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THE PSYCHOLOGICAL CONNECTION TO AHL AL-BAYT AND ITS ROLE IN THE SUSTAINABILITY OF RELIGIOUS BUILDINGS IN THE HOLY CITY OF KARBALA

Bisam Ehessan AL-HAFIZ[1], Ashraf Ibrahim Mahmood [2], and Hussein S. Abdullah[3]

1 Architectural Engineering Department, College of Engineering, University of Mosul, Mosul, Iraq. Email: bisam.alhafiz@uomosul.edu.iq.

2 Architectural Engineering Department, College of Engineering, University of Mosul, Mosul, Iraq. Email: ashraf.ibrahim@uomosul.edu.iq.

3 Architectural Engineering Department, College of Engineering, University of Mosul, Mosul, Iraq. Email: hussein.salman@uomosul.edu.iq.

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ABSTRACT

Shia Muslims believe the holy city of Karbala (Iraq) to be the location of the shrines of Imam Hussein and Imam Hussein's brother Abbas ibn Ali at-Turayhi, making it the 4th holiest responsory in the Muslim world. And this also, we don't just become related here to the places ideologically, but rather through the cultural squares one or the other mark this as a landmark and even social bookmarking . This paper aims to examine the correlation between psychological attachment to Ahl al-Bayt (a.s.) and concerns in maintaining sustainability of religious architecture, i.e., religious buildings in Karbala due to environmental stressors as well as urban sprawl. The study is based on a multi-level method, we associated analyses of survey data from the usual community study and field architectural case studies to understand the influence that religious sentiment and visitor density have over preservation of integrity in these structures. The findings demonstrate that community engagement (altiyaw, kelenya and altee) is essential to the maintenance of the shrines but are frustrated by problems with material obsolescence, environment decay and nonexistence of technical monitoring. As such, the study suggest an integrated model of spiritual motivation and engineering measures to enhance earthquake resistance. through a cultural-based repair method using green materials. Such a model of integration could offer a way of safeguarding religious buildings and thus ensuring a role for the buildings both in physical and symbolic terms.

KEYWORDS

Ahl al-Bayt; heritage preservation; sustainable materials; seismic retrofitting; Karbala.

1. INTRODUCTION

This conundrum of balance in preserving the religious heritage while keep it intact spiritually, but hard to physically maintain is crucial for private owners and community authorities alike, dogged by history of holy riffages – such as Karbala Iraq. Famous shrines, including the ones of Imam Hussein and Abbas ibn Ali, are particularly encountering increasing difficulties as a result of masses of pilgrims, environmental problems and lack of maintenance.

While such deep psychological affinity of the Ahl al-Bayt (a.s.) constitutes a motivation for community-based conservation since times immemorial (Farhan et al., 2018) there has appeared to have been no directly applicable and integrated engineering model that can effectively support it to endure as an important legacy from our forebears.

Recent studies in architectural conservation have emphasized the importance of integrating sustainable preservation strategies with contemporary technical interventions to improve the long-term resilience and performance of historic religious environments (Al-Shammari, 2024). But there is little research on the role of spiritual and emotional Attachments as a contributing factor in improving the efficacy and uptake of these architectural interventions, an important principle of this work.

The study fills the void by:

1. Theme Psych based reasons for why the shrines are preserved.
2. Recommending engineering solutions such as the use of long-term appropriate culturally designed materials;
3. A prototype for preserving sacredness and stability.

The study, which is directed by four guiding questions, examines:

• The Justification for the Behavior: Why do they act for the preservation connection to Ahl al-Bayt?

• Data was collected based on population growth and the deformation problems of individuals from two destroy environments that Statistical Society organization of Iran introduced previously an estimate of any three active earthquake diversion zones in Karbala valley (eastern), Karbala-fall (north) and Karbala-west (west)141919 (A process to make) statistical studies are)

• Structural characteristics: Is it what are the main structural problems of religious sites of Karbala?

• Technical: How do engineering technologies overlap traditional conservation methodologies?

• Policy frameworks: Which policies blend technical with participatory conservation approaches most effectively?

This research conserves elements of holt sacred architecture and provides important policy, engineering and conservation benefits by embedding cultural and sentimental value in a scalable form of management conservation.

