Heritage Conservation and Tourism Development in Vernacular Settlements: The Case of Dana Village in Jordan

A thesis submitted for the degree of Doctor of Philosophy

By

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2022

Abstract

The recent development of tourism in Jordan is considered a catalyst for the regeneration of the country's vernacular settlements. Long abandoned, many of these settlements are in poor condition, and their reinvention as tourist venues has recently been considered a way of saving their architectural heritage (Haddad and Fakhoury, 2016). One of the best examples of this phenomenon is Dana village, undergoing dramatic and rapid changes. The rehabilitation project launched by the Royal Society for the Conservation of Nature (RSCN) provided new tourist accommodations within the settlement. The existing dwellings were repaired and transformed while the demolished buildings were rebuilt. The impact of this transformation on the settlement's heritage has not yet been assessed. This lack of information is not only typical of Dana. There is a general lack of information about assessing the transformation of vernacular settlements into tourist accommodation. This thesis aims to fill this lacuna. Investigating Dana's transformation, the thesis aims to develop a methodology for assessing the regeneration of abandoned vernacular settlements. This methodology uses Dana as a case study, and starts from a comparative investigation of the original and rebuilt dwellings to understand the architectural, urban, and thermal impact of the adopted restoration approaches. Currently, the original and rebuilt buildings stand side by side, offering a unique opportunity to compare their physical conditions and thermal performance. Combining architectural and urban assessment with thermal assessment is not common in the bibliography, but it is deemed essential to provide an integrated framework for assessing development projects in vernacular settlements, especially in the era of climate change.

Field surveys, thermal monitoring, and post occupancy evaluation (POE) interviews were used to collect data, and this is the first attempt to combine these methods in the field of heritage conservation, offering an interdisciplinary study. The study has demonstrated an integrated assessment framework for assessing the transformation of vernacular settlements into tourist accommodations, including the architectural, urban, and thermal aspects. The framework will help local authorities and stakeholders assess the impacts of different transformations, identify challenges, and establish recommendations for professionals in the field of construction who are considering tourism development as a solution for regenerating abandoned villages.

Declaration

I, Rawan Allouzi, declare that no part of this thesis has been previously submitted to any other institution or university in consideration for any other degree or qualification. I also confirm that the work presented in this thesis is original and my own, apart from where acknowledgements are made by references.

Rawan Allouzi

30th November 2022

Acknowledgment

First and foremost, I would like to thank God for his blessing through the whole process of this research. Without his guidance and mercy, I would not be able to reach this far.

I am grateful to my supervisors, Dr Nikolaos Karydis and Prof. Marialena Nikolopoulou, for their continuous support and generous guidance throughout my study. Their inspiration, encouragement, and affording time for assistance are greatly appreciated.

I owe my deepest and honest gratitude to my beloved parents, Abdelkarim Allouzi and Khetam Alhiary, who always show their unconditional love and support throughout my life. I am genuinely grateful to them for all the sacrifices they have made, making me who I am today. The words cannot help me express my deep appreciation for their encouragement and faith in me, instil peace and happiness inside me, and perform the best example for my siblings and me.

I would also like to express my extraordinary gratitude to my precious sister, Razan Allouzi, for always standing by my side, especially during difficult times. Finally, special thanks to my siblings, who have provided support, understanding, motivation and inspiration.

May God bless you always.

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List of Abbreviations and Notations

ASHRAE	The American Society of Heating, Refrigerating and Air-Conditioning Engineers
°C	Degrees Celsius
Cm	Centimetre
DBR	Dana Biosphere Reserve
DoA	Department of Antiquities
HIA	Heritage Impact Assessment
ICDP	Integrated Conservation and Development Projects
ICOMOS	The International Council on Monuments and Sites
JEAW	The Jordanian Engineering Association Workshop
JREDS	The Jordan Royal Ecological Diving Society
JTB	The Jordan Tourism Board
km^2	Kilometres square
m	Meter
m^2	Meter square
MoTA	Ministry of Tourism and Antiquities
POE	Post Occupancy Evaluation
RSCN	The Royal Society for the Conservation of Nature
SLF	Sustainable Livelihoods Framework
SOC	State of Conservation
SPI	Sustainable Preservative Initiative
t(Ti.max)	The time the indoor temperature reaches the maximum
t(To.max)	The time when the outdoor temperature is at its maximum
Ti.max	The maximum indoor temperature
Ti.mean	The mean indoor temperature
TIES	The International Ecotourism Society
To.max	The maximum outdoor temperature
To.mean	The mean outdoor temperature

Tod−1	The mean outdoor temperature of the previous day
Trm	The outdoor running mean temperature
Trm−1	The outdoor running mean temperature of the previous day
UN	United Nations
USAID	The United States Agency for International Development

Chapter One: Introduction

1.1 Research Problem

In the last few decades, the concept of sustainable development has emerged in most practice and research fields. Sustainable development is defined as ‘development that meets the needs of the present without compromising the ability of future generations to meet their own needs’ (Simpson 2001, p. 6). It has gained significance as a result of increasing pollution, high consumption of natural resources, and the severity of climate change (Appendino 2017, p. 1). Historic and heritage sites have been the target of several sustainable development projects, aiming to revive those neglected or abandoned (Al Haija 2011). However, the integration of heritage conservation and sustainable development has become a major concern in the search for a balance between both approaches.

Finding such a balance between conservation and development in heritage sites needs to take into consideration various factors, including the social, cultural, economic, and environmental contexts (Rapoport 1969; Oliver 1997; Asquith and Vellinga 2006). Vernacular architecture has often been seen as a translation of these factors into buildings and urban forms (Rudofsky 1964).[1] In Jordan, most vernacular buildings and settlements have been abandoned because they failed to acknowledge the causes of the rapid changes in the needs of local people. Therefore, different types of development projects were

[1] Bernard Rudofsky was the first to use the term ‘vernacular’ and introduced the concept into architecture (Rudofsky 1964). In 1964, Rudofsky held the exhibition of ‘Architecture without Architects’ at the Museum of Modern Art, New York. He presented the vernacular built environment as a part of the architectural field for the first time. Such architecture was formed of local construction materials and techniques that emerged from the local culture and natural environment, showing the strong relationship between people and their place. It evolved over time due to the changing needs of the occupants, with gradual and continuous changes (Oliver 2007).

undertaken, aiming to revive and recapture their lost heritage. The established sustainable developments are mainly concerned with transforming vernacular settlements into tourism-related ones (Al Haija 2012).[2]

In the era of climate change, the regeneration of vernacular settlements by transforming their buildings into tourist accommodations is challenging and requires frequent assessments against sustainability. This is because climate change impinges on the sustainable development of developing countries, such as Jordan, compounding the pressure on the environment and putting sustainability into question (I.P.O.C. 2001, p. 8). Unfortunately, the study of heritage conservation and sustainability is usually conducted separately by researchers from different disciplines. There is also a shortage in the study of assessing heritage conservation and thermal performance of vernacular buildings, considering the thermal conditions as a key parameter of sustainability. This raises the problem of finding an integrated assessment framework that combines heritage conservation and thermal assessments.

Dana village is one of the vernacular settlements that has undergone sustainable development, with ecotourism as a catalyst for regenerating the abandoned settlement.[3] The development transformed the village's

[2] Rapoport (1990), Maffi and Daher (2000), and Orbaşli (2000) stated that heritage conservation faces challenges when vernacular buildings are transformed into tourism-related ones. The challenges are concerned with moving the conservation approaches from being community-initiated to tourism-inspired, raising the problem of neglecting the socio-cultural and climatic context and considering only the needs of the tourist economy.

[3] The International Ecotourism Society (TIES) defines ecotourism as 'responsible travel to natural areas that conserves the environment and sustains the well-being of local people' (Blangy and Mehta 2006, p. 233). Indeed, ecotourism is a type of tourism that enhances conservation, supports communities, and protects the environment. The RSCN claims that it plays an essential role in preserving the vernacular architecture in Jordan. This could be through the adaptive reuse of vernacular buildings to meet the needs of the tourists. In the last two decades, ecotourism has been recognised as one of the primary forces that

abandoned vernacular buildings into tourist accommodations. Assessing the recent transformation provides an ideal opportunity to investigate the problem of assessing the transformation of vernacular settlements into tourist accommodations, considering the conflicting requirements of heritage preservation, sustainability, and tourism development. This study aims to address this research problem, benefiting from the experience of Dana village.

1.2 Case Study of Dana Village

The case study research approach is adopted as it fits the discussion area of the study, with examination of the current situation of Dana village after its buildings were transformed to accommodate tourists.

1.2.1 Selection Criteria

The case study of Dana village was chosen due to its recent rehabilitation project that took ecotourism as a catalyst for regenerating the village. Dana is located in Tafilah governorate, 180 km southwest Amman, in the southern part of Jordan. It is managed by an NGO organisation called the Royal Society for the Conservation of Nature (RSCN), in cooperation with various local communities (Dudley and Phillips 2006).[4] The selection criteria include the village's **historical significance** (significant history reflects a rich built

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enhances sustainable tourism development and supports the economy in Jordan (Al-mughrabi 2007, p. 5).

[4] The RSCN, as one of the national non-governmental organisations in the Middle East, seeks to conserve the natural and heritage resources of Jordan and to protect the wildlife and wild sites. It has conducted several ecotourism projects in Jordan, which mainly focus on conservation and local development. Its practices in the conserved areas include community involvement, the protection of sites, sustainable development, and the provision of jobs (Alhasan 2019). Its main goal is to generate money through implementing ecotourism and then returning this to each site to be used in developing its infrastructure and public services.

environment to understand how societies behaved), **location** (unique location to ensure being an active tourist destination), **architectural heritage** (providing a variety of human interventions including vernacular dwellings), and **ecotourism development** (benefiting from a range of development practices). More specifically, Dana is selected as the best location for observing the research problem for the following reasons:

1. **The important history** of the village. Archaeological evidence shows that Dana was occupied since 4000 BC. Civilisations such as the Egyptian, Nabatean, and Roman settled in the village because of its strategic location, water springs, and fertile soil (Al-Qawabah et al. 2003; Al-Qawaba'a 2008). In the late 19th century, during the Ottoman period, Dana was built by a local tribe called the 'Al Ataata' (Al Haija 2011). It is a typical Jordanian village constructed between the 1890s and 1930s, the period when most Jordanian villages were built (Khammash 1995).
2. **Dana village became an active tourist destination after undergoing sustainable development.** It received attention due to its location, bordered by three of the main tourist destinations in Jordan, Petra, the Ma'in hot springs, and Dana Biosphere Reserve (DBR). In 1989, the RSCN established and managed DBR project to meet the needs of both nature and people in Dana district.[5] The reserve was created to ensure that Dana remains a sustainable

[5] Currently, Dana Biosphere Reserve is the largest nature reserve in Jordan, covering 320 square kilometres. It includes a series of mountains and valleys which extend from the desert lowland of Wadi Araba to the eastern Rift Valley (Al-Qawabah et al. 2003). It has been shaped by water, wind and earthquakes, and is an area where people benefit from nature.

location for nature and people. Subsequently, the RSCN considered Dana village as a part of DBR due to its location, historical significance, and architectural heritage.

3. **Dana village has adhered to nature conservation policies and sustainable development** after the United Nations Organisation for Education, Science, and Culture (UNESCO) considered it part of DBR in 1994 (Eid et al. 2013). Therefore, it became the first site in Jordan where nature conservation brought benefits to the local community (Dudley and Phillips 2006; Almughrabi 2007; RSCN 2011).[6]

4. **It benefitted from a range of ecotourism and socio-economic development projects** after being considered part of DBR. These projects aimed to develop the village and recapture its lost heritage.

5. **Dana village provides a variety of human interventions, including social, urban, and vernacular architecture**. The social interventions deal with the Jordanian community, reflecting their needs, behaviour, and culture, while the urban ones concern the rural Jordanian settlement, which is formed of traditional elements. It shows a typological variety of urban blocks, courtyards, and urban patterns. In addition, the vernacular architecture of Dana includes a rare conserved rural settlement in Jordan which used local materials and traditional construction techniques such as

[6] Sustainable management and development received significant attention after the Rio de Janeiro Earth Summit held in 1992. As a result of this summit, the nature conservation concept was changed from a 'fenced protected area', which eliminated any human activity and isolated the protected area, to socio-economic development that targeted local communities within the conservation activities (Almughrabi 2007; Dudley and Phillips 2006; RSCN 2011).

arches and masonry bearing walls. As a result, Dana provides valuable information about the local adaptation of vernacular architecture and landscapes.

6. Recently, **sustainable ecotourism development has been implemented in Dana village** as a part of DBR.[7] In 2009, a rehabilitation project was launched to restore the vernacular dwellings to accommodate tourists and visitors (Al Haija 2011). This project was managed by the locals themselves to respond to tourism needs (Guarasci 2018).
7. After the rehabilitation project, **some parts of the village were not restored and underwent no changes**, offering the chance to conduct a comparative study between the original and transformed vernacular dwellings.

1.2.2 Rehabilitation Project of Dana Village

The RSCN launched a rehabilitation project (2009-2015) to recapture its lost heritage, rectify the locals' random restoration attempts, and revitalise the ecotourism activities in the village (Alhasan 2019). It was based on sustainable development, with ecotourism acting as a catalyst for regenerating the village by transforming its vernacular buildings into tourist accommodations (Alhasan 2019). The significance of learning from the rehabilitation project of Dana village is that it advances the understanding of

[7] As a result of this sustainable ecotourism development and rehabilitation project, Dana village has become a popular tourist destination, which attracts around 100,000 tourists/year (RSCN 2010).

sustainable ecotourism development in conserving vernacular settlements by transforming their buildings to accommodate tourists.

The project is considered one of the few in the country to transform an entire village into a tourist destination, changing the whole population from locals to tourists. Such transformation is challenging concerning the compatibility between heritage conservation (maintaining the inherited cultures) and tourism development (adapting to the requirements of tourists). Therefore, the project aimed to achieve a balance between heritage conservation, sustainable development, and ecotourism (Alhasan 2019). The RSCN collaborated with Ammar Khammash engineering consulting office to design a proposal for the rehabilitation project (Alhasan 2019).

The project was divided into three stages, and the priority area was defined to be restored at stage one. Subsequently, a total of 120 houses were selected for restoration at this initial stage, which were within the zone of the first development area (stage 1). As these houses were transformed to accommodate tourists, several changes were made during the first stage of the rehabilitation project. For instance, new indoor facilities were added, such as bathrooms and lightning shafts, and external windows were enlarged to bring more daylight into the indoor spaces. Moreover, different construction materials were used to rebuild the abandoned demolished buildings, in an attempt to find durable and available solutions.

As a result, the original vernacular building changed, offering new building envelopes and spatial arrangements to meet the requirements of tourist development. Dana found itself between the conservation of its architectural heritage and the development of sustainable ecotourism; and between maintaining its vernacular architecture and transforming its buildings. It faced the challenge of keeping these two forces in balance within its social, cultural, economic, and climatic contexts. This study aims to investigate this challenge and assess the impact of changes by examining their purpose and validity.

1.3 Research Questions and Aims

The study responds to the identified research problem by addressing the following main research question:

> **How to assess the transformation of vernacular settlements into tourist accommodations, combining heritage conservation and thermal assessments?**

The question seeks to find how the transformation of vernacular settlements to accommodate tourists could be criticised and assessed in order to identify the weaknesses and challenges. To address the research question, this study aims to develop an integrated assessment framework that could be used to assess such transformations against heritage conservation and sustainability. To this end, it is necessary to examine the existing assessment frameworks in the literature, seeking to overlap their approaches to develop the study's theoretical framework.

Afterwards, the study aims to benefit from the experience of Dana village to test the developed theoretical framework and critically appraise the adopted assessment approaches. Accordingly, the study seeks to address the following secondary questions that target the case study of Dana village:

1. What are the original features of Dana's vernacular architecture?
2. How was Dana village transformed into a tourist settlement, and what are the urban and architectural impacts of such transformation?
3. What is the thermal impact of Dana's rehabilitation project, focusing on analysing the thermal performance of the original and rebuilt vernacular buildings?
4. What are the issues and challenges of Dana's original and rebuilt buildings regarding their built environment, thermal conditions, and tourists' satisfaction?
5. How does the experience of Dana village help in developing a framework for assessing development projects that transform vernacular settlements into tourist accommodations?

According to the established research questions, various research methods are used to address their interdisciplinary nature.

1.4 Research Methods

A new methodology was developed to address the interdisciplinary nature of the research questions, which combines architectural and urban assessments with the thermal assessment. Such methodology is new in the field of architectural conservation, combining field surveys of vernacular settlements, thermal monitoring, and Post Occupancy Evaluation (POE) interviews (**Figure 1.1**). These methods were used in two rounds of fieldwork to assess the architectural, urban, thermal, and occupants' satisfaction impacts of transforming Dana village into tourist accommodations.

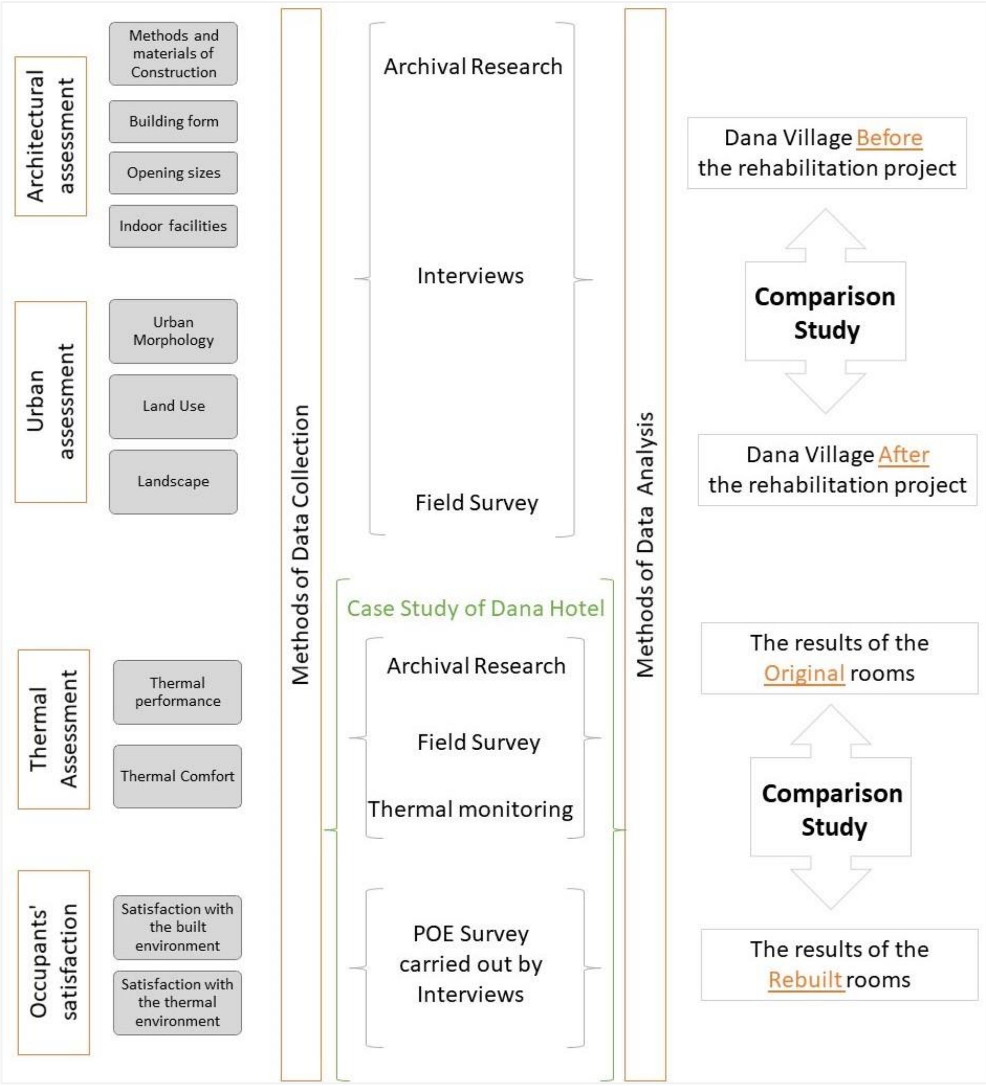

Figure 1.1: Methods of Data collection and analysis for the architectural, urban, thermal, and occupants' satisfaction assessments (Author 2020)

To begin, archival research was conducted before the fieldwork to find the documentation and records of the Dana village prior to the transformation process in order to provide the theoretical basis and guidance for the fieldwork. The archival data were collected from the RSCN, which was the client of this project, and from Ammar Khammash engineering consulting office, which was the designer. Having collected the archival data, a field survey was conducted to record some of the original vernacular buildings (representative buildings in ruins) and rebuilt buildings that had been transformed to serve the tourists' needs.

Subsequently, a comparison study was conducted between both types of building to monitor the changes that occurred after the transformation process. These records define Dana’s vernacular architecture and urban morphology, including the construction materials, methods of construction, types of openings, types of houses, street pattern, infrastructure, land use pattern, and urban configuration. These records will remain for future researchers as evidence of the original settlement and for reinterpretation to gain further insights.

Through a comparative study, this research further seeks to compare the thermal performance of the original and rebuilt buildings to assess the thermal impact of the transformation of Dana’s houses. Therefore, monitoring was conducted to measure the thermal environment of the village in August 2019 and February 2020.

After the thermal monitoring provided the measurements of the thermal environment, a POE survey was conducted to record the occupants’ responses to Dana hotel and its thermal environment. This helped to evaluate the original and rebuilt rooms of the hotel in terms of occupants’ satisfaction with the built and thermal environment. As a result of the POE, the issues and challenges related to Dana’s original and rebuilt buildings are identified, showing their problems, and suggesting potential solutions.

The application of the research methods aims to address the research questions. Therefore, the study is structured in a way by which each chapter shows the results of applying the adopted research methods, addressing one or more of the research questions.

1.5 Thesis Structure

This study contains ten chapters, with chapters 6 to 9 being the core chapters that analyse the architectural, urban, and thermal impacts of Dana's transforming into a tourist settlement while assessing the occupants' satisfaction and comfort. Following this introductory chapter, the thesis is structured based on the identified research questions as follows (with a brief description of the content of each chapter):

Chapter 2 presents the literature review of this study. It investigates previous studies that discussed the impact of transforming heritage buildings/sites, showing the methods used and the Heritage Impact Assessment (HIA) frameworks developed. Afterwards, the chapter identifies the gaps in the previous studies and adopts the most relevant theories, methods, and approaches to formulate the theoretical framework of this study.

Chapter 3 presents the methodological approach of this study. It investigates the application of the adopted methods, showing how the study was conducted in terms of data collection and data analysis to address the research questions. It also includes how the overall study is designed, illustrating the methodological paradigm and approaches.

Chapter 4 offers the background and context to the case study of Dana village. It investigates ecotourism and sustainable development in Jordan and situates Dana within the context of other developments, highlighting the similar and different approaches.

Chapter 5 includes a survey of Dana village. It records the original settlement and structures of the village, showing how the original settlement was originally built. The evident and inherited accumulations of human accomplishments in Dana are studied and documented on the urban and architectural scale. The urban documentation records Dana's urban configuration, land use, and street pattern. On the other hand, the architectural documentation records the village's construction methods and materials, house typology, and opening types. As a result of the chapter, comprehensive documentation of the original vernacular settlement of Dana village is provided in words and demographically.

Chapter 6 assesses the architectural impact of transforming the village to accommodate tourists. It investigates the changes and assesses their impact on the form and structure of Dana's buildings. According to the theoretical framework, the architectural assessment is mainly based on assessing the transformation of Dana's roofs, walls, forms, and opening sizes. The buildings before and after the interventions are compared to understand how they were transformed and to evaluate the impacts of the transformation, discussing the integrity of the changes in relation to the heritage of Dana.

Chapter 7 assesses the urban impact of transforming the village to accommodate tourists. It examines the approaches adopted for conserving the urban context and assesses their impact on Dana's urban heritage. The urban assessment is mainly based on assessing the transformation of Dana's land use, urban configuration, skyline, street pattern, infrastructure, and landscape. The village before and after the rehabilitation project is compared to understand how it was transformed and to evaluate the impacts of the transformation.

Chapter 8 illustrates the thermal impact of Dana's rehabilitation project, focusing on the analysis of the thermal performance of the original and rebuilt buildings. It first assesses the impact of the original vernacular principles, construction methods, and building materials on the thermal performance of the original vernacular buildings. Then, it assesses the impact of the transformation process on the rebuilt vernacular buildings by comparing their thermal performance with that of the original ones. As a result, the chapter establishes which type of building is thermally more effective in providing thermal comfort.

Chapter 9 introduces the POE of the occupants' satisfaction with the original and the rebuilt rooms of Dana hotel. It provides the subjective responses and indicates the behaviour of occupants while the thermal measurements are being made. The occupants' observations are used to identify the issues and challenges of both the original and rebuilt rooms. As a result of this POE study, the issues related to the original and rebuilt rooms are identified, and recommendations and potential solutions are suggested. This helps in providing lessons for future development projects to ensure better practices and avoid existing problems.

Chapter 10 represents the conclusion of this thesis. It critically appraises the employed methodology within the context of the theoretical framework. The findings derived from assessing Dana and the novelty of the employed methodology are synthesised and compared with the ones of other studies. Afterwards, the chapter presents the study limitations and makes a list of recommendations for future work.

1.6 Thesis Impact and Contribution to Knowledge

The study seeks to make a contribution to knowledge in the field of heritage conservation by investigating vernacular architecture through sustainable ecotourism development. It makes contribution to the following three areas:

1. **Advances the understanding of heritage conservation and sustainability in vernacular settlements**

The study of the architectural heritage of vernacular architecture and its thermal features is usually conducted separately by researchers from different disciplines, whose analysis concentrates on just one aspect. Therefore, it is rare to find studies that offer insights into both aspects. However, in the era of climate change, it is essential to assess every activity against sustainability criteria to reduce its impact on the environment. Therefore, this study fills this gap by taking an interdisciplinary approach, with the development of a new methodology that combines architectural and urban assessments with thermal evaluation in the study of heritage conservation.

To accomplish this, the study advances the understanding of existing HIA frameworks and methods. Consequently, it develops an integrated assessment framework to assess the impact of development projects that transform vernacular settlements into tourist accommodations. Testing this framework on Dana, this study synthesises the qualitative and quantitative findings by comparing them with the findings of previous studies. Corresponding or contradicting previous studies helps identify possible root causes for the similar or different findings. This contributes to the wider range of knowledge as it significantly advances the understanding of heritage conservation and sustainability.

Furthermore, future studies could employ the developed framework to assess other villages worldwide which are facing the same development interventions, aiming to assess the impact of the adopted changes while considering the principles of conservation and sustainable development.

2. Develops a novel methodology

A comprehensive methodological framework is designed to assess the rehabilitation of Dana, resulting in an interdisciplinary study. The combination of field surveys of vernacular settlements, thermal monitoring, and POE interviews, which investigated the occupants' satisfaction and comfort, is new in the field of heritage conservation. The POE adds more depth to the assessment method, providing a better understanding of the occupants' experience in terms of satisfaction and thermal comfort and thus establishing the challenges and issues around vernacular buildings.

The study also engaged with various stakeholders, including architects, tourists, and the local community, over a period of a year. The interviews with them provide an interactive instrument for researchers and other parties involved to gain insights into the process of transforming a vernacular settlement into a tourist destination with accommodation. The interviews clarify and justify the adopted changes, including the construction materials and methods, opening sizes, orientations, and building forms. Subsequently, the stakeholder's participation strengthens the significance of the research, enabling different points of view on the project to be gathered.

Overall, this comprehensive methodology enhances the opportunity to understand the actual implications, feasibility, and impact of development projects in vernacular settlements.

3. Improves heritage conservation in practice

The key contribution of the study is the framework developed to assess future tourism development projects in rural settlements. Through the framework developed, the study has a unique opportunity to make a significant contribution to the approach of tourism development for village regeneration in practice. The framework could support local authorities, architects, and stakeholders in assessing the overall process of development projects and allow them to compare the results of using different restoration approaches throughout the project life cycle. Such comparison assesses the impacts of different restoration strategies and identifies challenges.

Afterwards, recommendations could be suggested for professionals in the field of construction who are considering tourism development as a solution for regenerating abandoned villages. This ensures better practices and avoids existing problems, giving local authorities and stakeholders more confidence regarding the performance of different restoration options under varying conditions and scenarios. Overall, this improves the application of tourism development as a catalyst for regenerating abandoned vernacular settlements.

Chapter Two: Literature Review

2.1 Introduction

The idea of regenerating vernacular settlements by transforming their buildings into tourist accommodations, is challenging and requires finding a delicate balance between conserving the cultural heritage and achieving a satisfactory standard of tourist accommodation. A significant number of scholars and organisations concerned with heritage conservation have examined impacts related to cultural identity and authenticity, tangible heritage conservation, thermal performance, and occupants' satisfaction and comfort. They have developed different assessment frameworks and methods to assess the various impacts of reusing heritage buildings/sites for tourism purposes.

The available literature is reviewed herein to highlight these impacts, showing the methods used to assess them. It was observed that the impact assessments have been conducted by researchers from different disciplines with the aim of providing a better understanding of different aspects, including the architectural, urban, and thermal aspects. This chapter adopts the most relevant assessment methodologies and integrated them into a more comprehensive and interdisciplinary assessment framework and consequently formulate the theoretical framework of this study that combines the architectural, urban, and thermal assessments.

2.2 Regeneration of Vernacular Architecture: An Overview

A significant number of scholars have investigated the sustainable development approaches of regenerating vernacular architecture that aim to keep buildings suitable for occupation over time. Sustainable development projects take different approaches to regenerating vernacular settlements and recapturing their lost heritage. Adaptive reuse is considered one of these approaches that aim to conserve buildings' heritage and maintain sustainability (Anna-Maria 2009; Saljoughinejad and Sharifabad 2015). Vernacular buildings can be reused for different purposes, such as cultural, residential, recreational, and touristic purposes. Reusing vernacular buildings for touristic purposes has received attention in the practice and research field of conservation. Many researchers have discussed the role of tourism development in regenerating vernacular buildings and settlements.

2.2.1 Adaptive Reuse of Vernacular Buildings

Significant efforts were implemented to promote reusing vernacular buildings and settlements, especially after the industrial revolution, when constructing new buildings instead of adaptively reusing old ones became common on the global scale (Cantacuzino 1989; Fitch 1990, p. 44, 165). For instance, the International Council on Monuments and Sites (ICOMOS) emphasised the significance of reusing heritage sites and buildings to protect their identity and support cultural continuity. ICOMOS has considered the adaptive reuse approach in its recent development projects in heritage sites to present the cultural context of vernacular and traditional buildings on a larger scale (ICOMOS 1999).

