottoman shift toward monumentalized external façades and open forecourts.

Finally, the Al-Tawheed Mosque, inaugurated in 1981, exemplifies modern mosque architecture in Aleppo. Situated in the Baghdad Station neighborhood, the mosque is notable for its interfaith urban context, located between two Christian churches. When considering architecture, this mosque is distinguished by its striking central dome, four little domes, and four long minarets, reflecting a modern reinvention of standard mosque styles. A landscaped garden adjacent to the mosque enhances its role as a community space promoting religious coexistence and social interaction. Al-Tawheed stands as a symbol of modern architectural trends while maintaining the mosque’s role as a civic landmark.

These five case studies provide a comprehensive lens through which to analyze the morphological transformations of mosque architecture in Aleppo. From the inward-focused courtyards of the early Islamic periods to the externalized monumental spaces of the Ottoman and modern eras, these examples illustrate the shifting dynamics of solid and void in shaping the spatial, social, and environmental qualities of sacred architecture in the city. See figure 3

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| --- | --- | --- | --- | --- |
|  |  | A picture containing building, outdoor, road, sky  Description automatically generated | A picture containing sky, outdoor, building, old  Description automatically generated | A large white building with towers  Description automatically generated with low confidence |
| a) Great Umayyad Mosque | b) Al-Halawiyya Mosque | c)Al-Utrush Mosque | d)Al-Adilliyya Mosque | e) Al-Tawheed Mosque |

Figure 3. Photographs of the five analyzed mosques in Aleppo: (a) Great Umayyad Mosque, (b) Al-Halawiyya Mosque, (c) Al-Utrush Mosque, (d) Al-Adiliyya Mosque, (e) Al-Tawheed Mosque. Source: (a, e) Author; (b, c, d) Aleppo Heritage Project.

# **5.2 Solid/void: Significance and impact**

This study conducted a comprehensive analysis of the architectural plans of five selected mosques, applying the solid and void framework as a tool to interpret spatial transformations across different historical periods in Aleppo. This analytical approach provided valuable insights into how the position, configuration, and role of courtyards shifted over time, and how these changes influenced the architectural, social, and environmental performance of mosque spaces. Through this spatial investigation, the study was able to trace the evolution of mosque morphology, revealing significant transitions in the balance between enclosed (solid) and open (void) spaces. See Figure 4

|  |  |  |  |  |
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| Diagram  Description automatically generated | Diagram  Description automatically generated | Diagram, engineering drawing  Description automatically generated | Diagram, engineering drawing  Description automatically generated | A picture containing old  Description automatically generated |
| a) Plan of Great Umayyad Mosque | b) Plan of -Halawiyya Mosque | c) Plan of Al-Utrush Mosque | d) Plan of Al-Adilliyya Mosque | e) Plan of Al-Tawheed Mosque |
| A picture containing shape  Description automatically generated | Logo  Description automatically generated | Logo  Description automatically generated | Logo  Description automatically generated | Shape  Description automatically generated with medium confidence |

Figure 4. Analysis of solid and void distribution in the five mosque case studies: (a) Great Umayyad Mosque, (b) Al-Halawiyya Mosque, (c) Al-Utrush Mosque, (d) Al-Adiliyya Mosque, (e) Al-Tawheed Mosque. Source: (a–d) Aleppo Heritage Project; (e) Author.

The analysis demonstrated that during the Umayyad, Zengid-Ayyubid, and Mamluk periods, the mosque courtyards were designed as central, inward-oriented spaces, enclosed by arcades and prayer halls. This spatial arrangement not only enhanced environmental comfort—by providing shading, ventilation, and daylight modulation—but also supported the mosque’s social and spiritual functions. The courtyard functioned as an essential communal area, enabling not only formal religious observances but also informal social engagements, thus bolstering the mosque's position as a pivotal social nexus within the urban landscape.

However, a noticeable shift occurred during the Ottoman period. Influenced by architectural traditions from Anatolia and Istanbul, particularly the monumental design of Hagia Sophia, Ottoman mosque architecture prioritized external monumental visibility. This shift led to the repositioning of the courtyard outside the main prayer halls, reducing its functional integration with the mosque interior. The adaptation of outer courtyards emphasized the mosque’s external appearance and symbolic urban presence but came at the cost of diminishing the courtyard’s environmental and social roles. This transition weakened the microclimatic performance of mosque interiors and eroded the intimate social life once fostered by enclosed courtyards.

