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Sustainable Architectural Restoration of Heritage Villages in Jordan

Restauración arquitectónica sostenible de pueblos patrimoniales en Jordania

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Abstract

Traditional heritage architecture represents identity and cultural heritage. Given the importance of sustainability in preserving heritage architecture, this article, through theoretical and field studies, focuses on how heritage houses in two villages in southern Jordan (Al Taybeh and Al Nawafleh) were restored and rehabilitated. The goal is to preserve the identity and authenticity of these two villages by analyzing the architectural elements that characterize their heritage houses, as well as the restoration methods applied to them. This is achieved by studying sustainable restoration methods to highlight the positive aspects of these approaches, which can be recommended as good practices guidelines for future restoration efforts in other heritage villages in Jordan. The research methodology includes fieldwork, site observations, and interviews to evaluate the restoration process. Site selection was based on historical significance, level of degradation, and ongoing projects. The study assesses the advantages and challenges of the restoration techniques used, comparing them with international standards such as ICOMOS charters to highlight the need to balance the best global practices with local socioeconomic and environmental considerations. Findings emphasize the necessity of sustainable restoration techniques preserving architectural and cultural integrity of heritage villages. Rehabilitating these villages as cultural and tourist destinations can enhance local tourism, economic development, and community engagement. Their successful transformation demonstrates how heritage preservation supports cultural continuity and reinforces local identity. Finally, the study highlights the importance of government oversight, education, and community engagement in sustaining Jordan's architectural heritage. Establishing a structured maintenance program and promoting awareness will protect heritage villages, ensuring the preservation of their historical and cultural significance for future generations.

Keywords:
heritage village; restoration; good practices guidelines; sustainable architecture

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Resumen

La arquitectura tradicional patrimonial representa la identidad y el legado cultural. Dada la importancia de la sostenibilidad en la preservación de esta arquitectura, el presente artículo, a través de estudios teóricos y de campo, se centra en cómo se han restaurado y rehabilitado casas patrimoniales en dos pueblos del sur de Jordania (Al Taybeh y Al Nawafleh). El objetivo es conservar la identidad y autenticidad de estos pueblos analizando los elementos arquitectónicos que caracterizan sus casas patrimoniales, así como los métodos de restauración aplicados. Esto se logra estudiando métodos de restauración sostenibles con el fin de destacar los aspectos positivos de estos enfoques, proponiéndolas como directrices recomendables para futuros esfuerzos en otros pueblos patrimoniales de Jordania. La metodología de investigación incluye trabajo de campo, observaciones in situ y entrevistas, para evaluar el proceso de restauración. La selección de los sitios se basó en su relevancia histórica, el grado de deterioro y los proyectos en curso. El estudio evalúa las ventajas y desafíos de las técnicas de restauración utilizadas, comparándolas con normas internacionales como las cartas del Consejo Internacional de Monumentos y Sitios (ICOMOS), con el fin de subrayar la necesidad de equilibrar las mejores prácticas globales con las consideraciones locales, tanto socioeconómicas como medioambientales. Los hallazgos destacan la necesidad de aplicar técnicas de restauración sostenibles que preserven la integridad arquitectónica y cultural de los pueblos patrimoniales. La rehabilitación de estos pueblos como destinos culturales y turísticos puede fomentar el turismo local, el desarrollo económico y la implicación comunitaria. Su exitosa transformación demuestra cómo la conservación del patrimonio impulsa la continuidad cultural y refuerza la identidad local. Finalmente, el estudio pone de relieve la importancia de la supervisión gubernamental, la educación y la participación de la comunidad en el sostenimiento del patrimonio arquitectónico de Jordania. El establecimiento de un programa estructurado de mantenimiento y la promoción de la conciencia social contribuirán a la protección de estos pueblos patrimoniales, garantizando la preservación de su valor histórico y cultural para las generaciones futuras.

Palabras clave:
pueblo patrimonial; restauración; directrices de buenas prácticas; arquitectura sostenible

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1. Introduction

Jordan, an Arab country in Western Asia, occupies 89,213 km² and is located on the eastern bank of the Jordan River (Al-Khawaldeh & Akbalik, 2018). The country's geography is characterized by diverse landscapes, including the eastern deserts, western highlands, and the Jordan Valley in the south (Al-Thaher, 2005). The architectural heritage of Jordanian villages reflects the evolution of the country's-built environment in contemporary history and serves as a key component of Jordanian identity (Sokienah, 2020). Several villages were abandoned after the mid-20th century, particularly between 1970 and 1975, as residents migrated to larger cities and built new concrete houses with the increasing use of cement in construction. Restoration efforts in the villages began in the 1990s, around 1990. While some villages remained isolated and deserted, others were rehabilitated and repurposed, restoring their historical significance and highlighting their archaeological and heritage value. As a result, these villages have become attractive tourist destinations both locally and internationally (GIZ Jordan, 2019; Mustafa & Abu Tayeh, 2011). Al Taybeh and Al Nawafleh, two villages located in the Petra region of Wadi Musa, serve as notable examples.