Greene (1999, p. 45) noticed that most of these projects have been related to tourism investment and do not follow conservation guidelines and principles.[8]

[8] Greene (1999) investigated the challenge of cultural resource management in case studies from Tunisia, Cyprus, and Jordan.

Maffi and Daher (2000, pp. 31-37) agreed with Greene, stating that heritage conservation is affected by the centrality of tourism development in such projects. They criticised that vernacular settlements in Jordan are either transformed into tourist accommodations in a way that loses their cultural identity, or abandoned and demolished.

This raised the problem of finding a delicate balance between conserving the cultural heritage and undertaking development projects. Several scholars have responded to this problem and tried to address it from different perspectives. For instance, McQuitty (2005) linked this problem to the absence of clear guidelines for the control of tourist-driven development, as decisions were taken by those who implement and manage the rehabilitation projects. Mitcham (2005, p. 33) added that Jordan is currently losing a significant part of its heritage due to demolition in the name of progress and rapid development plans that prioritise economic opportunity rather than conservation.

Goring-Morris (2006) claimed that, by the beginning of the 21st century, the Jordanian government responded to this problem by collaborating with non-governmental, private, and foreign organisations to put more effort into the documentation and restoration of vernacular buildings.[9] As a result, many late 19th century and early 20th century buildings were restored for different purposes (Al-Asad, Khammash and Lyons 1997, p. 15), such as:

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[9] For instance, the United States Agency for International Development (USAID) funded the conservation of Dana village and the Salt mosque; the Spanish Archaeological Mission (SAM) funded the conservation of Ummayad palace, while the Japan International Cooperation Agency (JICA) funded the conservation of Amman downtown (Al-Asad, Khammash and Lyons 1997, p. 15).

1. Al-Bilbeisi house in Amman for residential use.
2. Darat Al-Funun in Amman for cultural use.
3. King Abdullah palace in Maan for public use.
4. Kan Zamman in Madaba for recreational use.
5. Taybat Zamman village in Petra for touristic use.

Consequently, many studies have been conducted to understand how heritage buildings were transformed to meet the requirements of new uses and evaluate the impacts of the transformation on the architectural heritage by comparing the buildings before and after their reuse. Making such a comparison enabled the assessment of various transformation approaches to certain architectural and urban features, with the evaluation of their validity and purposes. For instance, developers followed the approach of reconstructing heritage buildings and reshaping local cultures by associating cultural heritage with consumers' globalised cultures (Daher 2005).

Orbaşli (2007) criticised this approach, commenting that the greater the efforts required to rebuild a heritage, the lower the desire to conserve the original authenticity. Consequently, Orbaşli (2009) emphasised the need to adopt different restoration strategies according to the requirements of the new uses and the physical condition of the existing buildings, concluding that interventions should not be generic, but specific to each case. Furthermore, Orbaşli (2017) questioned whether the conventional approach is relevant to the changing demands of heritage conservation in the 21st century. She added that repairs or limited maintenance interventions rarely address the construction or aesthetic issues of ageing materials.

Therefore, an intermediate approach is required between the conventional one that restricts interventions and the reconstruction one that demolishes and rebuilds heritage while accepting interventions. Either approach is somewhat problematic. Regarding the former, it is challenging to conserve the original features while meeting the evolving needs of the new uses and users (Orbaşli 2017). Meanwhile, the latter provides new architectural models of new forms, materials, and techniques (SERBESCU 2009; Foruzanmehr and Vellinga 2011). This was previously highlighted by Shaw (2004, p. 170), who emphasised the need to know when to fight for conservation and when to allow interventions.

Vellinga (2017) consequently emphasised the necessity to adopt interventions to meet the new needs of new users and uses, such as adding or removing certain elements. He added that such interventions should be combined with an in-depth understanding of social structures, economic conditions, and religious values to learn why the vernacular buildings were built using specific construction materials and techniques and with particular spatial layouts and forms. This approach was introduced to deal with development strategies that target rural settlements, especially when reused for tourism purposes (Al Haija 2012).

2.2.2 Tourism Development in Vernacular Architecture

The concept of reusing vernacular buildings for tourist purposes has evolved over the last five decades as it plays an essential role in their regeneration (Smith 1989; Rapoport 1990). Many scholars have discussed how vernacular dwellings, which were built to meet the needs of specific people, can be transformed to provide tourist accommodations in a way that serves new people of various cultures and social backgrounds. Smith (1989, p. 14) stated that the greater the rise in the number of tourists, the greater the number of facilities and services should be provided, and infrastructure development is required. This includes opening shops to serve tourists, creating and widening roads to facilitate access, drainage facilities, public lighting, and public toilets. This kind of development creates challenges to heritage conservation (Rapoport 1990).

Several scholars have discussed these challenges from different perspectives. For instance, Rapoport stated that transforming vernacular buildings affects the cultural identity embodied in the buildings' forms and elements and peoples' behaviour (Rapoport 1990, p. 253). He explained that locals and tourists use tourist villages in different ways. Urry (1992) agreed with Rapoport, explaining that tourists consider streets as a stage show to explore and to view building facades. In contrast, the local communities used them to take part in recreational activities for socialising and transportation throughout the day. This has led to more emphasis on the external appearance of buildings when conserving the urban heritage to maintain a desired image for tourists.

Such an approach was taken during the post-war period in Germany, where there was a trend to retain only the facades of historic buildings and radically transform their inner parts (Soane 2013). As a result, the modern concrete structures were hidden from view, seemingly preserving the established images of buildings, while providing different structures, internal spaces, and dimensions (Soane 2013). This promoted the development of the 'facadism' approach while developing the infrastructure to serve tourists (Strike 1994, p. 7).

Abu Al Haija (2012) observed the facadism approach in the regeneration of Umm Qais village in Jordan. He stated that heritage buildings were demolished and rebuilt in a way that maintains as much as possible the visual appearance, stone cladding, and heights. Comparing the use of the original and new construction materials showed a clear desire to conserve the buildings' facades, while maintaining the surface materials as far as possible (Al Haija 2012). The same approach was also observed in the French Pavilion in Zagreb, which was reconstructed in 2007 by removing the corroded metal and rotten timber elements that could not be repaired.

The new pavilion replicated the original image, remaking the metal and timber elements and leaving only the concrete elements as evidence of the earlier building (Braun, Veršić and Vidović 2011). Orbaşli (2000) criticised that the facadism approach moved the tourism development from being community-initiated to tourism-inspired. Hence, the objectives of conservation have changed from the continuity of cultural heritage to more external and aesthetic qualities (Orbaşli 2000). Pedersen (2002) added that local communities became victims of increasing burdens of tourism, not earning sufficient income and only having temporary employment due to the nature of seasonal tourism.

Therefore, Orbaşli (2007) stated that heritage conservation and development projects should be controlled and implemented in ways that consider the local community's needs. This created a shift in the methodological approach of conservation, with present-day local communities given the power to decide what to keep or demolish (Avrami 2009). However, the consideration of local communities in tourism development plans is still limited in Jordan (Al Haija 2011). For instance, Abu Al Haija (2012) observed that when Umm Qais village became a tourist destination, places and spaces were created to serve and accommodate tourists regardless of the local communities' opinion and sometimes against their will.

The review of the previous studies highlighted that transforming heritage buildings or sites into tourism-related ones has impacted their built environment, socio-cultural life, and local identity. Therefore, assessing such transformation became essential, requiring more studies in this area. A significant number of scholars have discussed the various impacts of transforming vernacular buildings into tourism-related ones, seeking to examine what took place during the transformation, to trace changes, and to assess the various impacts of these. The following sections review these studies to highlight the adopted heritage impact assessment methods and frameworks.

2.3 Heritage Impact Assessment (HIA)

The consideration of vernacular architecture in the tourism industry affects the physical built environment, socio-cultural life, and local identity. Therefore, an assessment framework is essential to determine the extent to which the transformation of vernacular settlements into tourist settlements respected their historical significance. A significant number of scholars have developed different assessment frameworks and methods to assess the various impacts of reusing heritage buildings or sites. Qualitative and quantitative evaluation frameworks were developed, using different impact assessment models developed by local and international organisations.

The following sections review the existing assessment frameworks, methodologies, matrices, and tools concerned with heritage impact assessment.

2.3.1 Development of HIA Methods

The statistical analysis of UNESCO, which illustrated the State of Conservation (SOC) of cultural properties from 1979 to 2021, highlighted that development projects are a serious threat that endangers cultural properties (Veillon and UNESCO 2014). The statistics emphasised the increasing level of impacted cultural properties by development projects in the last few years (**Figure 2.1**). Therefore, an integrated Heritage Impact Assessment (HIA) was requested by the UNESCO World Heritage Committee (Seyedashrafi et al. 2017).

The heritage community responded to UNESCO's request by initiating HIA concept that is specific for heritage buildings. HIA is a tool to assess the impact of development projects on cultural heritage sites and buildings, aiming to support the management and conservation of heritage assets (Seyedashrafi et al. 2017). Some organisations have proposed guidance for HIA, concerning world heritage sites and buildings, such as the World Heritage Centre (WHC) and ICOMOS. The WHC (2008) developed a model for assessing the impact of threats in heritage sites and tested it on three heritage sites as pilot projects.

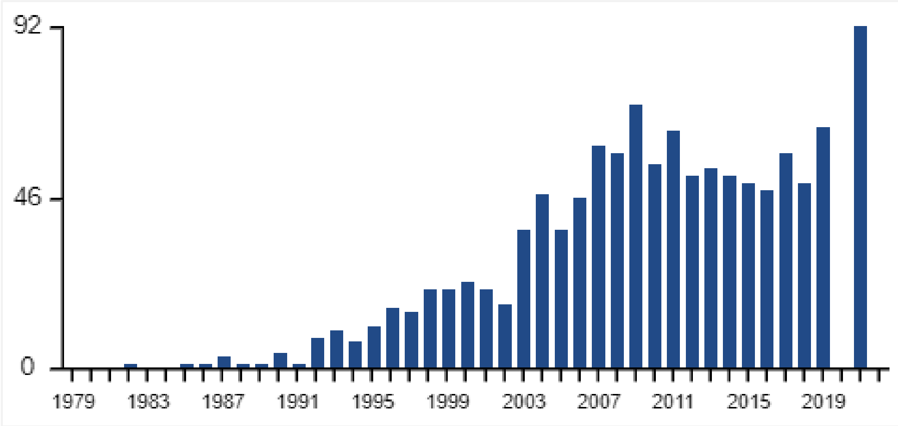

Figure 2.1: Distribution of cultural properties impacted by development projects (per cent) (UNESCO World Heritage Centre 2021).

WHC's model of HIA is formed by the 'extent/severity of changes' variable that demonstrates the threats' causes and impacts. The 'extent/severity of changes' is categorised into four levels of changes: from 'low' to 'very high'. **Table 2.1** presents the numerical ratings and includes the description of each level. The users of this assessment model should input the level of 'extent/severity of changes'. Then, they should suggest the actions required to manage the threat of impacts while indicating the urgency of actions from 'low' to 'very high' urgency (WHC 2008).

Table 2.1: Assessment model for the Extent/Severity of Impact (WHC 2008: 27)

Extent/Severity of Changes				
Level	1	2	3	4
	Low	Medium	High	Very High
Numerical rating	10% of the elements are changed	11-25% of the elements are changed	26-75% of the elements are changed	76-100% of the elements are changed
Descriptive rating	• Impact is not clear and can be inferred hardly. • Minor threat and barely noticeable impact.	• Impact is not clearly articulated but is implied or can be inferred. • Threat with a noticeable impact but considered not significant.	• Impact is reasonably articulated. • Threat with a significant reduction if keeps operating at the same level.	• Impact is explicitly articulated. • Threat that will lead to losing the value if keeps operating at the same level.

However, measuring the 'extent/severity of changes' without the 'effect of changes' is limited because, for instance, a historic settlement can be changed by maintaining its character, and small changes can be very detrimental. To address this limitation, ICOMOS (2011) developed a qualitative/quantitative assessment model that sets the scale of impacts and their attribute. ICOMOS's HIA model is formed by two variables: 'scale/severity of impact' and 'attribute/significance of impact'.

A five-point scale (from 0 = no change to 4 = major change) was used to indicate the scale of change/impact, taking into account the form of changes being direct or indirect, reversible or irreversible, permanent or temporary, visual or/and physical. As the attribute of changes can be beneficial or adverse, a nine-point scale (from -4 = major adverse to 4 = major beneficial) was used to indicate the significance of effect or overall impact (**Table 2.2**).

Table 2.2: ICOMOS's Assessment model for the 'severity of changes' and 'attribute of overall impact' (ICOMOS 2011, adapted by Author 2022)

Scale /Severity of Change/Impact					
Scale	0	1	2	3	4
Description	No change	Negligible Change	Minor Change	Moderate Change	Major Change
Architectural Heritage	No change to the heritage building elements or settings.	Heritage building elements were slightly changed, and the settings were hardly affected.	• Key heritage building elements were changed (Slightly modified the asset). • The settings of a heritage building were noticeably modified.	• Many key heritage building elements were changed (significantly modified). • The settings of a heritage building were significantly modified.	Comprehensive changes to key heritage buildings or their key settings.
Urban Heritage	• No changes to urban elements or components • No changes to visual appearance.	• Changes to key urban elements or components were very minor. • Virtually unchanged	• Few key urban elements or components were changed. • A slight change in the visual appearance of	• Many key urban elements or components were changed. • Changing the visual appearance of	• Comprehensive changes to most or all key urban elements or components. • Extreme visual impact.

	• No changes to the land use, leading to no changes to the urban context	visual appearance. • Very slight changes to the land use, leading to very small changes to the urban context	few key urban elements. • Slight changes to the land use, leading to limited changes to the urban context	many key urban elements. • Considerable changes to the land use, leading to moderate changes to the urban context.	• Fundamental changes to the land use, leading to total changes to the urban context.
Attribute/Significance of Overall Impact (Either Adverse or Beneficial)					
Scale	0	±1	±2	±3	±4
Description	Neutral	Negligible	Minor	Moderate	Major
	• No impact	• (Adverse): Insignificant impact on the key settings of cultural properties or sites. • (Beneficial): Insignificant socio-cultural and economic benefits.	• (Adverse): Slightly significant impact on the key settings of cultural properties or sites. • (Beneficial): Slightly significant socio-cultural and economic benefits.	• (Adverse): Significant impact on the key settings of cultural properties or sites. • (Beneficial): Significant socio-cultural and economic benefits.	• (Adverse): Extreme impact on the key settings of cultural properties or sites. • (Beneficial): Extreme socio-cultural and economic benefits.

Eventually, ICOMOS's model can be applied to architectural and urban development projects to assess the impact of such projects on the cultural heritage. However, Landrof (2009) stated that the impact of development should be interpreted in a wider sense that is beyond the tangible attributes. She developed a qualitative evaluation framework to assess tourism development in six World Heritage Sites in the UK. The framework included four main evaluation aspects: tangible attributes, strategic orientation, community values and attitudes, and stakeholder participation.

Overall, the review of the previous HIA methods highlights that further interdisciplinary frameworks are required to develop a more comprehensive and systematic methodology for HIA, combining quantitative and qualitative methods to enhance its practicability and effectiveness. Some scholars have contributed to addressing this shortcoming by developing different assessment frameworks through adapting the HIA methods to their aims and approaches.

2.3.2 Assessment Frameworks

In addition to the organisations concerned with heritage conservation like ICOMOS and WHC, scholars developed different assessment frameworks according to their different aims, approaches, and adopted HIA models. They used different assessment scales that were developed locally or internationally, depending on the location of the target case study. For instance, Seyedashrafi et al. (2017) developed an assessment framework using ICOMOS's HIA model to assess the urban development of Masjed-e Jame of Isfahan in Iran. They identified the key attributes affected by the development before determining the severity and the attitude of impacts on them (**Figure 2.2**).[10]

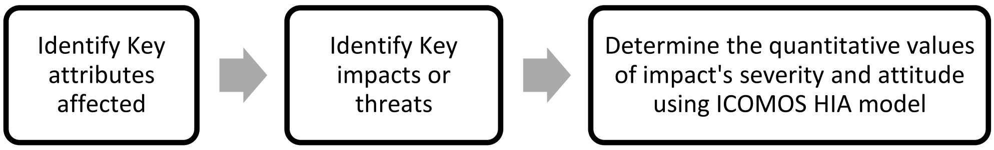

Figure 2.2: HIA process for assessing Masjed-e Jame of Isfahan (Seyedashrafi et al. 2017, adapted by Author 2022).

The study highlighted the efficiency of the internationally developed models; however, other scholars preferred the use of locally developed ones that are specific to the location of the target case study. For instance, Faria (2020)

[10] According to the Operational Guidelines for the Implementation of the World Heritage Convention, cultural buildings are formed of a variety of attributes including: form and design; materials and substance; use and function; traditions, techniques and management systems; location and setting; language, and other forms of intangible heritage; spirit and feeling; and other internal and external factors (UNESCO 2012, p. 22).

developed an assessment framework for evaluating vernacular limestone buildings in Serra de Santo António village in Portugal, using the Portuguese assessment matrix. The framework is formed of the impact/change score table that represents the impacted attributes of the transformed buildings, giving each attribute a 'significance/weight value' to determine the quantitative value of proximity to the architectural matrix (**Table 2.3**).[11]

Table 2.3: Proximity to the architectural matrix score table (Faria 2020: 96)

Category Weight	Category	Element Weight	Input Value	Existence	Including Element Value	Proximity to Architectural Matrix	Result
Exterior Walls							
0.40	Type of Wall	0.20					
	Coating	0.10					
	Finishing	0.10					
						Partial Sum	
Roof							
0.25	Roof Shape	0.1					
	Roof Cover	0.1					
	Chimney	0.02					
	Rainwater Drainage	0.03					
						Partial Sum	
Opening							
0.15	Window-Frame	0.03					
	Window-panes	0.03					
	Window-sills	0.03					
	Door Material	0.03					
	Door Sill	0.03					
						Partial Sum	
Equipment							
0.19	Fence	0.1					

[11] Faria used a four-point scale (from 0 = Totally different to 3 = Mostly the same) to indicate the proximity to the architectural matrix. Then, a set of calculations was made as follows: Input the score of proximity to the architectural matrix (0 - 3) by the user; Calculate the input value by dividing the proximity score by 3; Input the existence value with (1) if existed or (0) if not exist; Calculate the including element value (weighted proximity of each element) by multiplying the input value by the element weight; Calculate the partial sum of each category by multiplying the sum of the input values by the category weight and then by 3; Calculate the overall proximity to the architectural value by adding the partial sum of all categories (Faria 2020: 95).

	Threshing-floor	0.03					
	Porch	0.02					
	Water Tank/Well	0.03					
	Other Details	0.01					
						Partial Sum	
Access							
0.01	Stairs	0.01					
						Partial Sum	
						Final Result	

The recognition of the inherent value of each attribute or physical element became very important in the field of heritage conservation and played a crucial role in developing conservation policies (Richmond, Bracker and Bracker 2009; Clavir 2012).[12] Therefore, the conservation process and assessment became a value-based approach that many scholars have adopted (De la Torre 2013). This approach is supported by various studies that determined the significance/weight values of building attributes (Eriksson et al. 2014, Jokilehto 2016, and Faria 2020).

The criteria for selecting the 'significance/weight values' varied in the literature because there is no universally standard that details how heritage 'significance/weight values' should be determined (De la Torre 2013; Eriksson et al. 2014, p. 138). Two types of significance values were observed in the literature: the flexible and absolute values. Jokilehto (2016) and the Energy Efficiency for EU Historic Districts' Sustainability (EFFESUS) system developed flexible levels of significance values that require the users to determine the significance value based on several parameters (Eriksson et al. 2014). On the other hand, Faria (2020) employed the absolute

[12] The value of buildings, objects, or elements is the main driver for their conservation because the reason for conservation is to maintain valuable things for people and communities (Appelbaum 2012).

‘significance/weight values’ developed by the Portuguese assessment model to avoid the varying determination of values. Furthermore, Del and Tabrizi (2020) noticed that some building attributes were addressed more than others in the literature due to their different values in the conservation process.[13]

Therefore, they adopted the Shannon entropy weighting method to indicate the frequency of investigating each attribute in the literature and consequently determine their significance value. A total of 188 scientific papers were examined, and 34 physical elements were identified and categorised into four levels of significance (**Table 2.4**). The study highlighted the main architectural and urban physical elements that affect the conservation process and determined their weight of significance.

The analysis of the previous assessment frameworks highlights that any framework consists of four main parts: impacted building attributes (as the assessment criteria), description of changes, significance/weight value of criteria, and the scale of impacts (**Figure 2.3**). Eventually, there is no assessment framework that includes all the architectural, urban, and thermal impacted attributes identified by Del and Tabrizi (2020). The architectural, urban, and thermal assessments have usually been considered separately in previous studies, conducted by researchers from different disciplines with the aim of providing a better understanding of either aspect.

[13] Valuable objects are prioritised in the conservation study as their impact on conservation is more than less valuable objects. Therefore, different significance values are given to the building’s components during the conservation process and assessment (Del and Tabrizi 2020).

Table 2.4: Categorisation of physical elements' significance (Del and Tabrizi 2020, p. 12)

Degree of Significance	Physical elements	Weight of Significance	Frequency
Very High Significance	Building Material	0.889	106
High Significance	Geometry	0.703	39
	Construction technique	0.667	32
	Façade Design	0.667	32
	Structural System	0.667	32
Moderate Significance	Ornamentation	0.592	21
	Colour	0.574	19
	Functionality	0.544	16
	Roof Type	0.521	14
	Size	0.495	12
	Plan Design	0.495	12
	Yard	0.481	11
	Arch	0.481	11
Low Significance	Proportion	0.430	8
	Enclosure	0.430	8
	Urban Fabric	0.430	8
	Balcony	0.409	7
	Painting	0.409	7
	Temperature	0.409	7
	Pillar	0.386	6
	Number of Floors	0.386	6
	Greenery	0.361	5
	Plaster	0.361	5
	Arched Window	0.331	4
	Porch	0.331	4
	Window Dimension	0.331	4
	Building Height	0.331	4
	Vault	0.331	4
	Skyline	0.298	3
	Symmetry	0.298	3
	Dome	0.298	3
	Stone Cut	0.298	3
	Light	0.263	2

The following sections review these studies to be able to overlap their methods and consequently develop a more comprehensive and interdisciplinary assessment framework, combining quantitative and qualitative methods for the architectural, urban, and thermal assessments in this thesis.

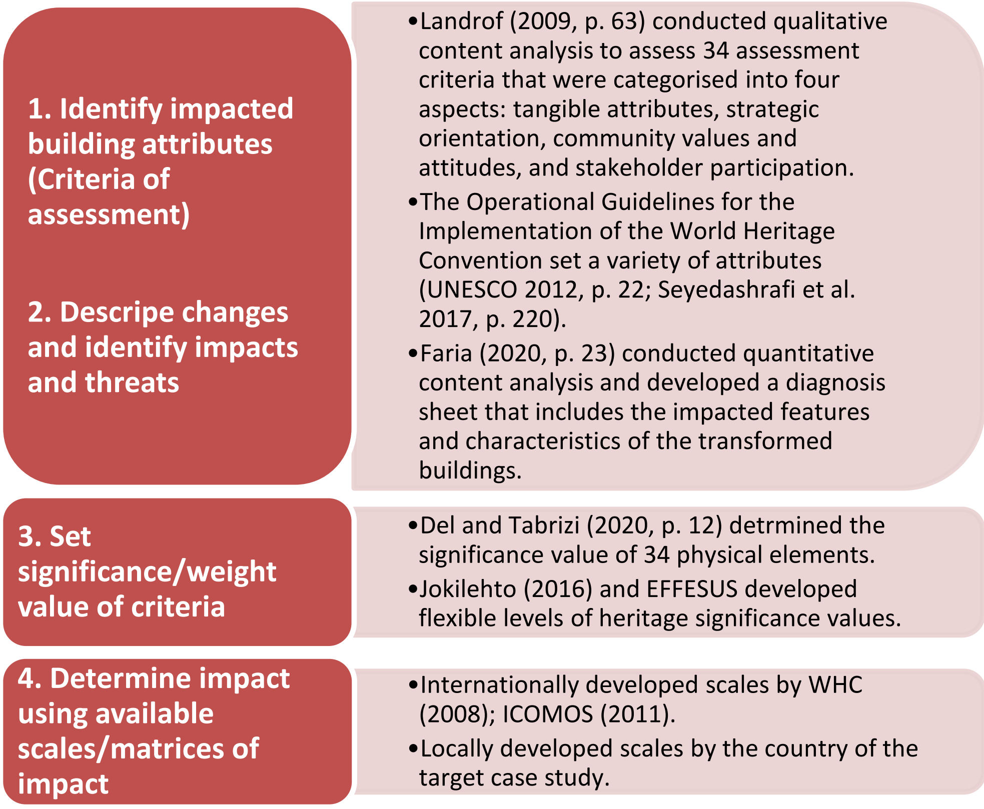

Figure 2.3: Process of developing a HIA framework (Author 2022)

2.4 Architectural and Urban Assessment

Over the years, the assessment of changing the architectural and urban features of vernacular settlements received increased attention across the vernacular architecture literature (Oliver 2007). For instance, Amos Rapoport (1969), in his first book *House Form and Culture*, proposed a theoretical framework by observing a great diversity of house forms and types and the parameters that shaped them. He aimed to provide better understanding of the forces that shaped the dwellings and to interpret how people had organised and used dwelling space. Rapoport stated that socio-cultural factors are the key determinants of the way vernacular buildings are shaped. These include religion, tradition and customs, economy, and defence.

On the other hand, he considered the building materials, construction techniques, and climate as modifying factors. For Rapoport, vernacular architecture is the process of translating the determinant parameters, and the vernacular built environment is the result of this process. Moreover, Paul Oliver (2003), in his book *Dwellings: The House across the World*, explored the varying domestic architecture around the world. He briefly defined the types of dwellings found in different village, rural area, and town environments. Oliver also documented the different types of global vernacular architecture in his *Encyclopedia of Vernacular Architecture of the World* (Oliver 1997). Douglas Fraser (1968) analysed the planning of vernacular villages and rural settlements across the world. Furthermore, Vellinga, Oliver and Bridge (2007) created an atlas to map out the world's vernacular architecture.

Overall, the studies focused on recording and assessing the physical built environment of vernacular architecture, such as vernacular forms, typologies, plans, traditional materials, and construction techniques. The typical technical approach for such assessment is surveying the restored buildings/settlements, focusing on the compatibility between the adopted changes, cultural identity, and the current needs of the occupants (Steele and Badran 2005; Asquith and Vellinga 2006). Besides, interviews with occupants and stakeholders were employed to consider their viewpoints in the assessment process (Steele and Badran 2005; Oliver 2007).[14]

[14] Oliver (2007) focused on vernacular know-how and how buildings are related to society and found that people's behaviour and climatic conditions translate vernacular traditions into buildings that have survived for centuries.

Such an approach would enhance the understanding of the mutual interaction of people and their built environment, in accordance with Rapoport (1976), who stated that a good understanding of behavioural patterns is essential to understand vernacular forms, and that vernacular forms affect people's behaviours and lifestyles. Bourdier and AlSayyad (1989) added that the dynamic nature of this interaction should be interpreted in a wider sense, showing how vernacular buildings adopt changes to meet the new needs of evolving cultures. This statement is supported by various field-based studies, such as Glassie (1990), who found that vernacular buildings and settlements are cultural representatives that vary over time and from place to place according to the evolving/different cultures.

Another research by Asquith and Vellinga (2006) highlighted that the restoration of vernacular buildings is a function of vernacular adaptation and reinterpretation, becoming the central theme in conserving vernacular architecture. Al Haija (2011) stated that there was a problem in preserving the compatibility between the overall context and restored buildings in Jordan, considering their cultural values and significance.[15] The same problem was well investigated and analysed by Waked (2008), who surveyed various restored buildings, focusing on the compatibility between their spatial arrangement and the current needs of the occupants. He found that some changes were applied, such as covering a courtyard with a transparent all-glass roof.

[15] The cultural context is the most vital and effective force that guides and controls society in Jordan. The cultural context is formed mainly according to locals' religious beliefs, as religion is very effective and controls every aspect of their daily life. This includes their food, clothing, behaviour, and houses (Waked 2008).

The courtyard, which is the heart and most active space in vernacular houses, was created for thermal and privacy purposes (Steele and Badran 2005). Covering its roof kept the introverted orientation with respect to privacy and cultural purposes. However, its thermal role was overlooked, leading to excessive heating in summer (Waked 2008). Further studies have discussed the problem of restoring vernacular buildings in the 21st century. For instance, Lawrence (2006) conducted a theoretical analysis based on the archives of various case studies to understand the previous practice of restoration aimed at conserving vernacular buildings that were neglected.

He found that restoring vernacular architecture is challenging because cultures become more open, complex, and dynamic due to cultural globalisation, environmental challenges, political crises, and the huge technological development of the 21st century (Lawrence 2006). Moreover, Asquith and Vellinga (2006) drew attention to new kinds of connections between local communities on the one hand, and between businesspeople, tourists, and immigrants on the other. They observed that local communities have become more dynamic and open to changes in the 21st century, leading to the participation of a larger diversity of people in the restoration of vernacular architecture (Asquith and Vellinga 2006).

Chandel, Sharma and Marwah (2016) stated that such participation increased the challenge of conserving vernacular buildings, making their use limited nowadays. They also identified various constraints that restrict the use of traditional approaches in the restoration process, including the non-availability of original skills of builders, economic status, inflexibility to undertake renovation works and deterioration defects, and the trends of construction (the preference for contemporary materials and techniques). Moreover, Fernandes et al. (2015, p. 324) stated that nowadays, the construction trend is towards the homogenisation of cultures due to increasing globalisation and the use of new and mass-produced materials instead of local and traditional ones.

The influence of changing the traditional approaches was investigated in many previous studies, showing their drivers and impacts. For instance, Lawrence (2006) and Oliver (2007) compared original (unaltered) and restored (altered) vernacular buildings. They found that the modern materials and the new technologies have homogenised buildings worldwide after replacing the original ones, following the trend of new construction methods and materials in each area.[16] The same comparison was well investigated by Tawayha, Braganca and Mateus (2019) who added that the construction and running costs of vernacular buildings are less than restored buildings that use modern materials, in accordance with previous studies (Steele and Badran 2005; Philokyprou, Michael and Thravalou 2013).

