Architectural Palimpsest of Peshawar: Engineering, Identity, and Conservation Peshawar

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Abstract

Peshawar, one of South Asia's oldest continuously inhabited cities, presents a living architectural palimpsest shaped by centuries of cultural, political, and religious transformations. This study explores the evolution of Peshawar's architectural heritage through photographic documentation and case studies of key sites, including Mughal mosques, colonial institutions, and contemporary structures. It integrates architectural analysis with civil engineering approaches to assess preservation challenges and propose sustainable conservation strategies.

The research employs a mixed-methods approach, including photographic documentation, structural analysis, and review of urban development policies. It highlights the role of civil engineering in structural retrofitting, digital documentation (e.g., HBIM), and seismic resilience. Findings reveal that modern urbanization, lack of awareness, and insufficient policy frameworks erode the city's rich built environment.

The paper advocates for an interdisciplinary conservation model, aligning architectural heritage with engineering innovation, urban planning, and community participation. By understanding Peshawar's layered built history, stakeholders can ensure that modernization complements rather than erases the city's historic identity.

Keywords: Peshawar, Architectural Heritage, Mughal Architecture, Colonial Era, Urban Modernism, Conservation, Civil Engineering, Islamic Architecture

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1. Introduction

Peshawar is one of South Asia's oldest continuously inhabited cities, with roots dating back to the Gandharan civilization and extending through Islamic, Mughal, Sikh, colonial, and contemporary eras. Each historical phase left architectural imprints that collectively form a palimpsestic urban fabric [1], [2], [3], [4].

Architectural palimpsest refers to a city where new developments overlay, but do not erase, earlier structures, resulting in a layered historical narrative (Ren, 2021). In South Asia, such sites are increasingly threatened by urban encroachment, weak policy frameworks, and limited technical interventions [6].

International charters such as UNESCO's Historic Urban Landscape (HUL) [7] call for integrating cultural heritage into urban planning and infrastructure development. This multidisciplinary approach is especially relevant for Peshawar, where heritage is embedded in daily life and evolving cityscapes [8], [9], [10].

The engineering dimension of conservation is increasingly emphasized, with tools like Building Information Modeling (BIM), laser scanning, and seismic retrofitting playing key roles This study analyses how civil engineering techniques, when used alongside architectural analysis, can offer sustainable solutions for heritage preservation in Peshawar [11], [12], [13], [14], [15], [16], [17].

Table 1: Historical Timeline and Architectural Evolution of Peshawar [18], [19], [20], [21], [22], [23], [24], [25], [26]

Period	Timeframe	Ruling Power / Influences	Architectural Characteristics	Legacy & Preservation Status
Ancient (Gandhara)	6th century BCE – 5th century CE	Gandhara Civilization, Kushan Empire	Buddhist stupas, monasteries, use of schist stone, sculpture-rich façades	Ruins at Gor Khatri and Shah-ji-ki-Dheri, with limited preservation
Early Islamic Era	7th – 12th century CE	Hindu Shahi Ghaznavids Ghurids	Fortifications, early mosques, mud-brick structures	Little survives; archaeological potential
Mughal Period	16th – 18th century	Mughal Empire (Babur to Aurangzeb)	Arches, domes, frescoes, gardens, mosques (e.g., Mahabat Khan Mosque)	Key heritage assets, partially conserved
Durrani & Sikh Rule	1747 – 1849	Durrani Empire, Sikh Confederacy	Fort renovation (Bala Hissar), blend of Central Asian and Sikh motifs	Bala Hissar remodeled; limited public access
British Colonial Era	1849 – 1947	British Raj	Indo-Saracenic style, red brick, symmetry, educational institutions (e.g., Islamia College)	Iconic landmarks, some well-preserved
Post-Independence	1947 – 2000s	Pakistan	Institutional expansion, civic buildings, mixed styles	Urban growth, limited zoning enforcement
Contemporary Period	2000 – Present	Government of KP & private sector	Glass façades, high-rises, BRT infrastructure, Brutalism	Modernization often lacks heritage integration

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Table 1 shows a Timeline of major historical periods in Peshawar and their associated architectural developments. This chronology highlights the city's layered urban fabric and the importance of context-aware conservation strategies [27], [28].

The city presents a living architectural palimpsest, each era contributing a new layer without entirely erasing the past. However, rapid urbanization, inadequate conservation efforts, and modern infrastructure development now threaten this delicate balance. Historic structures face neglect, while new construction often disregards heritage context and identity.

This research proposes to analyze and document the architectural heritage of Peshawar through a combination of photographic surveys, stylistic analysis, and case studies of significant

buildings. The study also examines how civil engineering techniques can support heritage preservation. It proposes a set of recommendations for sustainable conservation. By tracing these architectural layers, the paper aims to raise awareness of Peshawar's cultural identity and advocate for a thoughtful blend of modernization and preservation in urban planning[29], [30].

This paper argues that sustainable urban development in Peshawar must be grounded in a deep understanding of its architectural history, requiring interdisciplinary collaboration between civil engineering, architecture, urban planning, and heritage management. In this context, the study argues that interdisciplinary collaboration between architects, engineers, planners, and policymakers is crucial to sustaining Peshawar's urban character. The research framework (Figure 1) outlines the methodological flow from historical analysis to recommendations, capturing the interdisciplinary nature of the study. Additionally, weak enforcement of building bylaws and unauthorized development by municipal bodies has accelerated the erosion of historic character in the city's core.
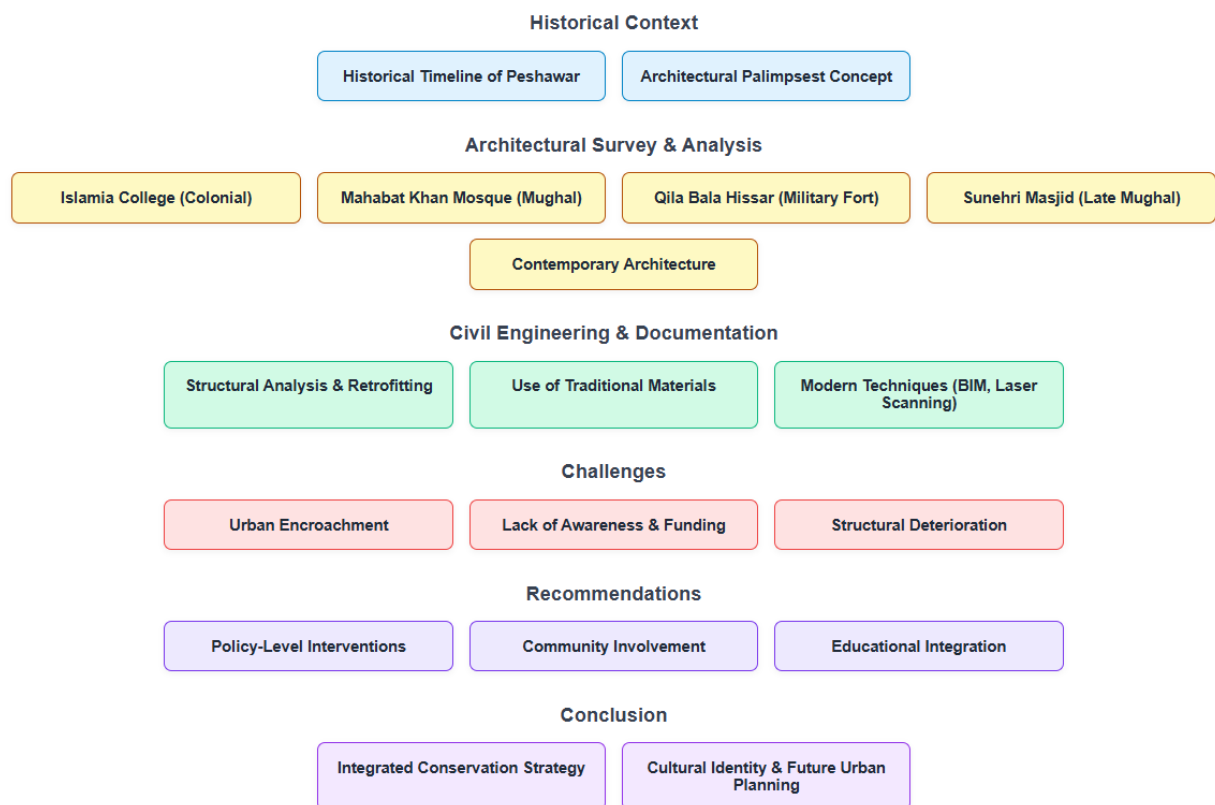
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Figure 1: Research framework illustrating the methodological flow of the study