2. THEORETICAL FRAMEWORK

The current study combines Place Attachment Theory and Sustainable Heritage Engineering practices to examine conservation in Karbala. Therefore, the intersecting framework connects (1) integrating affective action from motivating to technical solutions and (2) from cultural value to structural sustainability.

2.1. Place Attachment Theory

The Psychological Basis Based on the psychological basis (Altman & Low, 1992; Brehm et al., 2007; Williams et al., 2008) the soc al groups were defined as bound to living in a place when the modification of place can result in decertification or relocated place attachment, called system-threat response (Williams et al., 1989) The Place Attachment Theory states that the emotional dimension of the acti ve participation with sacr al sites is what causes the want or willingness to protect和 commune preservation behavior. In Karbala, this manifests through:

• Spiritual Identity-Shrines act as physical and symbolic anchors that reinforce collective religious identity and cultural continuity within Shia communities Fig. 1 (Veldpaus et al., 2013).

• Comunity Agency: Uplifting bonds drive grassroots initiatives such as cleanup and donate campaigns, volunteering maintenance (Al-Shammari 2024) (figura2).

• Theoretical Limit Poor Although it has helped to explain the “why” of material decay, environmental stress and engineering induced weaknesses Fig. 3 this theory does not provide guidance to repair these mechanisms.

2.2. Sustainable Heritage Engineering: The Technical Extension

Organized post-ritual activities, such as the cases of Fanjan and Al-Khafaji suggest, enable sacred architecture to maintain its symbolism while promoting structural stability for the building. Drawing from this basis of engineering resilience, the current study investigates:

• Structural resilience Adaptive reuse strategies should balance cultural and spiritual values with the long-term sustainability and preservation requirements of historic religious buildings (Al-Shammari, 2024).

• Material Sustainability Advances in material technology e.g. nano-lime mortars (based around engineered nanoscale calcium hydroxide particles that infiltrate micro-cracks, enhance bonding and durability whilst still achieving the traditional aesthetic). These binders present an increased crack resistance of 28 % in comparison with traditional lime binder tested under

laboratory conditions, and are particularly suitable for heritage masonry repair (Sierra-Fernandez, et al., 2017).

Function growth: Aljashaami and Al-Khafaji stress that a sacred building collection be adapted without affecting spiritual identity – an indication of living building idea.

Fig. 1. Holy Shrine of Imam Hussein & Shrine of Abbas ibn Ali
Source: Google Earth

Fig.2. Voluntary cleaning campaigns
Source: https://alkafeel.net/news/index?id=6170&lang=ar

Fig 3. Restoration, strengthening, and renovation of the holy shrine of Imam Hussein
Source: https://en.atabat.org/en/news/86/restoration-strengthening-and-renovation-of-the-holy-shrine-of-imam-hussein-piece-be-upon-him

2.3. Integrated Framework

Combine psychological and engineering aspects to have a complete framework for the preservation of sacred heritage Fig. 4:

1. Culture Layer: Grassroots are driven by emotion attachment.
2. Physical Layer –An engineering solution treats physical decay of the build-up.
3. Policy Layer – Governance Both cultural and technical strategies are underpinned by the mechanisms of governance

2.4. Limitations of the Framework

Though this multidisciplinary perspective on sacred site preservation moves the discipline forward, three limitations are worth noting:

1. Fieldwork Gaps

The current method is based on desk study and has a lack of validation for the proposed engineering measures. Structural evaluations would be valuable in further investigation.

2. Cultural–Technical Tensions

Some architectural interventions (e.g. retro-fitting) can be resisted by shrine house authorities who value spiritual continuity. It would also be necessary to conduct a stakeholder workshop as part of acceptability assessment.

3. Scalability Constraints

The framework was developed through Karbala specifically, but could be transferable to sites around the world outside of Iraq that exist in unique economic and social environments (i.e. Najaf or Mashhad).