However, vernacular houses still need frequent repairs and maintenance, such as replacing roofs every year and repairing the plaster layer that decays over time (Philokyprou, Michael and Thravalou 2013). Overall, the studies of architectural and urban assessment employed qualitative and quantitative

[16] One of the remarkable practices of traditional materials and techniques can be seen in New Gourna, Egypt, by Hasan Fathy. Fathy (1973), in his book Architecture for the poor: an experiment in rural Egypt, described his design strategies. He used traditional Egyptian architectural designs, including vaulted roofing and courtyards. Local materials such as mudbrick were used for their environmental and economic benefits. Fathy taught the villagers how to use the mudbrick, and he worked with them to observe the construction process and to understand and meet their needs in his design. He introduced design strategies to how vernacular buildings adapt to the hot, arid climate.

methods, indicating the significance of engaging occupants in adapting vernacular buildings to the socio-cultural and environmental contexts (Ali, Zoubi and Badarneh 2010; Almatarneh 2013).[17] Oliver (2007) stated that such engagement is formed by climatic, cultural, and environmental factors that affect the construction and development of vernacular architecture.

However, their influence degree varies in different circumstances and conditions. Therefore, further comparisons were made regarding adapting vernacular buildings to the surrounding environment. For instance, Fernandes et al. (2014) compared two types of Mediterranean vernacular architecture in southern Portugal and northern Egypt. Similar vernacular features and strategies were noticed in both case studies due to similar climatic conditions across the Mediterranean regions, despite the various Arab- or Roman-based cultures.

Hence, the study of climatic conditions and thermal assessment are essential when investigating the transformation of vernacular architecture. In this case, quantitative analysis can be undertaken according to Nicol, Humphreys and Roaf (2012), considering the thermal assessment as an integral part of the overall assessment framework.

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[17] Ali, Zoubi and Badarneh (2010) compared the energy consumption of both vernacular and modern buildings. In their study, 80 vernacular buildings were documented and monitored in different climatic regions and classified according to their form, materials, orientation, and shading devices. This was done to calculate the energy consumption according to the design parameters. They found that vernacular buildings provided short- and long-term benefits. Furthermore, Almatarneh (2013) investigated various vernacular case studies in As-Salt, Jordan to analyse the adaptation of Jordanian vernacular buildings to their environmental context. A range of typologies in six vernacular cases was comprehensively studied and analysed. He investigated the approaches of sustainability within Jordanian vernacular buildings, including indoor environmental quality, energy efficiency, sustainable site planning and management, water efficiency, material and resources, and innovation.

2.5 Thermal Assessment

Over the years, the assessment of the thermal performance and comfort of vernacular buildings received increased attention across the vernacular architecture literature (Hong et al. 2009). The typical technical approach for such assessment is monitoring the physical variables, e.g., temperature and humidity, to assess the performance of buildings in terms of daily variations and thermal comfort (Bozonnet, Doya and Allard 2011; Soebarto and Bennetts 2014). Besides, post occupancy evaluation surveys were employed to take the viewpoint of occupants in the thermal assessment by rating their satisfaction and comfort (Nicol and Roaf 2005).

Such an approach would enhance the understanding of the relationship between occupants and the buildings they occupy and the factors that shape their relationship (Leaman, Stevenson and Bordass 2010). Cole et al. (2013) added that the nature of this relationship should be interpreted in a wider sense that is beyond the typical technical approach. For instance, there is a prevalent belief that the different cultures, climates, places, or times affect the way people consider their satisfaction with the thermal environment (Chappells and Shove 2005; Nicol and Roaf 2017).

Chappells and Shove (2005) stated that the perception of comfort is a function of the socio-cultural contexts, the human physical state, the building attributes, and the way of life. This statement is supported by various field-based studies that investigated the influence of the mentioned factors. For instance, Wilhite et al. (1996) compared the way occupants control the indoor thermal environment in Norway and Japan. They found a clear difference in the comfort preferences and behaviour according to the impact of the different cultures. The same impact was well investigated and analysed by Kempton and Lutzenhiser (1992).

Another research by Leaman and Bordass (2007) illustrated the different perceptions of tolerance, comfort, and behavioural pattern of occupants in free-running and mechanically controlled buildings. Moreover, Gram-Hanssen (2010) observed that even family members, who live in the same building, could have different behavioural patterns and heat consumption due to their different thermal preferences. Overall, the thermal performance studies have employed quantitative and qualitative methods, indicating the significance of engaging occupants in adjusting indoor thermal conditions (Rijal et al. 2007; Hoes et al. 2009).

Cole et al. (2013) stated that such engagement is shaped by cultural, behavioural, psychological, economic, religious, and contextual factors. However, their influence degree varies in different circumstances and conditions. For instance, the study of human behaviour is quite essential when investigating thermal comfort in the developing world because of issues related to comfort affordability. In this case, social qualitative analysis can be undertaken according to Stevenson and Rijal (2010), considering occupants as an integral part of the overall thermal performance assessment.

In addition to the socio-cultural factors, the influence of changing the building parameters was investigated by many scholars. The problem of poor thermal performance when replacing original construction materials with new ones was the main topic of most studies (Singh, Mahapatra and Atreya 2010;

Weber and Yannas 2013). For instance, Priya et al. (2012) compared the thermal properties of traditional and contemporary materials and found that traditional ones are more efficient in providing thermal comfort and reducing energy consumption. This statement is supported by various field-based studies that investigated the advantages of using traditional construction materials in improving the thermal performance of buildings.

For instance, Weber and Yannas (2013) compared the thermal performance of vernacular and contemporary buildings to figure out which building envelope provides better thermal conditions. They found that traditional building envelopes offer more stable indoor thermal conditions due to the low conductivity of thermal transfer. Similarly, Michael, Philokyprou and Argyrou (2014) and Philokyprou et al. (2017) assessed the effectiveness of the building envelope and thermal mass of Eastern Mediterranean vernacular buildings. They found that the thermal mass of the thick stone walls and clay roofs resulted in smaller fluctuations in indoor temperatures.

However, there is a critical knowledge gap regarding the efficiency of contemporary construction materials used in restored buildings. The comparisons made in previous studies do not represent the comparison between original and restored buildings because they neglected the fact that the restored buildings have emerged from the original ones, whereas contemporary buildings have no connection with vernacular buildings. Therefore, a comparison study can be undertaken between original (unaltered) and restored (altered) buildings to illustrate the influence of the adopted changes on providing stable indoor thermal conditions and thermal comfort.

This study seeks to adopt this comparison approach to assess the thermal impact, e.g., indoor thermal environment and thermal comfort, of transforming vernacular dwellings into tourist accommodations. This can be used to compare the thermal performance of the original and restored buildings in the same circumstances, considering the thermal properties of the construction materials, urban pattern, and building envelopes. The combination of this assessment approach and the typical technical methodology (thermal monitoring and POE) will form a sufficient assessment approach, considering occupants as an integral part of the overall assessment framework.

2.6 Post Occupancy Evaluation (POE)

According to Leaman and Bordass (2001), the POE assessment tool was initiated in the 1960s, and received massive advancement in the literature throughout the 1980s. Over the last four decades, POE received increased attention across assessment studies as it collects a variety of information from buildings' occupants (Zimmerman and Martin 2001). Bordass (2004) stated that POEs are used to assess and improve the performance and functionality of buildings from occupants' perspectives. Occupants are used as participants or 'measuring instruments' in the process of assessing a building's performance and finding existing problems (Leaman, Stevenson and Bordass 2010, p. 564; Pereira, Rodrigues and Rocha 2016).

The typical technical approaches for employing POEs include semi-structured interviews and questionnaire-based surveys that aim to rate occupants' experiences and responses to the thermal and built environment

(Leaman, Stevenson and Bordass 2010). Studies concerned with occupants' satisfaction with the built environment have identified several factors that contribute to the overall satisfaction, such as satisfaction with the indoor facilities (Leaman and Bordass 2001), indoor physical conditions (Veitch et al. 2007; Thomas 2010), and opening sizes (Bluyssen, Aries and Dommelen 2011).

Meanwhile, Veitch et al. (2007) stated that the perception of the overall thermal comfort is a function of several factors, such as the air temperature, radiant temperature, humidity, and air movement. Studies concerned with the thermal environment have investigated occupants' responses to these factors by discussing their sensations, preferences, and behaviour in certain circumstances (Leaman and Bordass 2001). Another research by Wongbumru and Dewancker (2016) stated that most POE studies focused on energy consumption, occupant behaviour, indoor space arrangement, and overall satisfaction. For instance, Agha-Hossein et al. (2013) conducted a POE study to assess energy consumption and overall occupants' satisfaction in a refurbished office building in London.

Overall, POE studies have employed qualitative and quantitative methods for different purposes, such as evaluating thermal performance, comfort, and sustainability of buildings (Adekunle and Nikolopoulou 2016), assessing occupants' satisfaction and comfort (Preiser and Vischer 2006; Graham, Gosling and Travis 2015), and offering insights into the approaches of improving the built environment (Zallio and Clarkson 2022). Zimmerman and Martin (2001) stated that such POE studies provide useful information to improve the design guideline and criteria. This statement is supported by various studies that investigated the benefits of POE surveys.

For instance, Vischer (2002) found that POEs help identify features of successful design to be repeated, identify potential solutions to existing problems, ensure occupants' involvement in the assessment process, and understand the consequences of design approaches. Leaman and Bordass (2001, p. 142) stated that such benefits drew developers' attention to employ POE surveys, aiming to ensure that occupants perceived value in developed buildings and improve future developments by reviewing occupants' responses. Indeed, the analysis of POE surveys' findings provides lessons for future development projects to ensure better practices and avoid existing problems (Leaman and Bordass 2001). This approach would improve the building performance of developed buildings when similar development projects take place.

Such an approach was adopted by Dabaieh, Makhlouf and Hosny (2016), who assessed the development of two vernacular settlements in Egypt: the El-Gara and El-Heiz villages. They specifically aimed to assess the efficiency of rooftop photovoltaic (PV) retrofitting in providing zero-energy vernacular buildings. The POE survey measured the satisfaction responses of occupants with the PV features, such as the system flexibility, functionality, and maintenance. Discussing the results of the POE survey helped identify challenges and suggest potential solutions for future retrofitting and development projects (Dabaieh, Makhlouf and Hosny 2016).

This study seeks to adopt this approach to assess tourism development projects, that restore vernacular settlements by transforming their buildings into tourist accommodations, from the occupants' perspective. Tourist accommodations are occupied by people of different age, gender, and socio-cultural background. This raises the problem of considering different needs and requirements when planning the restoration approaches (Pereira, Rodrigues and Rocha 2016). The employment of POE would help overcome this problem in future tourism development projects by appraising the successful restoration attempts, identifying existing challenges, and suggesting potential solutions.

2.7 Research Gap

Several researchers have conducted work on the assessment of regenerating vernacular architecture. Their studies focused on the approaches of reusing abandoned vernacular buildings/settlements, presenting different case studies of reused buildings/settlements to show the significance of adaptive reuse in their conservation. Other studies have investigated existing HIA frameworks, methodologies, matrices, and tools concerned with heritage impact assessment. However, there remains a gap in studies on the HIA process of vernacular architecture when it is reused for tourism purposes, and this is the point of departure for this study.

Despite vernacular buildings/settlements have been affected by rehabilitation projects associated with tourism development in rural settlements worldwide, the conservation of vernacular assets and their tangible and intangible values has not been addressed through an integrated HIA methodology.

Furthermore, it was clear that the regeneration of rural settlements was challenging, concerning the compatibility between heritage conservation (maintaining the inherited cultures) and tourism development (adapting to the requirements of tourists). The gap between heritage conservation and tourism development should be addressed by combining both disciplines within the context of sustainable development.

Currently, there is no available study yet that offer insights into both conservation and sustainability, so more studies are required in this area. Moreover, there is no published study that combines architectural and urban assessment with thermal assessment. The study of vernacular architecture conservation and the thermal performance of vernacular buildings is usually investigated separately, conducted by researchers from different disciplines whose analysis concentrates on just one aspect. This study aims to fill this gap in the research field, taking an interdisciplinary approach, with the development of a novel methodology.

This study seeks to develop an integrated assessment framework for assessing the impact of development projects that transform vernacular settlements into tourist accommodations. The aim of this comprehensive framework is to examine what took place during the transformation, to trace changes, and to assess the impact of these, combining the architectural, urban, and thermal assessments. Moreover, it will assess the validity of the adopted changes, while considering the conservation of the original culture and the requirements and behaviour of the new users.

2.8 Theoretical Framework

The research problem of this study investigates the integration of heritage conservation and sustainable development in the era of climate change, searching for a balance between both approaches. The UNESCO institute of statistics defined heritage conservation as maintaining the physical and cultural features of the built environment by ensuring the transmission of their values over generations (UNESCO 2009). Meanwhile, Simpson (2001) defined ‘sustainable development’ according to the Brundtland Report definition as ‘development that meets the needs of the present without compromising the ability of future generations to meet their own needs’, and this remains the most common definition (Simpson 2001, p. 6).

As the key aim of this study is to assess the transformation of vernacular buildings/sites into tourist accommodation, the study focuses on the tangible heritage features (architectural and urban assets), thermal performance, and occupants’ viewpoints. Hence, this study aims to develop an integrated assessment framework to address the research question: *How to assess the transformation of vernacular settlements into tourist accommodations, combining heritage conservation and thermal assessments?* To do so, a critical review of assessing heritage conservation and thermal performance in transformed vernacular buildings was carried out in the previous sections, investigating existing assessment methodologies.

Considering the most relevant theories to this study’s scope, a theoretical assessment framework was developed in a way that combines the architectural, urban, and thermal assessments with the assessment of occupants' satisfaction and comfort (**Figure 2.4**). The first part of this theoretical assessment framework is the architectural and urban assessment. Three main theories (ICOMOS 2011; Del and Tabrizi 2020; Faria 2020) were adopted to develop a HIA framework, considering the most relevant assessment frameworks in the field of heritage conservation and sustainable development (**Table 2.5**).

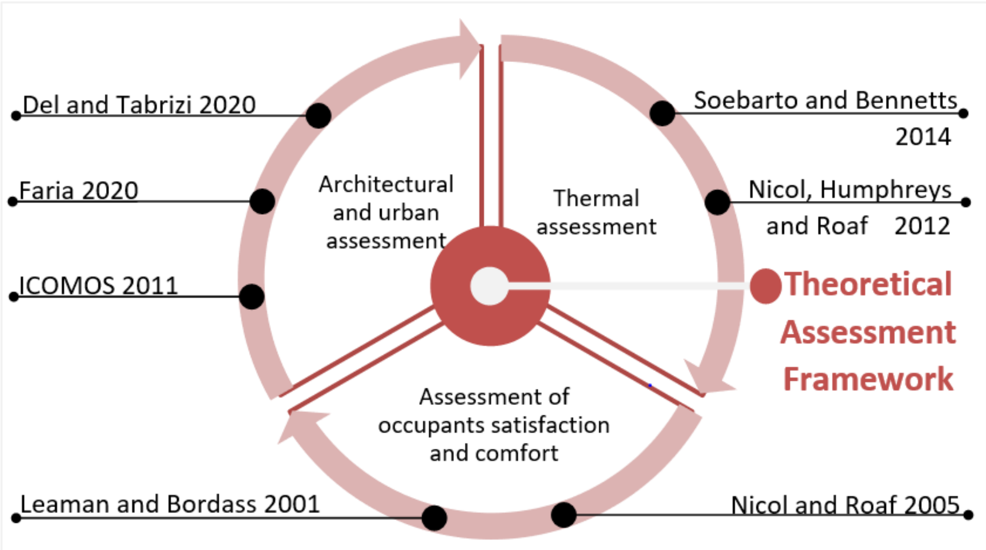

Figure 2.4: Components and main theories of the theoretical assessment framework (Author 2022)

Following the process of developing a HIA framework (illustrated in Figure 2.3), these theories were critically analysed to understand how they could be overlapped to develop an integrated HIA framework (**Figure 2.5**). Del and Tabrizi (2020) established 34 architectural and urban physical elements that affect the conservation process and determined their significance. This study used 19 architectural and urban elements as the assessment criteria for evaluating transformed vernacular buildings (**Table 2.6**). The other 15 physical elements were eliminated because they are considered irrelevant to the architectural and urban assessments, such as the ornamentation.

Table 2.5: Main three theories of the HIA framework (Author 2022)

Theory	ICOMOS 2011		Del and Tabrizi 2020	Faria 2020
Field of Application	World Heritage management		Methodological assessment of the significance of physical values in architectural conservation using the Shannon entropy method	Assessment framework for vernacular buildings
Type	Operational Qualitative Quantitative		Academic Qualitative Quantitative	Academic Qualitative Quantitative
Sample	Tested on 3 Natural World Heritage sites as pilot projects		Examination of 188 papers	Sample of 24 buildings in Serra de Santo António
Type of Data	Scale of impact	Significance of overall impact	Significance/weight values	Diagnosis and impact Excel sheets
Type of Rating	0= No change	0= Neutral	Very high significance (value > 0.80)	Building ID
	1= Negligible Change	±1= Negligible Adverse or Beneficial	High significance (value= 0.60-0.80)	Original features
	2= Minor Change	±2= Minor Adverse or Beneficial	Moderate significance (w= 0.45-0.60)	Current characteristics
	3= Moderate Change	±3= Moderate Adverse or Beneficial	Low significance (value= 0.20-0.45)	Impact of changes
	4= Major Change	±4= Major Adverse or Beneficial	-	-

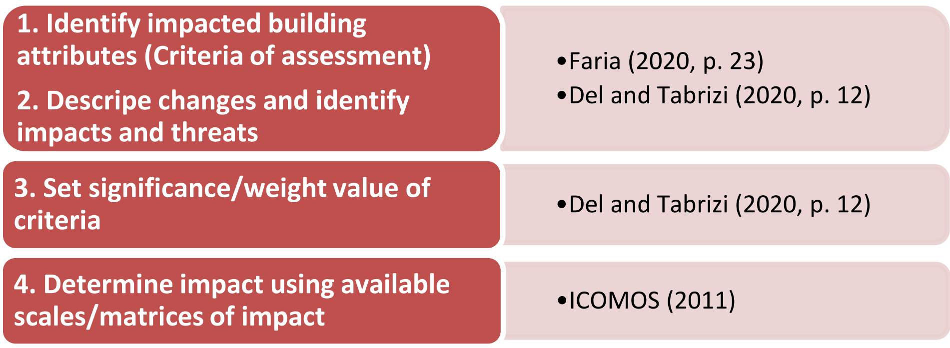

Figure 2.5: Contribution of each theory in the development of this study's HIA framework (Author 2022)

Moreover, Faria (2020) developed an assessment framework for vernacular limestone buildings using Microsoft Excel. Faria established a list of assessment criteria and categorised them in a way that promotes the assessment of each architectural element, such as wall, roofs, openings, and forms. This study overlaps the categories established by Faria (2020) with the architectural and urban elements established by Del and Tabrizi (2020) in order to establish comprehensive criteria of assessment. Afterwards, the significance/weight values, established by Del and Tabrizi (2020), are used to give each assessment criterion a value of impact (**Table 2.7**). It is found that few criteria have no significance values, such as windowpanes and windowsills. Therefore, the researcher suggested their significance values.

Table 2.6: Significance/weight values of the adopted assessment criteria (Del and Tabrizi 2020, adapted by author 2022)

Degree of Significance	**Physical Elements (Assessment criteria)**	**Significance Value**
Very High Significance	Construction Materials	0.889
High Significance	Form	0.703
	Construction technique	0.667
	Façade Design	0.667
Moderate Significance	Colour	0.574
	Land Use	0.544
	Roof/Wall Type	0.521
	Indoor Facilities	0.495
	Arch	0.481
Low Significance	Proportion	0.430
	Context (Enclosure)	0.430
	Urban Fabric	0.430
	Painting	0.409
	Number of Floors	0.386
	Plaster	0.361
	Shape of Window	0.331
	Size of Window	0.331
	Building Height	0.331
	Skyline	0.298

It is also noticed that the values are hard to compare and would complicate the calculations afterwards. Therefore, equivalent values are determined to give each criterion a significance value out of 1.00. The equivalent values are calculated as follows:

1. Sum the significance values of the architectural criteria of assessment,

2. Divide the significance value of each criterion by the sum of significance values.

Table 2.7: Categorised assessment criteria and their significance value developed by overlapping those from Faria (2020) and Del and Tabrizi (2020) (Author 2022)

<table>
<tr><th>Architectural Assessment</th><th colspan="2">Significance Value</th></tr>
<tr><td colspan="3">Roof</td></tr>
<tr><td>Type of Roof/ Thickness</td><td colspan="2">0.521</td></tr>
<tr><td>Construction Materials</td><td colspan="2">0.889</td></tr>
<tr><td>Construction Technique</td><td colspan="2">0.667</td></tr>
<tr><td>Plaster</td><td colspan="2">0.361</td></tr>
<tr><td>Painting</td><td colspan="2">0.409</td></tr>
<tr><td colspan="3">Exterior Walls</td></tr>
<tr><td>Type of Wall/ Thickness</td><td colspan="2">0.521</td></tr>
<tr><td>Construction Materials</td><td colspan="2">0.889</td></tr>
<tr><td>Construction Technique</td><td colspan="2">0.667</td></tr>
<tr><td>Façade Design</td><td colspan="2">0.667</td></tr>
<tr><td>Plaster</td><td colspan="2">0.361</td></tr>
<tr><td>Painting</td><td colspan="2">0.409</td></tr>
<tr><td colspan="3">Form</td></tr>
<tr><td>Building layout</td><td colspan="2">0.703</td></tr>
<tr><td>Proportion</td><td colspan="2">0.43</td></tr>
<tr><td>Number of Indoor Spaces</td><td colspan="2">0.495</td></tr>
<tr><td rowspan="4">Added Indoor Spaces</td><td>To the side</td><td></td></tr>
<tr><td>Blend in</td><td></td></tr>
<tr><td>Added floor</td><td></td></tr>
<tr><td>Total</td><td></td></tr>
<tr><td>Number of floors</td><td colspan="2">0.386</td></tr>
<tr><td colspan="3">Openings</td></tr>
<tr><td>Shape of Openings</td><td colspan="2">0.331</td></tr>
<tr><td>Size of Openings</td><td colspan="2">0.331</td></tr>
<tr><td>Windowpanes</td><td colspan="2">-</td></tr>
<tr><td>Windowsills</td><td colspan="2">-</td></tr>
<tr><td>Opening Frame</td><td colspan="2">-</td></tr>
<tr><td>Door’s Material</td><td colspan="2">-</td></tr>
<tr><td colspan="3">Urban Assessment</td></tr>
<tr><td>Land Use</td><td colspan="2">0.544</td></tr>
<tr><td>Urban Fabric</td><td colspan="2">0.430</td></tr>
<tr><td>Skyline</td><td colspan="2">0.298</td></tr>
</table>

For the urban assessment criteria, it is observed that Faria (2020) focused only on the architectural assessment. Meanwhile, the criteria established by Del and Tabrizi (2020) are not detailed enough, including only the urban fabric, skyline, and land use. Therefore, the researcher goes into more details with the urban assessment criteria and suggests their significance values. As a result, the urban fabric criterion is divided into more detailed aspects, including the urban configuration, street pattern, and infrastructure. The landscape criterion is also added. Moreover, the significance values are suggested as follows: 30% urban configuration, 20% land use, 20% street pattern, 10% skyline, 10% infrastructure, and 10% landscape. **Table 2.8** presents the final draft of the architectural and urban assessment criteria and their equivalent significance values.

Table 2.8: Final draft of the architectural and urban assessment criteria and their equivalent significance values (Author 2022)

Architectural Assessment	**Significance Value**	
Roof		
Type of Roof/ Thickness	0.06	
Construction Materials	0.10	
Construction Technique	0.07	
Plaster	0.04	
Painting	0.05	
Exterior Walls		
Type of Wall/ Thickness	0.06	
Construction Materials	0.10	
Construction Technique	0.07	
Façade Design	0.07	
Plaster	0.04	
Painting	0.05	
Form		
Building layout	0.08	
Proportion	0.045	
Number of Indoor Spaces	0.055	
Added Indoor Spaces	To the side	
	Blend in	
	Added floor	
	Total	
Number of floors	0.04	
Openings		
Shape of Openings	0.02	
Size of Openings	0.02	
Windowpanes	0.01	
Windowsills	0.005	
Opening Frame	0.005	
Door's Material	0.01	
Urban Assessment		
Land Use	0.20	
Urban Configuration	0.30	
Skyline	0.10	
Street pattern	0.20	
Infrastructure	0.10	
Landscape	0.10	

The final step of developing the HIA framework is using the ICOMOS's HIA model (2011) to evaluate the established assessment criteria, and consequently the transformed heritage buildings/sites. Microsoft Excel is then used to overlap the adopted data from ICOMOS (2011), Del and Tabrizi (2020), and Faria (2020) theories. A five-point scale (from 0 = no change to 4 = major change) is used to indicate the scale/severity of impact. Moreover, a nine-point scale (from -4 = major adverse to 4 = major beneficial) is used to indicate the attribute/significance of impact.

Table 2.9 illustrates the excel sheet of this study's HIA, resulting from integrating the criteria of assessment derived from Del and Tabrizi (2020) and Faria (2020) with the significance values derived from Del and Tabrizi (2020) with the HIA scales derived from ICOMOS (2011).

Table 2.9: Excel sheet of this study's HIA framework (Author 2022)

Criteria of Assessment	**Description**	**Significance Degree**	**Impact Scale/ Severity**	**Weighted Impact**	**Impact Attribute/ Significance**	**Weighted Attribute**
Architectural Assessment						
Roof						
Type of Roof/ Thickness	Before: After:	0.06				
Construction Materials	Before: After:	0.10				
Construction Technique	Before: After:	0.07				
Plaster	Before: After:	0.04				
Painting	Before: After:	0.05				
Sum of Significance		0.32	Total Result		Total Result	
			Score of Impact Scale		Score of Impact Attribute	
Exterior Walls						
Type of Wall/ Thickness	Before: After:	0.06				

Construction Materials	Before:	0.10				
	After:					
Construction Technique	Before:	0.07				
	After:					
Façade Design	Before:	0.07				
	After:					
Plaster	Before:	0.04				
	After:					
Painting	Before:	0.05				
	After:					
Sum of Significance		0.39	Total Result		Total Result	
			Score of Impact Scale		Score of Impact Attribute	
Form						
Building layout	Before:	0.08				
	After:					
Proportion	Before:	0.045				
	After:					
Number of Indoor Spaces	Before:	0.055				
	After:					
Number of floors	Before:	0.04				
	After:					
Sum of Significance		0.22	Total Result		Total Result	
			Score of Impact Scale		Score of Impact Attribute	
Openings						
Shape of Openings	Before:	0.02				
	After:					
Size of Openings	Before:	0.02				
	After:					
Windowpane	Before:	0.01				
	After:					
Windowsills	Before:	0.005				
	After:					
Opening Frame	Before:	0.005				
	After:					
Door's Material	Before:	0.01				
	After:					
Sum of Significance		0.07	Total Result		Total Result	
			Score of Impact Scale		Score of Impact Attribute	
Total Architectural Impact						
Sum of Significance		**1.00**	**Total Result**		**Total Result**	
			Score of Impact Scale		**Score of Impact Attribute**	

<table>
<tr><th colspan="7">Urban Assessment</th></tr>
<tr><td rowspan="2">Land use</td><td>Before:</td><td rowspan="2">0.20</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>After:</td></tr>
<tr><td rowspan="2">Urban configuration</td><td>Before:</td><td rowspan="2">0.30</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>After:</td></tr>
<tr><td rowspan="2">Skyline</td><td>Before:</td><td rowspan="2">0.10</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>After:</td></tr>
<tr><td rowspan="2">Street pattern</td><td>Before:</td><td rowspan="2">0.20</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>After:</td></tr>
<tr><td rowspan="2">Infrastructure</td><td>Before:</td><td rowspan="2">0.10</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>After:</td></tr>
<tr><td rowspan="2">Landscape</td><td>Before:</td><td rowspan="2">0.10</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>After:</td></tr>
<tr><th colspan="7">Total Urban Impact</th></tr>
<tr><td colspan="2">Sum of Significance</td><td>1.00</td><td>Total Result</td><td></td><td>Total Result</td><td></td></tr>
<tr><td colspan="3"></td><td>Score of Impact Scale</td><td></td><td>Score of Impact Attribute</td><td></td></tr>
</table>

The second part of the theoretical assessment framework includes the thermal assessment. Two main theories (Soebarto and Bennetts 2014; Nicol, Humphreys and Roaf 2012) are used, considering their approaches to assess the thermal performance and impact. Hence, thermal monitoring and POE are employed as a sufficient assessment approach, considering occupants as an integral part of the overall assessment framework. In accordance with Soebarto and Bennetts (2014), out of six physical variables established in ISO 7730 (2006), the thermal monitoring records the air temperature (°C) and relative humidity (%) in the original and rebuilt rooms of Dana to compare their thermal performance. This would assess of the thermal impact of the transformation and reveal which type is more efficient in providing thermal comfort.

The POE is also used as an assessment tool to assess the transformation of vernacular buildings from the occupant’s point of view, investigating occupants’ satisfaction and comfort. This presents the last part of the theoretical assessment framework, in accordance with Leaman and Bordass (2001) and Nicol and Roaf (2005). This study employs semi-structured interviews as the typical technical approach for conducting POEs, with residents asked about their experience, satisfaction, and conditions during their occupancy. This would help identify the challenges and issues related to the original and rebuilt buildings and consequently suggest potential solutions to improve future development projects.

The developed theoretical framework of this study indicates that different data collection methods are required due to the different nature of the assessment criteria. The study combines the field survey method to record the urban and architectural changes with the thermal monitoring to record the thermal environment. Furthermore, these methods are integrated with POE interviews to assess the occupants' satisfaction and comfort. This would conduct a novel methodology and intensive investigation to provide new knowledge to the field of vernacular architecture.

Chapter Three: Methodology

3.1 Introduction

This thesis aims to develop a comprehensive assessment framework to assess the transformation of vernacular dwellings into tourist accommodations. The previous chapter developed the theoretical assessment framework by examining and overlapping existed assessment frameworks. The developed framework offers an interdisciplinary comprehensive framework that combines the architectural, urban, and thermal assessments with the Post Occupancy Evaluation (POE) tool. Through the lens of this framework, various data collection and analysis methods were used to assess the various impacts of transforming vernacular dwellings.

Accordingly, the study carried out a coupling of qualitative and quantitative analyses, employing a combination of in-situ data collection methods, such as field survey, thermal monitoring, and POE. This chapter investigates the application of the adopted methods, showing how the study was conducted in terms of data collection and data analysis to address the research questions. Specifically, the data collection methods were conducted in two rounds of fieldwork in summer and winter. Archival research and field survey were employed to record and analyse the urban and architectural impact of Dana's rehabilitation project.