2. Historical and Colonial Landmarks

2.1 Islamia College Peshawar: Architectural and Historical Significance

Founded in 1913, Islamia College is a prominent example of Indo-Saracenic architecture, combining Mughal, Islamic, and colonial motifs. Its red brick façade, domes, minarets, and jharokhas embody educational and cultural symbolism.

Islamia College Peshawar is one of the region's most iconic educational and architectural landmarks. It was established by prominent Muslim leaders, including Nawab Sir Sahibzada Abdul Qayyum and Sir George Roos-Keppel, with the vision of promoting modern education among the Muslim population of the North-West Frontier Province (now Khyber Pakhtunkhwa) [31]. The college played a vital role in the Pakistan Movement. It later evolved into a university,

maintaining its status as a symbol of academic excellence.

Architecturally, the college is a striking example of Indo-Saracenic Revival architecture. This style blends Islamic, Hindu, and British colonial elements. Its grand façade features domes, minarets, cusped arches, and Mughal-style jharokhas (overhanging balconies), creating a sense of cultural continuity and colonial influence. The building's red brick construction, symmetrical layout, and intricately designed ironwork in the inner verandahs reflect meticulous craftsmanship. The central marble fountain in the courtyard evokes traditional Islamic garden design, emphasizing serenity and geometric harmony [32].

Islamia College is not only a masterpiece of architectural fusion but also a living monument to Muslims' socio-political and intellectual awakening in the early 20th century. Its preservation is crucial for its physical beauty andts legacy in Pakistan's cultural and educational landscape[33].

Figure 2: elevation of Islamia College Peshawar

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Islamia College's Indo-Saracenic architecture, with its red brick façade and Mughal-style jharokhas, is a prime example of architectural synthesis (Figures 2 & 3) [34].

Figure 3: Side view of Islamia College showing corner turret and Mughal-style jharokhas [35].

2.2 Arches and Engineering Techniques at Islamia College Peshawar

The arches, primarily cusped and pointed, are constructed using load-bearing masonry, distributing weight across voussoirs without modern reinforcement. The building also incorporates passive cooling features such as shaded verandahs and open courtyards, demonstrating climate-responsive design.

The architectural design of Islamia College Peshawar prominently features a series of carefully constructed arches, which serve both aesthetic and structural purposes. The arches, primarily pointed (ogee) and cusped in form, are inspired by Mughal and Islamic architectural traditions, contributing to the grandeur and rhythmic symmetry of the building's façade and corridors. These arches are constructed using traditional brick masonry techniques, with each voussoir (wedge-shaped brick) meticulously placed to distribute the structural load evenly across the span. This method eliminates the need for extensive steel reinforcement, relying on compression principles to maintain stability [36].

Many arches are enhanced with carved plaster or terracotta ornamentation, showcasing geometric patterns and floral motifs that reflect Islamic artistic sensibilities. The inner verandahs and entrances also feature multi-foil arches, adding a decorative richness and soft curvature. The engineering behind these arches reflects a balance of form and function, providing open, shaded walkways that improve airflow and reduce thermal heat gain, which is particularly suited to the hot climate of Peshawar [37].

The successful integration of traditional engineering knowledge with local materials and craftsmanship demonstrates how the builders of Islamia College achieved durability, beauty, and cultural identity. These arches are not merely architectural elements but essential to understanding the building's enduring strength and symbolic power [38].
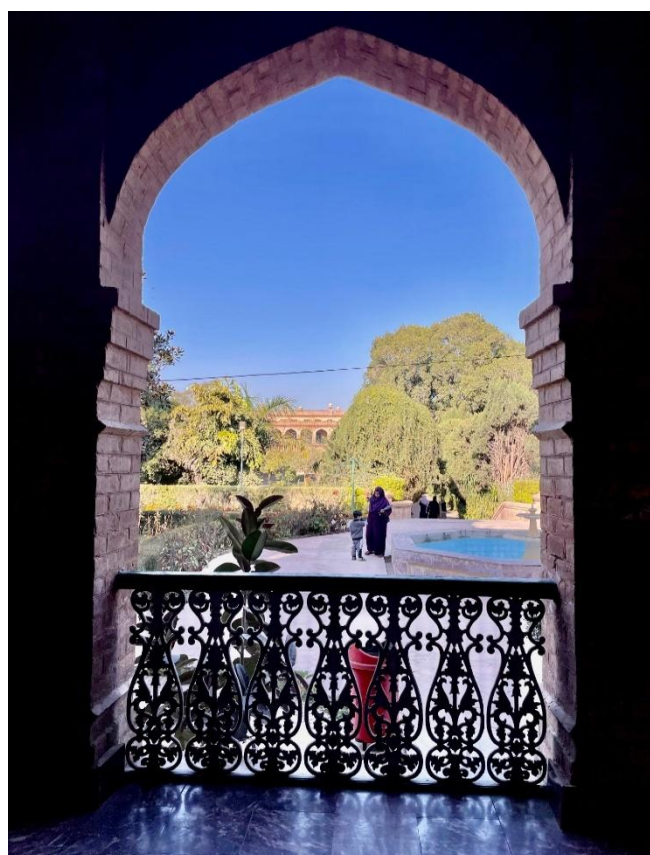
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Figure 4: View from the inner verandah of the Islamia College courtyard, showcasing carved ironwork and landscaped garden.

The inner verandahs, with carved ironwork and landscaped gardens (Figure 4), demonstrate a careful balance of aesthetics and environmental comfort.

2.3 The Central Fountain: Symbolism and Design

Inspired by Islamic Charbagh garden geometry, the octagonal marble fountain reflects spiritual and climatic sensibilities. Such water features served symbolic and microclimatic purposes in traditional Islamic architecture [38], [39].