Wadi Musa, one of the major valleys in southern Jordan, is characterized by its rugged terrain and narrow canyons formed by water erosion (Al-Thaher, 2005). This area showcases Jordan's geographical diversity, blending mountainous landscapes with a rich historical heritage, making it a prominent tourist attraction. With Petra's designation as a UNESCO World Heritage Site in 1985 and its recognition as one of the New Seven Wonders of the World in 2007, the ancient city has experienced a significant increase in tourism. In response, the Petra Development and Tourism Regional Authority (DPTRA) was established as an independent agency to oversee the region's development, particularly in sustainable tourism, as well as the preservation of tangible and intangible cultural heritage (Mustafa & Abu Tayeh, 2011; Al-Rawida, 2015). Considering these factors, the relevant authorities transformed the area's heritage villages into attractive tourist destinations, including Al Nawafleh Village (now known as the Old Village Resort) and Al Taybeh (now known as Taybet Zaman Resort).

While some studies have examined the economic and touristic aspects of a few heritage villages in Jordan, S-Twaisi et al. (2016) documented the architectural elements of several villages in southern Jordan, adjacent to Al Nawafleh and Al-Tayyiebeh, including their building technology, materials, and roofing systems. Moreover, Al-Rawida (2015) studied the tourism potential of Al Taybeh and its role in achieving the sustainable development of the surrounding community. Waked (2007) reported on the restoration and rehabilitation processes carried out at the heritage Al-Bahaniyya School in northern Jordan (Jordan Valley). Na'amneh et al. (2013) identified the social, economic, climatic, and environmental factors that influenced the development of traditional buildings in northern Jordan during the nineteenth and twentieth centuries.

Although previous studies have provided historical documentation of various villages, and some have focused on the restoration of heritage buildings in specific areas of northern Jordan, the current study aims to examine the historical development and architectural characteristics of Al Taybeh and Al Nawafleh. Additionally, it assesses the restoration initiatives implemented in these villages and highlights the sustainable practices adopted in both locations. This study seeks to enhance understanding of the significance of these heritage sites and emphasize the importance of their preservation.

This study explores how the villages of Al Nawafleh and Al Taybeh have been rehabilitated, how their buildings have been repurposed, and how to achieve a balance between protection and preservation while utilizing this heritage to benefit society. It explores the detailed architectural elements of these villages and provides an overview of the strengths and weaknesses of their restoration efforts by applying sustainable and practical methods, making this study serve as a reference for future rehabilitation models.

Moreover, given the lack of studies supporting the ideal rehabilitation of Jordan's heritage villages while preserving their importance and authenticity especially that linking the importance of restoration with sustainability, the importance of this study lies in:

- Assisting in shaping policies for the sustainability of Jordanian heritage villages. The study recommends guidelines for restoring and preserving these villages, ensuring their significance and value are maintained. These guidelines are particularly relevant for southern Jordanian villages that share similar terrain and materials with Al Taybeh and Al Nawafleh.

- Increasing governmental and social awareness of international restoration standards recognized by the International Council on Monuments and Sites (ICOMOS, 2023). These standards must be implemented during the restoration of Jordan's heritage villages to prevent violations.

2. Methodology

The methodology employed in this study builds on previous approaches to studying heritage sites in various regions (Imam et al., 2023; Wang et al., 2019). It involves assessing the current condition of the houses in the two villages through field visits, interviews, data documentation, and the analysis and evaluation of architectural and heritage elements, as outlined below:

- Field visits: During the field study of the two villages, a descriptive analysis was conducted through direct observation of the village's architectural elements.
- Interviews: Face-to-face interviews were conducted with residents whose ancestors inhabited the villages to document architectural and historical data. The interviews were structured into two groups. The first group consisted of 10 elders aged between 60 and 75 years. They were asked questions such as: When did they inhabit the village? Did they contribute to the village's construction, and if so, how? What construction materials were used? The second group included 20 men aged 40 to 59 years who participated in the villages' restoration efforts.

  Their interviews provided insights into the materials and methods used during the restoration process. These interviews aimed to capture the transformation and development of the villages. All interviews were audio-recorded and later transcribed into written material for research purposes.
- Literature review: Using several open sources, including Google Scholar, Scopus, Web of Science, and other scientific databases, a literature survey was conducted to examine the major findings related to the two villages.
- Data documentation: Visual materials (pictures) were used to document the heritage architectural elements in the study areas, including main entrances, windows, arches, walls, and ceilings of the houses.
- Data analysis of architectural and heritage elements: The architectural elements were analyzed by categorizing them into tables, with each element studied separately and compared to its counterpart in the two locations. The comparison included location, construction methods, building materials, and restoration work to highlight similarities between the areas. Additionally, the analysis examined the proportion of old heritage architectural elements in relation to new ones, explaining the reconstruction interventions for each element and their sustainability.
- Evaluation and recommendations: The assessment of architectural elements identified the strengths and weaknesses of restoration efforts and evaluated the sustainability achieved through restoration or rehabilitation.

3. Case Studies

This research focuses on two heritage villages, Al Taybeh and Al Nawafleh, located in the Wadi Musa region. They are situated in Petra, Ma'an Governorate, in the south of Jordan and are currently acting as tourist resorts.

