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Strategies for Reconstructing Historic Buildings in Saudi Arabia: Balancing Authenticity, Sustainability, and Community Identity

Gamal A. Abdelhamed
Professor of Civil and Architectural Engineering Department, College of Engineering and Computer Science Jazan University, Saudi Arabia.
Hassan Abdelrahman Mohamed Elsayed
PhD in Fine Arts - Specialization in Antiquities Restoration, Faculty of Fine Arts, Minia University, Egypt.
Heba Ahmed Abdelaal Elsayed
Lecturer, Department of Arts, College of Arts and Humanities, Jazan University, Saudi Arabia.
Osama Elsir Ali Ahmed
Lecture, Civil and Architectural Engineering Department, College of Engineering and Computer Science Jazan University, Saudi Arabia.
Musa Mohammed Babiker Mohammed
Lecture, Civil and Architectural Engineering Department, College of Engineering and Computer Science Jazan University, Saudi Arabia.

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Abstract
This research addresses the relationship between communities' need to restore damaged historic structures and the limits imposed by international heritage conservation charters, especially the Venice Charter (1964)2 and the Nara Document on Authenticity (1994). 3,4 The study is based on a descriptive-analytical comparative technique, relying on specialist academic literature and examining three Saudi case studies (Diriyah, Historic Jeddah, and AlUla) in comparison to three overseas models.
The research revealed that the tension between international charters and communities' desire to reestablish their visual identity is structurally anchored, but partially bridged by the recognition of genuine plurality in the Nara Document. 3,4 The introduction of advanced digital technology, such as Historic Building Information Modelling (HBIM) and Digital Twins, has changed reconstruction decisions from subjective evaluations to data-driven choices. 10,11 The findings indicate that the major heritage projects in Saudi Arabia represent an emerging regional model, informed by the King Salman Charter for Architecture and Urbanism (2026). 20 Main recommendations are the need for specialized national historic construction rules, the need for community involvement and adoption of sustainable productive heritage model.

Keywords: Heritage Reconstruction - Architectural Authenticity - HBIM - Saudi Urban Heritage - Vancouver Citation Style.

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(*) **Corresponding Author**:
Gamal A. Abdelhamed
Professor of Civil and Architectural Engineering Department, College of Engineering and Computer Science Jazan University, Saudi Arabia.
Hassan Abdelrahman Mohamed Elsayed
PhD in Fine Arts - Specialization in Antiquities Restoration, Faculty of Fine Arts, Minia University, Egypt.
Heba Ahmed Abdelaal Elsayed
Lecturer, Department of Arts, College of Arts and Humanities, Jazan University, Saudi Arabia.
Osama Elsir Ali Ahmed
Lecture, Civil and Architectural Engineering Department, College of Engineering and Computer Science Jazan University, Saudi Arabia.
Musa Mohammed Babiker Mohammed
Lecture, Civil and Architectural Engineering Department, College of Engineering and Computer Science Jazan University, Saudi Arabia.
E-mail: Ghamed@jazanu.edu.sa - drgamal_soh@yahoo.com - hassan_conservator@yahoo.com – hassan.conservator@gmail.com - habdelaall@jazanu.edu.sa – hhhrj2008@gmail.com - oeahmed@jazanu.edu.sa mmbabiker@jazanu.edu.sa

1. Introduction

Architectural heritage is a fundamental expression of human civilization - a repository of collective memory and a record of past modes of living, thought, and aesthetics. This heritage is today under unprecedented threat from natural disasters, armed conflict, and the pressures of urban expansion. Within the broader debate on intervention in heritage, the reconstruction of historic buildings is the most contested form of intervention. It raises fundamental questions about the possibility of recovering what has been lost, the nature of authenticity, and the boundary between genuine preservation and falsification. These questions have shaped international frameworks such as the Venice Charter (1964) and the Nara Document on Authenticity (1994), which represent the two principal poles of contemporary conservation practice. In the Saudi context, the diversity of urban heritage, together with Vision 2030 and the King Salman Charter for Architecture and Urbanism (2026), has driven a marked rise in heritage projects. Against this background, this study examines the strategies applied in the reconstruction of historic buildings and seeks to identify a balance between respecting the past and preparing for the future.

2. Research Problem

Historic buildings play a profound role in shaping the cultural identity of communities and reinforcing their sense of civilizational belonging. Their reconstruction after destruction or deterioration, however, creates a deep tension between two conflicting demands that are difficult to reconcile. On one hand, there is a growing social and national demand to restore the visual symbolism of demolished buildings. On the other hand, international charters for architectural conservation place strict limits on this direction. The Venice Charter (1964) states that restoration must cease where conjecture begins, and that reconstructing the missing parts of ancient buildings may compromise historical authenticity rather than preserve it. Under UNESCO guidelines and recommendations, any materials used in an intervention must be visually distinguishable from the original and must be reversible. This requirement effectively contradicts the notion of 'exact reconstruction' often sought by public will and political decision-making.

2.1 Core Research Question

How can a comprehensive strategy for the reconstruction of historic structures reconcile society's expectations for restoring visual symbolism and national identity with the conservation constraints imposed by international conservation charters? Sub-questions:

- What are the internationally recognized categories (levels) of architectural intervention, and what conceptual criteria distinguish each?
- How have contemporary digital technologies (HBIM, Digital Twins, etc.) helped to bridge the gap between authenticity demands and accurate reconstruction?
- How does the Saudi approach to heritage reconstruction under the King Salman Charter for Architecture and Urbanism differ from, or intersect with, established international practice?

3. Research Objectives

The main purposes of this study are:

- To examine the philosophical foundations and historical evolution of reconstruction concepts.
- To define the methodological controls governing the levels of architectural intervention in accordance with international norms.
- To assess the effectiveness of advanced digital technologies (HBIM, Digital Twins, laser scanning and AI) in balancing authenticity requirements and accurate reconstruction.
- To analyse the Saudi strategy for the reconstruction of national heritage assets under the King Salman Charter (2026).