At the heart of Islamia College Peshawar's central courtyard lies an elegant octagonal marble fountain, both a visual focal point and a cultural symbol. The fountain draws inspiration from traditional Islamic garden design, particularly the concept of the Charbagh, a quadrilateral garden layout. Its octagonal shape reflects a geometric balance common in Islamic architecture, representing order, harmony, and unity. Constructed from polished white marble, the fountain basin features subtle engravings and water outlets that would have initially created a gentle, cooling stream, enhancing the sensory experience of the courtyard. Though now primarily decorative, such fountains were historically engineered for microclimatic control, helping to cool the surrounding air and provide a sense of serenity in hot, arid environments. The location of the fountain, centrally aligned with the central axis of the building, demonstrates a strong understanding of symmetry, axial planning, and landscape integration.

This fountain adds aesthetic value and reflects the intellectual and spiritual ideals associated with Islamic educational institutions. It connects the built environment to nature and metaphysical symbolism, making it a timeless element within the architectural legacy of Islamia College.

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Figure 5: Octagonal marble fountain in the central courtyard of Islamia College, a nod to traditional Islamic garden design.

The octagonal marble fountain (Figure 5), centrally placed in the courtyard, reflects Charbagh-based Islamic garden symbolism.

3. Mughal era and Islamic Architecture

3.1 Gor Khatri

Originally a Buddhist site, Gor Khatri evolved into a Mughal caravanserai under Jahan Ara Begum. The site reflects Peshawar's transformation across religious and cultural regimes. Gor

Khatri is an archaeological site located in Peshawar, Pakistan, that includes a square-shaped compound that has been excavated and researched. In 1641, Jehan Ara Begum, daughter of Shah Jahan, built Gor Khatri as a caravanserai [40].

Alexander Cunningham initially identified Gor Khatri as the location of the Kanishka stupa. Ahmad Hasan Dani further discovered that it was also where the Buddha bowl tower once stood.

Figure 6: Gorkhatri's entryway as viewed from Peshawar's old city

Gor Khatri's gateway (Figure 6) reveals its transformation from a Buddhist site to a Mughal caravansary.

3.2 Qila Bala Hissar Fort: History and Architecture

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This elevated fort combines Afghan, Mughal, and colonial military architecture. Its earthquake-prone mud-brick walls require retrofitting via jacketing and stabilization. Qila Bala Hisar exhibits Islamic architectural elements, but is not solely an example of Islamic architecture. It is a historic fort with a composite architectural heritage.

Qila Bala Hissar, meaning "High Fort," is one of Peshawar's most significant historical landmarks, situated on a prominent elevation at the city's western edge. The fort's strategic location has made it a power centre for rulers throughout history, from the Mughals and Durranis to the Sikhs and British. Although its earliest foundations may date back centuries, the fort became prominent during the Durrani Empire in the 18th century, when it served as a royal residence for Ahmad Shah Durrani, the founder of modern Afghanistan.

Architecturally, Bala Hissar Fort is a classic example of military defensive construction, characterized by thick mud-brick and stone walls, watchtowers, and ramparts designed to withstand siege. The fort's rectangular layout encloses large open courtyards, administrative buildings, and barracks. The elevation of the fort provides panoramic views of Peshawar city, reinforcing its function as both a military stronghold and a seat of governance.

One of the defining architectural features of Bala Hissar is its massive gateways and bastions, which reflect elements of Mughal and Afghan fortification styles. The arched gateways, supported by large voussoirs and flanked by turrets, combine structural strength with symbolic authority. Inside, remnants of carved wooden balconies, brick arches, and water channels hint at the more refined aspects of royal life that once existed within the fortified walls.

Today, Bala Hissar remains under the control of Pakistan's Frontier Corps, with limited public access. Yet, it is a living monument to the region's turbulent history, architectural evolution,

and cultural resilience. Conservation efforts are essential to preserve this iconic structure, which encapsulates centuries of power dynamics, warfare, and regional identity in Peshawar [41], [42], [43], [44] .

Figure 7: A view of Qilla Bala Hisar

The elevated view of Qila Bala Hissar (Figure 7) illustrates the fort's strategic military and architectural importance

3.3 Mahabat Khan Mosque: Ornamentation and Arch Typology

Built in the 17th century, the mosque showcases multi-cusped arches, frescoes, and Persian-influenced ornamentation (Brumana et al., 2017). Conservation efforts have employed hidden steel rods and lime grouting to reinforce its structure (Ali et al., 2022). The Mahabat Khan Mosque, built in the 17th century during the reign of Mughal Emperor Shah Jahan, is one of Peshawar's most celebrated examples of Mughal Islamic architecture. The mosque is particularly renowned for its rich interior ornamentation and distinct arch types, which reflect both the artistic sophistication and engineering mastery of the Mughal period.

The interior of the main prayer hall is adorned with intricate frescoes, featuring floral patterns, arabesques, and calligraphy in traditional Mughal color palettes of deep reds, blues, and gold. The walls and ceilings are covered with stucco carvings and painted medallions, representing a fusion of Persian and Central Asian decorative styles. These ornamentations not only enhance visual beauty but also serve to inspire spiritual contemplation.

Structurally, the mosque employs a series of multi-cusped arches, also known as muqarnas or scalloped arches, particularly in the prayer hall and entrance bays. These decorative and functional arches distribute the roof's weight to the columns and piers. The central iwan (arched entrance) features a high, pointed arch, a hallmark of Islamic monumental architecture, flanked by smaller, blind arches that frame the façade with symmetry and depth.

These arch forms, combined with the lavish ornamentation, reflect the Mughal emphasis on harmony, grandeur, and spiritual symbolism in architecture. The Mahabat Khan Mosque is a prime example of how form, function, and faith converge in Islamic architectural design.
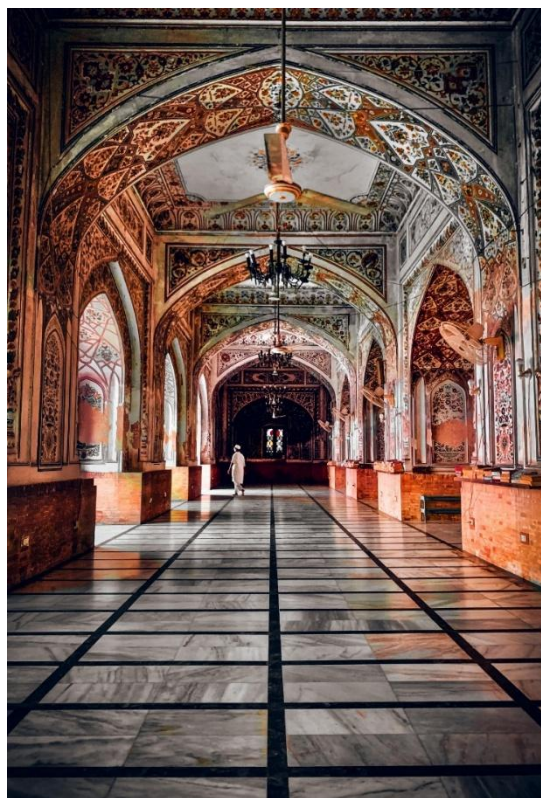
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Figure 8: The Mahabat Khan Mosque's richly ornamented prayer hall interior, with intricate floral frescoes and marble flooring.