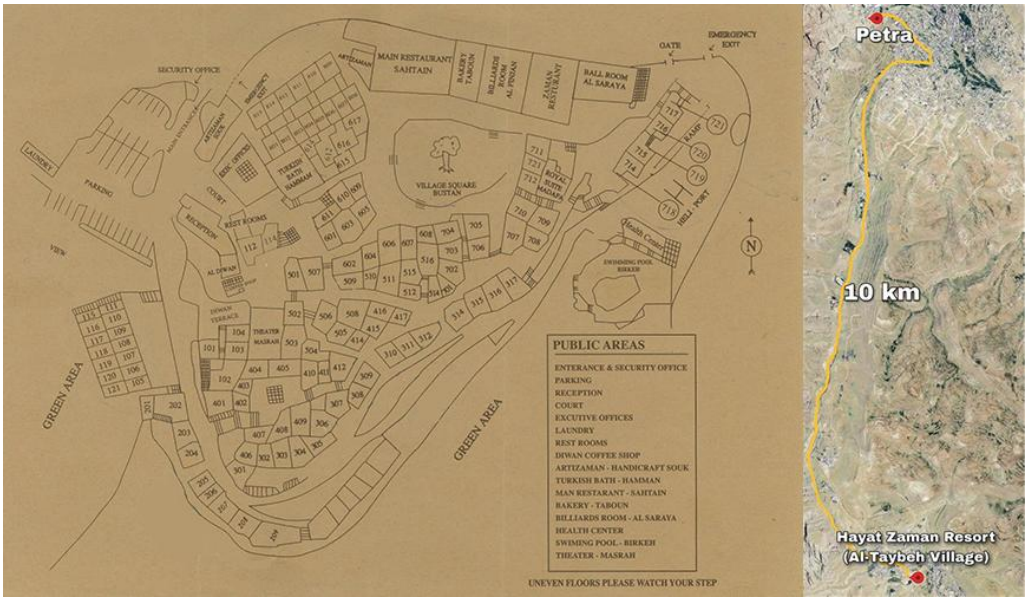
3.1. Al Taybeh village (Taybet Zaman Resort)

Al Taybeh village, currently known as Hayat Zaman, is in the centre of the Petra region, about 10 km from the ancient city of Petra along the King's Highway, leading to Wadi Musa in the north and Rajif in the south, as presented in Figure 1.

The village was abandoned until the construction of Hayat Zaman, a five-star resort, in the 1990s. Since then, the area has become a destination for developing tourist facilities (ATC Consultants, 2011).

The village covers an area of 4,500 m², including 125 houses, with size ranging from 40 to 100 m². Most houses are larger structure with total areas between 90 and 100 m². Additionally, six houses are located outside the tourist village and remain unrestored, as their owners refused their rehabilitation.

Figure 1. Al Taybeh Village



Sources: Obtained from Taybet Zaman Resort owner; satellite imagery from Google Earth (n.d.), modified by authors.

3.2. Al Nawafleh village (Old Village Resort)

Al Nawafleh village is located in Wadi Musa region, about 230km south of Amman and 6km away from Petra. It is within Khirbet Al Nawafleh, which covers an area of 50,000 m² as presented in Figure 2. The village is 7.3km away from Al Taybeh village (Al-Salameen and Falahat, 2009).

Figure 2. Al Nawafleh Village

Source: Plan obtained from Old Village Resort owner; satellite imagery from Google Earth (n.d.), modified by authors.

The village covers an area of 40,000 m², with approximately 34,000 m² built up area including 137 old houses, with size ranging from 40 to 70 m². Three houses remain unrestored. According to ATC Consultants (2011), twenty-eight houses were built in the village in 2019 using modern materials while maintaining the traditional style, due to the boom in Petra's tourism industry in recent years, bringing the total number of houses to 165.

4. Historical and Cultural significance of the two case study villages

4.1. Al Taybeh village

Al Taybeh village has great historical and heritage significance. According to its residents through their ancestors, the village was built in 1830 over the ruins of an old village dating back to the Nabataean era. The village is unique for its architectural style, which features a traditional

design prevalent in mountain villages of Jordan. The construction methods were suitable for the harsh weather conditions in both summer and winter, adding cultural significance to the village. Tracing the history of the village, the residents initially built it to protect their livestock during winter and later settled there. In the 1990s, the residents considered demolishing the village to create a cemetery. However, the mayor succeeded in convincing them to rent the houses to investors from Jordan Resorts Company, as 95% of the houses were still habitable and only needed restoration. As a result, the village was successfully restored and rehabilitated, becoming a tourist attraction for both domestic and foreign visitors. It has become an attractive cultural resource for those interested in history and heritage (ATC Consultants, 2011).

4.2.Al Nawafleh village

Al Nawafleh village is a traditional settlement dating back to the early 20th century. It shows the architectural style and simple village life that the region's inhabitants have lived for over a century. The village was built on barren land, once filled with scattered stones. In 1870, the Al Nawafleh tribe settled on the site and built a village in 1934 (Amr et al., 2000). They moved into it after living in tents.