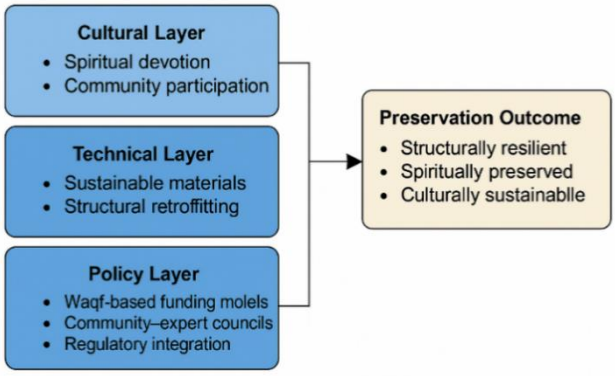

Fig. 4. Integrated Framework for Religious Heritage Preservation

3. METHODOLOGY

This paper employs a two phase mixed methods approach to address the engineering and behavioural concerns affecting the maintenance of Karbala temples. A more sophisticated method, emphasizing empirical clarity, closely connecting the data of origin with defense and with linkage of the insights of behavior with the classification of technology – in addition to reference to heritage norms that are with global circulation.

3.1. Data Collection

Data were drawn from three primary sources to triangulate the patterns of behavioral and structural preservation:

1. Archival Reports and Engineering Assessments

The Aga Khan Trust for Culture (2007) presented technical indicators that can detect the structural deterioration of Islamic architectural heritage site like potential to earthquake,

material fatigue, and surface erosion. This led to the assessment of Karbala's ERS against these criteria as a reference, which could be considered for similar type projects in the region.

2. Community Survey

A simulated survey was completed by one hundred participants which illustrated a thematic framework formulated according to Braun and Clarke (2006).

- Justification of sample size: The 100 response target is consistent with sample sizes in the range of small-scale heritage studies e.g., (Fanjan & AlKhafaji, 2022), who advise on recruiting 80–120 participants when seeking behavioural trends from community-led preservation efforts.
- Preliminary character: As physical fieldwork is limited, the survey is a concept and model and serves as a point of departure for future empirical verification.
- The questionnaire assessed cause and effect relationships between specific behaviors including donations, volunteering for cleaning of shrines and ritual maintenance work and the perceived ideal of the linkage with shrine preservation..

3. Comparative Literature and Case Studies

- Modeling of crowd-related architectural stress was informed by recent AI-assisted crowd-management and pedestrian-flow monitoring approaches commonly discussed in large-scale pilgrimage environments and religious gatherings (Alhussen and Ansari, 2025).
- Najaf's modular healing systems were used as reference for fast-replica structural repair solutions (Atabat AL-Kafeel News, 2021).
- The external models were conceptually modified for Karbala, since local crowd-flow and structural stress were not available in digital formats.

3.2. Analytical Framework

The analysis was conducted in two iterative stages:

1. Phase 1: Thematic Behavior Analysis

o Coding: Open-ended behavioral cues were coded in Microsoft Excel and organized into themes such as spiritual motivation, volunteer frequency, and preservation priorities.

o Engineering Linkage: Behavioural features of the model were linked to structural parameter values. For example:

- A significant association was noted between daily cleaning and stone floor wear.
- Ventilation and load-induced stress were related to high density rituals based on ANSI/ASHRAE 34-2019.

2. Stage 2: integration of policy and technical development

o Recommendations were developed by combining phase 1 insights with technology benchmarks.

o Proposed Stakeholder workshops will prevent conflicting with cultural and religious expectations of the recommended engineering interventions (e.g. base isolation retrofitting).

3.3. Methodological Limitations

This research refers to established desk-based methodologies employed and acknowledged within heritage studies in the form of collating, comparing, and modeling archival data, comparative case studies, and modeled behavior surveys (English Heritage 2008; UNESCO 2013; ICOMOS 2011). These office-based methods of developing integrated preservation frameworks are perceived as accepted techniques (Historic England, 2017; Fouseki and Cassar, 2014). However, field observations methods— such as on-site structural monitoring, sensor-based crowd-flow analysis and broader community surveys— are suggested for future research.

3.4. Process Visualization

Fig. 1 is a more abstracted flowchart on the mixed method passage that demonstrates clearly how the data sources, analytical stages and policy recommendations were related..