Meanwhile, thermal monitoring was conducted to record the physical variables, e.g., temperature and humidity, to assess the thermal performance of buildings. Paying particular attention to the personal experience of occupants and their interactions with the physical environment is believed to be fundamental in the study of vernacular architecture (Rapoport 1969; Oliver

2007; Weber and Yannas 2013). Therefore, the study employed the POE as an assessment tool to investigate occupants' satisfaction and comfort with the built and thermal environment.

As a result, an integrated methodological approach is designed for assessing the transformation of vernacular dwellings into tourist accommodation, offering an interdisciplinary study with a novel methodology. Such methodology is new in the field of architectural conservation, combining architectural and urban assessments by field surveys, thermal assessment by thermal monitoring, and occupant's point of view by POE.

3.2 Research Design

3.2.1 Methodology Paradigm

The study aims to assess the transformation of vernacular settlements into tourist accommodation, exploring the impact of sustainable ecotourism development on heritage conservation. According to the theoretical framework, the assessment of transformed settlements includes architectural, urban, and thermal assessments. For these in-depth assessments, the Case Study Method (CSM) is the ideal research approach. Yin (1984, p. 23) claimed that a case study approach is used to 'investigate a contemporary phenomenon within its real-life context when the boundaries between phenomenon and context are not clearly evident and in which multiple sources of evidence are used'.

Cohen, Manion and Morrison (2007, p. 253) added that the case study approach is useful for analysing a phenomenon's causes and effects by observing its real context. Since this study aims to explore and evaluate the transformation of vernacular settlements into tourist accommodation, the case study research is a helpful approach to achieve this aim. The case study chosen for this investigation is Dana village, which was constructed between the 1890s and 1930s, the period when most Jordanian villages were built (Khammash 1995). By the 1960s, the village was almost abandoned and started to crumble after the local community moved out looking for better services and job opportunities (Al Haija 2012).

Therefore, Dana village was transformed into an ecotourism site in an attempt to recapture its lost heritage. An integrated methodology for assessing the impact of ecotourism development on the regeneration of vernacular settlements is required to explore how far ecotourism development can act as a catalyst for regenerating abandoned vernacular settlements. Hence, this study adopts the positivist paradigm, which describes objective realities 'through observation and measurement in order to predict and control forces that surround us' (O'leary 2004, p. 5). The objective data is collected through a field survey to record the physical environment of Dana without much involvement from the researcher or occupants.

However, people's interactions with the physical environment cannot be eliminated when studying vernacular architecture (Oliver 2007). The evaluation of the efficiency of such an architecture is mainly based on the personal experience of occupants, and this would lead to another paradigm called interpretivist. Interpretivist paradigm uses human experiences to explore a phenomenon (Cohen, Manion and Morrison 2007). The subjective data of this study is collected through POE interviews to analyse the occupants' points of view within the studied area. Overall, both the positivist and interpretivist paradigms are adopted to achieve the aims of this study.

3.2.2 Integrated Methodological Approach

This study adopts the mixed-method research, combining qualitative and quantitative methods to measure objective (facts) and subjective (personal experience) data. Qualitative and quantitative data support each other and produce a better understanding that cannot be provided by either approach alone (Bernard 2017, p. 256). Thus, the overlapping of both approaches in collecting and analysing both types of data provides a stronger study compared with either qualitative or quantitative research (Saunders, Lewis and Thornhill 2009, p. 109; Creswell and Creswell 2017, p. 4). The adopted mixed-method research provides the opportunity to use a triangulation approach.

Triangulation, a way of combining quantitative and qualitative research identified by Bryman (2006), confirms the validity of data by using several methods to collect data for the same study. The qualitative approach of this study includes archival research and field survey, which were conducted to collect data required for the architectural and urban assessment. On the other hand, the quantitative approach includes thermal monitoring and POE, which were conducted to collect data required for the thermal and satisfaction assessments. As a result, an integrated methodological approach is designed to address the interdisciplinary aims of this study (**Figure 3.1**).

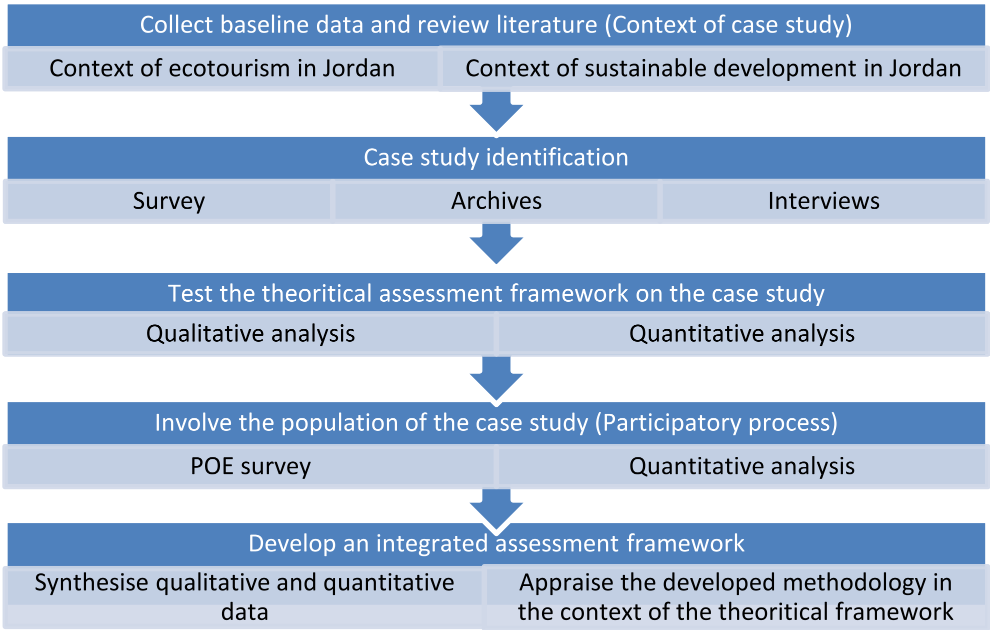

Figure 3.1: Integrated methodological approach for developing an integrated assessment framework that assesses the impact of transforming vernacular dwellings into tourist accommodation (Author 2022)

The first part of the methodology is to understand the context of the case study of Dana village, investigating ecotourism and sustainable development in Jordan and situating Dana within the context of other developments. According to the Sustainable Livelihoods Framework (SLF) developed by Simpson (2009), this initial part is essential within any integrated assessment approach. This necessitates understanding the context of ecotourism discussions in Jordan, with a particular focus on ecotourism projects, stakeholders' role in tourism development and their conflicts with the local community, before illustrating the significance of Dana village in the context of Jordan's ecotourism.

The background data was informed by related references of books, research, documents, and archives. Moreover, interviews were conducted with stakeholders during the fieldwork to enhance the basic understanding and obtain the background knowledge of the study. The identification of Dana's original vernacular architecture comes after the background data because the archival research found that the documentation of the original settlement and structures was unfortunately overlooked. Drawings, mapping, interviews, and measurements were conducted during the field survey to record the village and some representative buildings of the ruins, aiming to document the original vernacular features of Dana.

Afterwards, the theoretical assessment framework was tested on the case study of Dana village to explore the physical changes in the restored vernacular buildings and consequently assess their impacts. Through the lens of this framework, qualitative and quantitative analyses were used to assess the various impacts of transforming vernacular dwellings, including the architectural, urban, and thermal impacts. For the architectural and urban assessments, a HIA framework was developed using ICOMOS's HIA model (2011) to indicate the severity of changes/impact and the significance/attribute of the overall impact.

For the thermal assessment, thermal monitoring was carried out to measure the physical variables of the thermal environment. Measurements of the thermal environment were taken in two types of vernacular dwellings: the original buildings that reinstated the historic construction and form, and the rebuilt buildings that used modern construction materials and adapted the historic form. Furthermore, POE was used to evaluate the original and rebuilt buildings with reference to the occupants' point of view. The subjective responses were analysed statistically to measure the occupants' satisfaction and comfort with the physical and thermal environments. Finally, an integrated assessment framework was developed after synthesising the qualitative and quantitative data and critically appraising the developed methodology in the context of the theoretical framework.

The following sections illustrate in detail the application of the adopted methodologies, showing how the study was conducted in terms of data collection and data analysis to address the research questions.

3.3 Methodology of the Architectural and Urban Assessment

3.3.1 Archival Research

Archival research was conducted to collect multiple layers of data about the rehabilitation project of Dana village. The first layer of data included the theoretical basis of the rehabilitation project, such as its aims, strategies, resources, motivations, and limitations. This is presented in the reports that record the rehabilitation project to understand the applied strategies of heritage conservation and sustainable ecotourism development. These reports also provided information about the motivations offered to locals and building owners to encourage them to transform their buildings into tourism-related ones.

Further information is also provided, such as the required resources, skills, experience, technologies, and techniques fundamental to launching and completing the project. This layer of data provided a better understanding of how the rehabilitation project started and was completed. The second layer of data included the technical basis of the rehabilitation project in order to understand how the original vernacular buildings were transformed into tourism-related ones. This is presented in the architectural drawings of Dana village before and after the rehabilitation project, such as master plans, plans, sections, elevations, and 3D drawings. These architectural drawings illustrated the current physical conditions of the village on the urban and architectural scale.

The analysis of the master plans illustrated Dana's urban morphology, street pattern, pedestrian pattern, and urban elements. In addition, the analysis of the plans, sections, and elevations showed the buildings' indoor spaces, features, materials, construction techniques, and opening types. These archives were collected from the governmental, international, and private organisations involved in launching the rehabilitation project. These organisations include the Royal Society for the Conservation of Nature (RSCN), the coordinator of the project, the United States Agency for International Development (USAID), the project's funder, and Ammar Khammash engineering consulting office, the designer of the project.

3.3.2 Field Survey

The archival research showed that, unfortunately, the documentation of the original settlement has never been attempted before. Jokilehto (2007, p. 3) stated that the documentation of buildings is a vital part of the conservation process to understand the physical conditions of the buildings/sites and to document the changes that occur during the conservation process. Therefore, the field survey aimed to document the original features of Dana's vernacular architecture. The documentation will remain for future researchers as evidence of the original settlement that could be reinterpreted to develop the related knowledge, so in this sense this is a pioneering study.

The first round of the field survey was conducted in July 2019 with the aim of collecting the required data to fill the description part of the HIA sheet, indicating the original and current features of Dana's buildings (**Table 2.9**). Some of the original representative buildings that had been unaltered were recorded in order to discover their original features. This enhanced the identification of Dana's case study and supported the archival research data. The main approaches used to record the observed data during the field survey were pictures, sketches, videos, notes, and mapping.

The field survey also aimed to record the new characteristics of the transformed dwellings, which are required in the theoretical framework for the architectural, urban, and thermal assessments. For instance, the village's buildings and architectural details were sketched, such as the construction materials and techniques, forms, types of houses, types of openings, and functions, noting down the details of each sketch. These sketches are kept with a notebook of the observed traditions, customs, and behaviours. The village on the urban scale was also documented, such as the street pattern, infrastructure, land use pattern, and urban configuration, showing how the local community formed the urban morphology of the village.

Overall, as a result of the data collected through archival research and field survey, the current urban and architectural conditions of Dana village were identified. Moreover, the transformation process was identified, showing the adopted changes and alterations. This enhanced the understanding of how Dana was transformed to evaluate the transformation impact on the village's heritage by comparing the buildings before and after the interventions.

3.3.3 Data Analysis

After the documentation of the original and new form of Dana village, the study aims to assess the architectural and urban impact of transforming the village to accommodate tourists. Therefore, Dana village is compared before and after the rehabilitation project to illustrate the adopted changes and interventions and consequently evaluate their impacts. Subsequently, the adopted changes were analysed through the developed HIA framework (illustrated in Table 2.9 in the previous chapter). The investigation starts within each criterion, comparing its status before and after the rehabilitation project.

The before and after analysis was used to describe the carried-out changes and current situation of each criterion. For instance, within the methods of the construction criterion, the original methods were identified and compared to the new ones employed during the rehabilitation project. This step aimed to investigate the replacement of the original construction methods and to evaluate the extent to which the replacement respected the principles of heritage conservation and ecotourism.

Afterwards, the impact score was selected using the assessment scales developed by ICOMOS (2011). A 5-point scale (from 0 = no change to 4 = major change) was used to indicate the severity of changes/impact (**Figure 3.2**). Moreover, a 9-point scale (from -4 = major adverse to 4 = major beneficial) was used to indicate the significance/attribute of effect or overall impact (**Figure 3.3**). Overall, the transformation was quantitatively assessed as follows:

1. Trace the carried-out changes and current situation of each criterion by comparing the buildings before and after the transformation,
2. Input the level of 'scale/severity of impact' and 'attribute/significance of impact' according to ICOMOS's assessment model (illustrated in Table 2.2 in the previous chapter) by the user,
3. Calculate the weighted impact by multiplying the significance degree by the 'scale/severity of impact',
4. Similarly, calculate the weighted attribute by multiplying the significance degree by the 'attribute/significance of impact',
5. Sum the significance degrees, weighted impacts, weighted attributes of the architectural and urban criteria of assessment separately,
6. Divide the sum of weighted impact by the sum of significance degrees to determine the final score of the scale/severity of impact,
7. Divide the sum of weighted attribute by the sum of significance degrees to determine the final score of the impact attribute.
8. For the assessment of each category, repeat points 5-7, concerning the criteria of each category.

Figure 3.2: Scale of severity of change/impact (ICOMOS 2011)

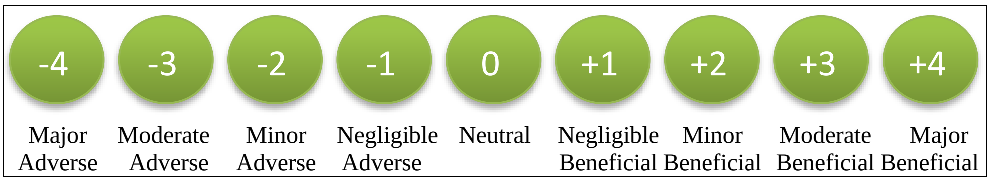

Figure 3.3: Scale of significance/attribute of effect or overall impact (ICOMOS 2011)

3.4 Methodology of the Thermal Assessment

The study also aimed to assess the thermal impact of transforming the original features of vernacular buildings. Therefore, thermal monitoring was conducted to record the thermal conditions in some of the original and rebuilt buildings. Dana hotel was selected as a representative case study to conduct the monitoring in its original and rebuilt rooms.

3.4.1 Case Study of Dana Hotel

Dana hotel, established in the late 1980s, was selected as a representative case study due to the availability of high-demand original and rebuilt rooms near each other. Moreover, as thermal monitoring needed to be conducted in buildings with no heating or cooling systems, the hotel matched this requirement as it has no mechanical systems in either type of room. Nevertheless, fans and/or heaters could be offered to both types of rooms according to the resident's demands.

The documents related to the rebuilt rooms were collected from the RSCN. These included the hotel layout, orientation, spatial arrangement, indoor facilities, construction materials, and openings sizes, quantity and orientation. Meanwhile, details of the original hotel rooms were recorded by the author as they had not been documented previously. These records illustrated the adopted changes that must have had an impact on the thermal performance of Dana hotel. Therefore, the internal and external thermal conditions were monitored to establish how the different physical features of the original and rebuilt rooms affected their thermal performance.

3.4.2 Thermal Monitoring

Out of six physical variables established in ISO 7730 (2006), thermal monitoring was conducted to record the air temperature (°C) and relative humidity (%), in accordance with other monitoring studies (Hong et al. 2009; Bozonnet, Doya and Allard 2011; Soebarto and Bennetts 2014). These variables were monitored in occupied spaces regardless of the subjective responses in order to provide data about the hotel rooms without much involvement from the occupants. Ten dataloggers were installed in ten rooms for one-month periods in August 2019 and January 2020, representing the warmest and coldest months of the year. These data-loggers were Tinytag TGU-4500 loggers for indoor monitoring and Tinytag TGP-4500 loggers for outdoor monitoring.

The monitored spaces included six original rooms and four rebuilt ones. The Tinytag loggers were adjusted to record air temperature and relative humidity every 15 minutes and were placed 1.5m above the floor level, representing the height of the occupants. The ideal location was the core of the room and away from any cooled or heated surfaces. Heating sources such as ovens, windows, doors, and solar radiation were also avoided. The monitored physical variables were then interpreted in accordance with the building design and envelope.

3.4.3 Data Analysis

The analysis started with a theoretical evaluation of the thermal performance, which included the thermal properties of the original and rebuilt rooms. This theoretical evaluation was based on the physical features of the hotel, including its form, layout, orientation, windows, and shafts. Based on these records, the ratio of glazed area to floor area was calculated for the original and rebuilt parts to determine which were more exposed to the outdoor conditions. Moreover, the thermal properties of the old and new building envelopes were calculated and compared, including the thermal resistance and U-values.

The internal and external temperatures were then analysed to practically illustrate the efficiency of the building envelope in resisting heat transfer. Preparatory calculations were first made to manage the recorded data and arrange them in a way that facilitated subsequent analysis. This included calculating the mean values of the indoor and outdoor air temperatures (°C), diurnal swing (°C), decrement factor, time lag (hours), outdoor running mean temperature (°C), and comfort temperature (°C).

The thermal performance analysis then started with analysing the variation in indoor temperatures throughout the day. A statistical method was used to illustrate the physical variables monitored in the different seasons to assess thermal performance, comparing the recorded physical measurements of the original and rebuilt rooms. Illustrative charts, figures and tables are presented to analyse the internal air temperatures of Dana hotel, including a line graph, scatter plot chart, box plot, and descriptive statistics table. As a result, the fluctuation in air temperatures in the original and rebuilt spaces in the different seasons is illustrated and compared.

The analysis proceeds with discussing the ability of the original and rebuilt rooms to provide thermal comfort. This was investigated through the adaptive thermal comfort standards BSEN15251, with plotting the hourly indoor temperatures compared to the outdoor running mean temperature, measured against the BSEN15251 adaptive comfort criteria. Comparing the hourly indoor air temperature with the BSEN15251 adaptive thermal comfort standards helped identify potential overheating and discomfort, thus showing which type of room provided better thermal comfort.

3.5 Post Occupancy Evaluation (POE) Survey

After the built environment of Dana hotel was recorded and measurements of the thermal environment provided, the study aimed to record the occupants' responses to the hotel and its thermal environment. This required the involvement of the hotel occupants, as they acted as participants, with their observations used to identify the issues and challenges of both the original and rebuilt rooms. Therefore, the study employed the POE method as an assessment tool to establish how the occupants felt during their stay at the hotel, in accordance with other studies (Agha-Hossein et al. 2013; Al-Shawabkeh, Alhaddad and Gandah 2016; Dabaieh, Makhlouf and Hosny 2016; Pereira, Rodrigues and Rocha 2016).[18]

The occupants' responses and behaviour were recorded and analysed to provide useful feedback on their occupation of both the original and rebuilt rooms. Feedback was obtained on the built and thermal performance of the original and rebuilt rooms that had undergone changes during the

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[18] Evaluation of occupied buildings' performance is essential to ascertain whether they meet the predictions of their owners and builders. POE is concerned mainly with the building, not its occupants (Nicol and Roaf 2005, p. 339). It includes evaluation of a building, as expressed by its occupants, who are asked about their personal experience, impressions, and satisfaction. Moreover, POE include the physical characteristics of the building in parallel with the occupants' level of control and any special features in the building.

rehabilitation project to adapt to the new uses, needs, and types of users. This feedback helped evaluate the validity of the adopted changes from the occupants' point of view. Consequently, the challenges and issues related to the original and rebuilt buildings were identified, and potential solutions were suggested to improve future rehabilitation projects.

The POE was conducted through semi-structured interviews, with participants (occupants of Dana hotel) asked about their experience, satisfaction, and conditions during their occupancy. The interviews were held at the same time as the thermal monitoring in August 2019 and February 2020. The interviewees were informed that their answers would be presented in an anonymous form. Moreover, they were asked to sign a consent form to ensure their willingness to participate. They were also informed about the meaning of each point in the descriptive scale of ASHRAE to avoid any misunderstanding that might occur due to different cultures and languages.

3.5.1 Structure of the POE Questionnaire

The questionnaire was structured to improve the quality of the data and to remove any vagueness.[19] It contained both closed-ended and open-ended questions (**Appendix F**). The ages of the target population varied between 18 and 65 years old. The occupants (interviewees) were asked to rate their feelings and experience on the descriptive scale of the ASHRAE standard. For most questions, the subjective responses and votes were determined using

[19] The questions obtained ethical approval from the Faculty of Humanities at the University of Kent.

a seven-point scale. Other subjective responses were determined using a five-point scale.

The questionnaire was divided into four sections, with 26 questions overall, and required 10-15 minutes to complete. General information about the interviewees was provided in the first section of the questionnaire. The second section included open-ended questions about the building features and attributes. This section aimed to provide useful feedback about the built environment of the original and rebuilt rooms of the hotel. Therefore, this section included questions such as why they chose to stay in the hotel; whether the buildings served their needs; whether they thought the buildings needed changes; and what were the best/worst attributes of the buildings?

The third section aimed to record the occupants' subjective measures and count their comfort votes regarding the temperature, humidity, and air velocity. The occupants were also asked about their preferences in order to overcome potential misunderstanding of the meaning of each point in the descriptive scale that might occur due to different cultures and languages. For instance, people from cold countries might consider 'warm' to be a positive sensation that is nice and comfortable, whereas those from hot countries might believe 'cool' to be a positive sensation that is pleasant and comfortable. The addition of the subjective preferences to the subjective votes consequently supported the accuracy of the results. The five-point scale was used to measure the preference votes.[20]

[20] The preference vote may be a preference for a warmer or cooler environment, or for no change. It can be a response indicating which of the points on the ASHRAE scale would currently be the preferred state' (Nicol, Humphreys and Roaf 2012, p. 162).

Overall, this section sets the data on the occupants' thermal sensation, thermal preference, air movement sensation, air movement preference, humidity sensation, humidity preference, day-lighting sensation, day-lighting preference, and overall thermal comfort. The final section focused on the adaptive behaviour of the occupants, the use of control, and the occupants' satisfaction with the level of control. The section aimed to record the participants' interaction with the building they were occupying, such as opening/closing windows, using heating/cooling devices, opening/closing blinds, etc. Moreover, it recorded how and when the occupants used the building's thermal controls, such as windows, doors, shading devices (blinds), lights, fans, and cooling/heating devices. After establishing the questions, the target population for the survey was selected.

3.5.2 Sampling Type

A randomly selected convenience sample was adopted due to the unknown and changing nature of the study's target population (tourists from different regions and social backgrounds staying at Dana hotel). Indeed, there was no clear or explicit sampling strategy due to the limited quantity of tourists within the survey duration. The survey was conducted in August 2019 and February 2020, with a total of 45 POE interviews: 32 in summer and 13 in winter. The interviewees were interviewed once, giving a single assessment, which aimed to understand how their responses changed from room to room, rather than understanding any change in the responses over an extended period of time.

3.5.3 Data Analysis

After conducting the POE survey, qualitative and quantitative analyses were conducted to analyse the open-ended and closed-ended questions respectively. The satisfaction and comfort votes were statistically analysed, and the frequency of the comfort/subjective votes was plotted. A histogram plot was used to show the frequency and distribution of the votes, including votes on satisfaction with the built environment, thermal sensation, and thermal preferences. The results were used to assess the efficiency of the hotel’s original and rebuilt rooms in providing satisfaction and comfort by comparing the results of both types of rooms. Moreover, the responses were used to bring to the surface issues and challenges pertaining to the original and rebuilt rooms.

3.6 Conclusion

The study aims to develop an integrated methodology according to the theoretical framework for assessing the architectural, urban, and thermal impacts of transforming vernacular settlements into tourist accommodations. It is based on the premise that heritage conservation and sustainability are aspects that should be considered in an integrated way, following an interdisciplinary approach. Indeed, the study of heritage conservation and thermal performance of vernacular buildings is usually separate, conducted by researchers from different disciplines whose analysis concentrates on just one aspect.

Therefore, it is hard to find studies that offer insights into both aspects. This study offers the first attempt to do so, taking an interdisciplinary approach, with the development of a novel methodology. This chapter has discussed this study's methodological approach, which combines qualitative and quantitative methods. Hence, several data collection and analysis methods were used due to the interdisciplinary nature of the assessment criteria established in the theoretical framework. Archival research and a field survey were conducted to record the urban and architectural context of Dana village before and after the rehabilitation project.

Thermal monitoring was also performed to monitor the indoor and outdoor thermal environment of some of the original and rebuilt buildings. Furthermore, a POE survey was used to investigate the occupants' satisfaction and comfort, considering occupants as an integral part of the overall thermal performance assessment. As a result, an integrated methodological approach has been developed to assess Dana's rehabilitation project and consequently develop an integrated assessment framework that assesses the transformation of vernacular settlements into tourist accommodations. The following chapters give the result of applying this methodology.

Chapter Four: Dana within the Context of Ecotourism and Sustainable Development in Jordan

4.1 Introduction

The initial step of any integrated assessment approach provides background data, using all available resources, such as archives from the field and institutions of the study location (Simpson 2009). This chapter aims to offer the background and context to the case study of Dana village. It starts with investigating the context of ecotourism and sustainable development discussions in Jordan, with a particular focus on stakeholders' role in tourism development and the significance of Dana Biosphere Reserve (DBR). The various roles of stakeholders and the presence of public and private partnerships are investigated, including the role of NGO organisations.

The discussion proceeds with comparing the development of Dana with previous development efforts to highlight the similar and different approaches. The comparison represents the extent to which Dana represents sustainable ecotourism development in Jordan. This background to the case study of Dana village is informed by literature and interviews conducted with stakeholders during the fieldwork.

4.2 Ecotourism in Jordan

The main tourist attractions in Jordan are Petra, Jerash, and Nebo Mountain, according to the number of tourists who visit these places (Statistical Department of Jordan 2009). This shows that tourists are more interested in visiting archaeological and religious attractions than traditional villages (Al Haija 2011). Therefore, seeking to revitalise the traditional villages, further efforts have been made in the last four decades by implementing a new form of tourism called 'Ecotourism'. The International Ecotourism Society (TIES) defines ecotourism as 'the responsible travel to natural areas that conserves the environment and sustains the well-being of local people' (Blangy and Mehta 2006, p. 233).

In the last four decades, ecotourism has been recognised as one of the primary forces that enhances the development of sustainable tourism and supports the economy in Jordan (Al-mughrabi 2007, p. 5).[21] The Royal Society for the Conservation of Nature (RSCN) states that ecotourism plays an essential role in preserving the vernacular architecture in Jordan (Alhasan 2019). As one of the national non-governmental organisations in the Middle East, the RSCN seeks to conserve the natural and heritage resources of Jordan and protect the wildlife and wild sites. Its practices focus on heritage conservation and sustainable development by involving the local communities, protecting natural reserves, and conserving heritage buildings (Alhasan 2019).

Osama Alhasan, the Head of ecotourism/ facilities development at the RSCN, claimed that the RSCN launched ecotourism projects that follow the TIES's ecotourism principles: Reduce physical, social, and behavioural impacts; Spread cultural and environmental awareness; Provide good experience for both locals and tourists; Offer financial support for conservation; Generate economic benefits for both tourism industry and local people; Operate low-impact facilities; Empower local societies through creating active job opportunities (TIES 2015; Alhasan 2019).

[21] Sustainable tourism refers to the continuous development in the tourism industry to meet the needs of the present generation, taking into account the needs of future generations (Al-mughrabi 2007, p. 6).

The Jordan Tourism Board (JTB) cooperated with the RSCN and the Jordan Royal Ecological Diving Society (JREDS) in 2004 to provide a brief description of all the ecotourism sites in Jordan (Al-mughrabi 2007, p. 54). Eight ecotourism sites were formed: Ajloun Forest Reserve, Azraq Wetland Reserve, Shaumari Wildlife Reserve, Dana Biosphere Reserve (DBR), Mujib Nature Reserve, Rum Protected Area, Yarmouk Reserve, and Dibeen Forest Reserve (**Figure 4.1**).

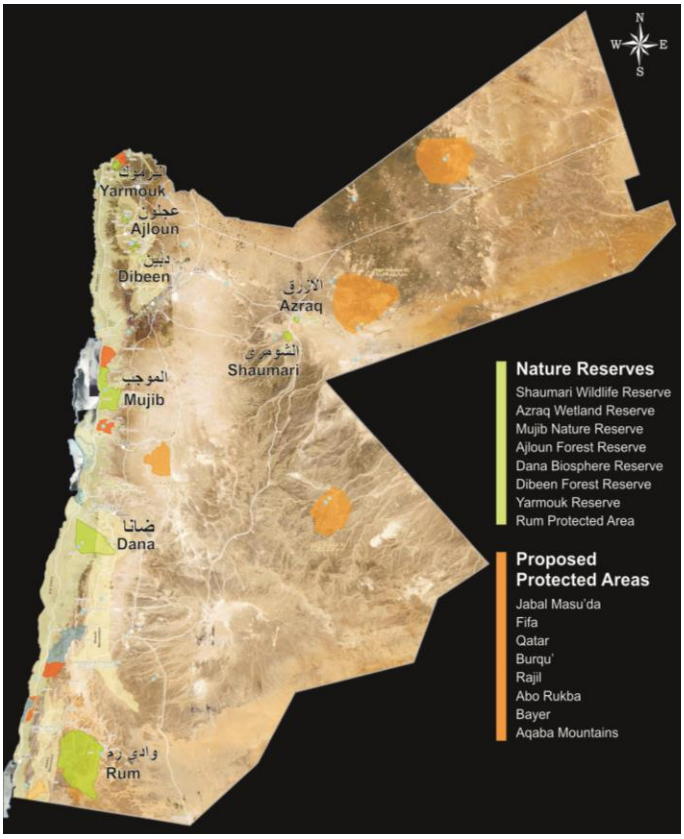


Figure 4.1: Ecotourism sites (nature reserves) in Jordan covering over 1300 km² (Archive, RSCN 2019)

4.3 Sustainable Development in Jordan

Ecotourism is considered one of the forces that direct sustainable development in Jordan and improve its economy (Al-mughrabi 2007).[22]

[22] Sustainable development is defined as the development that enhances the quality of life without harming the resources for future generations (Burtenshaw and Palmer 2014).

Meanwhile, cultural heritage is becoming a significant asset for tourism and sustainable development in Jordan. Therefore, a detailed understating of the value of heritage places and how they are affected by the context of sustainable development and ecotourism is vital to achieving the mutual aims of sustainability and conservation (Burtenshaw 2013).