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The richly ornamented prayer hall of the Mahabat Khan Mosque (Figure 8) showcases the Mughal mastery of geometry and fresco.

3.4 Sunehri Masjid: Ornamentation and Arch Typology

This 18th-century mosque features gilded domes, floral frescoes, and calligraphic ornamentation. Its triple-arched entrance and qibla-facing mihrab reflect Mughal religious architecture (Ahmad, 2006). The Sunehri Masjid, or "Golden Mosque," located in the heart of Peshawar's old city, is a remarkable example of late Mughal-era mosque architecture in the region. Built in the 18th century, this mosque is named after its distinctive gilded domes, which gleam in sunlight and serve as a visual landmark in the densely built urban fabric. Though more compact than the Mahabat Khan Mosque, the Sunehri Masjid showcases exquisite ornamentation and arch designs that reflect its time's aesthetic sensibilities and religious artistry[45].

The mosque's interior and façade are adorned with hand-painted floral motifs, geometric patterns, and Quranic inscriptions rendered in traditional Naqsh (stylized calligraphy). Using vibrant colors such as cobalt blue, turquoise, and deep green on white plaster creates a striking contrast. It enhances the spiritual ambience of the prayer space. The mihrab (prayer niche) is intricately decorated with layered arches and calligraphic panels, signifying the qibla direction and drawing the worshipper's attention toward Mecca.

Architecturally, the Sunehri Masjid features a series of pointed and cusped arches that frame the prayer halls and entryways. These arches are structurally significant, channelling the weight of the domes and upper levels down to the mosque's thick load-bearing walls. The main entrance is emphasized by a triple-arched façade, with the central arch slightly taller and more pronounced than the flanking ones, a classic feature in Mughal mosque design. Smaller blind

arches and recessed niches further enhance the depth and texture of the elevation.

Overall, the Sunehri Masjid exemplifies a refined blend of Mughal aesthetics, structural ingenuity, and religious symbolism, making it an essential part of Peshawar's Islamic architectural heritage.

Figure 9: Architectural details of Sunehri Masjid (or other historic mosque in Peshawar), showing red sandstone, geometric arches, and minarets.

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The Sunehri Masjid's compact layout and gilded domes (Figure 9) exemplify late Mughal religious architecture.

4. Architectural Synthesis: Interplay Between Eras

Peshawar's urban narrative blends Indo-Saracenic, Islamic, and colonial elements, challenging conservationists to preserve hybrid identities. Adaptive reuse strategies can help retain urban authenticity while accommodating development. While colonial and Islamic architectures are often studied separately, Peshawar presents a rare urban narrative where these styles coexist and influence each other. From red-brick colonial institutions with Mughal jharokhas to mosques with Indo-Saracenic motifs, the cityscape becomes a canvas of historical dialogue. This architectural synthesis offers both challenges and opportunities for conservation, as interventions must respect the hybrid character of such structures.

5. Infrastructure and Urban Development in Peshawar

Modern projects like the Peshawar BRT system contrast sharply with historic streetscapes. While infrastructure is essential, unregulated development often leads to site encroachment and demolition of traditional structures. Peshawar's urban landscape has significantly transformed in recent decades due to rapid population growth, increased vehicular traffic, and modernization efforts. Once defined by narrow streets, historic bazaars, and traditional courtyard houses, the city is now experiencing a wave of infrastructural expansion aimed at improving mobility, connectivity, and public services. One of the most notable developments is the Peshawar Bus Rapid Transit (BRT) system, which includes steel pedestrian overpasses, elevated tracks, and

dedicated bus lanes. These structures are functional and represent a shift toward sustainable and inclusive urban transport [46], [47].

Urban development has also introduced modern utilities infrastructure, including high-voltage electric transmission towers, sewage systems, and upgraded road networks. These changes are essential for supporting the city's growing demands, but often come at the cost of heritage preservation. Unregulated construction, encroachment on historic sites, and demolition of traditional buildings have created a conflict between modernization and cultural continuity.

Moreover, the increasing use of glass façades, concrete high-rises, and commercial plazas is reshaping Peshawar's skyline, reflecting a globalized architectural trend that often lacks sensitivity to the city's historical context. The challenge lies in achieving a balanced urban strategy that integrates modern infrastructure with heritage conservation, respects traditional spatial patterns, and fosters sustainable development. Addressing these issues requires comprehensive urban planning, public awareness, and policy-level interventions to ensure that progress does not erase the city's rich architectural identity.
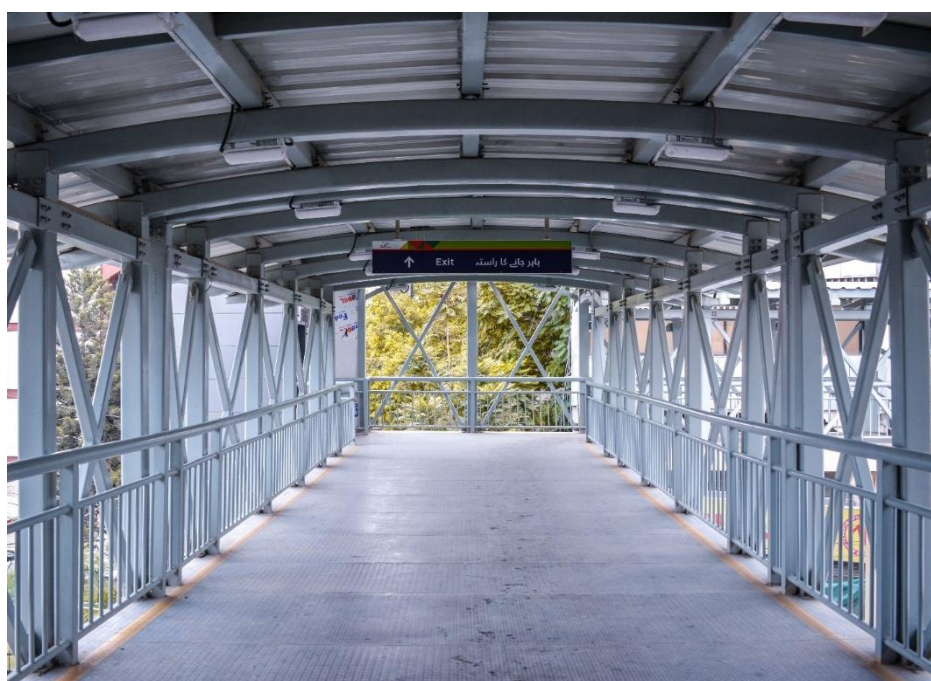

Figure 10: Steel pedestrian overpass of Peshawar BRT system, an example of modern transport infrastructure improving urban mobility.

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The steel pedestrian overpasses of the BRT system (Figure 10) contrast starkly with the city's historic architecture.

6. Contemporary Architecture

The rise of glass-clad towers and Brutalist concrete buildings reflects global trends but risks disconnecting from the local context. Few new buildings incorporate elements like colored glass or Islamic ornamentation that define Peshawar's historic vocabulary.