The historical value of the village is reflected in the ancient remains dating back to the first century BC, used during the Nabataean (169 BC/106 AD), Roman (106 AD/324 AD), Byzantine (324 AD/627 AD), and Islamic periods (627 AD/12 AD) (Nawais, 2011). The village also contains an olive press factory dating back to the Ayyubid period (1188–1263) and the Mamluk period (1263–1516), which was built on the ruins of a Nabataean olive press factory, adding to its historic value (Amr et al., 2020). Moreover, the village contains pottery pipes built by the Nabataeans to transport water from the Ain Musa source to the collecting pond inside the village, which was later transferred to the city of Petra. The canals were built by the Nabataeans during the Roman period to transfer water from Al Nawafleh village to Petra (Nawais, 2011).

5. Field Visit and General Overview

Reviewing the case studies documentation and conducting field observation, it was found that most houses in the two case studies have a rectangular shape. However, the houses in both villages feature architectural elements that reflect the style of the period in which they were built. These elements were recorded separately for future reference. Furthermore, restoration interventions were carefully examined to determine the extent to which each element was restored and whether sustainability principles were considered.

6. Architectural Elements

6.1. The main entrances and the doors of the houses

The main entrances in both case studies were made of wooden doors from Juniper trees, which are dominant in the Petra area (Abu-Darwish et al., 2014). While some old entrance doors in the houses of Al Taybeh still exist, most of them have been replaced with new doors made of Swedish wood (Table 1).

Table 1. The Characteristics of old and new doors in the villages of Al Taybeh and Al Nawafleh

Old doors (original)						
Village	**Construction Material**	**Installation Method**	**Renovation Work**	**Location**	**Number**	**Notes**
Al Taybeh	Juniper wood	(Jurn wa Laqet)	No reconstructive treatment was done	External Door	17	-
Al Nawafleh	No old interior doors remained in the building at Al Nawafleh Village					
New doors						
Village	**Construction Material**	**Installation Method**	**Location**	**Number**	**Notes**	
Al Taybeh	Swedish wood	Joints	Exterior and interior doors	108	There are modern doors in front of the old doors as the old doors are so corroded and can't function	
Al Nawafleh	Swedish wood	Joints	Exterior and interior doors	137	-	

Note: *Jurn wa Laqet: an old method used to install doors. It consists of two holes: one at the top of the door and the other in the ground, both aligned at the same level. The door moves using a wooden axis placed between the two holes. Source: Own elaboration.

Interestingly, only 13.6% of entrance doors in Al Taybeh are original, whereas all entrance doors in Al Nawafleh have been replaced with new ones. As for the internal doors in both villages, some of them have been replaced with modern doors made of Swedish wood. Figure 3 presents site photos of the village doors, taken by the author.

Figure 3. old and new doors in the villages of Al Taybeh and Al Nawafleh

3a The old exterior yard door at Al Taybeh village

3b The new door at Al Taybeh village

3c The new door in Al Nawafleh village

Source: Own elaboration.

6.2. Windows

Windows in both villages were designed to provide sunlight access and ventilation. They can be structured as internal openings between rooms or external windows that offer views of the surrounding areas. The size of these windows varies from small to large openings at the house wall level (Table 2).

Table 2. The specifications and sustainable characteristics of the original old windows in the houses of Al Taybeh and Al Nawafleh villages

Village	Construction Method	Hole Dimensions and their quantities (Qty.)	Location	Renovation work	Sustainability
Al Taybeh	Holes in the wall	20*30 Qty: 1 15*15 Qty: 2 40*40 Qty: 142	Some windows are internal, located between rooms, while others are external	One partition is covered with Swedish wood and glass, while another section is covered with juniper wood and nets	Utilizing local materials and natural resources while avoiding environmentally harmful materials
Al Nawafleh	Holes in the wall are clad at the top with juniper wood moldings	100*120 Qty: 12	External windows	It was painted with insulating materials, and the gaps between the moldings were filled with a mortar mixture of clay and straw	Utilizing local materials and natural resources while avoiding environmentally harmful materials

Source: Own elaboration.

Several windows have been renovated using aluminum and glass, while their old upper supporting frames have been preserved and covered at the top with juniper wood moldings (Figure 4).

The ratio of old to new windows in Al Taybeh village is approximately 60%, whereas in Al Nawafleh village, it is only 9%. Thus, the percentage of modern windows is 91% (Figure 4c).

The new windows were constructed in two ways: the first involved creating large openings within the old walls by demolishing part of them to form windows, while the second involved building new walls that included openings. In both cases, the new openings were framed with Swedish wood.

Figure 4. The original old windows in the houses of Al Taybeh and Al Nawafleh villages

4a The original windows in the houses of Al Taybeh village

4b The original windows in the houses of Al Nawafleh village

4c The new windows in the houses of Al Nawafleh village

Source: Own elaboration.

6.3. Arches

Arches are an important feature in the architecture of Arab heritage villages. They help bear the weight of roofs, reduce pressure on walls, and shape the interior design of houses (Abu Ghazala, 2021). Most houses in the studied villages have arches that divide the indoor space into two sections: a sleeping area and a living room (Figures 5a and 5b). These living rooms were also used for cooking food over an open fire, as evidenced by the charcoal residues found on some parts of the arches. However, when the two villages expanded and modern houses were built, arches were incorporated into these new houses to match the spirit of the heritage villages.