Recently, the involvement of local communities in Integrated Conservation and Development Projects (ICDP) has become of rising interest, with projects that involve a combination of public, private, NGO, and international stakeholders (Burtenshaw 2013). On the international scale, the International Council on Monuments and Sites (ICOMOS) has considered sustainable development as an essential theme in its recent activities in heritage sites, becoming a global trend. They use cultural heritage resources, associated with tourism to contribute to local development, bringing benefits to both the local community and economy (Girard and Nijkamp 2009).

Dr Monther Jamhawi, the former director general of Jordan's Department of Antiquities (DoA), brought this global trend to Jordan by promoting tourism to heritage sites and encouraging the participation of the local community. Hence, DoA collaborated with the RSCN due to its experience in engaging the local community and preserving the natural environment through its recent ecotourism projects in Jordan (Burtenshaw and Palmer 2014).

4.4 Stakeholder's Role in Tourism Development

The Ministry of Tourism and Antiquities (MoTA) is the main body that controls the tourism industry and organises the guidelines for tourism development in Jordan (Al Haija 2011, p. 94). The Department of Antiquities

(DoA), which sets within the MoTA, is the national authority responsible for protecting, restoring, conserving, developing and managing the antiquities of Jordan (Myers, Smith and Shaer 2010, p. 27). In accordance with the World Tourism Organisation's (WTO) comprehensive approach to sustainable ecotourism, the DoA has set a sustainable development approach for the tourism sector, concerning the features of the Jordanian situation (**Table 4.1**).

Table 4.1: Sustainable development approaches of the WTO and DoA (UNWTO 2009; Al Haija 2011)

	Sustainable Ecotourism Development Approaches
World Tourism Organisation (WTO)	1. Sustainable ecotourism should conserve the natural and architectural heritage, make optimal usage of the environmental resource which form a fundamental element in developing tourism and support vital ecological processes. 2. It should conserve the tangible (built) and intangible (traditional and cultural values) heritage of the host community, respect their socio-cultural identity, and contribute to tolerance and intercultural understanding. 3. It should guarantee viable and long-term economic plans, providing socio-economic benefits to stakeholders and producing stable employment opportunities and social services to host communities to alleviate poverty.
The Department of Antiquities (DoA)	1. Well-distribution of tourist interests. 2. Conserve the Jordanian natural resources. 3. Provide economic motivation for ecotourism and rehabilitation activities. 4. Enhance local and tourist awareness of Jordanian culture. 5. Consider the Jordanian community and the spirit of place in the local plans and policies.

International organisations have also played a significant role in developing tourism in Jordan. For instance, the World Bank implemented significant projects, such as the preservation projects of Petra and Jerash that developed their tourism infrastructure and facilities and resettled the Bedouin population of Petra (Burtenshaw 2013). Moreover, the Sustainable Preservative Initiative (SPI) conducted projects and extensive research to examine the success of implementing their model in Jordan (Burtenshaw 2013).

Another key stakeholder is the RSCN. It has controlled conservation and ecotourism in protected nature reserves, as in Dana. It is interested in the heritage resources within the nature reserves but lacks experience in managing the cultural heritage. Therefore, it collaborated with private organisations such as engineering consultant offices that have the skills required for maintaining the cultural heritage while developing its resources. Dana Biosphere Reserve (DBR) represents the RSCN's most significant project in Jordan, according to the project's area, fund, and various accomplishments (Alhasan 2019).

4.5 Dana Biosphere Reserve (DBR)

Dana Biosphere Reserve (DBR) is located in Tafilah governorate, in the southern part of Jordan. In 1989, the RSCN managed the project of DBR to ensure that Dana remains a sustainable place for nature and people (Dudley and Phillips 2006). In 1994, the United Nations Organisation for Education, Science, and Culture (UNESCO) considered Dana a nature biosphere reserve (Eid et al. 2013). Currently, DBR is the largest nature reserve in Jordan, covering 320 km^2. It is unique due to its climate, which varies widely following the topography that includes a series of mountains and valleys (Shehadeh and Ananbeh 2013). Consequently, the reserve is ecologically diverse, including three biogeographical zones: Mediterranean, Irano-Turanian, and Sudanian (**Figure 4.2**).

Table 4.2 highlights the diverse characteristics of the three biogeographical zones (RSCN 2011). Due to the reserve's biodiversity, it contains various types of species, and some of them are globally considered endangered, such as the Arabian leopard, Lesser Kestrel, Desert Monitor, and Cypress tree (Al-Qawaba'a 2008; Eid 2013).

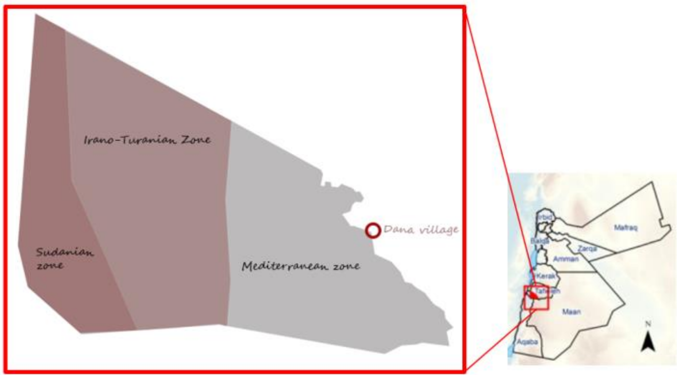


Figure 4.2: DBR's three biogeographical zones (RSCN 2011, adapted by author 2019)

Table 4.2: Characteristics of the three biogeographical zones of DBR (RSCN 2011).

Biogeographical Zones	**Altitude (m)**	**Rainfall (mm/year)**	**Average Temperature (C°)**	
			Jan.	**Aug.**
Mediterranean Zone	800m – 1500m	350	4	30
Irano-Turanian Zone	400m – 800m	250	6	33
Sudanian zone	-50m – 400m	50	10	37

After Rio de Janeiro Earth Summit (1992), the nature conservation concept was changed from a 'fenced protected area', which eliminates any human activity and isolates the protected area, to 'socio-economic development to local communities within the conservation activities' (Alhasan 2019). The RSCN employed this new concept in DBR, becoming the first place in Jordan where nature conservation brings benefits to local people. A range of ecotourism and socio-economic projects were applied to create new jobs and income-generating opportunities (Dudley and Phillips 2006; RSCN 2011).

For instance, the reserve lacked accommodations for tourists, bringing more attention to Dana village to be reused to provide tourist accommodation.

Therefore, Dana village was restored to support the implementation of ecotourism in DBR and support the local community (Al-Khawaldeh 2019).

4.6 Dana Village

The main factors for considering Dana village as a part of DBR are its heritage significance and strategic location that overviews DBR (Alhasan 2019). The village was radically exposed to continuous changes in line with the enthusiasm for modernism in Jordan (Al Haija 2012). It had also undergone several restoration efforts since the late 1960s, when many local families began moving out of the village to the Qadisiyah urban area, seeking better job opportunities, services, schools, housing, and a better quality of life. By 1990, the village was semi-abandoned and had begun to die gradually (**Figure 4.3**).

Figure 4.3: Dana village in the 1930s before it was abandoned (top), and at the end of the 20th century after it was abandoned (bottom) (Archive, RSCN 2019)

As a part of DBR, Alhasan (2019) claimed that the village became a significant concern after locals' random development attempts (Alhasan 2019). Therefore, the RSCN launched a restoration project funded by a group of local women from Amman called ‘Friends of Dana’ to revitalise the village’s traditional fabric (Alhasan 2019). Basic refurbishment works were done on 70 vernacular houses, such as repairs to walls and roofs, to motivate families to stay in the village. Moreover, water supply, electricity, and telephone networks were extended to Dana. However, few families responded and remained in the village, and most moved out to Qadisiyah (Alhasan 2019).

By 1996, the village was almost abandoned, and most of its buildings had become ruins. Hence, the RSCN launched a low-impact ecotourism project in the reserve to generate new job opportunities for the local community, such as tourist guides and souvenir-making for direct sale to tourists. Afterwards, locals started to open low-budget hotels to accommodate tourists in their houses or rented houses (Alhasan 2019). After the success of the RSCN projects and after winning ‘green tourism’ awards, the village received several funds for further development projects (Alhasan 2019). For instance, in 2005, it received funding from the United States Agency for International Development (USAID) to establish the Rummana campsite near the village (Alhasan 2019).

Most recently, the RSCN received further funding from USAID in 2009 to launch the rehabilitation project of Dana (**Figure 4.4**). The project used ecotourism as a catalyst to regenerate the architectural heritage, support the local community, and provide tourist accommodations.

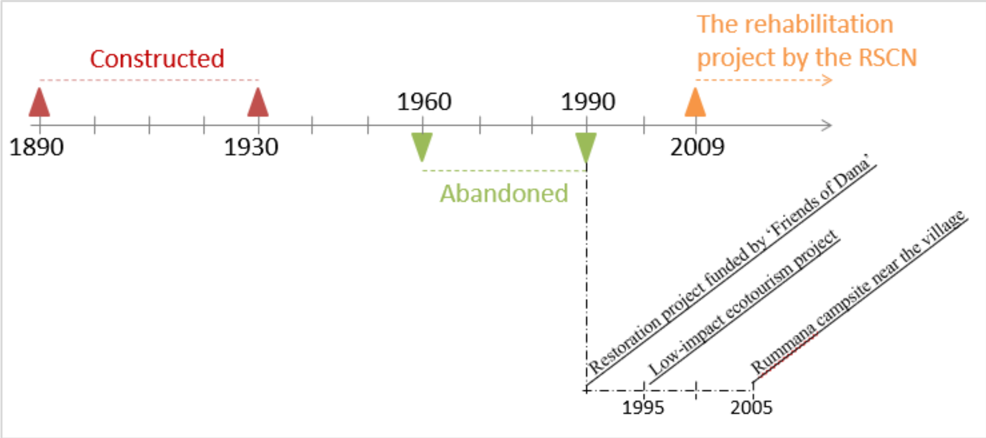


Figure 4.4: Dana Village Timeline (Khammash 1995, adapted by the author 2019)

4.7 Dana vs Previous Development Efforts in Jordan

In addition to Dana village, the context of sustainable ecotourism development in Jordan includes various development efforts that followed similar or different approaches. The adopted approaches were criticised by some archaeologists (Daher 1999), stakeholders (RSCN), and scholars (Comer 2012; Al Rabady 2013). Comparing the development of Dana with previous development efforts showed the extent to which Dana represents sustainable ecotourism development in Jordan. The comparison is based on the ability of the development efforts to provide socio-economic benefits while conserving the intangible and tangible heritage (UNWTO 2009).[23]

4.7.1 Socio-economic Benefits

For a sustainable approach to ecotourism development, viable and long-term economic plans should be guaranteed to provide socio-economic benefits to stakeholders and produce stable employment opportunities and social services to host communities (UNWTO 2009). Nevertheless, several

[23] In 2009, the United Nation World Tourism Organization (UNWTO) established guidelines for planning ecotourism development in heritage sites.

development projects in Jordan ignored the consultation and participation of local communities and overlooked their benefits, becoming a key criticism (Al Haija 2011). For instance, the development of Petra, whose rock-cut temples are the most important tourism destination in Jordan, became the subject of criticism in terms of its conservation, development, management, and locals' involvement (Comer 2012).

Comer (2012) criticised the tourism efforts in Petra, concluding that they damaged the social fabric. He explained that, in 1968, the USAID recommended relocating the local community of Petra (Bdul tribe), who practised grazing (animal farming) over generations, due to site preservation concerns. The houses within the new village, called Umm Sayhun, did not meet the needs of the tribe due to the lack of consultation with them (Brand 2001). The lack of consultation with the local community led to overlooking the provision of their benefits, becoming a key criticism of Petra's management (Angela 2012).

Akrawi (2012) also criticised the lack of management that led to some conservation issues, such as the number of daily visitors (2740 on average) that surpassed the carrying capacity of this major historic site, especially after its consideration as one of the world's seven wonders. More visitors and unplanned developments around Petra, including Wadi Musa village, caused problems of pressure on water resources and sewage networks (Comer 2012). Local NGOs, such as the RSCN, raised the awareness of engaging the local communities in such projects. However, the local community of Petra still lacks political representation and economic benefits from the management of Petra (Farajat 2012).

Similar challenges and difficulties were seen in the village of Umm Qais (Brand 2001). Over the past fifty years, national and international stakeholders reshaped the physical and socio-economic context of the village. The local community struggled to have their voices heard after being displaced by the name of development (Brand 2001). In the 1970s, the local authorities relocated the local community of Umm Qais due to preservation concerns (Brand 2001). The local community accepted this attempt at the beginning, however, conflicts occurred between them and the local authorities afterwards due to delays in payments and the insufficiency of the new village.

The houses within the new village were smaller than those in Umm Qais, forcing families to split and occupy different houses. Moreover, most families had to give up some work traditions appropriate for their original housing and lifestyle, such as farming and keeping animals. As a result, they lost their source of income and became obliged to search for new job opportunities in other neighbourhoods (Alzoubi and Almalkawi 2019, p. 16). Brand (2000) criticised that the local community felt detached from such projects and received no economic benefits, although development projects stressed the significance of involving and employing locals.

Similar issues and challenges are again observed within the development projects of Wadi Rum. National and international stakeholders competed over controlling the economic resources of the site without adequate local consideration and consultation in the development plans (Chatelard 2003). For instance, the RSCN was criticised for its surface management and development plans that were based on little understanding of locals (Brand 2001).

Similarly, the initial efforts by the RSCN were also criticised in DBR, describing them as non-participatory, focusing only on nature and biodiversity conservation without the involvement of the population and sometimes against their will. For instance, several restrictions were established on grazing and mining in the reserve. As the local community of Dana was mainly Bedouins, who used their lands for grazing, the restrictions affected their primary source of income without providing alternative job opportunities. This strategy reflects the adopted approach in Wadi Rum and Petra, which focused on conserving the nature and wildlife while restricting the locals' access to these sites.

Alhasan (2019) commented that after the RSCN realised the problems of its previous efforts, it insisted on involving the communities and promoting their socio-economic situation by providing tourism-related job opportunities.[24] Al-Khawaldeh added that locals were employed in implementing the rehabilitation project and operating the RSCN's branch and hotel in Dana (Al-Khawaldeh 2019). A similar approach was noticed in Wadi Feynan, located at the western edge of DBR. A new ecolodge was built as an income-generating option to replace the overgrazing activities.

The ecolodge generated new job opportunities to support the local community as it is operated by local Bedouins, and all the employees are from the local

[24] The approaches to providing new job opportunities to Dana's community were discussed with Osama Alhasan and Sulieman Al-Khawaldeh, the president of Dana and Al-Qadisiyyah local community cooperative.

community (Burtenshaw 2013). Further tourism-related job opportunities were created in Dana, such as tourist guides, drivers, and chiefs (Alhasan 2019). Moreover, handicraft workshops were built to make and sell products made by the local community in an attempt to support their economy (Burtenshaw 2013).

For instance, Dana's local women use the fruit and herb drying workshop to make fruit jams, make soap from the local olive oil, produce medicinal herbs, and dry fruit and herbs, such as apricots, grapes, lemons, and rosemary (Al-Khawaldeh 2019). Moreover, other locals were employed to create souvenirs for tourists, such as silver products and accessories, at the silver-making workshop. Afterwards, these products are sold to tourists at the nature shop at reasonable prices (Al-Khawaldeh 2019).[25] Al-Khawaldeh added that new hotels were also established to use further restored buildings.

The hotels run the restored houses, using them as tourist accommodations, with the profit shared between the hotel and the house owners. As a result, the local community (the hotel founder, staff, and house owners) benefits financially, the restored buildings are protected from being abandoned again, and tourist accommodations are provided (Al-Khawaldeh 2019). Overall, the job opportunities provided have revitalised ecotourism in the village and improved the income of the local community. Although the local community does not live in Dana, creating these job opportunities and workshops has promoted their involvement in promoting ecotourism in the village.

[25] Similar workshops were observed in the baptism site of Jesus Chris, which was considered a tourist site due to its religious and historical significance.

4.7.2 Intangible Heritage Conservation

Al Haija (2011) observed that prioritising the needs of tourists over locals and neglecting the intangible heritage (traditional and cultural values) were the source of conflicts between the local communities and authorities in Jordan. As the heritage sites were developed mainly according to the interests and policies of foreign organisations, the local communities became the victims of some development projects (Al Haija 2011). For instance, several projects were implemented to regenerate traditional villages in Jordan, such as Umm Qais, Taybet Zaman, and Kherbat Alnawafleh villages.

The private houses in the villages were transformed into tourist accommodations without paying attention to the socio-cultural context and the traditional lifestyle, structures, and neighbourhoods (Al Haija 2011). The development of these villages displaced local communities without adequate economic benefits, leading to conflict of interest between the local, private, and foreign stakeholders (Al Haija 2011). Daher (1999, p. 39) criticised these approaches, which included relocating the local communities and converting their houses into hotel rooms. He described such initiatives as museumification of the intangible heritage, transforming it into a staged artefact (Daher 1999, p. 39).

For instance, Taybet Zaman village, which is 10 kilometres away from Petra, was transformed into a tourist village to accommodate tourists after transferring its community to another neighbourhood. The Jordanian Engineering Association Workshop (JEAW) evaluated this project and experience as negative because the former community of the village felt that they were detached from their social environment and that the government confiscated the village from them (Daher 1999, p. 35). In this case, therefore, tourism became the reason for the local communities losing their villages. It was also the origin of the conflict between host communities and local authorities, believing that the local authorities prioritised the tourists' needs, regardless of the rights and needs of the host communities (Al Haija 2011, p. 97).

This kind of village transformation is also altered in Umm Qais, leading to shortage of faith in the real intentions of the local authorities. Therefore, some representatives of Dana's local community, including Sulieman Al-Khawaldeh, were against the transformation of the village. They were afraid of losing their houses without adequate economic benefits and being new victims of such development plans, as happened in Umm Qais and Taybet Zaman villages (Alhasan 2019). Al Haija (2011, p. 97) claimed that the government encouraged the local community to move to a new neighbourhood located 3 kilometres away from the village called Al-Qadisiyya.

However, Alhasan (2019) argued that the village was already abandoned before the village's development. He added that the local community in Dana decided by themselves to move out, leaving their properties abandoned. Alhasan emphasised that there were no attempts to relocate them, but on the contrary, the RSCN implemented several sustainable development plans to encourage locals to return to their village, aiming to empower the emotional nostalgia for the past and to rebuild the community's sense of belonging to the village (Haddad and Fakhoury 2016, p. 45).

4.7.3 Tangible Heritage Conservation

During the second half of the 20th century, the Jordanian vernacular typologies and characteristics were radically changed due to the lack of suitable legislation in the field of urban and architectural conservation (Abu Al Haija 2012). Western-driven prototypes are threatening the conservation, management and presentation of heritage sites. This raised the problem of gentrification, which transforms the original sites into new ones with new identities and images. The concept of gentrification has been endorsed in the Jordanian market to open the Jordanian urban centres and heritage sites to global consumption and accept new users who would make new memories and identities (Al Rabady 2013).

Four urban centres were the target of such concept, including Amman, Al-Salt, Irbid, and Madaba. Madaba was regenerated to become an active tourist destination in Jordan. The emphasis was on preserving the 'high-profile' tangible heritage while neglecting the intangible heritage, leading to superficial improvements to the quality of Madaba's spaces (Al Rabady 2013). For instance, the stone pavement of pathways and streets was transformed into a new style imported from outside (**Figure 4.5**).

Figure 4.5: The stone pavement as appears in the mosaic churches surrounding the Roman Cardo (left) and the imported style of pavement as occurred in a recently regenerated street in Madaba (right) (Al Rabady 2013)

Al Rabady (2013) argued that this provided homogenised, placeless, and soulless urban spaces that neglected the intangible heritage represented in people's cultures and traditions. Orbaşli (2017) explained that the effects of modernity and globalisation played a crucial role in causing such a problem after the mid-20th century, sometimes leading to the loss of heritage in the name of development and making heritage conservation a serious global concern.

Such a problem mainly concerns the conservation of heritage sites rather than archaeological ones in Jordan as they receive more attention due to cultural and economic reasons (Abu Al Haija 2012). The recent development projects in Jordanian heritage sites focused on improving the infrastructure of rural settlements while following facade-based approaches to maintain their visual appearance (Al Rabady 2013). The facadism approach has emerged, focusing on restoring the historical image of buildings rather than the cultural authenticity of settlements. Daher (2005) called this approach museumification when rural settlements are transformed for tourism purposes and got their local communities relocated.

Such transformation is not recommended by some international organisations, e.g. ICOMOS charters, because of the incompatible changes that occur to the architectural, urban, and thermal environments (Al Rabady 2013). For instance, in 1980, Taybet Zaman village was entirely transformed into a five-star resort to accommodate and serve tourists. The original architectural features were replaced with new ones, including the construction materials and indoor spaces. The development efforts of Umm Qais are similar to Taybet Zaman village in certain circumstances, as both were demolished and rebuilt in a way that maintains as much as possible the visual appearance, stone cladding, and heights (Abu Al Haija 2012).

The demolition and transformation of vernacular dwellings are frequently ongoing in Jordan when restoring Jordanian heritage sites and buildings (Al Haija 2011). They were rebuilt with new construction materials (concrete structures) and openings and superimposed over the same footprint. Moreover, most windows and doors were replaced by new metallic or wooden ones, making the rebuilt buildings easily distinguished from the original vernacular buildings. Developers followed the trend of reconstructing heritage buildings and reshaping local cultures by associating cultural heritage with consumers' globalised cultures. This trend was also observed in Dana, as most of its restored buildings were demolished and rebuilt, following the facadism practice to give the same external appearance.

The introduction of cement materials to Jordan led to abandoning the original construction materials and techniques while maintaining the surface materials as far as possible. Altogether have shifted the Jordanian structures from the local traditional ones (Abu Al Haija 2012). Indeed, the implementation of interventions caused conservation issues in several development practices in Jordan. For instance, the restoration of Umm Qais village led to demolishing the village's original walls to enlarge the internal courtyards. This transformed the urban fabric and compromised the integrity of spatial arrangement because the external walls acted as key space definers that formed the urban configuration (Abu Al Haija 2012).

Further interventions include the development of the infrastructure, as seen in most of the recent development projects in Jordan (Dana, Taybet Zaman, and Kherbat Alnawafleh). In Dana, the installation of sewage and water networks was essential to meet the new requirements of the new uses and users. Moreover, the old roads and open spaces were repaired, conserving the original street pattern of Dana while adding new ones to connect the new buildings with the original village (Al-Khawaldeh 2019). The lack of such infrastructure makes tourism destinations inaccessible, especially in rural areas (Almughrabi 2007).

4.8 Conclusion

The above gives the background to examine the case study for this research, that of the area of Dana village. Dana was selected as the case study of this thesis to represent the Jordanian heritage sites that concerned sustainable ecotourism development as a catalyst to regenerate abandoned rural settlements. It has an important history (going back to the late 19th century) and location (overviewing DBR). The rural settlement also has rich social, urban, and architectural environments, presented in its vernacular architecture preserved to this day. Different development efforts were established to restore the village and transform it into a tourist settlement, altering the spirit of Dana and the original features of its architecture.

The most recent rehabilitation project represented a different development approach than other projects implemented in Jordan. The approach was the result of realising the problems of previous development efforts. For instance, the RSCN insisted on involving the local community by providing tourism-related job opportunities to promote the economic situation. Moreover, the RSCN put more emphasis on conserving Dana’s urban fabric. However, it followed the demolition and reconstruction approach to restore its buildings, as seen in most development efforts in Jordanian rural settlements.

As a result, Dana’s development approach deserves specific attention because it contains innovative ideas and irreversible solutions that have not been experienced previously in the Jordanian development context. Therefore, the identification of the vernacular architecture in Dana village comes after this background data. The archival research found that the documentation of the original settlement and structures was unfortunately overlooked. Thus, the following chapter shows the results of recording the village and some representative buildings of the ruins, aiming to document the original vernacular features of Dana.

Chapter Five: Survey of Dana Village

5.1 Introduction

The documentation of buildings or places is a vital part of the conservation process in order to understand the physical conditions of the buildings or location in question and accordingly to document the changes that have occurred during the conservation process (Jokilehto 2007, p. 3). In the last century, different schools of thought have developed guidelines to define a methodological approach to the conservation of historic and traditional buildings. They all agree that documenting buildings should be a primary step in the methodological approach towards conservation. However, they consider the conservation issues from different angles and translate the approaches based on different concepts (Jokilehto 2007).

The situation of vernacular settlements in Jordan is critical due to the limited methodological approaches to controlling the process of architectural and urban conservation (Al Haija 2012, p. 62). This chapter aims to document the urban and architectural context of Dana village before the rehabilitation project. The documentation will help to understand how the original vernacular settlement was built in the late 19th century. It will also reveal the changes that occurred after transforming the village to accommodate tourists from the 1980s onwards. To this end, a field survey was conducted to record Dana's urban morphology and vernacular architecture.

This chapter starts with the documentation of Dana's vernacular architecture, as observed in selected ruined buildings in the settlement. This provides insights into the typical materials and methods of construction, the types of houses, and types of openings. The chapter proceeds by documenting the urban morphology of Dana village, including the street pattern, infrastructure, land use pattern, urban configuration, and sequential order of movement, showing how the local community formed the urban morphology of the village.

As a result of the chapter, comprehensive documentation of the original vernacular settlement is provided to understand its physical condition, and consequently monitor the changes that have occurred over time. It will remain for future researchers as evidence of the original settlement, available for reinterpretation for more knowledge.

5.2 Vernacular Architecture of Dana Village

5.2.1 Materials and Methods of Construction

The original construction materials used in Dana village were extracted from the surrounding natural environment, including stone, clay, juniper wood, straw, and cane from the neighbouring areas and mountains (Al-Khawaldeh 2019).

5.2.1.1 Types of Walls

The original vernacular buildings in Dana were built of rubble masonry walls with a thickness of 60 cm or more. The walls were constructed of rough, undressed, and unhewn local stone and laid in irregular horizontal courses. The gap between stone courses was filled with mortar, made of a mixture of clay and straw. Two types of walls were found in the village: those with a single or double layer. The single-layer walls have similar external and internal stone masonry faces, while the external face of the masonry is different from the internal face in the double-layer walls as they were built of two different layers of stone, with the external joints relatively thinner than the internal ones (**Figure 5.1**). Plaster, which was sometimes used to cover the internal face of the walls, was composed of clay and straw. Different layers of plaster were applied, overlapping each other as each layer represented a period in the history of the buildings.

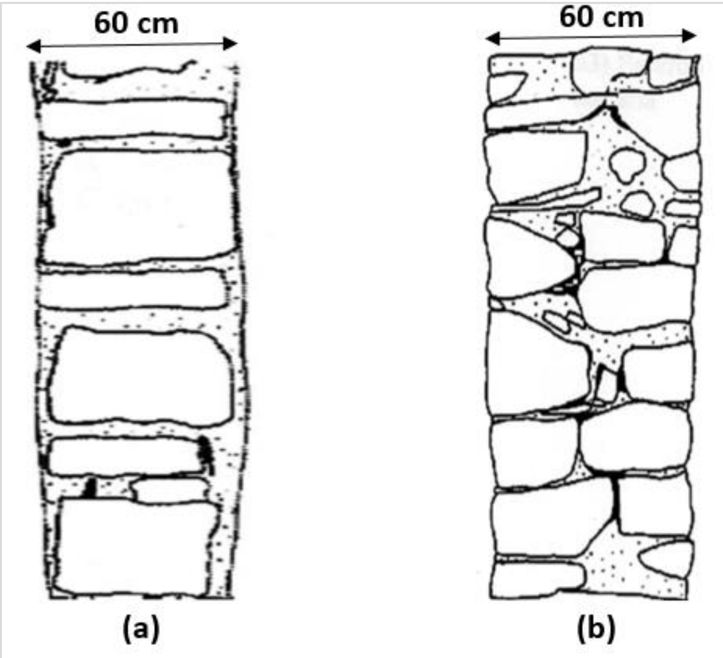


Figure 5.1: Typology of Dana's walls: (a) single- layer walls; (b) double-layer walls (Al Haija 2011, adapted by the author 2019)

5.2.1.2 Types of Roofs

Like the external walls, the roofs of the buildings in Dana have several types. They are flat roofs, made of timber beams spanning load-bearing walls, secondary beams, or arch walls, topped with a cane layer, and covered by layers of clay and straw. Every year when winter comes to an end, local families start to remove the layer of clay and straw, replacing it with a new one. This replacement applies to all types of roofs, as various types of roof construction methods were found in the village. The different methods of roof construction depended mainly on the building area and type, but also on the availability and quality of the construction materials.

The simplest roofs were made of one-way timber beams of juniper wood running along the long span of the building and covered with a layer of cane and a mixed clay and straw layer (**Figure 5.2a**). In bigger buildings, the simple method of construction underwent modifications and development, including the addition of single or double primary timber beams that divided the long span into bays. These bays were covered by secondary timber beams running along the short span of the building and supporting a layer of canes, with finally a top mixture of clay and straw (**Figure 5.2b**).

The addition of a primary beam distributes the load of the roof on two parallel bearing walls. Meanwhile, the secondary beams distribute the load either on the two parallel primary beams or on a bearing wall from one side and a primary beam from the other. Further developments were made due to the shortage of long juniper wood that could cover long spans without being bent. The methods developed included the placing of one to a maximum of three arches parallel to the front facade and each other. These arches divided the long span into shorter spans in order to use the typical short juniper wood (**Figure 5.2c**).