4. Research Gap

The research gap addressed by this study lies in the absence of a systematic academic examination of historic-building reconstruction in the Arab-Saudi context. While the philosophical basis of authenticity has been examined in relation to international charters (Venice 1964, Nara 1994), and while individual Saudi projects (Diriyah, Historic Jeddah, AlUla) have been documented separately, no prior study has integrated these two strands. Specifically, the literature lacks an analysis that links the conceptual framework of authenticity to the applied Saudi experience under the King Salman Charter for Architecture and Urbanism (2026), and that evaluates the role of modern digital technologies in reconciling authenticity, sustainability, and community participation within a coherent regional model.

5. Research Significance

The significance of this research can be summed up in its contributions, both at the academic and applied levels, as follows:

- Clarifying the tension between the social need for reconstruction and the limits set by international charters, and offering a framework for navigating it.
- Comparing successive international charters to provide a theoretical basis for the concept of authenticity across diverse cultural contexts.
- Documenting and assessing the Saudi experience in the reconstruction of architectural heritage. - Demonstrating the contribution of

digital technologies - including HBIM, Digital Twins, and laser scanning - to the accuracy and objectivity of historic reconstruction projects.

- Enabling local communities to actively participate in the safeguarding of their heritage.

6. Methodology

This research adopted a descriptive-analytical comparative methodology. This design was selected because the research question requires both an interpretive reading of conceptual frameworks - the philosophy of authenticity in international charters - and a structured comparison of applied cases across different contexts. A descriptive-analytical comparative approach is well suited to this dual aim, as it allows theoretical principles to be tested against documented practice. The methodology was structured into three main phases:

1. **Phase I:** Theoretical Framework: Included a survey of specialist academic literature in the field of architectural heritage conservation and reconstruction, with reference to international charters on heritage work.
2. **Phase II:** Data Collection: The research involved the use of several secondary sources, such as academic peer-reviewed studies published between 2013 and 2025, official reports by international bodies including UNESCO and ICCROM, and institutional reports by bodies that oversee Saudi heritage initiatives.
3. **Phase III:** Case Study Selection Criteria: Three Saudi projects (Diriyah, Historic Jeddah, AlUla) were selected based on specific criteria: diversity in architectural intervention style, variation in environmental and historical context, availability of published scientific documentation, and the linkage of each to a different phase of heritage development in the Kingdom. Three international comparisons (Warsaw, Dresden, Mostar) were also used to shed light on reconstruction models with diverse cultural-symbolic motivations. The selected cases were then analysed using a comparative analytical matrix built around consistent authenticity indicators (material, formal, functional, and symbolic authenticity) and the recognised levels of architectural intervention. This matrix enabled a thematic comparison across all six cases, so that each experience could be assessed against the same conceptual criteria rather than described in isolation.

7. Historic Building Reconstruction: Conceptual Overview

The reconstruction of destroyed historic buildings is among the most complex challenges in contemporary architectural conservation. It is not limited to the retrieval of physical fabric, but also involves the recovery of collective memory and the fulfilment of environmental and technical sustainability standards. Intervention in the historic fabric therefore requires a methodology - at once philosophical and technological - centred on the equilibrium between "material authenticity" and "authenticity of meaning". This conceptual tension, which runs through both the Venice Charter (1964) and the Nara Document on Authenticity (1994), has developed over decades of international charters and field practice. Reconstruction thus becomes necessary chiefly where natural disasters, armed conflict, or rapid urban change have damaged a community's visual identity. [7]

8. Philosophical Frameworks and the Historical Evolution of Reconstruction Concepts

8.1 Introduction

The reconstruction of historic buildings reflects two centuries of intellectual debate over the nature of heritage, the meaning of authenticity, and the limits of architectural intervention in the past. This debate has developed through successive historical stages, each responding to and revising the assumptions of its predecessor, leading to the contemporary normative framework [5]

8.2 Origins: From Romantic Restoration to Scientific Critique (Nineteenth Century)

The earliest origins of systematic thought on architectural heritage are to be found in the 19th century, when a romantic revival swept across Europe, restoring prestige to medieval architecture, Gothic churches and historic castles as emblems of developing national identity. Two schools of thought arose that set up the argument that is still alive today.[6]

8.2.1 The school of stylistic restoration - Viollet-le-Duc

The French architect Eugène Viollet-le-Duc led what might be called the bold interventionist school, believing that reconstruction does not mean returning the building to a condition documented in a historical document but restoring it to 'a complete state that may never have existed at any moment of its existence.' On this approach he repaired and rebuilt dozens of French buildings – including the fortress of Carcassonne and Notre-Dame Cathedral, Paris – adding elements that did not previously exist but that he considered as compatible with the 'stylistic spirit' of the building.[5]

8.2.2 The Anti-Restoration School – John Ruskin

The opposing position was held by the British critic John Ruskin, who strongly objected to what he regarded as 'destruction masquerading as restoration'. In Ruskin's view, a historic building derived its value from the reality of its own time rather than from an imagined ideal state; ageing, erosion, and the marks left by time were not defects

to be concealed, but part of the building's authenticity and evidence of its history. He described restoration as a particularly damaging form of intervention, and established a line of thinking that continues to influence heritage practice today.