This transformation continued into the modern period, as evidenced by the spatial configuration of the Al-Tawheed Mosque. Modern mosque designs in Aleppo typically feature open, undefined exterior spaces that surround the building on all sides. While these spaces may offer visual openness, they lack the spatial hierarchy, climatic responsiveness, and social vitality historically provided by traditional courtyards. This contemporary shift represents an extension of the Ottoman transformation but reflects an even greater disconnection between mosque architecture and its environmental and social context. See Figure 5

The model of the Umayyad, Ayyubid and Mamluk eras

Ottoman era model

Modern and current stage model

Figure 5. Evolution of solid and void relationships in Aleppo’s mosques across historical periods. Source: Author.

These findings suggest that the loss of courtyard-centered spatial organization has had lasting implications for the social, spiritual, and environmental qualities of mosque architecture in Aleppo. Reintegrating these traditional spatial strategies could offer significant benefits for the revitalization of mosque environments. Further architectural and urban design research is needed to explore how the outer spaces surrounding existing mosques can be reactivated as climatically comfortable and socially vibrant public realms. Additionally, the study encourages future investigations into environmental design strategies that leverage the potential of these spaces to restore the lost social and ecological functions weakened by the adoption of borrowed, less-contextual architectural models.

Table 1 presents a comparative summary of mosque elements in Aleppo across different historical periods, focusing on the location of the courtyard, architectural characteristics, and their resulting social and environmental impacts. This comparison reveals profound transformations in spatial and architectural configurations that reflect the cultural, social, and climatic changes the city has undergone.

Table 1. Comparative summary of courtyard positioning, architectural characteristics, and socio-environmental impacts across different historical periods in Aleppo’s mosques.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Period |  | Courtyard Location and Role | Architectural Character | Social and Environmental Impact |
| Umayyad, Zengid-Ayyubid, Mamluk |  | Centrally located, enclosed by prayer halls and arcades | Inward-oriented, balanced solid-void integration | Strong social interaction, environmental comfort, spiritual focus |
| Ottoman |  | Shifted to exterior, positioned in front of main prayer hall | Emphasis on external monumental façades and domed interiors | Reduced microclimatic performance, weakened social courtyard role |
| Modern |  | Open spaces surrounding building on all sides, undefined hierarchy | Detached architectural form with little environmental control | Loss of social vibrancy, thermal discomfort, lack of spatial coherence |

The table traces the evolution of courtyard positioning and architectural features, showing that during the Umayyad, Zengid-Ayyubid, and Mamluk periods, mosques relied on a centrally located courtyard surrounded by prayer halls and arcades, enhancing the integration of solid and void, providing a comfortable environment, and serving as a center for social and spiritual interaction. In contrast, Ottoman architecture shifted the courtyard to the mosque’s front, emphasizing monumental façades and domed interiors, which weakened the courtyard’s climatic function and social role. In modern architecture, the courtyard lost its central importance, replaced by undefined open spaces surrounding the building, resulting in a loss of social vibrancy, deteriorated environmental comfort, and diminished architectural coherence — all reflecting a deep transformation in the relationship between architecture, society, and environment over time.

# **Recommendations**

Based on the findings of this study, it is evident that the historical evolution of mosque architecture in Aleppo, particularly the transformation of solid and void relationships, holds important lessons for contemporary mosque design and heritage preservation. The following recommendations are proposed to guide future research, design interventions, and policy development:

Reintegrating Courtyard Typologies in Contemporary Mosque Design: Designers and planners are encouraged to revisit and adapt traditional courtyard-centered spatial configurations as an effective strategy for enhancing environmental comfort, social engagement, and spiritual experience in modern mosques. The reintegration of semi-enclosed courtyards has the potential to reinstate microclimatic advantages, including natural ventilation, shading, and daylighting, while simultaneously revitalizing the mosque's function as a locus for social and communal congregation.

Revitalizing the Social Function of Mosque Exterior Spaces: Existing mosque environments, especially those dominated by undefined open spaces, should be reconsidered through socially responsive landscape and architectural interventions. Design strategies should focus on transforming these outer spaces into active, shaded, and climatically comfortable public areas that support community life, intergenerational activities, and social cohesion.

Contextualizing Imported Architectural Models: It is recommended that contemporary mosque projects critically assess the adoption of architectural models borrowed from other cultural or climatic contexts, such as the Ottoman or modern monumental styles. Future designs should prioritize context-sensitive solutions that respond to local environmental conditions, cultural practices, and urban patterns, thereby avoiding spatial and social disconnects.

Advancing Environmental Performance Research: Further interdisciplinary research should explore the environmental performance of historical mosque typologies, including empirical studies and environmental simulations. Such research would provide quantitative evidence to support the climatic advantages of traditional courtyard designs and inform sustainable architectural practices in contemporary mosque construction.

Supporting Post-Conflict Heritage Rehabilitation: For cities like Aleppo, where many historic mosques have suffered conflict-related damage, restoration efforts should not only aim to preserve physical structures but also revive their original spatial and social functions. Heritage management policies should integrate architectural, social, and environmental perspectives to ensure that restored mosques contribute to the cultural and communal revival of their urban contexts.