The number of arches in houses varies across the two studied villages. For instance, the village of Al Taybeh has houses with up to three arches, while the village of Al Nawafleh has houses with up to two arches. The field study findings indicate that 62% of houses in Al Taybeh village have arches, while in Al Nawafleh village, this percentage is only around 9%.

In both villages, the arches helped divide the spaces of the houses according to their functions, while keeping the total space of each house open to allow the maximum amount of sunlight to enter, thereby reducing the energy used for lighting and heating. These findings agree with Sokienah (2020), who reported that the design of interior spaces and the distribution of functions in traditional Jordanian houses had a positive sustainable effect in reducing energy consumption. The characteristics of the arches in the studied villages, including the restoration procedures applied to sustain them, are listed in Table 3.

Table 3. The characteristics of the restored vernacular architectural arches in the villages of Al Taybeh and Al Nawafleh

Village	N° of Houses containing arches	Arches per house	N° of arches in houses	Height and width	Building material	Restoration	Sustainability
Al Taybeh	78	1,2, or 3 arches	150	Height range: (330-350) cm Width range: (350-450) cm	Local stone	Repaint the stone with a mortar mixture of cement and sand in a suitable color, but its texture is more solid compared to the stone	The presence of arches creates large open spaces in the house and allows sunlight to reach all parts, reducing the need for energy for lighting and heating
Al Nawafleh	9	1 or 2 arches	10	Height range: (330-350) cm Width range: (350-450) cm	Local stone	Repaint the stone with a mortar mixture of cement and sand in a suitable color, but its texture is more solid compared to the stone	The presence of arches creates large open spaces in the house and allows sunlight to reach all parts, reducing the need for energy for lighting and heating

Source: Own elaboration.

Figure 5. Arches in the houses of Al Taybeh and Al Nawafleh villages

5a Arches in the houses of Al Taybeh village

5b Arches in the houses of Al Nawafleh village

Source: Own elaboration.

6.4. Building walls

It is evident that the native inhabitants of these villages constructed their homes based on practical experience accumulated over time. The oldest house in Al Taybeh village (house number 308, Fig. 6) features irregularities in its architecture, including the walls, the arch with an irregular shape, and the main door, which has varying dimensions (100 cm at the bottom and 80 cm at the top). In contrast, the houses built later exhibit more precise dimensions for their architectural elements compared to the oldest ones.

Figure 6. The oldest house in Al Taybeh village (House number 308)

Source: Own elaboration.

Regarding the construction method, the walls of the houses were built in a style like those used in traditional Jordanian architecture found in other old villages of the southern and northern regions of the country (Twaissi et al., 2016). The walls of both villages were constructed using two rows of irregular and semi-rectangular local stones, which varied in size from small to large. The space between these rows was filled with mud and small crushed stones.

This method increased the thickness of the walls to approximately 70-80 cm in the houses of both villages. This thickness helped the houses adapt to the surrounding climate, maintaining a comfortable internal temperature during both summer and winter.

These findings align with a study by Alrashed et al. (2017), which found that vernacular architecture techniques traditionally used in hot regions of the Arab world played a crucial role in regulating house temperatures. Additionally, Sharhan et al. (2017) reported that traditional Arab architecture is influenced by various factors, including culture, climate, and terrain. They also noted that Arab vernacular houses are constructed using natural materials and designed to suit the regional climate, with indoor temperatures remaining relatively constant throughout the day in both summer and winter, providing comfort for inhabitants of Arab regions.

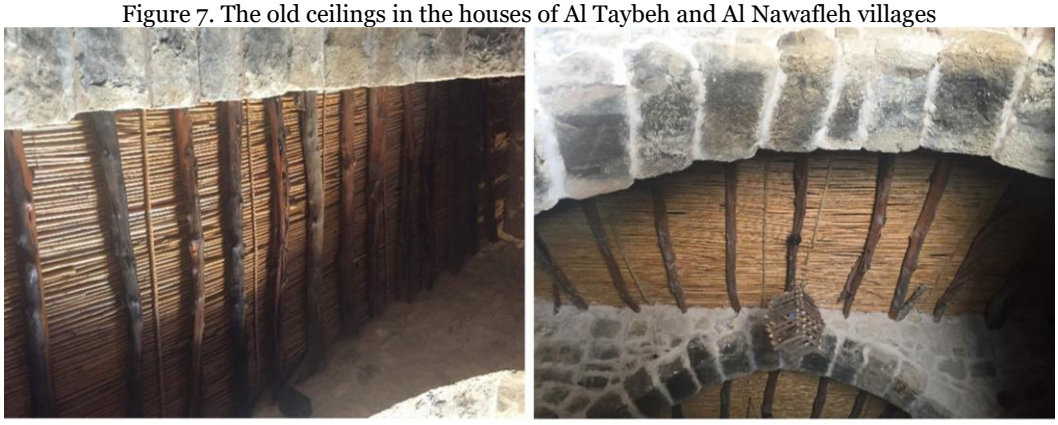
6.5. Ceilings

During the study, interviews conducted with the inhabitants to gather historical information about the two villages revealed that both villages had been deserted for around forty years before restoration and rehabilitation began. Due to the long period of desertion, most of the ceilings in the houses were destroyed. However, the remaining ceilings that were not restored revealed that the houses in both villages had flat ceilings, with no evidence of domes or vaults in their ceiling style.