8.3 International Normative Building: From Athens to Venice (1931–1964)

8.3.1 The Athens Charter, 1931

The first systematic worldwide statement containing standards for the treatment of architectural heritage was the result of the worldwide Conference of Architects and Technicians for Historic Monuments, held in Athens in 1931.8 The Athens Charter set out a series of principles which would become the pillars of global heritage practice: the need to conserve on an ongoing basis rather than intervene intermittently; that modern techniques can be used to support historic structures as long as they are hidden; the emphasis on the value of the urban environment surrounding the building as part of the heritage system. The Athens Charter, despite its obvious limits today, was an important historical precedent in establishing the notion that architectural conservation is an international affair outside the borders of national sovereignty.[6,8]

8.3.2 The Venice Charter, 1964 – The Great Foundation

The Venice Charter of 1964 was a significant breakthrough in the history of international architectural conservation, setting out principles that still form the backbone of contemporary preservation practice six decades after its promulgation.[2] The Charter was based on the premise that historic structures convey cultural meaning from the past and serve as evidence of long-standing traditions, and that their preservation and restoration constitute a shared responsibility.[5] On the question of reconstruction in particular, the Charter laid down a firm barrier that should not be crossed, saying that "the process of restoration must stop where conjecture begins", and that any addition made to a historic building must carry the imprint of its own time to be distinguishable from the original, and must be removable so as to leave room for future generations to make their own choices. The Charter also confirmed the legitimacy of the Reassembly of original scattered elements provided original materials and sufficient documentation exist, but every new addition must be marked with a distinctive sign.[2]

8.4 The Crisis of European Centrism and the Plurality of Concepts of Authenticity (1970–1994)

As UNESCO membership grew and Asian, African, and Latin American countries joined the international heritage system, concerns were increasingly raised about the universality of the values anchored in the Venice Charter. The principal point of conflict was the Western concept of authenticity based on 'material authenticity', which in practice marginalised numerous non-European architectural traditions, excluding many from World Heritage Lists or placing them at a disadvantage. These concerns directly prepared the ground for the later Nara Document on Authenticity (1994), which sought to broaden the concept of authenticity beyond its material dimension.[4] Take traditional Japanese architecture, for example. It is based on the principle of rebuilding temples every twenty years using the same materials and techniques-as in the famous Ise Shrine, which has been rebuilt more than sixty times in thirteen centuries. This is not seen as a violation of its authenticity, but rather as an embodiment of "artisanal authenticity" based on the continuity of craft and knowledge rather than the continuity of material. In many African and Islamic civilizations, for example, the social and spiritual function of the building is more important than the literalness of its building elements.[9]

8.5 The Nara Document on Authenticity (1994) – A Conceptual Shift

This growing criticism was directly addressed by the Nara Conference, held in Japan in 1994, which produced a text now regarded as a reference no less significant than the Venice Charter itself. The Nara Document was founded on the principle that 'the assessment of authenticity cannot be based on fixed criteria, but must take into account the cultural context in which the heritage was produced'.[3,4] With this admission, the document opened wide doors to reconsider the idea of authenticity, and to extend the range of its sources to:

- Authenticity of form and design: the visual and aesthetic extension of the building in accordance with its original design logic.
- Authenticity of material and substance: the basis of the Venice Charter and the foundation of the Western concept. - Authenticity of usage and function: the continued execution of a building's social or spiritual mission.
- Authenticity of traditions and techniques: Continuity of craft skills in inherited building processes.
- Authenticity of setting and surroundings: the relationship of the building to its geographical and natural setting.
- Authenticity of spirit and feeling – the intangible dimension, which received limited recognition in earlier material-based approaches, but which carries considerable weight in many non-Western contexts.

The development of the concept of authenticity has been an impetus to the legitimization of reconstruction models previously considered contrary to international conservation principles, and thus the possibility of

recognizing, for example, the reconstruction of the Old City of Warsaw in faithful replication of the original as an exceptional legitimate model rather than a departure from sound methodology.

8.6 Maturity Phase: Digital Documentation and Sustainable Heritage (2000-Present)

At the turn of the third millennium, architectural conservation entered a new era in which three key shifts overlapped, redefining the rules of involvement with heritage:

1. The Digital Revolution and Precision Documentation Technologies: Technologies of laser scanning, drone aerial photography, and Historic Building Information Modelling (HBIM) afforded documentation at a degree of precision inconceivable at the time the Venice Charter was formulated.10 It became possible to digitally capture every millimeter of a historic building and then model several scenarios of renovation and assess their impact before actual execution. Artificial intelligence has introduced a new level to these capabilities by identifying patterns of structural deterioration and suggesting most appropriate materials for restoration based on big datasets.[11]
2. The Heritage Crisis in Times of Armed Conflict The heritage question had an exceptional urgency, in the events at the turn of the millennium, from the destruction of the Mostar Bridge in Bosnia in 1993, to the blowing up of the Bamiyan Buddhas in Afghanistan in 2001, to the enormous destruction that struck archaeological sites in Syria and Iraq. In all these circumstances, the argument increased over the right to rebuild and controls over it, putting practical pressure on the international normative system of providing more flexible and unambiguous responses than existing documents allow.
3. Environmental Sustainability as a New Heritage Dimension: The growing concern for climate change and energy efficiency has given rise to a new philosophical dimension that was not taken into account by the framers of twentieth-century charters. Another reason to reconstruct heritage is the environmental sustainability argument. Research has demonstrated that the process of restoring and modernizing a historic building consumes far less energy than demolishing it and rebuilding it from scratch, thus making heritage conservation an environmentally responsible choice before it is a cultural one.[17,18]

8.7 The Contemporary Philosophical Framework: Between Two Poles

The philosophical framework in which contemporary reconstruction strategies operate may be described as a continual tension between two intellectual tendencies that do not negate one another. These are best understood as broad orientations rather than rigid, mutually exclusive schools: The First Pole – the Philosophy of 'Material Authenticity': embodied in the Western school of Ruskin and formalised in the Venice Charter, this view holds that the value of heritage lies in its literal materials and the marks left on them by time, and that reconstruction tends to produce a reinvention of the past rather than its recovery.[2] The Second Pole – the Philosophy of 'Authenticity of Meaning': represented by non-Western cultures and recognised in the Nara Document, this view holds that authenticity lies in the continuity of a building's social, spiritual, and symbolic function, and that the community which produced the heritage has a primary role in determining how it is treated.[12] The strategies discussed in this research represent practical attempts to reconcile these two tendencies - drawing on current digital technology and respecting the cultural particularity of each context - rather than privileging either pole.

9. Levels of Architectural Intervention in Historic Buildings

Architectural interventions are commonly classified, in the specialist conservation literature and international charters, into seven principal levels - from preventive maintenance to complete reconstruction - according to a building's structural condition and historical significance. These levels and their methodological controls[13] are summarized in Table 1.