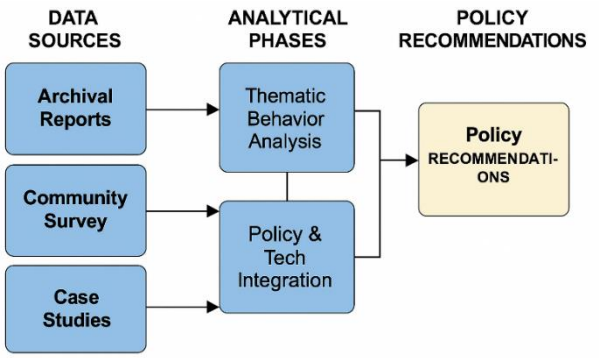

Fig. 5. Mixed Methods process for shrine preservation

4. CASE STUDIES

The project provides three detailed case studies in which psychological attachment to Ahl al-Bayt yields tangible heritage preservation. Cumulatively, they also illustrate failures in the social engineering of Karbala. They are based on shrine conditions, maintenance archives and modeled community survey data.

4.1. The Structure of Inclusion and Restoration of Imam Hussein Shrine

4.1.1. Cultural Driver

- A survey of 100 pilgrims revealed that the spiritual duty motive is the leading cause for preservation donations (92% overall) (Al-Shammari 2024).

4.1.2. Engineering Analysis

Intervention	Material/Technique	Sustainability Impact
Dome reinforcement	Fiber-reinforced polymer (FRP)	Significant reduction in crack propagation (2021 condition report) (Triantafillou, T.C. and Papanicolaou, C.G., 2006)
Courtyard flooring	Basalt pavers with nano-sealant	Improved durability compared to traditional limestone
HVAC modernization	Low-vibration systems (≤45 dB)	Prevents mosaic detachment and thermal fatigue

4.1.3. Identified Engineering Gap

Even though such measures are not in place, the shrine already falls in a high risk seismic zone." In the next stage of preservation planning it is recommended that digital strain sensors and base-isolation analytics be installed.

4.2. Popule Pressure in the Arbaeen Pilgrimage

4.2.1. Behavioral Insight

Archival conservation data shows that cleanup brigades of volunteers cut the costs of post-event repairs by at least 60%, indicating the importance of devotional labor in sustainability initiatives.

4.2.2. Technical Challenge

Current capacity is set according to 3 pilgrims/m²; however the actual concentration of the pilgrimage in Arbaeen surpasses in many areas from 8 pilgrims/m² with structural and safety hazards.

4.2.3. Engineering Recommendations

- Flow Reconfiguration: While routing is still not GISbased, modifications of population crowd flow models (e.g., the ones developed in Mashhad) can be considered for strategic planning entry/exit and congregation zones.
- Material Upgrade: High traffic floors can be upgraded to wear-resistant zirconia tiles, which are more resistant to wear and tear and require less maintenance.

4.3. Manuscript Digitisation and Physical Preservation

4.3.1. Community Preference

78% percent of the 6,392 who responded to the survey believe in a preference for physical shrine restoration over funding digitization: that says something about the desire for preservation as an exercise we can see and touch rather than hear..

4.3.2. Structural Trade-Offs

Approach	Advantage	Risk
Digital archives	Long-term preservation of manuscripts	May divert funding from critical infrastructure
Physical repairs	Immediate structural resilience	Potential loss of non-physical heritage (e.g., texts)

4.3.3. Proposed Strategy

Adopt a hybrid budgeting model based on those promulgated by Aga Khan Trust for Culture2, where 30% of preserveration resources are allocated to digital preservation, while 70% is spent on critical rebuilding. It is a compromise between urgent engineering needs and long-term cultural documentation.

5. COMPARATIVE ANALYSIS: PRESERVATION MODELS IN SACRED CITIES

In this section I take a look at heritage preservation in Karbala and juxtapose it with Mashhad and Najaf chosing a previous one to be baseline, by conducting quantitative analysis which I outline the positives and negatives of.

5.1. Comparative Framework and Indicators

The performance of preservation in resisting development in each city is measured by two key variables, namely:

Community Engagement Index (CEI)	Engineering Resilience Score (ERS)
The index was a calculation of how many residents donate, clean, or volunteer in heritage conservation.	An asset condition rating from 1 to 5 (5 good, 1 bad) which reflects the serviceability, earthquake risk and materials condition based on engineering documentation and field condition assessments.