As with other Jordanian heritage villages, the houses in these villages were constructed using materials from the surrounding natural environment (Tarrad and Abdel-Aziz, 2018). The main structural materials for the ceilings were Juniper trunks, which were used as supporting and bridging rows. Each row was spaced 50-60 cm apart, and was covered with reed sticks and small Juniper branches. After this basic ceiling structure was in place, a thick layer of mud mixed with straw (15-25 cm) was added to cover it. This layer was compressed using a cylindrical stone repeatedly, resulting in a final ceiling thickness of approximately 40 cm. The cylindrical stone is still preserved in Al Nawafleh village as an architectural heritage tool.

In Al Taybeh village, the roofs of 25 houses were rehabilitated using traditional methods, while 100 other houses had their ceilings restored with reinforced concrete, which was later plastered and painted. In contrast, in Al Nawafleh village, only five houses had their ceilings restored using traditional methods. To preserve the traditional forms of the ceilings in the remaining 133 houses, a new method was employed. The rehabilitated ceilings were roofed with concrete as the upper surface, which was then covered by a mixture of mud and straw. The internal side of the roofs was covered with Juniper trunks (Figures 7a and 7b). Furthermore, due to the lack of long horizontal wooden struts, the ceilings were internally covered with short Juniper horizontal struts fixed with iron beams, whose direction was opposite to that of the flat wooden struts (Figures 7a and 7b).

Figure 7. The old ceilings in the houses of Al Taybeh and Al Nawafleh villages



7a The old ceilings in the houses of Al Taybeh village

7b The old ceilings in the houses of Al Nawafleh village

Source: Own elaboration.

During the field study, it was observed that six houses in Al Taybeh village and four houses in Al Nawafleh village, located outside the resorts, had not been restored or rehabilitated. According to the villagers interviewed, the owners of these houses refused to restore or rehabilitate them. This lack of awareness among residents regarding the preservation of their architectural heritage is a matter of concern. More efforts should be made to implement strategies that can address this issue. This aligns with the work of Al-Orainat (2022), who emphasized the importance of involving local inhabitants in conserving their heritage. Additionally, it is crucial to have governmental policies and strategies that include local inhabitants in initiating projects and initiatives to safeguard cultural and architectural heritage.

A large proportion of the interior walls in the houses of both villages remained without plastering, while approximately 20% of the walls were covered with local plaster made of black cement and sand and then painted white. According to those who worked on restoring the two villages, the walls were painted to vary the shapes and break the monotony of the repeating stone walls.

With the advent of cement at the beginning of the twentieth century, the owners of affordable houses randomly and irregularly covered some external walls with cement. During restoration, this covering was preserved.

As for the pointing of the walls, the traditional joints were removed from all the walls of the houses in both villages and replaced with cement joints (Figures 8a, 8b, and 8c). See Table 4.

Figure 8. Cladding and painting of the walls in the villages of Al Taybeh and Al Nawafleh

8a Cladding and painting of the interior walls in Al Taybeh village

8b Cladding and painting of the exterior walls in Al Taybeh village

8c Cladding and painting of the walls in Al Nawafleh village

Source: Own elaboration.

Table 4. The details of the cladding and painting of the walls in the villages of Al Taybeh and Al Nawafleh

Village	Cladding materials	The proportion of the plastered walls	Walls' painting	Percentage of painted walls	Restoration	Sustainability
Al Taybeh	Some external walls were randomly covered with cement, while the internal walls were partly jointed and partly painted with plaster and white paint	External walls 5% interior walls 90%	With a cement joint (cement, sand, and water)	External walls 95% Interior walls 10%	Removing the traditional joint and replacing it with a cement layer	Painting the walls white creates a cool feeling in the summer
Al Nawafleh	Plaster some walls and then paint them white	Interior walls 80%	-	External walls 100% Interior walls 20%	-	-

Source: Own elaboration.

7. Evaluation and feedback

This research aims to shed light on the restoration and rehabilitation of heritage houses in two southern villages of Jordan, with a focus on sustainable design. The study analyzes the architectural features of the houses in these villages and presents the methods used for their restoration and rehabilitation. Specifically, the research focuses on the following topics:

- The use of sustainable design as the foundation for restoration and rehabilitation methods.
- The advantages and disadvantages of the restoration and rehabilitation methods used in the studied villages.