Table 1. International Levels of Architectural Intervention and Their Methodological Controls

Level of Intervention	Technical Description	Strategic Objective	Methodological Controls
Prevention	Routine maintenance	Extend building life without change	Minimum physical intervention
Preservation	Stabilize the current condition	Maintain the original state	No additions or modifications
Consolidation	Strengthen the structural system	Ensure structural safety	Use chemically compatible materials
Restoration	Recover a known prior condition	Reveal aesthetic and historical values	Rely on precise historical documents
Rehabilitation	Adapt building for new use	Ensure functional continuity	Preserve architectural character
Reproduction	Copy missing parts from an original	Compensate decorative elements	Visual distinction between old and new
Reconstruction	Completely rebuild a destroyed structure	Restore identity symbolism	Must be an exceptional case only

A closer analysis of these levels indicates that 'reconstruction' remains the most far-reaching form of intervention, generally justified only where the loss of a building has created a substantial and otherwise irreparable gap in the collective identity or national memory of a society - as was the case in Warsaw and Dresden after the Second World War.[12]

10. Collective memories and visual symbols in processes of reconstruction

Historic buildings serve not only a functional purpose but also act as repositories of collective memory, anchoring communal identity in space and time. Architecture provides a central material reference point for this process. In situations of armed conflict, the deliberate destruction of symbolic buildings is frequently intended as a form of cultural erasure aimed at the loss of a people's shared past.

10.1 Sociology of the Reclamation of Demolished Buildings Identity

The societal impulse to bring back the visual symbolism of the demolished structures is rooted in the drive to reclaim the national identity, where the reconstructed building acts as 'memory itself' for the generations that did not witness this historical period, as demonstrated in Table 2.[1]

Table 2. Comparative Analysis of Symbolic Reconstruction Cases

Case Study	Symbolic Motivation	Methodology Adopted	Societal Impact
Old City of Warsaw	Challenging Nazi cultural annihilation	Faithful reconstruction based on Canaletto paintings	UNESCO inscription as exceptional model of national will
Church of Our Lady - Dresden	Symbol of German unity and reconciliation	Original remaining stones (anastylosis) with new stone	Transformed into world shrine embodying peace and memory
Old Mostar Bridge	Restore connection between ethnic components	Traditional Ottoman techniques, stone from same original quarry	Symbol of reconciliation despite ongoing political tensions

Figure 1 show Warsaw before and after reconstruction and Faithful Reconstruction Figure 2 show The church in Dresden and its reconstruction, with the use of original and new stones Figure 3 show The Old Bridge Mostar and the use of stone from the same

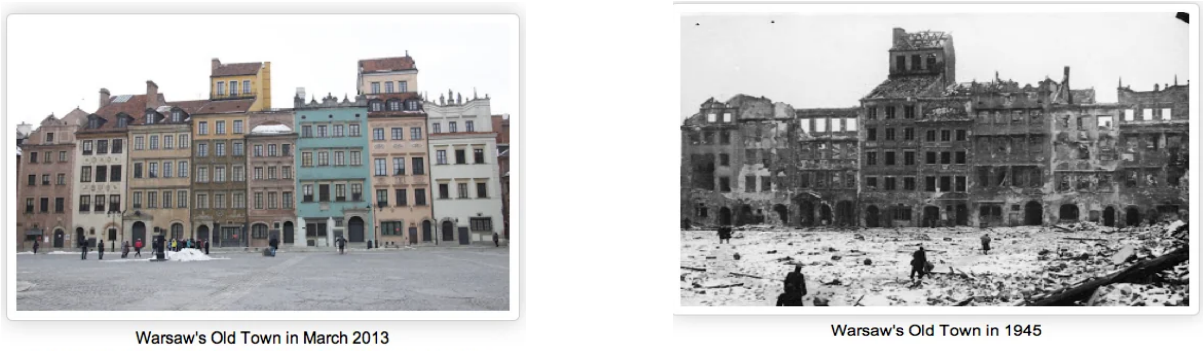


Figure 1: Old Warsaw before and after reconstruction. Source[37]



Figure 2: The Frauenkirche church in Dresden, Germany before and after reconstruction. Source[38]

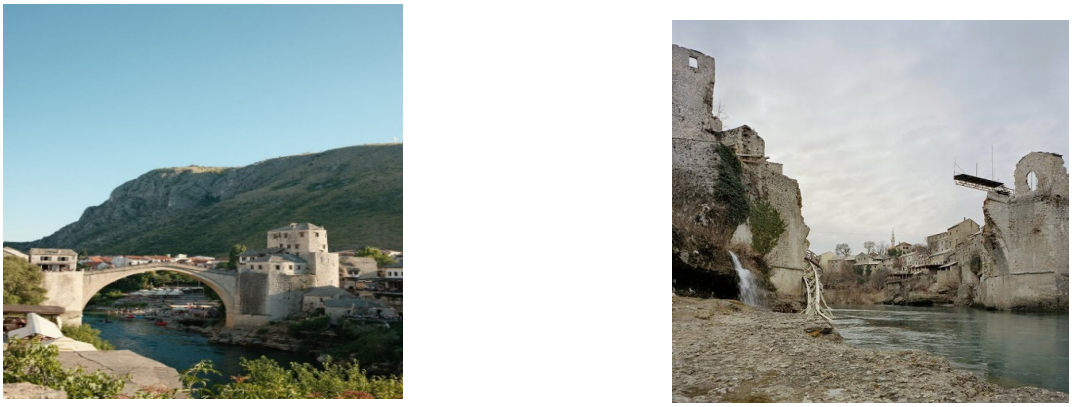


Figure 3 Old Bridge Mostar before and after reconstruction Source

The psychological process of the recovery of identity via architecture needs participation of the society at large so that the process of rehabilitation does not degenerate into commercial 'heritagisation' aimed at tourists exclusively, but remains connected to its living social roots.[14]

11. Balancing Authenticity and Contemporary Sustainability Standards

Sustainability in the architectural heritage presents a double challenge: conservation of ancient buildings is, in principle, a sustainable act, since it maintains 'embodied energy' and avoids demolition and construction waste. At the same time these structures often have poor energy efficiency by current standards and require precise technical interventions.