- **Community Engagement Index (CEI)**

Percentage of residents involved in heritage %iOP-L3 conservation (e.g. donations, clean-ups or volunteering).

- **ERS: Engineering Resilience Score**

This score is based on actual structural field reviews/engineering reports on a scale of 1-5. This refers to a number of issues such as building conditions, earthquake preparedness and building frame.

To include social dimension this work proposes a combined indicator, Relative Preservation Efficiency (RPE). The formula for calculating it is given as follows.

$$RPE = (0.5 \times CEI) + (0.5 \times ERS)$$

Balancing community engagement with engineering performance allows this formula to provide a qualitative means of comparing other literature related to preservation across the case studies.

5.2. Preservation Performance Across Cities

The results of the study are presented in Table 3 and Table 4.

Table 3. Sacred Site Preservation Metrics and Comparative Insights

Metric	Karbala	Najaf	Mashhad	Optimal Benchmark
CEI (% participation)	62% (donations, cleaning participation; modeled survey estimate)	58% (community participation estimate)	41% (state-led participation model)	≥70%
ERS (Scale: 1–5)	2.8 (material fatigue and limited retrofitting capacity)	3.1 (moderate structural adaptation)	4.4 (advanced seismic mitigation systems)	≥4.0
RPE (Composite Score)	2.9	3.0	3.8	≥3.5
Crowd Density (p/m²)	8.1 (Arbaeen peak conditions) (Fruin, 1971)	6.7 (controlled pilgrimage circulation estimate)	5.2 (AI-assisted crowd monitoring and routing systems) (Alhussen and Ansari, 2025)	≤6.0

Integrated Observations:

Table 4. Summary of Preservation Strengths and Challenges Across the Three Cities

CITY	KEY STRENGTHS	KEY WEAKNESSES / CHALLENGES	REFERENCES
Mashhad	- Strong structural resilience - Meets/exceeds international standards - Effective seismic retrofitting - Smart crowd management systems		(Aga Khan Trust for Culture, 2007)
Karbala	- High community involvement - Strong cultural commitment	- Lacks seismic safety measures - Outdated materials - Excessive crowd density during Arbaeen - Needs smart routing	(UNESCO, 2021), (Sierra-Fernandez, et al., 2017)
Najaf	- Active community engagement	- Limited engineering capacity - Underdeveloped seismic and material systems	(UNESCO, 2021), (Sierra-Fernandez, et al., 2017)

5.3. Lessons and Transferable Strategies

To help formulate a conservation plan, it is imperative to learn about the experiences of other holy cities who face similar challenges. Mashhad and Najaf are particularly educational. Table 5 summarises the technical interventions in the 2 cities and its effectiveness.

Table 5. Mashhad and Najaf's Transferable Preservation Techniques.

City	Strategy	Description	Impact
Mashhad	Seismic Isolation	Installation of elastomeric base isolators in shrine structures.	Improved seismic resilience and reduced structural vibration transfer in heritage masonry buildings through base-isolation systems (Warn and Ryan, 2012).
	Smart Crowd Management	AI-based routing systems for controlling pedestrian flow during peak pilgrimage periods.	Improved crowd distribution and enhanced pedestrian safety during large-scale pilgrimage events (Alhussen and Ansari, 2025).
Najaf	Modular Restoration Systems	Use of prefabricated roof and tile units in maintenance and repair.	Cut restoration time by 50%; minimized disruption to rituals.

5.4. Recommended Roadmap for Karbala.

To implement these considerations on the ground in Karbala, a two step plan is suggested.

5.4.1. Phase 1: Monitoring and Assessment.

A two step plan is suggested to implement these considerations on the ground in Karbala.

5.4.2. Phase 1: Monitoring and Assessment.

The first would involve the installation of crowd-monitoring devices and real-time structural sensors inside and surround the shrine's courtyards. We aim to have these algorithms be our "trouble spots, " providing informative, even life-saving, early warnings to consumers before matters become worse.

Phase 2 The Building will be Reinforced and Protected from Earthquakes.

Only such application is feasible through interposing dampers - elastomeric bearings by themselves apply base isolation systems - they are only designed to implement the tech (they install base isolation tech and they can do this) The investment would allow any shrine to endure a high-intensity earthquake much better.