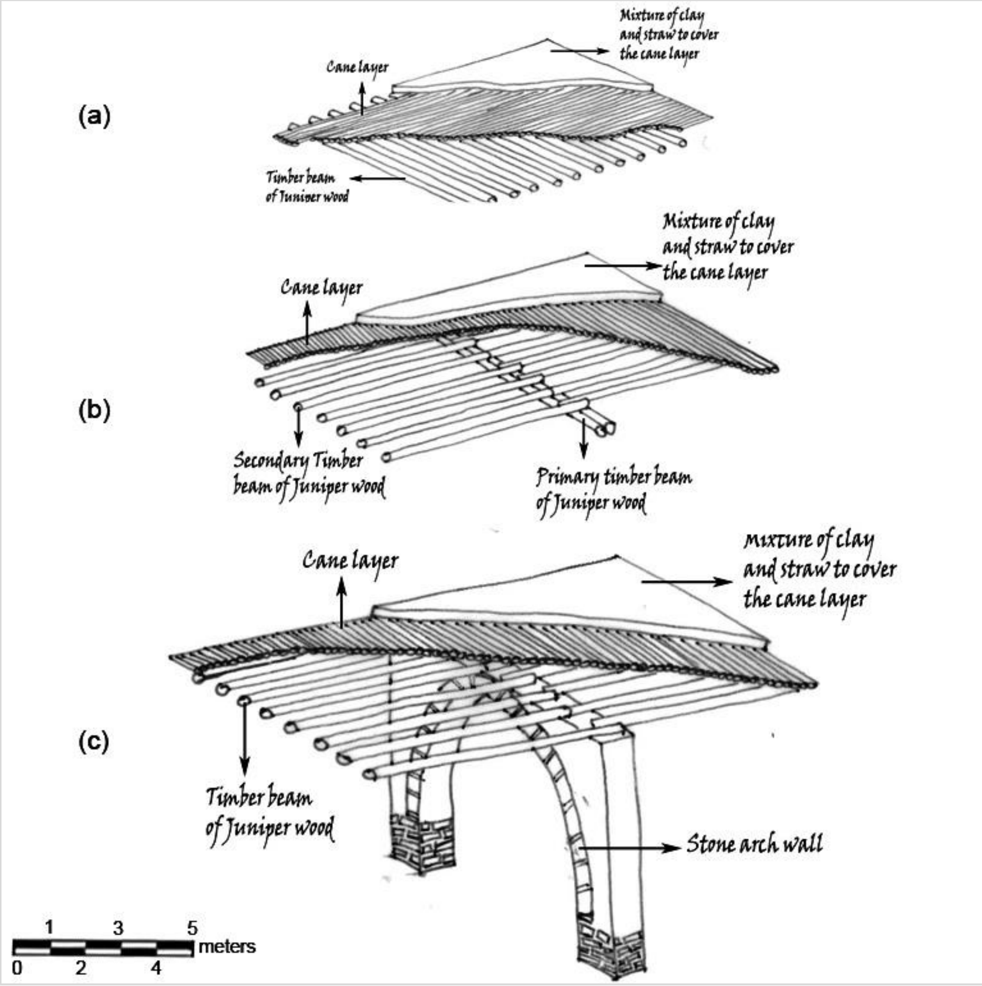


Figure 5.2: Types of roofing methods: (a) the simplest method of just one-way timber beams; (b) for bigger buildings, single or double primary timber beams were added; and (c) the developed method with the incorporation of one to a maximum of three arches (Author 2019)

Arches provide stronger support for the roof than the beams as they avoid the risk of using beams which could bend because of the heavy load of clay layers (Al Haija 2011). In the past, arches were constructed using timber scaffolding which included two ladder-like pieces fixed at the arch base and tied with ropes to create an equilateral triangle shape with the ground (**Figure 5.3**) (Khammash 1995, p. 78). This technique created the arch in a closer way to the ideal shape of a curve that can efficiently handle the compression forces. In fact, this construction method was used in most Jordanian vernacular settlements, including Dana village (Khammash 1995).

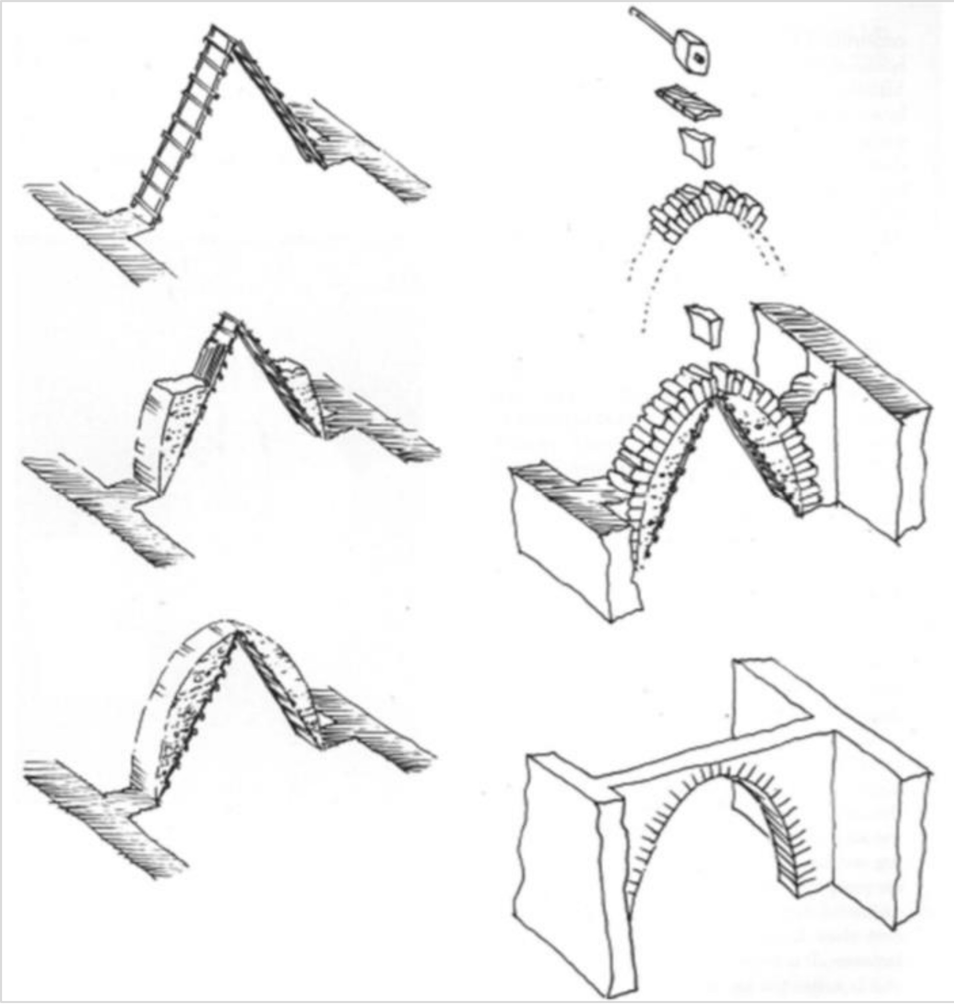


Figure 5.3: Traditional method of constructing arches in Jordan (Khammash 1995, p. 78)

5.2.2 Types of Houses

The vernacular architecture of Dana village adapted to its harsh arid climate and at the same time produced its unique characteristics, including the superb simple forms and the strong dedication to function. These simple forms varied according to the social and economic status of the local community, leading to the creation of three different types of houses in the village. An extensive survey was conducted to document the typology of the houses in July 2019. Three types of houses were identified, including simple single-space houses, courtyard houses, and front-yard houses. The following sections investigate these three types, with (A) and (B) representing the single-space houses; (C) the courtyard houses; and (D) the front-yard houses (**Figure 5.4**).

Figure 5.4: Location of the houses that represent the house typology of Dana village (Author 2019)

5.2.2.1 Single-Space Houses

Dana offers examples of one of the most common types of Jordanian vernacular houses, known as single-space houses (Al Haija 2011). Their main characteristic is that they are formed of a single and multi-functional space, used as a living room and kitchen in the daytime, and as a bedroom at night. The village is mainly formed of this type of house, but with different sizes, according to the family's size and economic status. In fact, the size of these houses is relatively small compared with the other types. For instance, house A is 18 m^2, formed of a single space and with one window (0.7 m^2) and one door (2.3 m^2) (**Figure 5.5**).

However, other single-space houses owned by wealthier families are bigger than these simple houses and display advanced construction techniques. For instance, house B is a 95 m^2 house formed of a single space, also with one window (1.1 m^2) and one door (3.1 m^2). Although it is a single space, it is spatially divided into nine separate spaces by its two double arches that support the roof (**Figure 5.6**).

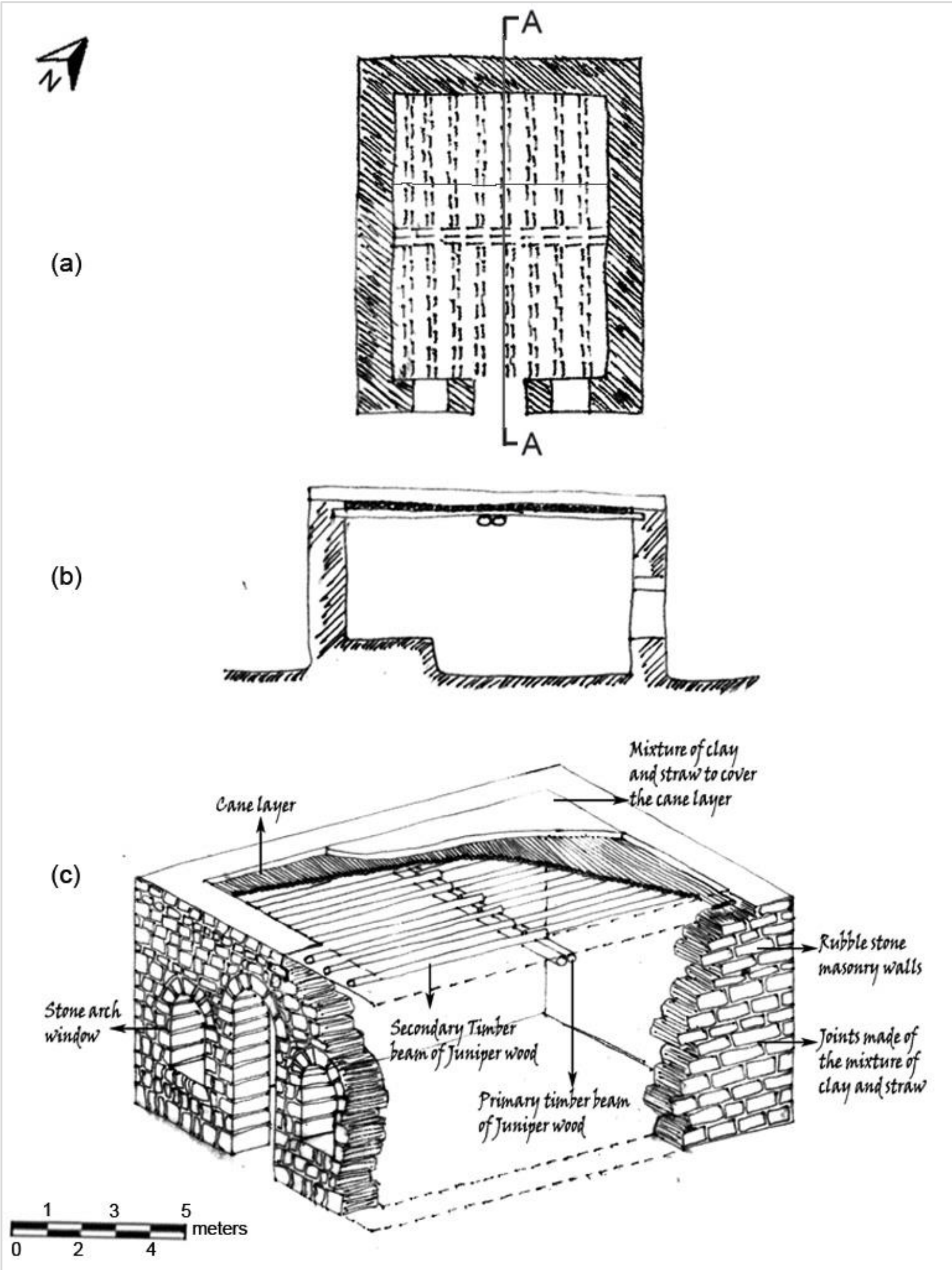


Figure 5.5: House A, a sample of the simple single-space house type: (a) plan; (b) section; (c) axonometric (Author 2019)

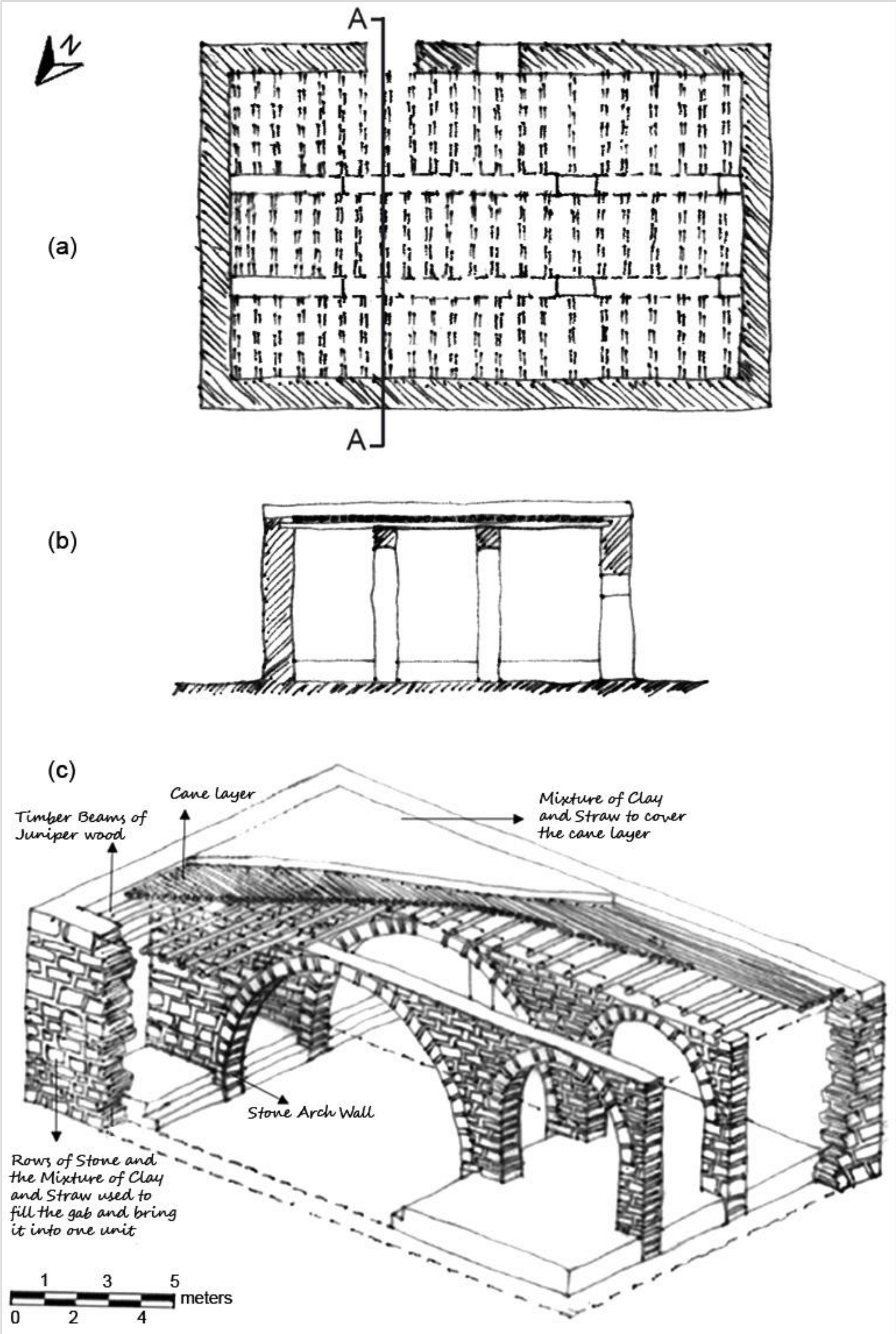


Figure 5.6: House B, an example of the simple single-space house type: (a) plan; (b) section; (c) axonometric (Author 2019)

Both A and B houses are in the northern part of the village, surrounded by a complex layout of other houses. From the outside, both are similar and built of rubble stone masonry walls. Their main facade, which contains the entrance and windows, faces a primary pedestrian road, while the other facades are attached to other buildings to reduce thermal loss and gain. From the inside, both houses contain built-in furniture such as shelves and chairs made of a mixture of clay and straw. The interior of the houses is dark due to the small opening area and the thick external walls. The eyes need a while to adjust to the darkness of the house when coming from the bright outside, which gradually lightens to reveal the rich interior contents.

However, differences were found in house B due to its bigger area, such as the construction technique represented in its arches and the split floor level. House B is a rectangular space supported by two thick double arches which are parallel to the entrance wall. Unlike most beams and arches, which span the short side of spaces in order to break the long side into shorter bays, the arches in this house span the longer side.

This could be because the builders intended to build the arches parallel to the entrance wall, representing the long side of the house. Therefore, they created two double arches made of rubble stone to support the long span of the house. In addition, two split levels in the floor, 0.5 m high, were created on the right and left side of the entrance, parallel to the short side of the house. The two double arches, combined with the two split levels in the floor, divided the space into nine zones without the use of partitions.

5.2.2.2 Courtyard Houses

The type of courtyard houses is a common form that has evolved in vernacular and rural settlements in Jordan (Haddad et al. 2016). It shows efficiency in meeting the needs of people and adapting to the arid climate, especially in the southern part of Jordan. It provides privacy from adjacent and outdoor areas by facing inwards, with its indoor spaces directed to the inner courtyard. Furthermore, it displays good thermal performance in the arid climate, as it brings cool air into the indoor spaces in summer and prevents heat loss in the winter. Therefore, courtyard houses are considered the result of socio-cultural, climatic, and economic factors. Socio-cultural and climatic conditions have always been vital forces that control the design and layout of vernacular buildings (Rapoport 1969; Fathy 1973).

In Dana village, courtyard houses are generally rectangular in plan; the ceiled space is in a 'U' shape, and the entrance wall closes the open central area, identifying the house's courtyard. This can be seen in house C, whose central courtyard is surrounded by attached small single-storey rooms on three sides and by the entrance wall of the same height of the building on the fourth side. The courtyard is mainly used as a multi-functional space where most of the occupants' activities take place, such as chatting, eating, cooking, and celebrating. Therefore, courtyard houses could be described as multi-small unit houses arranged around a courtyard as the shared space (Haddad et al. 2016, p. 91).

As one of the partly preserved samples of these houses, house C is a 210 m^2 house formed of seven rooms: two rooms to the left and right sides of the house and three rooms on the opposite side of the entrance. Each room was used by the nuclear family (a small unit) of the extended family. The entrance wall is up to 3m in height, equalling the height of the whole building. The roofs of the rooms are 3.2m high, supported by timber beams made of juniper wood, topped with a cane layer, and covered with a layer of clay mixed with straw (**Figure 5.7**).

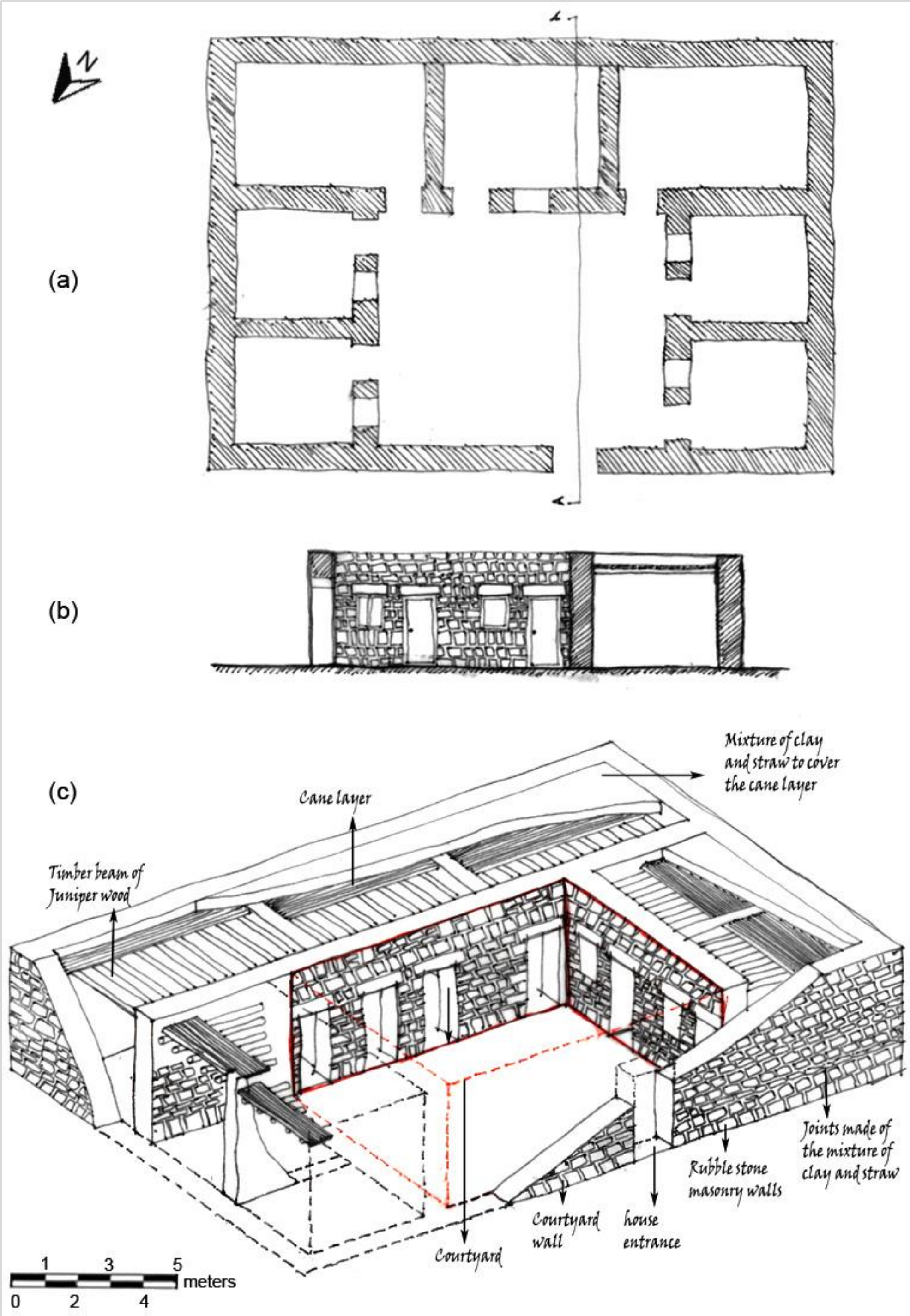


Figure 5.7: House C, an example of a courtyard house: (a) plan; (b) section; (c) axonometric (Author 2019)

There is no evidence to identify the function of each room, but based on similar houses, they were used as bedrooms, a living room, kitchen, and storeroom. Each room has one door and one window that face the courtyard, showing the inward orientation that maximises privacy. The central courtyard connects these rooms with the front facade, which has one door (entrance) that opens directly onto the outdoors. The house looks simple and austere from the outside. From the inside, it provides a common open area for all the occupants to conduct their domestic activities in the courtyard.

The courtyard also plays an essential role in bringing sunlight into the indoor spaces. The windows of these rooms are relatively bigger than those of the single-space houses because they face the courtyard (semi-private space), not the street (public space). Locals claimed that a wealthy extended family occupied the house until it was abandoned when the local community started to move out of the village.

5.2.2.3 Front-Yard Houses

The type of houses with a front yard could be described as a middle point between single-space houses and those with a courtyard, sharing common characteristics with both types. They are medium sized compared to the small single-space houses and the large courtyard houses. They are mainly noticed in the scattered houses of the village, which are not attached to other houses. In fact, houses with a front yard and their organisational pattern are suitable for use as detached or semi-detached houses. They have either four free facades, or at least three, with one side attached to another house.

This type of house is formed of two or three attached rooms, accessed from a semi-private, enclosed front yard. Surrounded by 2m-high rubble masonry walls, the yard constitutes a semi-private open space that connects the attached rooms and provides an open space to the house. Moreover, the semi-private front yard contributes to the green feel of the house, with the planting of seedlings and trees. It also provides a gathering area for the occupants, similar to the gathering area provided by the courtyard, where they can do their domestic activities, such as chatting, cooking and cleaning.

The occupants of this type of house were more likely to be shepherds because they could use the front yard as a pen for animal husbandry and a place to keep them safe at night. Based on the size of this type of house, they were occupied by medium-sized families that owned a piece of land away from the high-density residential area. As one of the partly preserved samples of these houses, house D is a 110 m^2 house formed of two rooms (60 m^2) and a front yard (50 m^2). Each room has one door and one window facing the front yard. The roofs of the rooms are 3m high, supported by timber beams made of juniper wood, topped with a cane layer, and covered with a layer of clay mixed with straw.

The house is built on two levels due to the topography of the site; the yard wall is built on the lower level, and the rooms are built on the higher level (**Figure 5.8**). The yard wall contains the house's main entrance, which fronts the outdoor stairs that leads to the front yard and the rooms on the upper level. The current situation of this house shows that the external and internal wall faces were clad with a mixture of clay and straw. There is no evidence of the reason for cladding the stone exterior facade. Moreover, the windows were shut using the demolished stones found on the site (**Figure 5.9**). These actions were taken after the house was abandoned in an attempt by the owner to protect it from demolition.

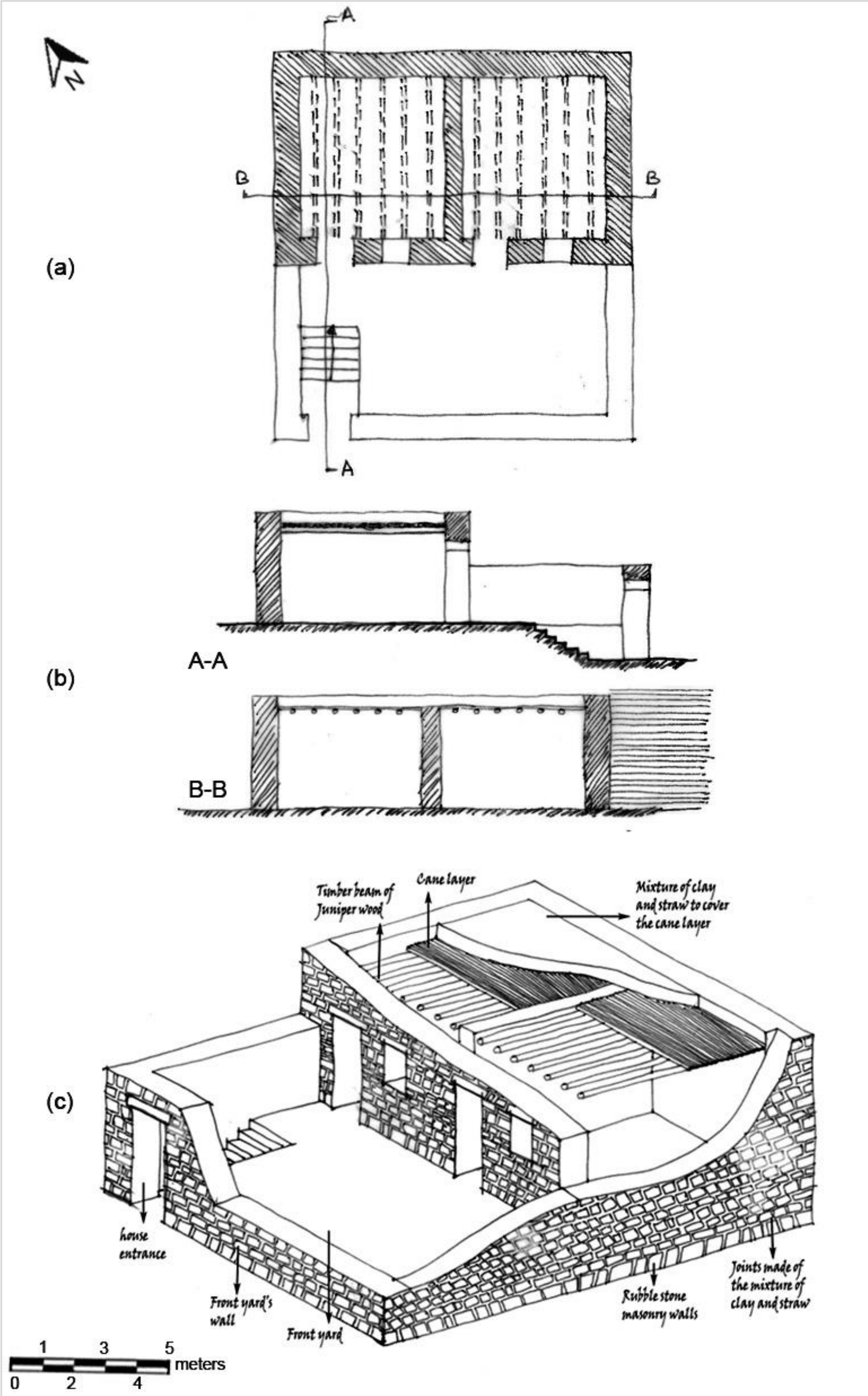


Figure 5.8: House D, an example of a house with a front yard: (a) plan; (b) section; (c) axonometric (Author 2019)

Figure 5.9: Current situation of house D, showing the clad walls and shut windows (Author 2019)

5.2.3 Causes of Decay

By the 1980s, most houses in Dana village had become ruins because of the lack of appropriate maintenance and conservation efforts (Alhasan 2019). For instance, the climate conditions played a significant role in damaging houses A and B (**Figure 5.10**). The different seasons in the village, including summer and winter, affect the clay and straw roof layers. After this layer has become wet and then dried many times, cracks start to appear, turning the roof into a fragile layer that is unable to cover and protect the internal spaces (Naanaa 2019).

Heavy rain can enter the houses through cracks or open gutters and lie on the floors. Subsequently, water on the roof and floor starts to penetrate more deeply into the houses, remaining on the back of the plaster and leading to the erosion of the plaster surface. The roof then begins to crack and sometimes collapse, as is the case of most houses in Dana village. House B shows how rainwater has leaked into the house and created a pool of water in the middle of the space.

(a) (b)

Figure 5.10: Current situation of houses A and B, showing how they were left to ruin after they were abandoned (Author 2019)

Like most villages in Jordan, Dana underwent random renovation attempts and transformation processes by locals after the 1960s. Subsequently, restoration actions took place in the village after it was abandoned, aiming to restore the demolished buildings. This included transforming the original construction materials and methods, replacing them with new ones (Alhasan 2019).

5.2.4 Transformation of Vernacular Architecture

In the last 50 years, Jordanian villages have undergone a transformation that has replaced the original vernacular houses and features with new ones (Alhasan 2019). For instance, new materials and methods of construction have been employed, and wider windows installed (**Figure 5.11**). Masonry bearing walls (70-80 cm) have been replaced with non-bearing walls (25-35 cm) composed of two layers, with stone masonry for the external face (10-15 cm) and hollow cement blocks for the internal one (15-20 cm). Clay roofs, timber beams, and indoor stone arches have also been replaced with reinforced concrete slabs and beams, offering wider spans. Moreover, no thermal insulation was previously applied for walls and roofs, leading to a high rate of thermal transmittance (Al Haija 2012, p. 87).