11.1 Resource Efficiency and Renewable Energy

Studies have demonstrated that it can take between 10 and 30 years for a new structure constructed to high green standards to compensate for the energy used in their original erection, relative to a historic building that has been repaired and modernised.[15] Therefore, the rehabilitation strategy should seek to harness the climate solutions inherent in traditional design including:

- High thermal mass: thick walls of clay or stone that naturally regulate heat exchange.
- Passive ventilation: Natural cooling without using power, through wind catchers and courtyards.
- Local sustainable materials: the use of local clay and timber decreases the carbon impact from travel and assures biological compatibility with the environment. Modern research confirms these old tactics as suitable responses to today's environmental challenges.[16]

11.2 Integrating Sustainability Systems in Historic Buildings

Contemporary methods can be included into the reconstruction or restoration of old structures to enhance their energy efficiency without losing architectural authenticity. Some of these strategies[17] are shown in Table 3.

Table 3. Strategies for Integrating Modern Sustainability in Historic Buildings

Modern Technology	Application in Heritage	Technical Challenge	Authenticity Standard
Internal thermal insulation	Adding insulating layers of natural materials (e.g. cork)	Preventing moisture accumulation inside walls (vapor barriers)	Preserving the original exterior appearance
Photovoltaic cells (solar)	Integrating in non-visible surfaces or as building materials (BIPV)	Visual interference with historic fabric	Reversibility
Smart control systems	Motion sensing and lighting to reduce consumption	Routing cables without destroying historic elements	Minimum intervention principle

To find a balance between authenticity and sustainability, a 'conscious recovery' process is required, in which the outward form is not only simulated, but the environmental logic on which the original structure was designed is comprehended and improved using modern instruments.[18]

12. Advanced Digital Technologies: HBIM, Digital Twins, and Artificial Intelligence

The digital revolution has substantially changed the ways in which heritage assets are documented and reconstructed. Conventional paper-based documentation has been largely superseded by Historic Building Information Modelling (HBIM) - a digital modelling approach that integrates engineering, historical, and material data within a single parametric model.

12.1 HBIM for Accurate Re-construction

The HBIM technology allows the construction of parametric 3D models capable of accurately represent the structural deformations, the deterioration patterns and the historical changes happening in a structure. Digital workflow comprises:[10] • Laser Scanning – captures millions of points to form a 'point cloud' of the building showing measures to the millimeter. • Photogrammetry: Using high-resolution photos to wrap the digital models with realistic texture and hues. • Digital Twin – Develop a live model that interfaces with IOT sensors to monitor the stability of the building and its reaction to environmental conditions in real time. These instruments help to take data informed judgments and so minimize the risks of wrong intervention.[11]

12.2 The Added Value of Technology in Heritage Management

For example, in the Tousson Palace project in Egypt, the application of BIM and Digital Twins led to: reduction of carbon emissions by 2.8 tons per year per building; the provision of visitor behavioral simulation models to improve the management of the tourist site; and the development of technical employment opportunities in the survey and modelling fields for local populations. Furthermore, Artificial Intelligence (AI) is turning into a tool for the prediction of degradation patterns of structures and suggesting the most suitable materials for restoration based on a huge database of historic and modern materials.[19] These technologies are not without limitations, however. HBIM and Digital Twin workflows require significant initial investment, specialised expertise, and sustained data management, and the accuracy of any model remains dependent on the quality of the underlying survey and archival evidence. In contexts of incomplete documentation, digital tools can support but cannot fully resolve the uncertainties inherent in reconstruction decisions.

13. Cultural Tourism and Heritage: Prospects for Vision 2030

Vision 2030 aims to increase the contribution of tourism to GDP to 10% by 2030, supporting economic diversification beyond oil dependency. Heritage sites occupy a central place in this strategy as a significant national asset that can generate renewed economic value when managed appropriately. A central challenge for decision-makers and specialists alike is to maintain a balance between the economic use of heritage and the preservation of its authenticity. The over-commercialisation of historic sites can lead to what the heritage literature terms 'heritagisation' - a process in which a living cultural inheritance is gradually reframed as a tourist commodity, with a corresponding loss of social meaning and depth. Conversely, conservation that disregards the needs of use and investment can result in functional rigidity, which may in turn lead to neglect and the slow deterioration of these assets.

14. King Salman Charter for Architecture and Urbanism:

A National Vision for Authenticity and Innovation In the Saudi context, the King Salman Charter for Architecture and Urbanism provides a national framework intended to define an architectural identity grounded in authenticity. The Charter sets out six core values, presented in Table 4, which serve as a reference guide for reconstruction and development processes at Saudi historic sites. While the Charter articulates these values within a national vision, it can also be read in relation to established international conservation principles: its emphasis on authenticity and continuity is broadly consistent with the Venice Charter and the Nara Document, although its explicit linkage of heritage to contemporary social needs and national identity gives it a distinct orientation. Examining this relationship critically - rather than treating the Charter solely in descriptive terms - helps locate the Saudi approach within the wider discourse on heritage conservation.[20]

Table 4. The Six Values of the King Salman Charter and Their Heritage Applications

Value	Concept in Reconstruction Context	Practical Application
Authenticity	Core of creativity and design logic connected to place	Avoid superficial imitation; focus on design spirit
Continuity	Community growth while respecting the past and celebrating identity	Link traditional architecture to contemporary social needs
Human-centricity	Making the individual and community the centre of the design process	Create social spaces that reinforce bonds between residents and heritage

Value	Concept in Reconstruction Context	Practical Application
Liveability	Improving quality of life and creating a safe, attractive environment	Transform heritage zones into living centres for residence, work, and leisure
Innovation	Exploring new horizons and non-traditional solutions	Use advanced digital technologies to enhance conservation
Sustainability	Protecting environmental, social, and economic objectives	Use local materials and enhance energy efficiency

These values manifest in major projects such as Diriyah and Historic Jeddah, where the goal is not limited to restoring buildings, but extends to building a sustainable urban environment that reflects national pride and supports Vision 2030.