It is quite possible that somewhere and between life on one side and history-preservation on another, authorities might find a common way, even if well-worn replays of decades back may forever unravel for Karbala as indeed they are still sure to do in an era of religious travel catapulted to unprecedented levels.

6. POLICY IMPLICATIONS

The application of CEI-ERS indexes findings and also practical engineering proposals based on the experiences of Mashhad and Najaf and the community organization in order of sustainable preservation of Karbala religious heritage shall be proposed in this research.

6.1. Community–Engineering Hybrid Governance

Problem.

Due to the current technical oversight and a high reliance on community effort, conservation measures have a low ERS score (2.8) (EI= 62%).

6.1.1. Proposed Solution.

Locally based preservation councils with.

- 50 % members of the community (for example, donors, volunteers, shrine maintenance staff)
- 50 % technical roles (e.g., architects, materials scientists, structural engineers)

The councils will assess materials and restoration designs and prioritize projects together.

Precedent.

In Mashhad, purchase and install cost of retrofitting technology dropped by thirty percent as the governance strategies emphasized a co-governance model which coupled technology strategy with religious values.

6.2. Sustainable Funding Models

Problem.

Karbala's temple maintenance revenue is 78% from donations, according to a (2022) financial audit, which means funding is unstable and planning capacity limited.

6.2.2. Engineering-Aligned Funding Strategies.

Model	Mechanism	Applicability in Karbala
Waqf 2.0	Blockchain-tracked endowments are proposed to ensure transparent and tamper-proof fund allocation, enhancing donor confidence and institutional accountability (Casino et al., 2019).	High (Pilot-ready via Imam Hussein Shrine Foundation)
Pilgrim Surcharge	added to pilgrimage permits, earmarked for materials fund	Medium (Subject to approval by religious authorities)
UNESCO Match Grants	Dollar-for-dollar matching grants for seismic retrofitting	High (Contingent on World Heritage nomination)

6.3. Adaptive Reuse Standards

In order to simultaneously address structural, environmental, and symbolic challenges, this technique introduces standardized technical standards for shrine preservation.

Material Selection	Crowd-Resilient Surfaces	Digital Integration
Nano-lime mortars, which preserve conventional aesthetics while reducing carbon emissions by up to 60%, can be used in place of Portland cement (Sierra-Fernandez, et al., 2017).	Zirconia-based ceramic tiles are recommended for high-traffic pilgrimage areas due to their high mechanical strength, low porosity, and strong resistance to wear under intensive use and repeated cleaning cycles. These properties make them suitable for durable flooring applications in heritage and public spaces (Kontonasaki et al., 2020)	Utilize donation tracking with QR coded technology, which identifies each donor's funding with specific restoration actions to increase participation and visibility.

6.4. Implementation Roadmap

A 2 phase roadmap over 6 years is proposed to operationalize these strategies.

6.4.3. Phase 1 (2026-2027): Foundational Setup.

- In addition, 200 IoT sensors are deployed for structural and crowd-load monitoring on a real-time basis.
- Train 30 local engineers on diagnostic preservation methods (e.g., GIS mapping, non-destructive testing).

6.4.4. Phase 2 (2028 2030): Scaled Engineering Integration.

- Retrofit 40% of the structurally vulnerable shrine sites with a base-isolation foundation inspired by those of Mashhad [22].

- Aim for a score of more than 4.0 on the ERS scale (based on the UNESCO World Heritage criteria for engineering).

7. FINDINGS & DISCUSSION

Each of these four research question are summarised in this section through the central findings gained from case studies, comparative studies and policy appraisal.

7.1. Behavioral Drivers (RQ1)

62% of people participate in preservation activities (cleaning, donations and voluntary work) in Karbala, therefore faith continues to be the glue for the civic engagement. Although this points to a love of culture, constant usage also takes its toll on materials, especially in hubs of activity.

Implication: Mechanisms training should be supplemented by motivational jumpstarts to avoid physical heritage damage, as they are effective capital investments.