6.1 Modern architecture

In recent years, Peshawar's architectural landscape has become a mix of evolving contemporary designs and deeply rooted local vernacular styles. On one hand, the rise of glass-clad

commercial towers, shopping plazas, and high-rise apartments reflects a shift toward modernist and global architectural trends. Buildings like the AMC Tower symbolize this change, with their sleek façades, minimal ornamentation, and use of industrial materials such as steel, aluminum, and reflective glass. Commercial needs, modern construction techniques, and aspirations of a cosmopolitan urban image drive these structures.

The rise of contemporary architecture in Peshawar often lacks contextual sensitivity, risking a disconnect between the city's past and future. While modern materials and forms serve functional needs, there is a growing need for an architectural language that bridges tradition and innovation, potentially through adaptive reuse or culturally informed design templates.

Figure 11: AMC Tower in Peshawar, reflecting the emergence of glass-clad, Low-rise commercial architecture.

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Modern high-rises such as AMC Tower and Hotel Tourmaline (Figures 11 & 12) reflect global architectural trends with minimal contextual sensitivity.

A distinctive feature of Peshawar's traditional architecture is the creative use of colourful glass in windows and openings, which transforms natural daylight into vibrant patterns across the building's surfaces. Especially in mosques, older homes, and cultural landmarks, small sections of walls or arches are fitted with multi-colored glass panes commonly in red, green, blue, and yellow hues. These elements are often integrated into arched window frames or domes, allowing daylight to enter in a filtered, decorative form.

The resulting play of light is visually striking and symbolically rich, evoking spiritual beauty and sensory comfort. During early morning or late afternoon, the sun's rays passing through these glass elements create a luminous, stained-glass effect on the floor and walls, adding color, warmth, and movement to otherwise plain exteriors. This technique reflects a climatic and cultural adaptation, enhancing aesthetic appeal while softening harsh daylight in Peshawar's arid environment. Though less common in modern construction, the tradition of using colored glass in architectural design remains an important part of the city's visual identity. It represents a unique blend of local craftsmanship, Islamic art influences, and an architectural approach that values beauty in harmony with function.

Figure 12: Hotel Tourmaline in Peshawar, reflecting the emergence of glass-clad, Low-rise commercial architecture.

6.2 Brutalism in Peshawar

Brutalist elements can be seen in some government offices, educational institutions, and civic infrastructure, where functionality and durability are prioritized over ornamentation. These buildings often feature massive concrete walls, recessed windows, and minimal decorative detail, conveying a sense of permanence and authority. While not widely adopted in private construction, Brutalism's austerity and structural clarity have left a modest yet visible mark on the city's evolving architectural identity. However, its stark appearance often contrasts sharply with Peshawar's more intricate and ornamental historic architecture, highlighting the tension between global modernism and local tradition. However, a few local architects and design studios have begun experimenting with contextual design, integrating jharokhas, screened windows, and colored glass into new constructions to respond to cultural homogenization.
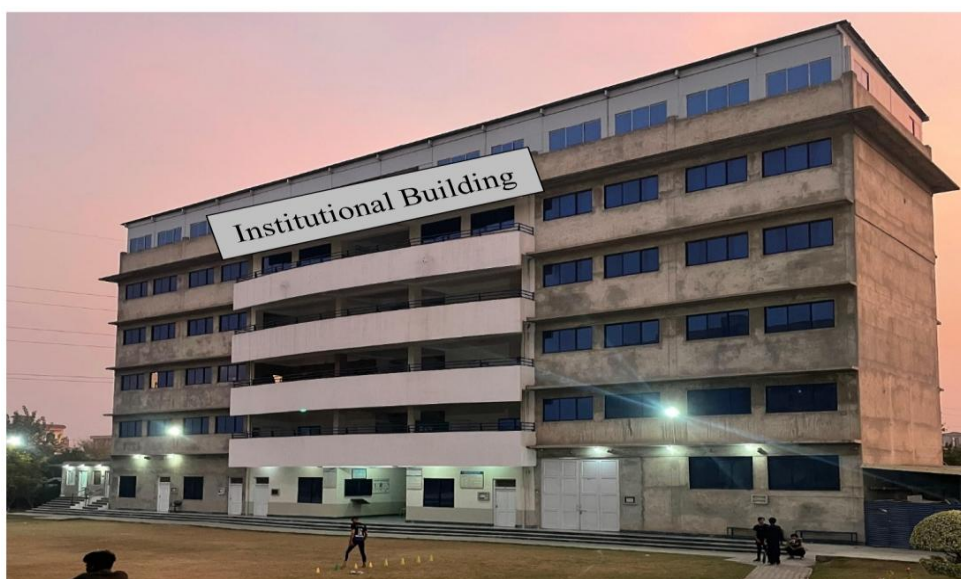
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Figure 13: An institutional building in Peshawar reflecting the emergence of glass-clad, Low-rise commercial architecture.

The Brutalist design of an institutional building in Peshawar (Figure 13) highlights the tension between utilitarian modernism and traditional ornamentation.

7. Challenges in Heritage Conservation

7.1 Urban encroachment

Historic sites are increasingly surrounded by informal and commercial structures, causing loss of context and visibility. Urban encroachment is one of the most serious threats to Peshawar's architectural heritage. As the city expands to accommodate a growing population and commercial demand, historic sites are increasingly surrounded or engulfed by unregulated construction, particularly in the old city. Narrow alleys that once led to centuries-old mosques, havelis, and bazaars are now cluttered with concrete shops, high-rise buildings, and encroachments that obscure or damage heritage structures. The lack of zoning control and ineffective enforcement of preservation laws have allowed private development to overtake historically significant areas, leading to the loss of authenticity and contextual integrity of many monuments [48], [49], [50].

7.2 Lack of awareness and funding

Public disregard and poor policy enforcement hinder conservation. Investment is often redirected toward infrastructure rather than heritage . Public and institutional lack of awareness is a major obstacle in heritage conservation. Many local communities and property owners are either unaware of the historical value of old buildings or consider them obsolete in the face of modern construction. There is also a general lack of educational outreach and heritage promotion at the policy level. Compounding this issue is the shortage of funding, as conservation efforts often take a back seat to infrastructure and commercial development. With limited budgets, local authorities and heritage organizations struggle to carry out even basic documentation, let alone restoration or maintenance. Private investment in heritage preservation is rare, and without incentives or public-private partnerships, many historical sites continue to fall into neglect.

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7.3 Structural deterioration

Many of Peshawar's historic buildings are in a state of advanced deterioration, owing to age, neglect, and environmental factors. Prolonged exposure to rain, extreme temperatures, and pollution weakens traditional materials like mud brick, lime plaster, and timber. Minor damages escalate into severe structural failures without regular maintenance and conservation practices. Additionally, the lack of skilled professionals trained in traditional restoration techniques results in improper repairs using incompatible materials such as cement, further accelerating damage. Earthquakes and seasonal floods also threaten already vulnerable structures, making structural stability a critical challenge in the long-term survival of Peshawar's built heritage. Environmental factors, poor repairs, and incompatible materials (e.g., cement instead of lime) accelerate decay [51], [52].

7.4 Institutional Weakness and Bylaw Violations

Another critical challenge in conserving Peshawar's architectural heritage is the lack of institutional enforcement of building regulations and conservation bylaws. Despite the presence of urban development frameworks and heritage protection policies, these are frequently bypassed by municipal authorities and developers. Development authorities often approve construction projects that violate heritage zoning rules or proceed without adherence to the approved architectural drawings.