15. Saudi Arabia Heritage Reconstruction Case Studies

Saudi Arabia has embraced heritage rehabilitation practices that strive for a balance of authenticity, symbolism and sustainability.

15.1 Diriyah: 'City of Earth' and Al-Turaif Quarter

The Al-Turaif Quarter – included on the UNESCO World Heritage List - is a difficulty in conserving mudbrick ruins. The Diriyah Gate Development Authority (DGDA) devised a strategy that integrated:

- Rigorous history documentation: recreate missing elements with precision using archival pictures and surveys.
- Traditional materials improved: reuse of clay and straw with natural additions to increase durability and tensile strength.
- National symbolism: reconstruction of Diriyah as a cultural capital to reinforce the feeling of Saudi identity.
- Al-Bujairi Terrace: a model of urban growth that reflects the topography of Najd (small lanes, cubic masses) and provides a luxury and sustainable tourism experience.

The Diriyah project is an innovative model for identity-based reconstruction based on scientific evidence and national symbolism.[21,14] Figure 4 shows The Al-Turaif area, one of the historic Diriyah communities before and after reconstruction.

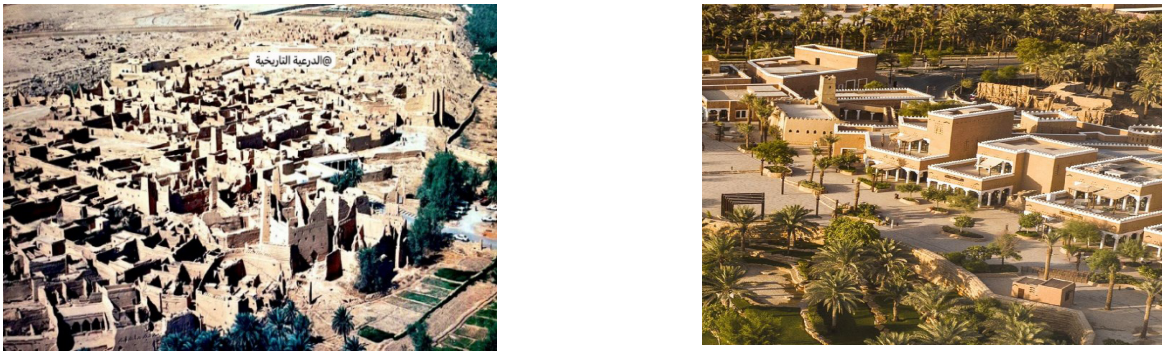


Figure 4: Al-Turaif neighborhood in historic Diriyah before and after reconstruction

15.2 Al-Balad (Historic Jeddah) Adaptive Reuse as a Model of Living Conservation

15.2.1 Heritage and Historical Significance

Historic Jeddah, or 'Al-Balad', is one of the oldest cities in Hijaz, and one of the most architecturally diverse cities in Hijaz. The city developed as the gateway to the Two Holy Mosques and as a foremost station on maritime trade routes between the Arabian Peninsula, Africa and South Asia for over fourteen uninterrupted centuries, which created a unique urban fabric that reflects the depth of cultural exchange and civilizational diversity the city witnessed through the ages.[22] In 2014, UNESCO listed Historic Jeddah as a World Heritage Site for its exceptional value expressed in three integrated aspects: first, the cohesive urban fabric based on a branching network of lanes, markets and tall residential buildings; second, the unique Hijazi architectural style with its distinctive decorative elements - especially the carved wooden balconies and coral stone extracted from the Red Sea As shown in Figure 5, third, continuity of the city's social and commercial activity, making it living heritage rather than mere museum ruins.[23].



Figure 5: The authentic Hijazi architectural style in historic Jeddah - wooden Roshan-window and coral stones

15.2.2 Challenges to Heritage

1. Environmental and Structural Challenges The buildings of Al-Balad are subject to a double threat of humid coastal circumstances and the particularity of traditional construction materials. The coral stones, the raw material for most of these buildings, are excellent insulators against heat but are greatly affected by the salinity and high humidity that prevails throughout the year in the Red Sea climate, which accelerates the fragmentation of these stones and the collapse of historic walls.[23] To this is added the potential of excessive amounts of ground water that cause ongoing corrosion in the building foundations, an engineering challenge that defies conventional traditional remedies. Figure 6. Effect of the restoration method to a Historical-building.



Figure 6: Historical-building-restoration-before and after

2. Social and Demographic Challenges: Over the past decades, historic Jeddah has witnessed an accelerating wave of population exodus, as many original residents abandoned their traditional homes in search of modern housing more comfortable and suitable for contemporary life, leaving behind towering buildings and ancient lanes slowly collapsing in the absence of those to preserve and care for them .[22] This residential vacuum created a painful reality in which some historic homes became abandoned warehouses or temporary housing that lacked the minimum standards of conservation.
3. Legal and Development Challenges: Al-Balad is situated in the midst of one of the most vibrant and expanding Saudi cities, and therefore constantly faces the pressures of real estate development and urban expansion. In earlier phases, the lack of specific heritage building codes resulted in the defacement of sections of the historic fabric with inappropriate additions, and traditional owners could not balance the high costs of restoration with the low economic return of their heritage buildings.[24]

15.2.3 Adaptive Re-Use Strategy

In the face of these multi-branching challenges, the Historic Jeddah Programme has chosen a core methodology based on the concept of "Adaptive Reuse" – an approach that refuses the two extreme options: museum mummification which freezes the building in a particular historical moment and deprives it of vitality, and radical renewal which keeps the external shell and empties the heritage core. This strategy rather seeks a fine balance between the preservation of historical architectural values and the providing of a new use to the building, which pumps current vitality into it, insuring its life and assuring ongoing maintenance resources.[22]