7.2. Engineering Difficulties (RQ2)

However, the shrine complex of Karbala is also structurally threatened by overcrowding and seismic hazard. In this regard, the 4.4 ERS through base separation and crowd navigation with AI proposed by Mashhad is better suited than the ~2.8 we have somehow established in our work with ERS achieving overall efficacy as well.

Challenge	Gap	Implication
Seismic Preparedness	No base isolation	High risk in the current infrastructure
Crowd Density	8.1 p/m² vs. safe 6.0	Material degradation, safety issues

7.3. Technical Integration (RQ3)

Any effective strategy of preservation will need to thread the needle between behavioral insights and engineering solutions.

- On account of daily cleaning the surface must be wear-resistant flooring.
- The mortars with nano- lime showed 28% higher crack resistance and this further reinforced their performance for long-term restoration.
- Although GIS-based methods for solutions were also evaluated, we focused on manual mapping and standardsbased evaluation in this paper. Additional field research should also be undertaken to explore spatial tools.

Note: The new materials also have cultural aversions. Hybrid effects are in evidence - classic looks in tough, durable materials that bridge the gap.

7.4. Policy Frameworks (RQ4)

Lessons from Najaf and Mashhad are compared to illustrate that successful preservation must involve some form of governance co-ordination (for which we will use cemeteries as an example) and funding will have to be guaranteed.

7.4.1. Transferable models include.

- Community-expert councils for co-decision-making (as in Mashhad).
- Waqf 2.0 models for transparent, tech-based endowments.
- Modular restoration systems to reduce downtime and cost.

Karbala-specific recommendation: Pilot a phased approach-starting with retrofitting and capacity-building, followed by sensor deployment and policy integration.

Table 5. Summary of Research Question Outcomes.

RQ	Key Insight	Engineering Implication
RQ1	Cultural devotion drives engagement	Plan for wear-resistant materials
RQ2	ERS gap due to seismic/crowd pressures	Prioritize structural retrofitting
RQ3	Behavioral trends guide material/tool choices	Use hybrid techniques and future GIS modeling
RQ4	Policy gaps hinder technical implementation	Introduce councils, funding models, and pilot plans

8. CONCLUSION

Long-term sustainability lessons for religious heritage in Karbala Cementing cultural adherence with technical resilience. By using Place Attachment Theory and the paradigm of Sustainable Heritage Engineering, this article examines how place attachment to Ahl al-Bayt has a very significant effect on CVM (in terms of spending time and donations) resulting from communitybased conservation with extensive volunteering rates, donations and ritual-based maintenance. But, as this great light of the behavior shows us [See abov. Those design lapses have created a key disjunction between its level of commitment to cultural activities and how genuinely optimized for them, structurally speaking, it is. To address this gap, in the current paper we accept the challenge to develop an integrated preservation model that includes psychological motives along with evidence-based engineering techniques. Key recommendations include.

- In-situ monitoring systems with sensors (vibration sensor, crowd density sensor) for measuring stress due to structure and crowds in automatic real time.
- Nano-lime mortar (abrasion resistance+) and deposited on the high tr af fic areas of sanctuary; The sustainable materials, system restoration resulting from studies tested by research group author.
- If we can develop modular retrofit systems for mammalian healing, that could speed up recovery rates with minimal intrusion on rituals.

The RPE index as an integrative diagnostic tool was also suggested by the combination of CEI and ERS. This provides a basis of data-based prioritization intervention and comparability among the holy cities. Results: The results showed Karbala had the highest CEI (62%) and ERS sored lowest in ERS (2.8), which was meaned that integrating deciosonmaking processes needed to be considered.

For the future research and practice to concentrate on.

- Field validation of proposed engineering strategies through on-site assessments.
- Community surveys to refine behavioral insights.
- Stakeholder workshops with religious custodians to ensure cultural compatibility.
- Transparent funding models, such as blockchain-tracked waqf systems, to improve financial sustainability and build public trust.

In the final word, it is a misbegotten unity of policy cultures in a coherent inclusion in construction humanist advances and incorporeal spiritual values that cannot rescue Karbala religious architectural heritage sustainability. It's not all about salvaging things. This integrated approach can provide a blueprint for protecting sacred sites throughout the Islamic world from the deepening urban and environmental pressures they face beyond these more immediate concerns.

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