7.1. The restoration and rehabilitation based on sustainable design

- The preservation of historical buildings is crucial for the sustainable development of ancient cities, as pointed out by Salameh et al. (2022). One simple way to achieve sustainability is by reusing existing buildings, which was done in the two case studies. Additionally, sustainability has been achieved in the villages of Al Taybeh and Al Nawafleh using locally sourced, natural building materials. This is important because building materials significantly impact the sustainability of architecture and design. Extracting and transporting building materials to the construction site requires considerable energy, which can be minimized by reusing local resources. Traditional houses in the villages of southern Jordan were restored using natural stone, juniper wood, and other local materials, except for the reinforced concrete used in the ceilings of some houses. This approach promotes the use of natural resources and avoids environmentally harmful materials, which is a key aspect of sustainability.

- The involvement of the local community is a key factor in achieving the sustainable development of reconstruction. This was evident in the studied villages through the active participation of residents in the restoration and reconstruction efforts. Interviews with locals from both villages that public contributions to the construction of these villages were made by their ancestors during the villages' establishment, as well as by the recent participation of current residents in the reconstruction process. The locals made significant efforts to preserve their architectural heritage.

  These interviews provided a clearer understanding of the local community's contributions to the construction of the two villages, the construction methods and materials used, and their role in the restoration and rehabilitation efforts. This ongoing interaction between the local community and the ecosystem supports the concept of sustainability, emphasizing the importance of preserving the environment for future generations.

- The design approach used in heritage houses and how it is preserved during restoration is crucial for sustainability. This is because the interior design and distribution of functions can significantly reduce energy consumption in buildings. This was demonstrated in a study by Salameh et al. (2022), which examined heritage houses in two villages. The study found that these houses were characterized by arches, with at least one arch defining a large area. The presence of these arches allowed sunlight to reach all parts of the house, reducing the need for artificial lighting and heating.

- The walls of houses in Al Taybeh and Al Nawafleh were notable for their thickness, ranging from 70 to 80 cm, which provided excellent insulation against both cold winter temperatures and hot summer days. During renovation, the use of white paint on plastered walls further enhanced the cool feeling in the summer.

- To achieve the sustainable utilization of wastewater, plant purification units were established in both villages. While the water purification plant failed in Al Taybeh village, it was successful in Al Nawafleh village, where the purified water was reused to irrigate the village gardens.

- To harness solar energy, solar devices were installed on rooftops in Al Nawafleh village to heat water and reduce electricity consumption.

7.2. The advantages of the methods used in restoration and rehabilitation

Based on the investigation of the methods used for restoration in the two villages, the advantages and positive aspects of the restoration in the villages studied are as follows:

- The methodology used to restore the houses in the studied villages successfully preserved their urban layout. This approach aligns with Article 1 of the 1964 Venice Charter for the restoration and conservation of historic sites and monuments. The article emphasizes that the concept of a historical monument includes not only the architectural work itself but also the surrounding urban or rural fabric, which provides evidence of a particular civilization, vital development, or historical event (ICOMOS, 2023).

- Although the heritage villages have been expanded by constructing new houses or adding more rooms, the original natural structural materials and construction

techniques have been maintained to preserve the traditional heritage and spirit of the villages. This approach is consistent with Article 1 of the Venice Charter.

- The heritage houses of the studied villages had their ceilings demolished due to weather and neglect resulting from the abandonment of the residents. However, they were reconstructed in the same traditional manner while keeping the conventional cladding to avoid affecting their classic external shape. This reconstruction method is compatible with the one used by the Aleppo City Council, in cooperation with the German Agency for Technical Cooperation (GTZ), to restore the ceiling of Al-Shaibani Church in the Old City of Aleppo (Al-Sayed, 2014). This approach is consistent with Article 2 of the Venice Charter: 'The conservation and restoration of monuments must have recourse to all the sciences and techniques which can contribute to the study and safeguarding of the architectural heritage' (ICOMOS, 2023).

- The two studied villages were reused in a way compatible with their original purpose as clustered human settlements and continue to serve their surrounding community without altering the spirit and identity of the heritage village. This is confirmed in Article 5 of the International Charter for the Restoration and Conservation of Historic Sites and Monuments: 'The conservation of monuments is always facilitated by making use of them for some socially useful purpose' (Al-Mahari, 2017).

7.3. The disadvantages of the methods used in restoration and rehabilitation

Based on the field study observations, it was found that certain negative procedures were implemented during the restoration and rehabilitation process. These procedures should be avoided in future restoration projects in other heritage villages of Jordan. The negative aspects that need to be avoided include:

a) Using the procedure of cladding stone walls with plaster and then painting over them to break the monotony of repeating stone goes against Article 9 of the Venice Charter. This article emphasizes the importance of specialized restoration processes that aim to preserve and reveal the aesthetic and historical value of antiquities while conserving the original materials and structures. Figures 9a and 9b show onsite photographs taken by the author, highlighting the disadvantages observed in Al Taybeh and Al Nawafleh villages.