As a result, different types of buildings have appeared, with new characteristics and features (Al Haija 2012, p. 87). Similar problems were noticed in Dana village before the rehabilitation project. Some collapsed buildings were restored by their owners, transforming them into concrete structures formed of concrete walls, beams, and slabs. Dana mosque is a representative sample that shows how original vernacular buildings were transformed into concrete structures. The mosque underwent several changes, in terms of construction materials, methods of construction, and types of opening.

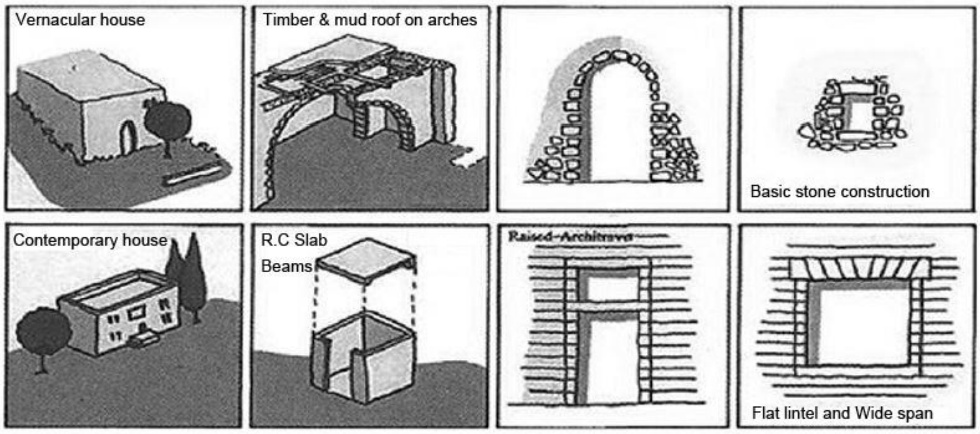


Figure 5.11: Transformation of the vernacular houses in most Jordanian villages (Al Haija, 2012, p. 87)

5.2.5 Dana Mosque

Dana is one of the few villages in Jordan with a mosque that is as old as the village's vernacular houses. It is hard to find mosques similar to vernacular buildings built of stone masonry in Jordanian villages; most are concrete structures built after the 1950s (Khammash 1995). Dana mosque is the only one in the village, located in the centre. This location makes approaching the mosque easier for everyone in the village. After the village was almost abandoned, the mosque was left to ruin. It was restored by the RSCN in 1990 and funded by a group of local women from Amman called 'Friends of Dana' (Alhasan 2019).

As there are no records of the original mosque, interviews with the RSCN and locals were conducted to create the closest image of the original mosque, comparing it with the current condition. They all claimed that the mosque was similar to the village houses because the local community did not know how to build a mosque with its elements or found no ability and experience to build these elements. The original mosque had a rectangular plan of 90 m^2, divided into three spaces by two masonry arches. It is assumed that the mosque kept the outline and the two arches of the original mosque (**Figure 5.12**).

The original walls were composed of a single layer of rubble masonry. The original roof was supported by two masonry arches and timber beams, topped with a cane layer and covered with a layer of clay mixed with straw. Later, the construction materials, methods of construction, and types of openings were replaced with new ones. After transformation, the original walls and roofs were replaced with concrete ones, because after the 1980s concrete structures were a construction trend in Jordan and were widely used (Naanaa 2019). Various additions were also noticed for functional purposes. The current walls were built of concrete and covered with rubble stone cladding to match the theme of the village.

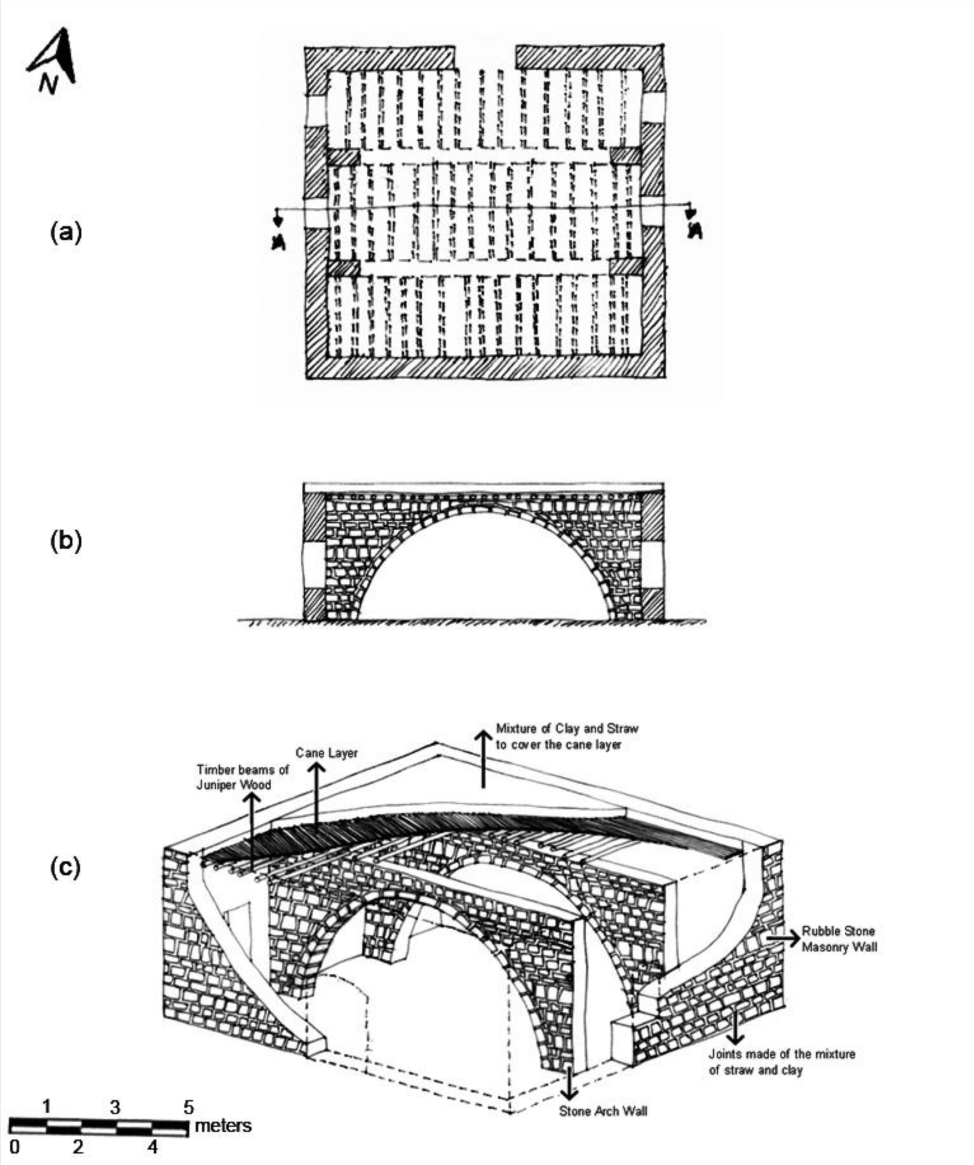


Figure 5.12: Original image of Dana Mosque: (a) plan, (b) section; (c) axonometric (Author 2020)

A protrusion was added to the south-eastern wall, representing the 'Mihrab' in order to stand as a sign of the Qibla direction. Similarly, the current roof was constructed of concrete but with the addition of clerestory windows and a minaret (**Figure 5.13**). Based on the interviews, the clerestory windows, minaret and 'Mihrab' did not exist in the original mosque (Alhasan 2019). The four-metre-high minaret, located at the eastern corner of the mosque, was added to facilitate finding and distinguishing the mosque from a distance.

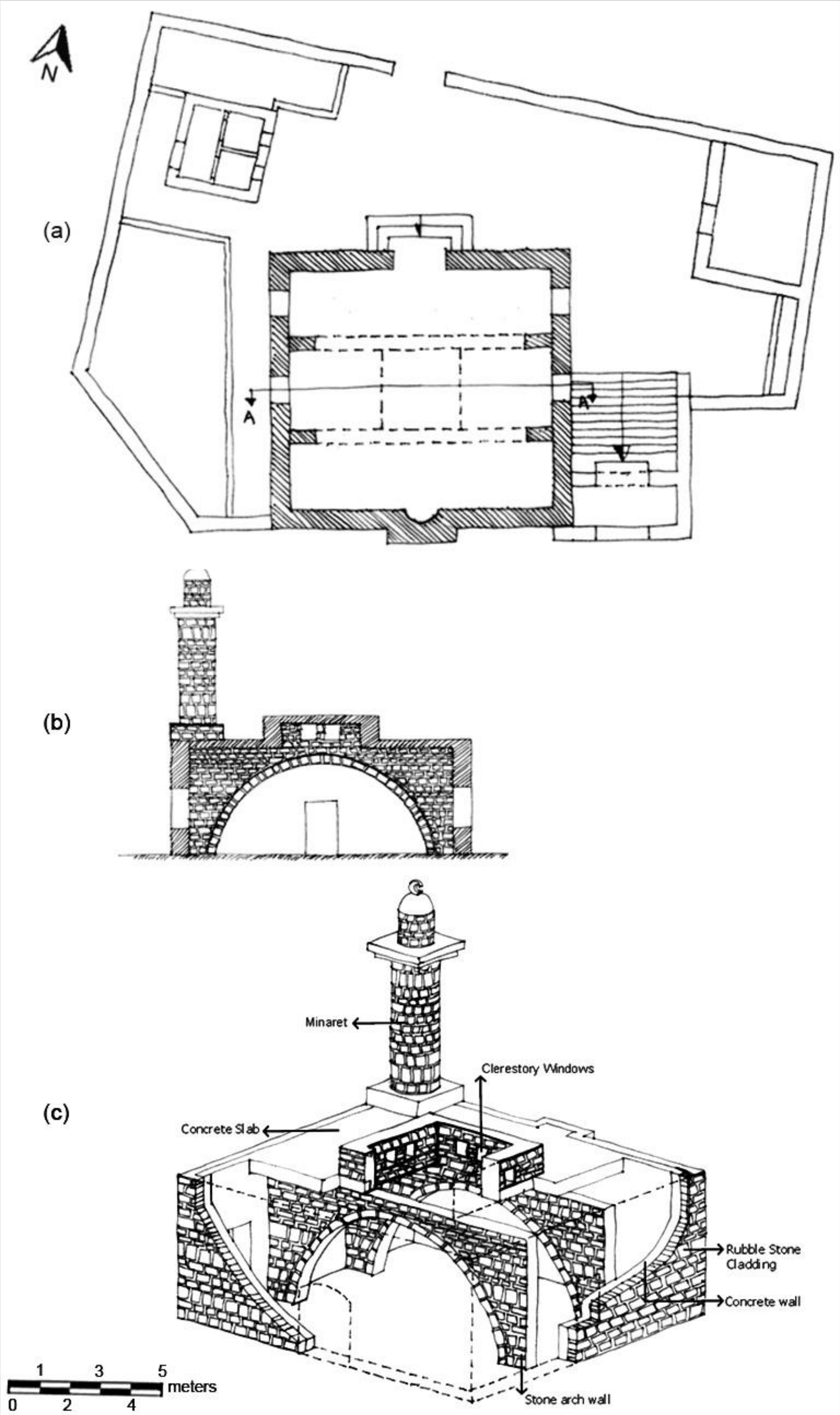


Figure 5.13: The current Dana Mosque: (a) plan; (b) section; (c) axonometric (Author 2020)

The mosque’s elevations are fairly simple; the main elevation, which faces the northwest, contains the entrance of the mosque, which is centrally located. The south-eastern elevation contains a protrusion that shows the external effect of the ‘Mihrab’ to stand as a sign of the Qibla direction. The other two elevations are identical; each contains two rectangular windows that front the external yard of the mosque. From inside, one sees the ‘Mihrab’ that faces the entrance and the two arches parallel to the entrance wall.

The arches divide the interior into three spaces: the entrance space, the ‘Mihrab’ space, which contains the first two prayers rows, and the middle space, which contains the clerestory windows. The eight clerestory windows located at the centre of the mosque were built to allow sunlight to enter the indoor space (**Figure 5.14**). From the outside, the mosque is surrounded by a yard which was added to provide outdoor facilities, such as a planting area, ablution area, WC, and the Imam’s house. The yard of the mosque has two entrances because of the different levels; one from the car park and one from the pedestrian way at the lower level.

Figure 5.14: The added clerestory windows and ‘Mihrab’ of Dana Mosque (Author 2020)

5.2.6 Types of Opening

The doors and windows of the original vernacular buildings were mainly made of wood due to its availability and efficient thermal insulation. The size of the windows was relatively small due to the short stone lintels covering their width and to provide privacy. Although all the openings are small, some have a horizontal stone or wooden lintel (**Figure 5.15a**), while others feature semi-circular arches (**Figure 5.15b**). In most buildings, the windows and doors face a street, courtyard, or front yard, as the other sides are attached to other buildings.

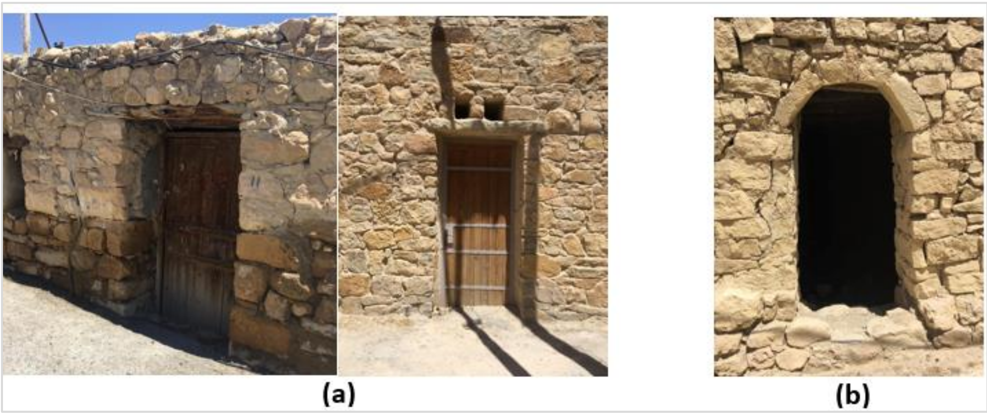


Figure 5.15: Types of door lintel: (a) straight stone or wooden lintel; (b) stone arch lintel (Author 2019)

The overall building layout affects the form of the openings. Small, single-space houses have small openings that face the street, while larger houses feature bigger windows opening onto semi-private front yards. Courtyard houses have relatively bigger windows because they front the courtyard (semi-private space). The three types of houses in Dana village display differences not only in the type of openings, but also in the construction techniques and sequential order of movement.

5.2.7 Sequential Order of Movement

Dana village is mainly formed of single-space buildings with flat roofs attached to each other, built in linear form, and fronting main or secondary roads. In this type of building, the sequential order of movement takes place from public spaces (outdoor roads) directly into private spaces (**Figure 5.16a**). Other buildings contain multiple rooms distributed in a way that creates a central courtyard. In this type of building, the sequential order of movement occurs from public spaces (outdoor roads) to a semi-private space (courtyard) and ending in private spaces (indoor rooms) (**Figure 5.16b**).

Few buildings are detached or semi-detached, with a front yard surrounded by yard walls to provide privacy. In this type, the sequential order of movement occurs from public spaces (outdoor roads) to a semi-private space (front garden) and ending in private spaces (indoor rooms) (**Figure 5.16c**). The differences between the types of building are due to the different socio-economic status of the local community. In other words, on the one hand there is a strong relationship between the local community of Dana village, and on the other hand between its urban morphology and architectural typology.

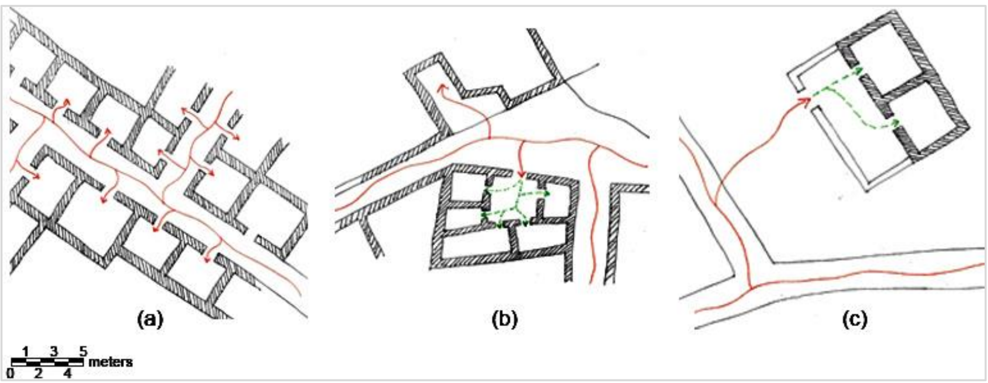


Figure 5.16: Sequential order of movement in (a) attached buildings; (b) courtyard buildings; (c) buildings with front yards (Author 2019)

5.3 Urban Morphology of Dana Village

5.3.1 Street and Road Patterns

Dana village has one primary street, running from the entrance of the village to its outskirts by the edge of Dana valley. It is the only way that connects the village with the surrounding primary street network. The main street divides the village into two parts: the north and the south. On the macro scale, the hierarchy of streets and roads shows that only pedestrian roads branch off the primary street, connecting the whole village with the primary street, as all the houses front either the primary street or pedestrian roads (**Figure 5.17**). The capacity of the pedestrian roads decreases as one moves away from the primary street.

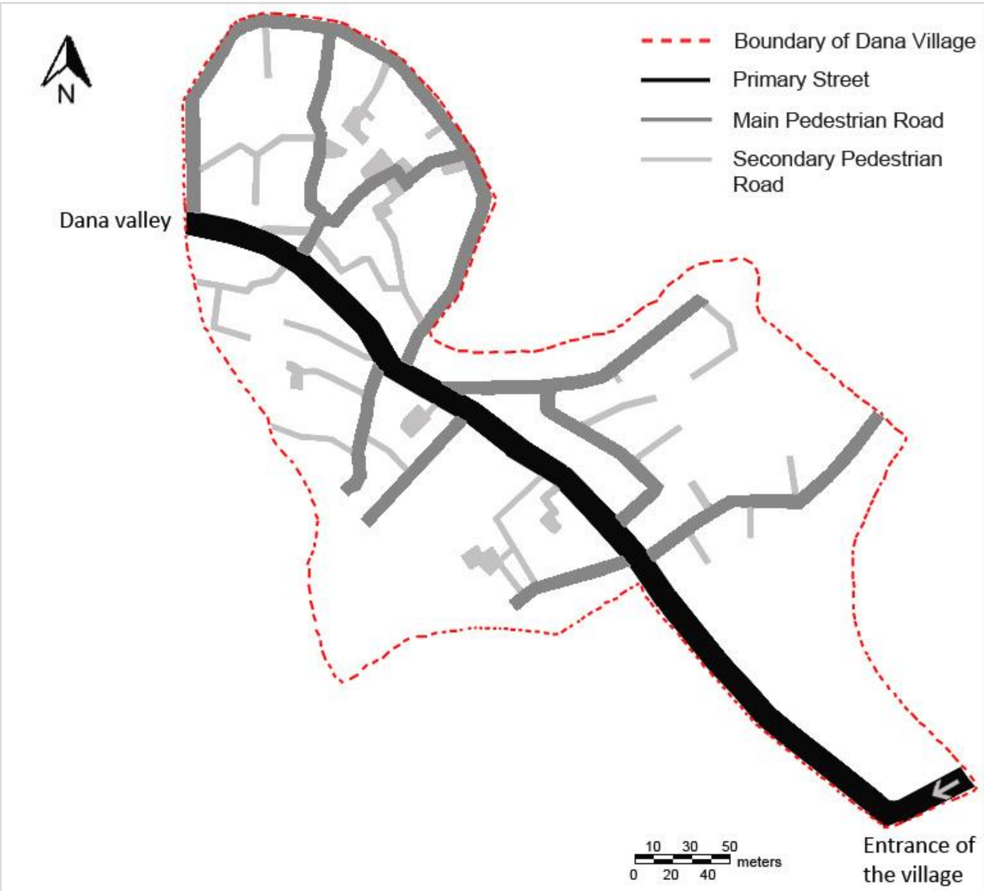


Figure 5.17: Street and pedestrian road pattern of Dana village (Author 2019)

The primary pedestrian roads had a higher capacity as they link the primary and secondary pedestrian roads, dividing the village into zones. Each zone is served by a different number of secondary pedestrian roads, depending on housing density. The lower (western) part of the village had more pedestrian roads, branching from the primary street due to the higher housing density. This suggests that the village was originally built at the lower part of the village, facing Dana valley, before expanding along the primary street towards the upper (eastern) part (**Figure 5.18**).

Figure 5.18: Upper and lower parts of Dana village, showing the capacity of the housing and pedestrian roads in each part (Author 2019)

On the micro scale, the primary and secondary roads also connect the urban open spaces that represent the void spaces between the village buildings

(**Figure 5.19**). The local community used to take part in recreational activities in the neighbouring roads and open spaces due to the limited space in the houses, such as gatherings, celebrations, and cooking. The streets, roads, and open spaces were used as public spaces for socialising in addition to transportation, due to the low volume traffic and the lack of planned public transportation networks.

Figure 5.19: Urban open spaces in the upper and lower parts of Dana village (Author 2019)

No buses ran to and from the village, as it was neglected and isolated between the mountains. Transportation was mainly by bullock cart or private vehicles, although most locals did not own one. Therefore, if residents needed to go to any other town or city, they had to walk to Al-Qadisya bus station in order to use public transportation. In addition to the lack of public transportation, the village suffered from a lack of other public services and infrastructure, such as water supply, and electricity and sewage networks.

5.3.2 Infrastructure

The lack of infrastructure and public services was one of the main reasons that forced people to move out of Dana; for instance, the village had no sewage or electricity networks. The absence of such networks was acceptable when the village was established because of the prevailing lifestyle at that time; locals had no choice but to use kerosene or oil lamps for lighting. Moreover, the absence of private toilets led to the lack of a sewage network. However, over time this lifestyle became unacceptable to the locals due to their evolving needs and requirements. Therefore, they moved out of the village when they realised that there were no short-term plans to supply it with such networks.

The village had no problem with water resources but did face a problem in distributing water to each building. In contrast, the village's experience with water supply was different, as several efforts were made to address the problems. More specifically, water wells were created to collect rainwater and melted snow, while the village water also flows in the form of permanent streams from three springs. The water from these springs was channelled to the village through water channels, for collection by the locals from the water distribution point. The knowledge and experience of the locals were essential in implementing the best arrangement and routes for the water channels to ensure the most efficient water flow.

However, the lack of water supply for each house and the low productivity of the village farms remained a problem because of the poor water management system. Therefore, the ‘friends of Dana’ and the RSCN, in collaboration with the local society, established an effective water network to connect the occupied buildings with water channels. Consequently, a significant number of pipes were installed, linking the water channels not only to occupied buildings, but also to the 40 hectares of Dana’s farms. A total of 19 farmers benefited from this water network for irrigating their farms (RSCN 2009).

5.3.3 Land Use Pattern

Dana village developed into a multi-functional, self-sufficient village in the 1980s, consisting of residential houses, commercial shops, medical services, a mosque, public spaces, and public buildings. Specifically, the village was formed of approximately 85% houses and 15% other services. The commercial facilities, constituting around 10% of the built-up area, were easily accessible throughout the village, being mainly distributed along the primary street. In addition, the residential buildings, which covered most of the built-up area, were constructed and located based on the socio-economic status of the families.

The local community in Dana village is divided into two main groups: landowners and sharecroppers. The landowners own their own houses and the neighbouring land. They settled on both sides of the main street and in the lowest part of the village, overlooking the valley. Their houses are relatively large, some with courtyards, some with front yards, and some are supported by internal stone arches.

In contrast, the sharecroppers work as tenant farmers for the landowners and claim an amount of the crops as rent. Their families settled in scattered small houses near the boundary of the village. Their houses are relatively small and comprise a single space. The difference in the socio-economic status of the families not only affected the location and type of building, but also their architectural features. Therefore, Dana's vernacular architecture includes various types of houses, openings, and construction materials and methods.

However, after the village was abandoned in the 1960s, the RSCN had no option but to reuse the buildings for other purposes. Some were transformed and reused as hotel rooms to accommodate tourists. In the 1980s, two hotels were opened, Dana hotel and Dana Tower hotel, which converted the village's abandoned houses into hotel rooms to accommodate tourists. Despite their well-meaning goal of reviving the abandoned village, they made some alterations that contradicted the village's urban configuration.

5.3.4 Urban Configuration

Dana village reflects the harmony of its urban fabric with the surrounding natural environment and the geological features. By the end of the 20^{th} century, the built-up area occupied 65% of the total village area; the public open spaces occupied 20%; while streets, roads, and pathways covered the remaining 15% (**Figure 5.20**). The figure ground plan received no changes until the rehabilitation project of Dana village in 2009. However, the built environment underwent several changes after the abandonment of the village in the 1960s.

Figure 5.20: Figure Ground Plan of Dana Village (Author 2019)

Originally, before the 1960s, Dana's built environment was formed of single-storey buildings with flat roofs that followed the slope of the site, reflecting the harmony of the village with the topography of the land. It showed the natural slope of the land in a manner that maintained its consistency with the distinctive topography of the location. In addition, the organisation of contiguous buildings in clusters is one of the main characteristics of the village, giving the appearance of a cohesive/compact unit. To some extent, the contiguous houses were formed in equal sizes, making their gradient and interlocking roofs one of the unique features that distinguished the village. These characteristics should have been conserved and protected from any distortions or extraneous additions.

By the end of the 20th century, due to abandonment, most buildings deteriorated as some parts collapsed, such as roofs and arches (**Figure 5.21**). Approximately 45% of Dana's buildings had collapsed roofs, and more than 80% of the house roofs had deteriorated and needed restoration. The RSCN claimed that fewer than 20% of buildings were in good condition, only taking into consideration if the buildings were used or occupied (Alhasan 2019). Indeed, the buildings in use had a better chance of surviving, while the abandoned buildings tended to deteriorate rapidly. The RSCN explained that even if there were no problems with the roofs and walls, their integrity would be affected over time due to their abandonment. Not only would the integrity of roofs and walls be affected, but also that of the plaster, pavement, doors, and windows, which are essential elements that also need to be conserved.

Figure 5.21: Dana village in the 1930s before it was abandoned (top), and at the end of the 20th century after it was abandoned (bottom) (Archive, RSCN 2019)

Some semi-public spaces were partially destroyed, such as fences (garden walls), courtyards, and steps that connected various open spaces. Therefore, like most of the villages in Jordan, Dana underwent random renovation attempts and transformation processes by locals after the 1960s (Alhasan 2019). For instance, although the village was formed of single-storey buildings, some locals added a second floor as an extension (**Figure 5.22**). These additions did not respect the skyline of the village, which followed its topography. They were constructed of galvanised steel corrugated roofing sheets and glass windows surrounding the added spaces. The adopted materials broke the harmony of the village, which was basically built from stone.

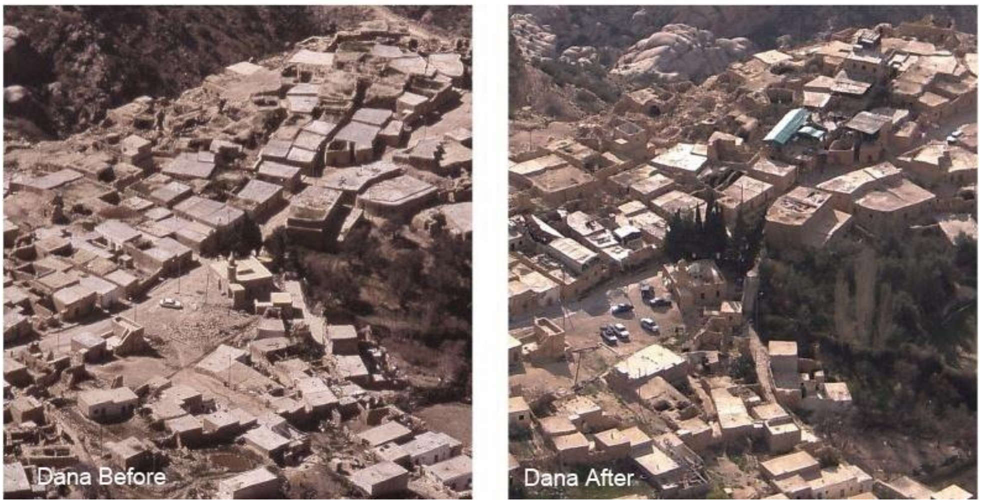


Figure 5.22: Single-storey buildings following the topography of Dana village in the 1930s (left), and additions and extensions that broke the harmony and skyline of the village in the 1990s (right). (Archive, RSCN 2019)

Mostly unlicensed, these additions were made in contravention of the building legislation of Dana village. Therefore, the municipality of Tafilah tried to remove them. The owners of the buildings claimed that the additions were temporary, using the materials used as an excuse. As a result, due to the lack of determined actions, these additions still exist. Unfortunately, the locals were not aware of the extent to which these additions detracted from the authenticity of Dana's vernacular architecture. In 2009, therefore, the RSCN launched the village rehabilitation project to recapture the lost heritage and to adjust the locals' transformation activities. Despite these changes, the original form of the village's figure ground plan was maintained because the structural elements were mostly conserved, such as the masonry-bearing walls of the buildings. Indeed, the external bearing walls of the village buildings serve as key space definers that create the village's urban configuration.

5.4 Conclusion

According to the ICOMOS training guidelines of 1993, conservation is defined as a process that consists of the identification, documentation, interpretation, understanding, and presentation of heritage (ICOMOS 1993). Therefore, as this study is concerned with the impact of the transformation of Dana village, some representative samples of the original buildings are documented by analysing the available evidence. This step is necessary before launching a new restoration or rehabilitation project in order to define the construction methods, construction materials, the condition of the buildings, and the causes of decay (Jokilehto 2007, p. 3). However, this step was overlooked when the rehabilitation project was launched; this chapter has compensated for this gap.

A field survey was conducted in July 2019 to record the original buildings in Dana. It showed that most had deteriorated because they had been abandoned for almost 60 years. Most of the unrestored buildings had collapsed, including their walls, roofs, and arches. Specifically, the original buildings were composed of rubble masonry walls with a thickness of 60 cm or more. The gap between the stone courses and units was filled by mortar made of a mixture of clay and straw. Moreover, the original roofs were made of timber beams spanning the bearing walls, secondary beams, or arch walls, topped with a cane layer, and covered by layers of clay and straw.