Furthermore, architects and contractors often neglect municipal bylaws, especially in the old city, where unauthorized modifications to historic structures are common. Such practices result in overbuilt structures, incongruent façades, and the demolition of heritage elements without proper documentation or mitigation. These actions compromise the aesthetic and structural integrity of the urban fabric and erode public trust in regulatory institutions.

The absence of strict monitoring, limited accountability, and institutional overlap between heritage, planning, and municipal departments weakens conservation outcomes. Strengthening enforcement mechanisms, digitizing permit approvals, and empowering heritage departments are crucial steps to address this systemic issue. The absence of a digital permit system or heritage impact assessment process also exacerbates the issue, allowing irreversible changes to heritage zones under loosely monitored approvals.

8. Role of Civil Engineering in Heritage Preservation

8.1 Techniques for restoration and retrofitting

Techniques like masonry stitching, steel tie rods, and FRP jacketing reinforce vulnerable buildings. Retrofitting must ensure minimal alteration to visual identity.

- Restoration and retrofitting are essential civil engineering practices used to strengthen and preserve aging heritage structures in Peshawar. These techniques begin with a detailed structural assessment, identifying weaknesses in foundations, load-bearing walls, arches, and domes. Traditional materials such as lime mortar, stone, and mud-brick are often used to maintain authenticity. However, they are combined with modern reinforcement methods for added strength. Techniques like grouting, masonry stitching, jacketing, and the use of steel anchors or tie rods help stabilize cracks and prevent further structural failure.

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- In earthquake-prone areas, seismic retrofitting has become crucial. Engineers use base isolators, shear walls, or fiber-reinforced polymer (FRP) wraps to enhance resistance without visually altering the original design. These interventions are carefully chosen to ensure that the building's aesthetic and historical value remains intact. At the same time, its load-bearing capacity and durability are improved. Retrofitting is particularly important for mosques, forts, and havelis in Peshawar, many of which were built before modern seismic codes existed.

For instance, the partial retrofitting of Mahabat Khan Mosque using lime-based grouting and hidden steel tie rods demonstrates how traditional aesthetics can be preserved while reinforcing structural stability against seismic activity .

8.2 Use of modern technology in documentation

The documentation of heritage buildings is now more accurate and efficient thanks to the integration of modern technology in civil engineering and conservation efforts. Techniques such as 3D laser scanning, photogrammetry, and drone mapping allow professionals to create highly detailed digital models of heritage sites without physically altering them. These models help record the building's current condition, plan conservation strategies, and simulate structural behavior under stress. Another key tool is Building Information Modeling (BIM) for historic structures, often referred to as HBIM (Heritage BIM). It allows engineers and architects to digitally reconstruct and manage conservation projects with layered historical data, structural analysis, and future maintenance plans. This digital documentation not only supports the physical restoration process but also preserves a virtual record for educational, research, and cultural purposes [53], [54], [55], [56], [57].

By applying these technologies, civil engineers contribute to both the preservation and modernization of Peshawar's architectural heritage, ensuring that the past is documented accurately and protected intelligently for future generations. Tools like 3D laser scanning, photogrammetry, and Heritage BIM (HBIM) allow digital archiving and simulation for stress analysis.

9. Recommendations

9.1 Policy-level suggestions

Government institutions must play a proactive role in protecting heritage structures through clear, enforceable conservation policies. This includes implementing heritage zoning laws, restricting unauthorized construction around protected sites, and offering legal protection to historically significant buildings. Budget allocations for heritage preservation should be increased and integrated into urban planning frameworks. In addition, public-private partnerships can be encouraged to fund restoration projects and adaptive reuse of old buildings for cultural or civic purposes. A centralized heritage management authority in Khyber Pakhtunkhwa could coordinate efforts, maintain a heritage site registry, and ensure conservation standards. Enforce zoning, heritage mapping, and legal protections.

9.2 Community involvement

Local communities must be seen as active stakeholders in the preservation process. Awareness campaigns, guided heritage walks, and public exhibitions can help residents understand the' cultural and historical value. Incentives such as tax breaks or restoration grants could encourage homeowners and businesses to maintain historic façades and structures. Involving local artisans, masons, and traditional craftsmen in restoration supports cultural continuity and economic participation. Community-driven projects build a sense of pride and responsibility, ensuring long-term stewardship of heritage assets. Use incentives, awareness campaigns, and local participation.

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9.3 Educational initiatives

Educational institutions can play a major role in shaping future conservation efforts. Schools, colleges, and universities should integrate heritage studies into their curricula, especially those offering architecture, civil engineering, or urban planning. Workshops, field studies, and student documentation projects can help foster interest and skills in heritage conservation from an early stage. Furthermore, partnerships between academic institutions and local government bodies can lead to research-based conservation strategies using traditional knowledge and modern technology. Encouraging youth engagement is essential for ensuring that Peshawar's architectural legacy is not only preserved but actively celebrated. Integrate heritage studies in civil engineering and architecture curricula.

Together, these recommendations emphasize the importance of multi-level action policy reform, community engagement, and educational integration to ensure that Peshawar's architectural heritage is preserved and revitalized as a living part of the urban fabric.

9.4 Strengthen enforcement of conservation bylaws

Municipalities and development authorities must be held accountable for approving construction violating zoning laws or disregards heritage protection. Architects and developers should be required to follow approved drawings, and strict penalties should be enforced for violations. Authorities should integrate digital building permit systems, public grievance mechanisms, and third-party audits to ensure transparency in enforcement.

10. Conclusion

This study documents Peshawar's architectural evolution, identifying challenges and engineering solutions for heritage conservation. It emphasizes that interdisciplinary collaboration is essential to balance modernization with cultural continuity. As Peshawar grows, its development must reflect economic aspirations and its layered historical identity.

The study has explored the architectural richness and historical layers of Peshawar, highlighting key examples such as Islamia College, Mahabat Khan Mosque, Sunehri Masjid, and Bala Hissar Fort. The research demonstrates how Peshawar's built environment reflects centuries of cultural exchange, colonial influence, and Islamic tradition. It also examined the evolving nature of the city's urban development, showcasing the contrast between traditional craftsmanship and contemporary architecture. While the city's architectural heritage remains a source of cultural identity and historical continuity, it is increasingly threatened by urban encroachment, neglect, and structural decay. The role of civil engineering and architects in heritage preservation was emphasized, particularly through modern restoration, retrofitting techniques, and digital documentation technologies like BIM and laser scanning. In addition, challenges such as a lack of public awareness, funding limitations, and inadequate policy enforcement were identified as major barriers to effective conservation.

The findings make it clear that sustainable heritage conservation is essential for protecting historical monuments and maintaining the cultural identity, social continuity, and collective memory of the people of Peshawar. Heritage buildings are more than relics of the past; they are living narratives that inform urban character and civic pride. By integrating conservation efforts into urban planning, education, and community involvement, we can ensure that development does not come at the cost of history. Moving forward, adopting inclusive, interdisciplinary approaches that balance modernization with preservation is imperative. This will allow Peshawar to grow as a dynamic, livable city while honouring its rich architectural legacy. This legacy must be preserved for future generations to experience, study, and appreciate.