Figure 9. Disadvantage A: Cladding stone walls with plaster and then painting over them in Al Taybeh and Al Nawafleh villages

9a Al Taybeh village **9b** Al Nawafleh village

Source: Own elaboration.

b) Some ceilings (roofs) of the houses in Al Taybeh and Al Nawafleh villages were restored using short juniper horizontal struts instead of the long wooden struts that were unavailable. These juniper struts were fixed with iron beams and placed in the opposite direction to that of the flat wooden struts (Figure 10 and Figure 11). However, this method of restoration has certain disadvantages. It does not respect the

original material of the roof and distorts the aesthetics due to the placement of the iron beams. Additionally, this method contradicts the principles for the preservation of historic timber structures adopted by ICOMOS in 1965 (Aslan et al., 2023). According to Article 9 of these principles, when repairing a historic structure, replacement timber may be used, but only with due respect to the relevant historical and aesthetic values. It also states that when replacing decayed or damaged members, or restoring them, new members or parts should be made from the same species of wood with the same or, if possible, better grading than the original members. The replacement timber should also have similar natural characteristics, and other physical characteristics should be compatible with the existing structure.

Figure 10. The disadvantage in the ceiling restoration of some houses in Al Taybeh village

Source: Own elaboration.

Figure 11. The disadvantage in the ceiling restoration of some houses in Al Nawafleh village

Source: Own elaboration.

c) One of the downsides of the method used to restore the houses in the two villages was the replacement of the traditional joint in all the walls with solid cement mortar (Kohal), which violated Article 9 of the International Charter for the Conservation and Restoration of Monuments and Sites (Venice Charter), which states that: 'The process of restoration is a highly specialized operation. Its aim is to preserve and reveal the aesthetic and historic value of the monument and is based on respect for original materials and authentic documents' (ICOMOS, 2023). This process could harm the integrity of the stones, as they are weaker than cement mortar. If the houses are exposed to external factors such as earthquakes, the stones could be affected and damaged (Figure 12 and Figure 13).

d) In the two studied villages, some houses had electrical extensions that were not concealed within the stones of the building's façade. These extensions were installed in a haphazard and distorted manner. Such practices violate Article 9 of the International Charter for the Restoration and Maintenance of Historical Sites and Monuments (Figure 13).

Figure 12. Disadvantage C: The replacement of the traditional joint with solid cement mortar in Al Taybeh village

Source: Own elaboration.

Figure 13. Disadvantages C and D: The replacement of the traditional joint with solid cement mortar and the haphazard, distorted installation of electricity extensions in Al Nawafleh village

Source: Own elaboration.

e) The use of new doors and windows made of Swedish wood does not align with sustainable practices.

f) In the village of Al-Tayyiebeh, some homeowners covered the external walls of their houses with cement in a random and irregular manner, which led to deformations in the facades. During the restoration process, this added cement was preserved, despite its haphazard application. This approach contradicts Article 9, which emphasizes the importance of preserving the aesthetic and historical value of the monument (Al-Mahari, 2017) (Figure 14).

Figure 14. Disadvantage E: Retaining the previous deformations of the walls in the village of Al Taybeh after restoration

Source: Own elaboration.

8. Conclusion

The villages of Al Nawafleh and Al Taybeh serve as good examples of effective strategies for restoring and revitalizing neglected heritage sites in southern Jordan through implanting good sustainable practices. These revitalized villages provide valuable insights for similar initiatives across the country, highlighting key measures to preserve local identity. They underscore the importance of sustainability in protecting architectural heritage while maintaining the unique character of the area.

Moreover, the local communities' efforts to revive these two heritage villages offer a valuable model for other communities in Jordan. Incorporating these experiences into school and university curricula could enhance education at all levels and increase young people's awareness of human history and civilization.

The restoration of Al Nawafleh and Al Taybeh, guided by international restoration charters approved by the International Council on Monuments and Sites, raises awareness among the Jordanian government and neighboring communities about the importance of adhering to these guidelines. It also highlights the need for government authorities to monitor the restoration process, ensuring compliance with these standards. This approach helps prevent potential violations and preserves the architectural and cultural values of Jordan's heritage villages during their restoration.

However, to safeguard Jordanian heritage villages from neglect and destruction, it is essential to stablish a permanent restoration and maintenance program aligned with international restoration principles, and the integration of modern restoration technologies, alongside traditional materials, achieves cost-effective and durable conservation outcomes. This initiative will help preserve traditional architecture and ensure that these culturally and historically significant sites are maintained for future generations.

Additionally, the rehabilitation of Al Nawafleh and Al Taybeh as tourist resorts enhances local tourism and increases the region's visibility on the Petra tourism map. This initiative creates employment opportunities for community members and can serve as a model for transforming other heritage villages into tourist destinations.

The rehabilitation efforts in these villages align with their original functions and preserve their cultural and historical significance. Consequently, they can serve as both tourist attractions and cultural landmarks, fostering a sense of belonging among local generations.

To promote the cultural significance of Jordan's heritage villages, particularly Al Nawafleh and Al Taybeh, the country's cultural and tourism authorities can initiate various engaging cultural and artistic activities. These events would not only showcase the rich architectural and historical heritage of these villages but also foster a deeper appreciation for their unique cultural values within the community.

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10. Authorship

Salma Egho is the main corresponding author of the article and the originator of its topic and concept. She conducted the literature review and field study, documented the findings through photographs, figures, and tables, analyzed the architectural elements of village houses, and wrote the manuscript, including the discussion, results, conclusion, and references. Hanan Ahmad is the co-author, who contributed by reviewing, editing the draft, and preparing the final version of the manuscript.

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