Promoting Community-Informed Design Processes: Lastly, mosque development and rehabilitation projects should adopt participatory design approaches that engage local communities, worshippers, and stakeholders. Incorporating user feedback and community needs into design and planning processes will ensure that mosque environments remain relevant, inclusive, and responsive to the evolving social dynamics of contemporary urban life.

These recommendations aim to bridge the gap between historical architectural wisdom and the challenges of contemporary urbanism, ensuring that mosque environments continue to serve not only as places of worship but also as vibrant social and environmental assets within their communities.

# **Limitations and Implications**

**7.1 Limitations**

While this study offers valuable insights into the morphological evolution of mosque architecture in Aleppo, several limitations should be acknowledged. First, the research is limited by the availability of pre-conflict architectural documentation and field observations. Due to the ongoing conflict and restricted access to many historical sites, real-time fieldwork, user experience assessments, and environmental performance measurements could not be conducted. This limitation restricts the ability to validate findings through contemporary user behavior or on-site environmental data.

Second, the study focuses primarily on spatial and morphological analysis, without incorporating quantitative environmental simulations or social impact assessments. While the qualitative findings highlight the loss of environmental and social functions, future research could benefit from empirical validation using simulation tools and participatory methods involving mosque users.

Third, although the study draws comparisons with other Islamic and Mediterranean contexts, the geographical focus on Aleppo may limit the generalizability of the findings to different cultural or climatic regions. Additional comparative investigations in diverse urban centers exhibiting distinct socio-cultural and environmental contexts are essential to enhance the generalizability of these findings.

**7.2 Implications**

Notwithstanding these constraints, the research yields significant ramifications for architectural praxis, heritage preservation, and urban governance. First, the findings underscore the importance of re-evaluating courtyard-centered designs in modern mosque architecture to restore lost social and environmental benefits. Designers, urban planners, and policymakers may utilize these insights to develop contextually relevant design parameters that emphasize user comfort, promote social engagement, and enhance environmental performance.

Second, the research highlights the need for heritage restoration projects in Aleppo to go beyond physical reconstruction and address the functional and social reintegration of mosque spaces within the urban fabric. This approach could contribute to post-conflict community rebuilding and cultural resilience.

Finally, the study opens pathways for future interdisciplinary research, combining architectural analysis, environmental simulations, and user-centered methods to further investigate the climatic, social, and spiritual functions of mosque architecture. These future studies could provide evidence-based design recommendations for sustainable and culturally responsive mosque development in Aleppo and beyond.

# **Conclusion**

This study has examined the morphological evolution of mosque architecture in Aleppo, with particular attention to the changing relationship between solid and void spaces across different historical periods. The findings reveal that the interplay between enclosed (solid) and open (void) elements has long served as a defining characteristic of Islamic architecture, shaping not only the aesthetic identity of mosque forms but also their social, spiritual, and environmental performance.

Historically, Aleppo’s mosques—such as the Great Umayyad Mosque, Al-Halawiyya Mosque, and Al-Utrush Mosque—demonstrated a carefully balanced spatial organization in which inward-oriented courtyards played a central role in facilitating natural ventilation, daylighting, and communal interaction. This courtyard-centered design strategy provided a sense of enclosure and protection while maintaining strong connections to the surrounding environment and community life.

However, this spatial balance began to shift during the Ottoman period, as mosque designs increasingly prioritized external monumentality over internal social and environmental functions. The displacement of courtyards to exterior forecourts marked a significant transformation, diminishing the role of these spaces as climatic buffers and social gathering zones. This shift continued into the modern era, where open spaces surrounding mosques became increasingly undefined and detached from the building’s core functions. As a result, many contemporary mosques in Aleppo have lost the social, spiritual, and environmental richness that historically characterized their courtyard-based predecessors.

These findings highlight the need to critically reassess contemporary mosque design practices. There is a growing opportunity to reintegrate traditional spatial strategies, such as courtyard-centered layouts, to restore environmental comfort and strengthen social engagement. Revitalizing the outer spaces surrounding existing mosques could transform them into active, climatically responsive, and socially vibrant public realms that reflect the cultural and environmental values of the community.

Future research should extend this investigation by employing environmental performance simulations and engaging user-centered design processes to validate the environmental and social benefits of traditional mosque morphologies. Such efforts can inform sustainable and culturally relevant mosque development, not only in Aleppo but in other urban contexts facing similar architectural and social challenges. Ultimately, reconnecting mosque architecture with its historical principles of solid-void balance offers a path toward more meaningful, resilient, and community-oriented sacred spaces.

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