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As Peshawar continues to grow, its architectural identity must evolve not through erasure but through thoughtful integration of past and present. This vision requires commitment, creativity, and collaboration across disciplines. The architectural narrative of Peshawar is not merely about buildings; it reflects the collective memory, identity, and future trajectory of its people.

Future research could expand on this study by incorporating GIS-based heritage mapping, interviews with local artisans, and real-time structural monitoring of vulnerable monuments. The insights from Peshawar's experience may serve as a model for other historic South Asian cities facing the dual pressures of modernization and heritage erosion.

While this study offers a comprehensive overview of Peshawar's architectural heritage, it is limited by the availability of access to specific heritage sites under military or private control. Future research could include on-site structural analysis, interviews with local artisans, and integration of GIS-based heritage mapping to enhance documentation and planning further.

References

K. Behrendt, *The Buddhist Architecture of Gandhara*. 2018. doi: 10.1163/9789047412571.

K. A. Muiz, "Analytical Study of Uniqueness of Culture of Pakistan," *Journal of Art, Architecture and Built Environment*, vol. 3, no. 2, 2020, doi: 10.32350/jaabe/2020/32/973.

I. Seemi, Z. Jan, Z.-E.-H. Mujeeb, and S. Rafiq, "A Short Note on the Indigenous and

Western Architectural Traditions in the Buildings of Islamia College Peshawar," *Ancient Pakistan*, vol. XXVI, 2015.

S. Badalkhan, "Pashtun Tales from the Pakistan-Afghan Frontier (review)," *Marvels & Tales*, vol. 18, no. 2, 2004, doi: 10.1353/mat.2004.0023.

Z. Ren, "Architectural Palimpsest and Its Effect on Cultural Identity A Tool of Manipulation and Its Social Power." [Online]. Available: http://archnet.org/collections/843/publications

K. Z. Tun *et al.*, "Cooling the cities: A comprehensive review of urban heat island mitigation strategies in Southeast Asia," *Human Settlements and Sustainability*, vol. 1, no. 2, pp. 91–102, Jun. 2025, doi: 10.1016/j.hssust.2025.05.002.

"World Heritage Centre - Recommendation on the Historic Urban Landscape." Accessed: Sep. 12, 2025. [Online]. Available: https://whc.unesco.org/en/hul/

A. Samad and R. Young, "Buddhist Heritage and Tourism in Khyber Pakhtunkhwa, Pakistan," *South Asian Studies*, pp. 1–15, Jul. 2025, doi: 10.1080/02666030.2025.2530833.

I. Shah, "Hindu Iconography in the Gor Khatri Temple (Peshawar): Sacred Imagery Painted in the Śaiva Shrine," *South Asian Studies*, vol. 32, no. 2, 2016, doi: 10.1080/02666030.2016.1218125.

A. M. Malik, M. Rashid, and F. Jamil, "GOR KHATRI PESHAWAR- RETROSPECT OF THE ARCHEOLOGICAL REMAINS TO REBUILD," *Pakistan Journal of Social Research*, vol. 04, no. 04, 2022, doi: 10.52567/pjsr.v4i04.810.

P. Rathnasiri, S. Jayasena, and M. Siriwardena, "Assessing the applicability of green building information modelling for existing green buildings," *International Journal of Design and Nature and Ecodynamics*, vol. 15, no. 6, 2021, doi: 10.18280/ijdne.150601.

Y. Chen, X. Wang, Z. Liu, J. Cui, M. Osmani, and P. Demian, "Exploring Building Information Modeling (BIM) and Internet of Things (IoT) Integration for Sustainable Building," *Buildings*, vol. 13, no. 2, 2023, doi: 10.3390/buildings13020288.

K. N. Ali, H. H. Alhajlah, and M. A. Kassem, "Collaboration and Risk in Building Information Modelling (BIM): A Systematic Literature Review," *Buildings*, vol. 12, no. 5, 2022, doi: 10.3390/buildings12050571.

H. Gao, C. Koch, and Y. Wu, "Building information modelling based building energy modelling: A review," 2019. doi: 10.1016/j.apenergy.2019.01.032.

S. Azhar, M. Khalfan, and T. Maqsood, "Building information modeling (BIM): Now and beyond," *Australasian Journal of Construction Economics and Building*, vol. 12, no. 4, 2012, doi: 10.5130/ajceb.v12i4.3032.

O. Doukari, M. Kassem, and D. Greenwood, "Building Information Modelling," in *Palgrave Studies in Digital Business and Enabling Technologies*, vol. Part F1217, 2023. doi: 10.1007/978-3-031-32309-6_3.

E. Valero, F. Bosché, and M. Bueno, "LASER SCANNING FOR BIM," *Journal of Information Technology in Construction*, vol. 27, 2022, doi: 10.36680/j.itcon.2022.023.

I. Ullah, M. A. Soomro, and Mudassar Zulfiqar, "A Review of Archaeological Reports and Literature on the Gandhara Sculpture Collection of the Royal Ontario Museum," *Academic Journal of Social Sciences (AJSS)*, vol. 4, no. 3, 2020, doi: 10.54692/ajss.2020.04031212.

I. S. Hussein and Z. S. Hama Arif, "Minaret, Importance in Islamic civilization,"

338

Halabja University Journal, vol. 8, no. 1, 2023, doi: 10.32410/huj-10454.

E. Makovicky, "Tomb towers and minarets: analysis of symmetries and geometries of Iranian geometrical ornaments of the Seljuq era. Pictorial requiem for the Kharraqan towers," *Rendiconti Lincei*, vol. 34, no. 3, 2023, doi: 10.1007/s12210-023-01171-3.

M. B.- Hamouche, "ISLAMIZATION OF CONTEMPORARY ARCHITECTURE: SHIFTING THE PARADIGM OF ISLAMIC ARCHITECTURE," *Journal of Islamic Architecture*, vol. 1, no. 2, 2012, doi: 10.18860/jia.v1i2.1720.

S. F. Azzahrah, S. A. Salih, A. Sabil, N. Asif, and S. Ismail, "Morphology and Typology of Islamic Dome Architectural Design in the Middle East and Central Asia: Persian Islamic Dome," *International Journal of Academic Research in Business and Social Sciences*, vol. 13, no. 9, 2023, doi: 10.6007/ijarbss/v13-i9/18436.

G. Elgemaiey, "THE INFLUENCES of ISLAMIC ARCHITECTURE on SIKH ARCHITECTURE in PUNJAB REGION from the 16th-19th CE," *Shedet*, vol. 8, no. 8, 2021, doi: 10.21608/SHEDET.2021.207836.

M. Khazaee, N. Yaacob, Z. A. M. Awad, and Z. Md Ali, "Mughal or Moorish architecture: The origins of Malaysian mosques during colonial periods," *Pertanika Journal of Social Sciences and Humanities*, vol. 23, no. 3, 2015.

K. Shannon, "Beyond Tropical Regionalism: The Architecture of Southeast Asia," in *A Critical History of Contemporary Architecture: 1960-2010*, 2016. doi: 10.4324/9781315263953-26.

"Architectural conservation in Europe and the Americas: national experiences and practice," *Choice Reviews Online*, vol. 50, no. 01, 2012, doi: 10.5860/choice.50-0099.