This technique is reflected in a number of interconnected axes:

1. Functional Conversion with Architectural Conservation: Historic Jeddah has seen pioneering efforts in turning traditional residential structures into boutique hotels, heritage cafés, cultural and arts centres, and specialized local museums. All these experiments are founded on the same constant principle: that functional conversion should not impact on the original structural system or the distinctive decorative elements; rather, it uses these elements as an added value that sets the new establishment apart and increases its commercial and tourist attraction.[22]
2. Facing Structural Challenges, Technical Intervention: Engineers working on Al-Balad projects have devised novel engineering solutions to confront the specific challenges of this site. To address the problem of eroded coral stones, specialized injection techniques were developed to consolidate the structure of the stone without changing its appearance or texture, and reversible moisture-proofing materials were also tested to meet the 'reversibility' principle required by the Venice Charter.[23] The groundwater problem was caused by installing underground drainage systems that took water away from the historic foundations, thereby avoiding the necessity for excavations that could harm the historical fabric.
3. Reviving Traditional Crafts as a Pillar of Sustainability the Al-Balad strategy quickly learned that protecting a heritage structure is not complete without keeping the craft that generated it. Carved wooden balconies are a traditional talent, requiring years of training and expertise, and sculpting coral stones demands a careful grasp of the qualities of this fragile material. As a result, specific craft training programmes were initiated for young generations from local communities, offering them sustainable economic opportunities tied to continuing restoration initiatives.[25]
4. Socio-economic Sustainability: An essential pillar in the Al-Balad strategy is the re-settling of original residents and their involvement in the economic activity of the cultural zone. These include providing financial benefits and concessional loans to the owners of heritage buildings in return for their commitment to approved standards of restoration; creating economic platforms that allow craftsmen and local producers to benefit from the growing tourist movement; and the periodic hosting of cultural events that reconnect residents to their architectural heritage.[26]

15.2.4 Results and lessons learned

The tangible results of the Historic Jeddah experience are the following: increased tourist occupancy rates in the historical zone; proof of the viability of the "productive heritage" model, which relies on creating economic income from the historic building itself, instead of depending solely on government funding for maintenance[22]; the creation of a model that can be duplicated in comparable heritage zones that combine high historical value with complex environmental and social challenges[23]; and the discovery of the limits of approaches that focus on tourist attraction at the expense of social continuity.

15.2.5 Historic Jeddah and King Salman Charter

The values of the King Salman Charter for Architecture and Urbanism (2026)[20] are evident in the Historic Jeddah experience: it manifests the value of 'Continuity' by connecting traditional architecture with current social needs; the value of 'Human-centricity' by putting the resident and visitor alike in the center of the development process; and the value of 'Livability' by making the historic zone a living urban environment that integrates residence, work and leisure in a single urban fabric.

15.3 The 'Light Touch' Methodology in alUla

15.3.1 Documentation and Planning First Survey Phase

The restoration of the Old AlUla town (Al-Deira) was initiated with the stage of detailed and accurate documentation, which served as the foundation for all subsequent intervention decisions. In 2019, the Royal Commission for AlUla commissioned HCC Heritage Conservation Consulting[28] to undertake a comprehensive conservation program. This program began with a comprehensive 3D laser survey of the entire site, to identify priority areas for study, and to identify the factors contributing to deterioration and to implement preventive conservation measures to address these issues. This investigation resulted in an extraordinary digital database that documents all the houses, lanes and walls of the urban fabric covering an area of around 67,286 square meters, consisting of more than 900 residential and urban units crossed by a network of lanes over 3,135 meters long.

15.3.2 The Multidisciplinary Approach

HCC's proposed plan was characterized by the innovative methodology of bringing together all professionals and stakeholders at the same time on the same site to test methodologies and define precise protocols for each phase of intervention. Conservators, heritage architects, engineers, archeologists, materials specialists and social scientists worked simultaneously.[28] The MUDUD project partnership with the French Agency for Alula Development (AFALULA) brought a comparative academic dimension with the use of a multidisciplinary methodology combining architectural

archaeology and materials and mortar analysis to date buildings and understand traditional construction patterns through the ages.

15.3.3 Principles of Intervention: Light Touch and Real Materials

Work that is focused on the notion of Light Touch Interventions that highlight the vast cultural heritage and natural landscape, repair natural ecosystem systems and safeguard heritage and nature within a 'living museum'.[28,29] At the technical level, architects promised to use tamarisk trunk and palm trunk as structural supports, to restore palm-woven roofs and to make mudbrick by the same ancient techniques to rebuild walls. As indicated in Figure 7, while attempting to make use of natural airflow as much as possible in order to lessen the dependence on electricity using air conditioning.[27.]



Figure 7: Al-Ula Old Town - The condition of the mud-brick buildings (A) before the restoration project & (B) after the restoration

15.3.4 Use of the Living Memory of Residents

The most unusual characteristic of the AlUla technique, compared to other historical initiatives, is the use of human memory as the major source of technical information. When researcher Noura Ghobra came in AlUla, she spoke with the elders who have memories of how these buildings were cared for and preserved. Their testimonies told more about the real building methods. They highlighted that not only were the people using local resources in the construction but they were also maintaining and restoring their houses every year using the clay that was gathered from their surrounding farms.[27] This living memory revealed interesting architectural features such as 'al-Tayyara' the lofty air passage between two houses that contains an amazing temperature management mechanism that shades the lanes and directs the air movement for natural ventilation.[27]

15.3.5 Geological and environmental hazards

The range of the technical intervention was not just restricted to the walls and roofing, but also to the geological context of the site. To reduce the risk of landslides, engineering measures were taken, such as the construction of retaining walls with an inclination on the eastern edge of the old town, whose work began in 2023 and are constantly monitored, in order to reduce the slope angles and avoid possible collapses that could endanger the neighboring heritage buildings, all under constant archaeological supervision.