E. Sesana, A. S. Gagnon, C. Ciantelli, J. A. Cassar, and J. J. Hughes, "Climate change impacts on cultural heritage: A literature review," 2021. doi: 10.1002/wcc.710.

F. Francioni, "Cultural Heritage and Human Rights," *Max Planck Yearbook of United Nations Law*, vol. 25, 2023, doi: 10.1163/18757413_02501007.

Z. Fatima, U. Ahmed, and A. Khursheed, "Revitalizing the Cultural Heritage: Assessing the Historical Significance and Conservation Potential of Hindu Sites in Punjab, Pakistan," *ANNALS OF SOCIAL SCIENCES AND PERSPECTIVE*, vol. 4, no. 2, 2023, doi: 10.52700/assap.v4i2.307.

P. J. Armstrong and P. H. Kapp, "Preserving the past or past preserving: sustaining the legacy of postmodern museum architecture," *Built Heritage*, vol. 6, no. 1, 2022, doi: 10.1186/s43238-022-00055-z.

"pashtoonkhwa:pashtoons social democratic party د پښتنو تولنیز ولسوالیز ګوند پښتونخوا/ افغانستان." Accessed: Sep. 12, 2025. [Online]. Available: https://www.pashtoonkhwa.com/?page=news&cnt=2309

"Indo Saracenic Architecture – 20 Historic Landmarks in the Country." Accessed: Sep. 12, 2025. [Online]. Available: https://thearchitectsdiary.com/indo-saracenic-architecture-20-historic-landmarks-in-the-country/

I. Seemi and Z. Jan, "The Islamia College Peshawar: History and Architecture," 2014.

Sanaullah, W. U. N. Faizi, and M. Kamran, "Islamia College Peshawar (ICP), Pakistan: An Icon in Academia and Research for the Region," *Qlantic Journal of Social Sciences*, vol. 4, no. 3, 2023, doi: 10.55737/qjss.945308128.

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S. Ansari and A. Khan, "Studying Mughal Architecture Under Shah Jahan: Mosques of Agra In History."

A. A. Abdulhameed and A. M. I. Said, "Experimental investigation of the behavior of self-form segmental concrete masonry arches," *Fibers*, vol. 7, no. 7, 2019, doi: 10.3390/FIB7070058.

L. Li *et al.*, "The Impact of Coverage Forms of Exterior Vertical Greening Walls on the Thermal Environmental Benefits of Buildings in Hot and Humid Regions," *Buildings*, vol. 14, no. 12, Dec. 2024, doi: 10.3390/buildings14123840.

M. Ayub, Q. Ali, K. Shahzada, A. Naseer, and M. Shoaib, "Conservation of Islamia College Building in Pakistan," in *Procedia Engineering*, Elsevier Ltd, 2013, pp. 465–471. doi: 10.1016/j.proeng.2013.03.042.

A. Madanipour, *Cities in Time: Temporary Urbanism and the Future of the City*. 2017. doi: 10.1080/20419112.2019.1616924.

"Peshawar, Gor Khuttree - World Archaeology." Accessed: Sep. 12, 2025. [Online]. Available: https://www.world-archaeology.com/features/peshawar-gor-khuttree/

M. Saquib and A. M. Asif, "PERSIAN ARCHITECTURE: A SOURCE OF INSPIRATION FOR MUGHAL IMPERIAL MOSQUES IN NORTH INDIA," *Journal of Islamic Architecture*, vol. 7, no. 4, 2023, doi: 10.18860/jia.v7i4.21013.

M. Chida-Razvi, "Resituating Mughal Architecture in the Persianate World: New Investigations and Analyses," 2019. doi: 10.1080/02666030.2019.1628690.

S. Khurshid. Hasan, *Historical forts in Pakistan*. National Institute of Historical & Cultural Research Centre of Excellence, Quaid-i-Azam University, 2005.

S. M. Hanifi, "Shah Shuja's 'Hidden History' and its Implications for the Historiography of Afghanistan," *South Asia Multidisciplinary Academic Journal*, May 2012, doi: 10.4000/samaj.3384.

S. Qureshi and M. A. Khan, "MAHABAT KHAN MOSQUE - AN ISLAMIC SYMBOL OF PEACE," *Journal of Research in Architecture and Planning*, vol. 28, no. 1, 2020, doi: 10.53700/jrap2812020_2.

"Peshawar ZU System - Zu Peshawar." Accessed: Sep. 12, 2025. [Online]. Available: https://transpeshawar.pk/services/peshawar-zu-system/

F. Haider, Z. U. Rehman, A. H. Khan, M. Ilyas, and I. Khan, "Performance evaluation of brt standard in decision support system for integrated transportation policy," *Sustainability (Switzerland)*, vol. 13, no. 4, 2021, doi: 10.3390/su13041957.

H. Hirsenberger, J. Ranogajec, S. Vucetic, B. Lalic, and D. Gracanin, "Collaborative projects in cultural heritage conservation – management challenges and risks," *J Cult Herit*, vol. 37, 2019, doi: 10.1016/j.culher.2018.10.006.

M. A. Coombes and H. A. Viles, "Integrating nature-based solutions and the conservation of urban built heritage: Challenges, opportunities, and prospects," 2021. doi: 10.1016/j.ufug.2021.127192.

M. Rössler and R. C. H. Lin, "Cultural Landscape in World Heritage Conservation and Cultural Landscape Conservation Challenges in Asia," *Built Heritage*, vol. 2, no. 3, 2018, doi: 10.1186/BF03545707.

A. Cruz, V. Coffey, T. H.T. Chan, and M. Perovic, "Model for the maintenance-

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focussed heritage building conservation," *Journal of Cultural Heritage Management and Sustainable Development*, vol. 12, no. 4, 2022, doi: 10.1108/JCHMSD-09-2020-0127.

Y. Zhang and W. Dong, "Determining Minimum Intervention in the Preservation of Heritage Buildings," *International Journal of Architectural Heritage*, vol. 15, no. 5, 2021, doi: 10.1080/15583058.2019.1645237.

G. Rocha, L. Mateus, J. Fernández, and V. Ferreira, "A scan-to-bim methodology applied to heritage buildings," *heritage*, vol. 3, no. 1, 2020, doi: 10.3390/heritage3010004.

Z. Liu, M. Zhang, and M. Osmani, "Building Information Modelling (BIM) Driven Sustainable Cultural Heritage Tourism," *Buildings*, vol. 13, no. 8, 2023, doi: 10.3390/buildings13081925.

D. P. Pocobelli, J. Boehm, P. Bryan, J. Still, and J. Grau-Bové, "BIM for heritage science: a review," 2018. doi: 10.1186/s40494-018-0191-4.

V. Croce, G. Caroti, A. Piemonte, L. De Luca, and P. Véron, "H-BIM and Artificial Intelligence: Classification of Architectural Heritage for Semi-Automatic Scan-to-BIM Reconstruction," *Sensors*, vol. 23, no. 5, 2023, doi: 10.3390/s23052497.

F. J. López, P. M. Lerones, J. Llamas, J. Gómez-García-Bermejo, and E. Zalama, "A review of heritage building information modeling (H-BIM)," 2018. doi: 10.3390/mti2020021.

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