15.3.6 International Partnership and Attainment Standards

The repair was carried out pursuant to the principles of UNESCO and international standards for the protection, restoration and reconstruction of heritage sites.[30] These efforts lead to an excellent international partnership. The Royal Commission for AlUla and the Archaeological Park of Pompeii continue their joint collaboration in the preservation of the Old Town, within the framework of the cooperation agreement signed in January 2025, with the aim of advancing protection research and developing techniques of conservation that support long-term sustainability.[31]

16. Legal and Administrative Challenges and the Community Participation Principle.

Reconstruction does not occur in a legal vacuum, and UNESCO requirements for conservation often conflict with local building laws about fire safety and accessibilities.[24]

16.1 Reconciling Conflicting Codes

Architects often adopt 'performance-based engineering' solutions - an approach in which compliance is demonstrated by meeting defined safety performance objectives (for example, a required level of fire safety or structural stability) rather than by applying prescriptive code provisions designed for modern concrete buildings. Examples include the use of water mist systems in place of standard sprinklers to reduce water damage to historic fabric, and ramps and

lifts that are concealed or integrated into the architecture to provide accessibility for people with disabilities. Such solutions require close collaboration between conservation specialists and local regulatory bodies to create context-sensitive compliance approaches.[32]

16.2 The Centrality of Community Participation in Heritage Sustainability

Effective heritage conservation tends to occur where residents act as active custodians of their heritage rather than as passive observers of externally managed projects.[33] Comparative research on community engagement in historic Cairo and Jeddah reports that active community involvement can increase residents' sense of ownership by more than 70%, with associated reductions in vandalism and improved maintenance of buildings after project completion.[25] Models of participation include: * Co-design workshops: Residents are involved in identifying new roles for restored buildings. • Craft training: establishing economic pathways for local craftsmen (carpenters, clay builders, etc.) that assure sustainability of crafts associated to the building; Community involvement is not just an ethical obligation but also a practical assurance for the long-term viability and sustainability of any historic repair project.[26]

17. Results:

- Structural tension between international charters and actual reality, based on basic philosophical disputes about what authenticity means and who determines it.
- The Nara Document (1994) marked a significant conceptual shift, recognising that authenticity of craft and socio-spiritual significance are valid heritage values alongside material authenticity. This broadening of the concept of authenticity is what makes a structured reconciliation between charters and community expectations possible.
- The seven levels of intervention represent strategic decisions based on historical and symbolic significance, the degree of damage, and the available evidence. Complete reconstruction remains exceptional and is generally justified only where the loss of a building constitutes a substantial and otherwise irreversible breach in community identity.
- Digital documentation tools (HBIM, laser scanning, Digital Twins) help convert conjecture into verifiable evidence. Within the limits of available documentation, technical precision can strengthen the evidentiary basis for reconstruction decisions rather than constrain them.
- AI and Digital Twins can be used to predict structural degradation, propose compatible materials and simulate interventions in real-time before they are implemented.
- Heritage conservation is an environmentally friendly act, saving embodied energy and minimizing demolition trash.
- Three international models demonstrate that symbolic reconstruction is feasible if social purpose is unambiguous: Warsaw (united popular will), Dresden (original stones making anastylosis possible), Mostar (technical authenticity compensating for political difference).
- Complementary methods of three Saudi models:

1. Diriyah: Reconstruction rooted on identity with rigorous documentation and traditional materials.
2. Historic Jeddah: Adaptive reuse between authenticity and economic and social renewal.
3. AlUla: light touch approach, landscape, clay architecture and living memory.

- King Salman Charter (2026): a significant development at the national level, introducing a comprehensive value system (authenticity, continuity, human-centricity, liveability, innovation, sustainability) that seeks to balance commitment to heritage with contemporary requirements.

18. Summary Finding.

The reconstruction of historic buildings is not a purely technical decision determined by material properties and structural codes. It is a multidimensional process that requires the convergence of scientific method, social will, and long-term vision. As the case studies in this research indicate, an effective strategy is one that draws on the available tools - digital documentation technologies, international conservation frameworks, and comparative case experience - to determine when material authenticity should take precedence, when authenticity of meaning should, and when the two can be integrated. The aim is an approach that respects the past without freezing it, and engages with the future without losing continuity with its origins.

19. Recommendations.

Based on the results of study and comparative analysis of international and local experience, the research proposes an integrated system of recommendations at four levels:

19.1 Policy and Legislation:

- Develop and issue a national code for heritage buildings, based on the King Salman Charter (2026), translating its six values into binding technical requirements that respect regional architectural diversity (Najdi, Hijazi, Asiri, Gulf).
- Develop a national classification system for heritage buildings, based on objective criteria:

historical/symbolic significance, architectural authenticity, social importance and available evidence.

- Connecting international charters to the Arab environment: Participation in global heritage conferences and the integration of references to Arab-Islamic values in future normative frameworks.

19.2 Documentation & Technology:

- Demand HBIM and Digital Twins for big national heritage reconstruction projects and create a centralized national digital repository for scholars and future generations
- Support preemptive and wide-ranging surveying of heritage buildings before threats emerge, including a nationwide campaign targeting less-documented places, such as historic villages and small cities.

19.3 Project Management and Professional Practice:

- Use a multidisciplinary approach including heritage architects, structural engineers, archaeologists, materials experts, social scientists and local craftspeople.
- Investment was put into upgrading traditional materials, which were preferred to imported new materials and were compatible with original materials.
- Apply the idea of reversibility to all modern modifications or interventions. - Regular methodological reports documenting and sharing knowledge across Saudi and Arab heritage projects.

19.4 Economy and Community:

- Require community participation in the feasibility studies for each heritage project, ensuring that the original inhabitants have a real say in the decision making process.
- Adopt the 'productive heritage' approach through adaptive reuse options that achieve a balance between authenticity and sustained economic rewards.
- Balance tourism needs with local community needs and ensure heritage projects benefit original residents first.

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