The form of the original vernacular houses varied according to the size and socio-economic status of the local community. Three types of houses are found in Dana: single-space houses, courtyard houses, and front-yard houses. The single-space house type is formed of a single and multi-functional space attached to each other. Second, houses with courtyards are generally rectangular in form, with the central courtyard surrounded by rooms on three sides and the entrance wall on the fourth. The courtyard is used as a multi-functional space, where most of the occupants' activities take place, such as chatting, eating, cooking, and celebrating. The third type is houses with front yards, as a middle point between the single-space houses and courtyard houses. This type is observed mainly in scattered houses and is suitable for application in detached or semi-detached houses.

On the urban scale, the village is mainly formed of single-storey buildings and flat roofs. The urban pattern of Dana has been conserved, as the masonry bearing walls of the buildings were either fully or partially conserved. Even if the walls were partially destroyed, their presence creates the boundaries of space, conserving the urban fabric and morphology. Furthermore, the residential buildings, which covered the majority of the built-up area, were built and located according to the socio-economic status of families, reflecting the background of the local community.

Comprehensive documentation of the original vernacular settlement is provided in the chapter, including the construction materials, construction methods, and types of houses on the architectural scale. Moreover, the chapter records the urban configuration of the village, its street pattern, land use, and infrastructure. This documentation will remain for future researchers as evidence of the original settlement for reinterpretation in pursuit of further knowledge. It also establishes the first step of this study, identifying the first aspect of the comparison study between Dana village before and after the rehabilitation project.

This comprehensive documentation is essential to understand Dana's original vernacular settlement in order to monitor the changes that occurred during and after the transformation process as a part of the rehabilitation project. These changes are investigated in the following chapter, which shows their impact on the authenticity of Dana village, including Dana's architectural and urban environment.

Chapter Six: The Architectural Impact of the Transformation of Dana Village

6.1 Introduction

After the documentation of Dana's original architectural and urban form in the previous chapter, this chapter aims to assess the architectural impacts of the rehabilitation project that transformed Dana into a tourist settlement. The RSCN launched the rehabilitation project (2009-2015) to conserve Dana's architectural heritage and adjust the random and unplanned transformation activities of locals. It adopted sustainable ecotourism development as a methodological approach to regenerating the abandoned village by reusing the vernacular buildings as hotel rooms to accommodate tourists. The main purpose of the project was to establish a sustainable and balanced relationship between the conservation and development of Dana in a way that met the requirements of the new use and users.

Recording, documenting, and managing the transformation process were undertaken at all the stages of Dana's rehabilitation project, including the tangible heritage in its architectural and urban forms (Naanaa 2019). The transformation eventually made several changes that transformed some of the main characteristics of the village. The changes were adopted due to financial and maintenance issues, space needs, occupant changes, and adaptive reuse purposes. To assess the impacts of changes on the form and structure of Dana's buildings, a coupling of qualitative and quantitative analyses was carried out, employing a combination of in-situ data collection methods, such as archival research, field survey, and interviews.

Archival research was conducted to collect specific village documentation at every stage of the transformation process. To support this, interviews were held with Osama Alhasan, head of ecotourism/ facilities development at the RSCN, Malik Naanaa, head of the RSCN (Dana branch), and Sulieman Al-Khawaldeh, the president of Dana and Al-Qadisiyyah local community cooperative (**Appendix A**). As the documentation was insufficient for the analysis, a field survey was also conducted to examine the current built environment of the village.

Afterwards, the developed HIA framework was used to assess the architectural impact of transforming the village to accommodate tourists. On the basis of the framework's criteria, the architectural assessment is mainly based on assessing the transformation of Dana's roofs, walls, building forms, indoor facilities, and opening sizes. The buildings before and after the interventions were compared to understand how they were transformed and to evaluate the impacts of the transformation, discussing the integrity of the changes in relation to the village heritage. As a result, this chapter provides a comprehensive architectural assessment of the transformation of Dana village into a tourist settlement.

6.2 Limitations and Change Drivers

The RSCN collaborated with Ammar Khammash engineering consulting office to design a proposal for the rehabilitation project (Alhasan 2019). They faced various limitations and change drivers that led to the adoption of several changes. For instance, they replaced the original construction materials with industrial ones; added new spaces and facilities; constructed new buildings; and added infrastructure. These changes were driven by the financial limitations, maintenance and space needs, occupant changes, adaptive reuse purposes, and conflicts with the local community (Naanaa 2019).

The financial limitation was the most significant factor that played a key role in making the changes and limited the overall project. The fund from the United States Agency for International Development (USAID) was not enough to restore the entire village, which consists of 350 houses and other types of property (Naanaa 2019). Therefore, the village was divided into three zones, and the rehabilitation project was divided into three stages. The priority area was that located near the village's main street. Some conflicts with the two main bodies (Dana hotel operators and Dana tower hotel operators) in Dana were raised before the rehabilitation project started.

The Dana hotel operators wanted the rehabilitation project to be exclusive to their part of the village. In addition, the Dana Tower hotel operators refused to remove its two additional floors, which was one of the rehabilitation project aims. As a result of this conflict of interests, the project was delayed for a year and a half. Accordingly, the RSCN was forced to develop plan B (Naanaa 2019). It posted a declaration in the municipality of Al-Qadisiyah to all the house owners in the village. This contained the objectives of the project, how the houses could be restored, and the options of the new functions of the houses, including hotel rooms, shops, cafes, mini-markets and personal use (Naanaa 2019).

It also included the financial commitment of the house owners, who were expected to pay 50% of the cost of restoring their houses in instalments within ten years.[26] Those who were interested in restoring their houses were required to submit an application to the RSCN. A total of 200 applications were submitted. The RSCN approved only 54 applications after dividing the project into three stages and defined the priority area to be restored at stage one. Consequently, 120 houses were selected for restoration at stage one, those which were within the zone of the first development area (**Figure 6.1**).

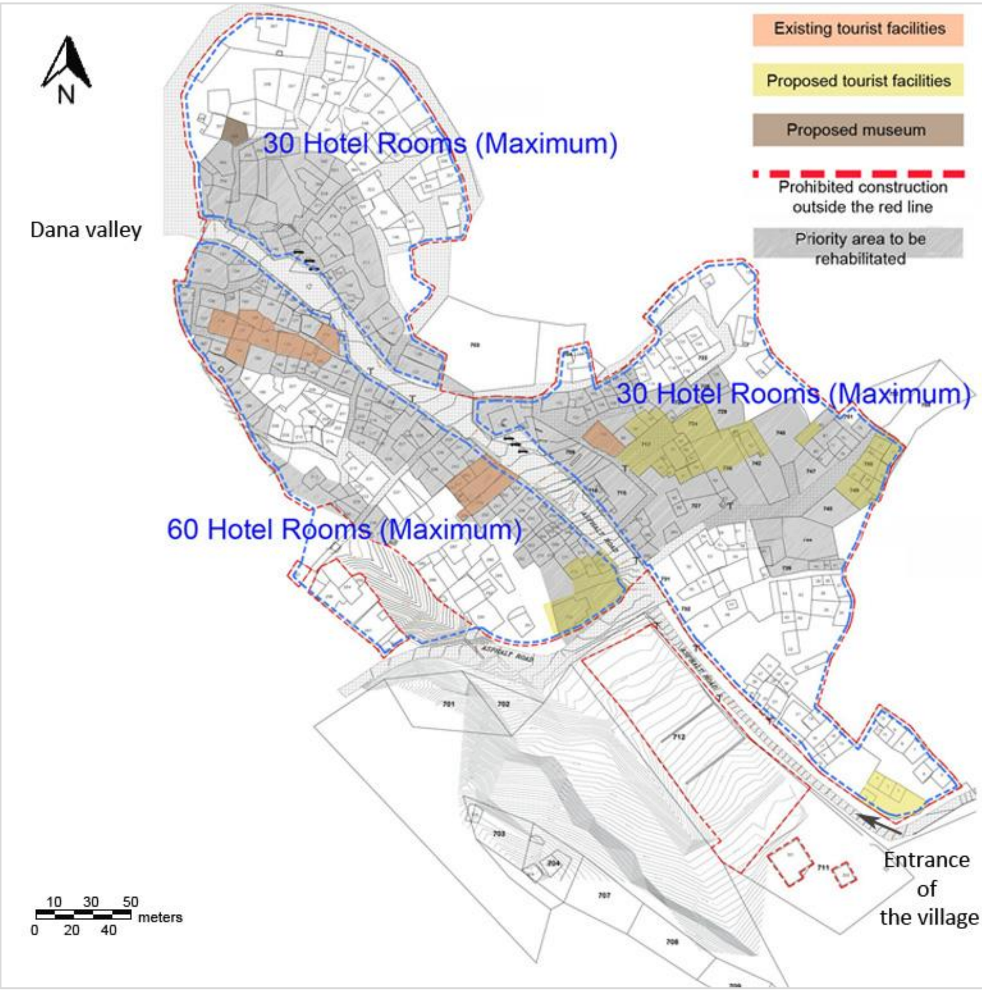


Figure 6.1: Master plan of Dana village, showing the priority area of the rehabilitation project (Archive, RSCN 2019)

The priority area was defined as that around the main street of the village, near the hotels in operation, and by the edge of Dana valley (Naanaa 2019).

[26] The minimum cost of restoring each house was 35900£ (Naanaa 2019).

It was divided into three zones, each with a limited number of houses to be restored: the north-eastern zone comprising 30 houses, the north-western zone 30, and the southern zone 60 (Naanaa 2019). Besides the existing tourist facilities, new ones and a museum were proposed to fulfil the requirements of the village's adaptive reuse. Specifically, the implementation of sustainable ecotourism development required the addition of new buildings and infrastructure to adapt the village to its new use.

Ammar Khammash engineering consulting office was responsible for regulating the rehabilitation process and deciding changes to be approved by the RSCN.[27] For instance, new tourist facilities and spaces were added in order to adapt the restored buildings to the new occupants. New spaces were needed to meet the needs of tourists, such as bathrooms, shafts for lighting and ventilation, and windows added to the dark and closed houses. Furthermore, the original construction materials were replaced with new ones due to financial and maintenance limitations.

The RSCN claimed they used new construction materials because they are more durable and do not need frequent maintenance. Naanaa (2019) added that they were also more affordable due to their availability and frequent use in Jordan. Moreover, it was difficult to use the original materials due to the non-availability of original skills, proper tools, trained craftsmen, and certain materials such as cane and juniper wood. Indeed, the local community

[27] The RSCN was in charge of approving the rehabilitation process on behalf of the Ministry of Tourism and Antiquities, as the municipalities are not authorised to approve proposals concerning archaeological sites, according to Law No. 21 for year 1988 (Al Haija 2012, p. 76).

undertook the rehabilitation project after being trained in the basic techniques and skills (Naanaa 2019).

As a result, the project's limitations and changes affected the overall vernacular settlement of Dana, transforming its architectural and urban context. The architectural impact of transforming Dana's vernacular houses into hotel rooms is one of the essential aspects to be assessed in order to evaluate the rehabilitation project and its adopted changes. The transformation of Dana's original buildings involved different approaches, according to the type of restoration. The physical situation of these buildings played an important role in deciding the type of restoration and, consequently, the materials and methods of construction adopted. The RSCN undertook two types of restoration, total and partial, with each type adopting a different approach.

6.3 Types of Restoration

Based on previous practice, the type of restoration was decided based on different factors, including the significance and physical condition of the building. Some restoration projects map the significance of buildings, classifying buildings into significant and less significant ones. The significant buildings, which have architectural, historical and location significance, were totally restored, both internally and externally. For instance, the restoration of facades is obligated to be integrally restored, restricting the ability to accept changes. However, the less significant buildings were only partially restored, and their facades were flexibly restored with the possibility of applying changes (Al Haija 2012, p. 80). Furthermore, other buildings could be either totally or partially restored based on their physical condition and degree of deterioration, and this was the case in Dana village.

Malik Naanaa explained that the restoration of the vernacular buildings was divided into two main types, total and partial restoration, according to their physical situation. Some buildings were entirely demolished and needed total restoration (only the layout of buildings exists). Meanwhile, others were partially demolished, either their roofs or walls, and so needed partial restoration. In the case of total restoration, the buildings were superimposed over the outline of the original building and built on the same footprint (Naanaa 2019). These buildings were distinguished from the original ones by the use of new construction materials and the design of new openings.

Most of the windows and doors were replaced by new metallic or wooden elements. However, in the case of partial restoration, the original form was restored by reconstructing the demolished and missing elements using the same original materials collected from the same site. In this case, it is hard to distinguish these buildings from the original ones. Moreover, in both total and partial restoration, the adopted approach for restoring the roofs was to remove and replace them with new ones. Most of the cases were totally restored because most of Dana's buildings were in total ruin (Naanaa 2019). The demolished roofs and walls were the only evidence of the existence of these buildings (**Figure 6.2**).

In other cases of totally restored buildings, either the borders of the walls were identified, or the walls existed but were in bad condition (**Figure 6.3**). Few buildings were partially restored where the walls were in good condition, with just the roof in poor condition. However, the adopted approach in some cases, when the walls were in good condition, was still to demolish them because they did not have openings for ventilation and lighting. This was the case when tourist accommodation was to be the new use for the buildings. The RSCN and Ammar Khammash engineering consulting office, therefore, provided guidelines that outlined the adequate conservation process in order to control the different interventions in the village (Alhasan 2019).

Figure 6.2: Demolished roof and walls of a totally ruined building (Author 2019)

Figure 6.3: A building before the rehabilitation project, showing the wall borders in bad condition (upper), and the building after it was totally restored (lower) (Archive, RSCN 2019)

The adopted approaches for totally restoring buildings to accommodate tourists included constructing new roofs; replacing the bearing walls with non-bearing ones; creating shafts for ventilation and lighting; adding new openings for ventilation and lightning if these did not exist; and creating a bathroom in each building. As a result of these interventions, some of the main features of the original buildings were lost as their conservation was challenging during the development process (Naanaa 2019). Further details about the adopted changes and their purposes and impacts are investigated in the following sections. The transformation of Dana's original roofs, walls, form, and openings is assessed, detailing the replacement of their original features.

6.4 Transformation of Dana's Roofs

The construction materials and techniques of Dana's roofs were changed due to the limited availability of original ones and the lack of locals' experience in implementing the original techniques and methods of construction (Naanaa 2019). The timber beams were replaced by reinforced concrete beams, and the cane and clay roofs were replaced by reinforced concrete roofs. Inside, they were plastered with roughcast or smooth cement mortar and painted with white 'sheed' paint, that is lead-free, anti-insect, and affordable. This transformation was necessary due to the limited availability of juniper wood used in constructing the original roofs.

During the Ottoman period (100-150 years ago), juniper was available due to the proliferation of large trees with large branches. However, the quantities required for the restoration process were unavailable when the rehabilitation project was launched (Naanaa 2019). Besides, even if another type of wood had been chosen to replace the juniper wood, it would be light wood and might be damaged over time. Similarly, there were no available quantities of the cane required for the restoration process. Moreover, as the original roofs needed frequent maintenance, the mixture of clay and straw was replaced with concrete, intended as a durable solution for roof construction.

The original mixture needs frequent maintenance due to the different seasons in Dana. The original roofs are often wet or dry, turning them into a fragile layer that incapacitates the covering and protection of the internal spaces. Therefore, the original roofs were rebuilt every year when the village was occupied by locals (Naanaa 2019). The analysis of previous practices in Jordan reveals that replacing the top layer of Dana's original roofs would better protect the vernacular houses (Baglioni 2014, p. 109). Oleander branches were used instead of canes, which have fibrous leaves that last well over time, and require less maintenance. In addition, the mixture of clay and straw was replaced with pressed earth, mixed with straw, gravel, and sometimes small stones.

Finally, a layer of waterproof fine-grained plaster was applied on the top to protect the compacted earth layer (Al Haija 2012). The overall compacted earth layer of 40 cm thickness produces better natural insulation and indoor thermal comfort than the concrete roofs spreading throughout Jordan (Baglioni 2014, p. 109). Compared with Dana's original roofs, only the plaster layer requires constant maintenance rather than the entire roof, including the application of a new layer of plaster every year before winter.

In addition, the compacted earth layer requires less frequent maintenance, only every 3-4 years (Baglioni 2014, p. 110).

Regardless of this preservation option, the roof construction method in Dana was completely changed in the restored buildings, as most roofs were in ruin (Naanaa 2019). The clay roofs supported by timber beams and canes were transformed into reinforced concrete roofs (**Figure 6.4**). In both the partial and total restoration processes, the roof construction method replaced the timber beams with reinforced concrete ones, so wider spans were achieved. Therefore, the internal stone arch walls were no longer required to support the wide roof spans. However, these stone arch walls were rebuilt after the roofs, with no functional purpose other than to preserve the visual appearance and elements of the vernacular houses (Naanaa 2019).

Figure 6.4: Original roof of timber beams and canes before being removed (Archive, RSCN 2019)

Eventually, comprehensive changes to key settings of Dana's roofs were applied, including their construction materials, techniques, plaster, and painting. On the basis of ICOMOS's assessment scales, these settings received major changes (scale of impact numerical value = 4), causing an extreme adverse impact on Dana's cultural heritage (attribute of impact numerical value = -4). **Table 6.1** illustrates the HIA of transforming the roof's key settings and the final results of calculating the severity of impact and the attribute of overall impact.[28] The results show that the transformation of Dana's roofs caused major changes (score of impact scale = 3.81) and major adverse impact (score of impact attribute = -3.81) (**Figure 6.5**).

Table 6.1: HIA score table of transforming Dana's roofs (Author 2022)

Criteria of Assessment	**Description**	**Significance Degree**	**Impact Scale/ Severity**	**Weighted Impact**	**Impact Attribute/ Significance**	**Weighted Attribute**
Architectural Assessment						
Roof						
Type of Roof/ Thickness	Before: flat timber roof (40-50 cm) After: flat concrete roof (25-30 cm)	0.06	3	0.18	-3	-0.18
Construction Materials	Before: timber, cane, clay, and straw After: concrete and steel	0.10	4	0.40	-4	-0.40
Construction Technique	Before: timber structure After: concrete structure	0.07	4	0.28	-4	-0.28
Plaster	Before: N/A After: roughcast or smooth cement mortar	0.04	4	0.16	-4	-0.16
Painting	Before: N/A After: white 'sheed' paint	0.05	4	0.20	-4	-0.20
	Sum of Significance	0.32	Total Result	1.22	Total Result	-1.22
			Score of Impact Scale	3.81	Score of Impact Attribute	-3.81

[28] The steps of calculations were discussed in the methodology chapter, section 3.3.3.

The analysis concludes that the replacement of the roofs' construction materials and methods is not intended for 'like for like' repairs, as recommended by most conservation guidelines. Moreover, it is not a type of adaptation that takes into consideration modification to meet new needs, such as adding or removing certain elements. Instead, entire roofs were removed, and new types imposed that had no connection with the original ones. This shows that the RSCN failed to reconcile the objectives of conservation, leading to the loss of an essential part of the architectural heritage.

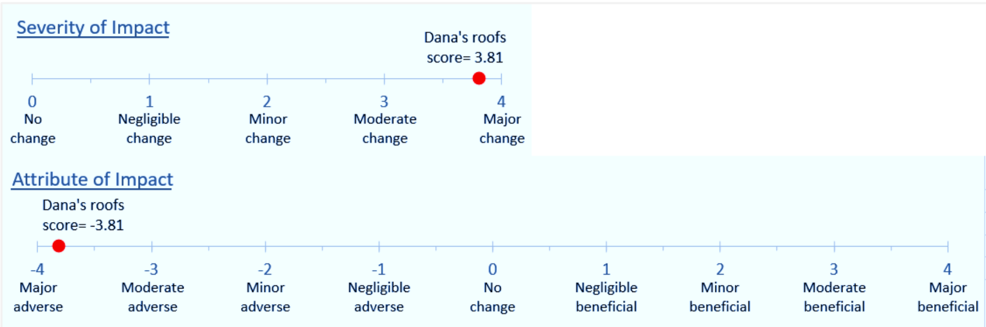


Figure 6.5: Severity of impact (top) and attribute of impact (bottom) of transforming Dana's roofs (Author 2022)

6.5 Transformation of Dana's Walls

The development of Dana village transformed the original bearing walls into non-bearing ones, using new construction materials and techniques. Most of the original walls, composed of stone, clay and straw, were transformed into new walls constructed of stone, hollow cement blocks, and concrete (Naanaa 2019). This transformation is used in the case of total restoration, rebuilding a new type of wall that is frequently used in Jordan. The rebuilt walls were composed of stone masonry for the external face (10cm) and hollow cement blocks for the internal face (10 cm), with concrete filling in-between (**Figure 6.6**).

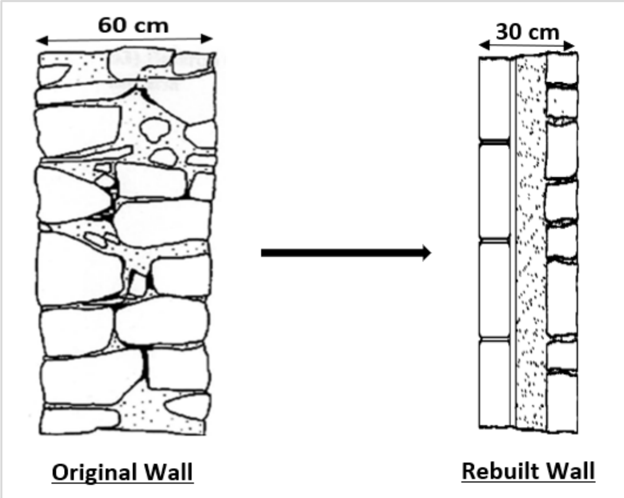


Figure 6.6: Transformation of Dana's original walls (Author 2020)

However, in the case of partial restoration, the walls were restored using the original vernacular method of construction. The same original materials were employed; stone on both sides (external and internal faces), with clay filling in between, mixed with a small amount of cement (1:10) instead of straw in order to strengthen it (Naanaa 2019). **Figure 6.7** shows the facades of the restored buildings, indicating an obvious desire to conserve the building facades and to maintain as much as possible of the original form, surface materials, and heights.

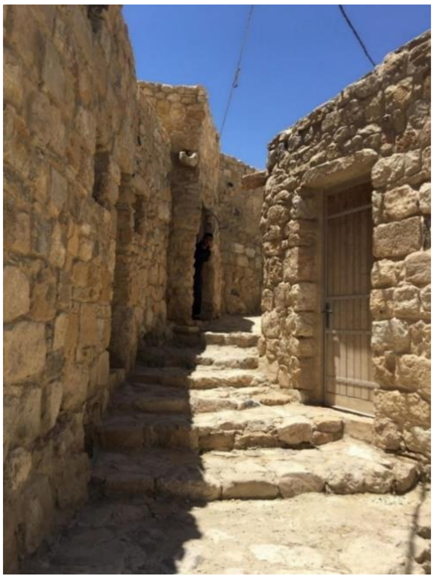


Figure 6.7: Rubble stone masonry facades of the restored buildings (Author 2019)

The rubble stone masonry and irregular horizontal courses of the original buildings were conserved in the restored buildings. The stone masonry was either left without being repointed or repointed with cement mortar to avoid insects and reptiles. The suitable proportions of cement mortar were as follows: 1 unit of white cement to 2 units of fine powder to 2 units of Dana village soil (Naanaa 2019). Plastering the external faces of stone walls was prohibited, as permitted use of roughcast or smooth plaster was limited to the internal wall faces (**Figure 6.8**).

Figure 6.8: Permitted and prohibited external and internal wall plaster (Archive, RSCN 2019)

To finish the internal wall faces, some were left without plaster, leaving the inner face of the stone exposed. These walls were repointed with cement mortar whose colour was the same or close to that of the stone. However, most internal walls were plastered using either roughcast or smooth plaster, again with the same or similar colour to the stone; it is forbidden to use plaster with exaggerated textures. Like Dana's rebuilt roofs, the painting was done with white 'sheed' paint on the interior walls because it is free of lead, anti-insect, and affordable (**Figure 6.9**). In contrast, the internal arches were conserved by not removing them, nor changing their texture or covering them with plaster or painting.

Figure 6.9: Permitted new finishing of the internal wall face (Archive, RSCN 2019)

Substantially, key settings of Dana's walls were comprehensively changed, including their construction techniques, plaster, and painting. The analysis revealed that these settings received major changes (scale of impact value = 4), causing a major adverse impact on Dana's cultural heritage (attribute of impact value = -4). Other settings were significantly modified, such as the wall's type/thickness and construction materials. The former received moderate changes but kept the masonry structure of walls (scale of impact value = 3), causing a moderate adverse impact on the architectural heritage (attribute of impact value = -3). For instance, thinner walls were produced, making the openings in general and the windows specifically look shallower.

Similarly, the latter were moderately changed, keeping the stone material but as a cladding, not construction one (scale of impact value = 3). Although such changes maintained the visual appearance of buildings, following the facadism approach, they caused a moderate adverse impact on Dana's architectural heritage, transforming Dana's bearing walls into non-bearing ones (attribute of impact value = -3). Furthermore, the conservation of the rubble stone masonry and irregular horizontal courses maintained the façade design, causing a moderate beneficial impact on the architectural heritage (attribute of impact value = +3). However, changing some opening sizes slightly modified some facades, leading to minor noticeable changes (scale of impact value = 2).

Table 6.2 summarises the HIA of transforming the exterior wall's key settings and the final results of calculating the severity of changes/impact and significance/attribute of overall impact. The results indicate that the transformation of Dana's walls included moderate changes (score of impact scale = 3.23) that caused 'minor-moderate' adverse impact (score of impact attribute = -2.33) (**Figure 6.10**). As in the case of the transformation of Dana's roofs, the transformation of the walls did not follow a type of adaptation that allowed modification to meet new needs. The original walls were entirely removed and replaced with a new wall type with no connection to the original.

However, unlike the replacement of Dana's roofs, there was no valid reason for the transformation of the walls. The original construction materials were available, providing a more affordable and durable solution. Moreover, the original wall construction method is simple, requiring basic training for the local builders implementing the rehabilitation project. This indicates that the RSCN failed to find a balance between conservation and development in the case of restoring Dana's original walls, leading again to the loss of an essential part of the village's architectural heritage without any valid justification.

Table 6.2: HIA score table of transforming Dana's walls (Author 2022)

Criteria of Assessment	Description	Significance Degree	Impact Scale/ Severity	Weighted Impact	Impact Attribute/ Significance	Weighted Attribute
Architectural Assessment						
Exterior Walls						
Type of Wall/ Thickness	Before: bearing masonry walls (60cm or more) After: non-bearing masonry walls (30cm)	0.06	3	0.18	-3	-0.18
Construction Materials	Before: local stone and mortar made of clay and straw After: local stone, hollow cement blocks, and concrete	0.10	3	0.30	-3	-0.30
Construction Technique	Before: bearing walls of single or double layer After: non-bearing walls of three layers	0.07	4	0.28	-4	-0.28
Façade Design	Before: rubble stone masonry and irregular horizontal courses Before: rubble stone masonry and irregular horizontal courses	0.07	2	0.14	+3	0.21
Plaster	Before: N/A or mixture of clay and straw After: roughcast or smooth cement mortar	0.04	4	0.16	-4	-0.16
Painting	Before: N/A After: white 'sheed' paint	0.05	4	0.20	-4	-0.20
	Sum of Significance	0.39	Total Result	1.26	Total Result	-0.91
			Score of Impact Scale	3.23	Score of Impact Attribute	-2.33

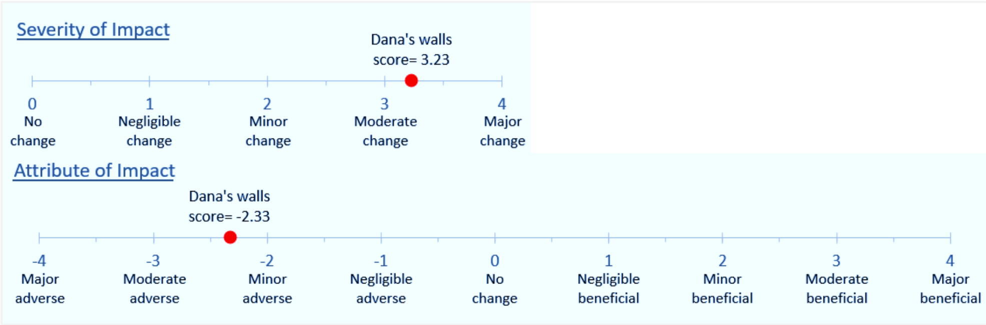


Figure 6.10: Severity of impact (top) and attribute of impact (bottom) of transforming Dana's walls (Author 2022)

6.6 Transformation of the Building Form

The rehabilitation project in Dana village aimed to remove any additions that broke the skyline to maintain the original form of the buildings (Naanaa 2019). However, the RSCN failed to do this due to the absence of determined actions, as these additions continue to exist. Although the RSCN was unable to remove these additions, it has prevented similar ones from being built since it started managing the village. In addition, it adopted several approaches to conserving the original form of the village buildings. Specifically, the building layout was conserved, as the restored buildings were superimposed over the outline of the original ones.

The restored buildings were rebuilt on the same footprint and at a similar height and proportions, following the RSCN's approach of maintaining the buildings' original form as much as possible while keeping interventions and additions limited to the minimum needed to run the buildings in line with their new use within the development process (Naanaa 2019). For instance, the indoor space of Dana's restored buildings underwent changes to meet the requirements of the hotel rooms. The adopted restoration approaches considered private bathrooms as a primary need that needed to be added to each restored building, especially the hotel rooms (Naanaa 2019). Therefore, bathrooms were created in each totally restored building and connected to the public services, including water supply, sewage network, and infrastructure.

Each restored building was connected to a manhole, which is a part of the sewage network, to dispose of wastewater. Further changes were also implemented as a result of placing several elements on the roofs of the buildings that had not been used previously. For instance, water tanks were installed after the village was connected to the water supply network. Solar panels were also installed for sustainability and energy-saving reasons. Therefore, the RSCN proposed a solution to hide the added water tanks and any other elements in a way that conserved and did not distort the general image of the village. The solution invented recesses in the roofs in which to place and hide the water tanks and any other added elements, respecting the village skyline (**Figure 6.11**).

Figure 6.11: Recess in the roof to hold the water tank and any other elements that are usually placed on the roof (Author 2019)

The recesses were built above the bathroom space, at a level 70 cm lower than the main roof (**Figure 6.12**). Therefore, the internal height of the bathroom is

70 cm less than that of the main space (usually the bedroom). The dimensions of the water tanks needed to be suitable to fit and be hidden in these recesses. In most cases, the height is less than 70 cm, and the length and width vary according to the building area. Furthermore, the restored roofs were built with no parapets, but with simple and small edges similar to the original buildings. The aim of these edges is not to provide safety for people but to contain the rainwater and direct it to the rain gutters.

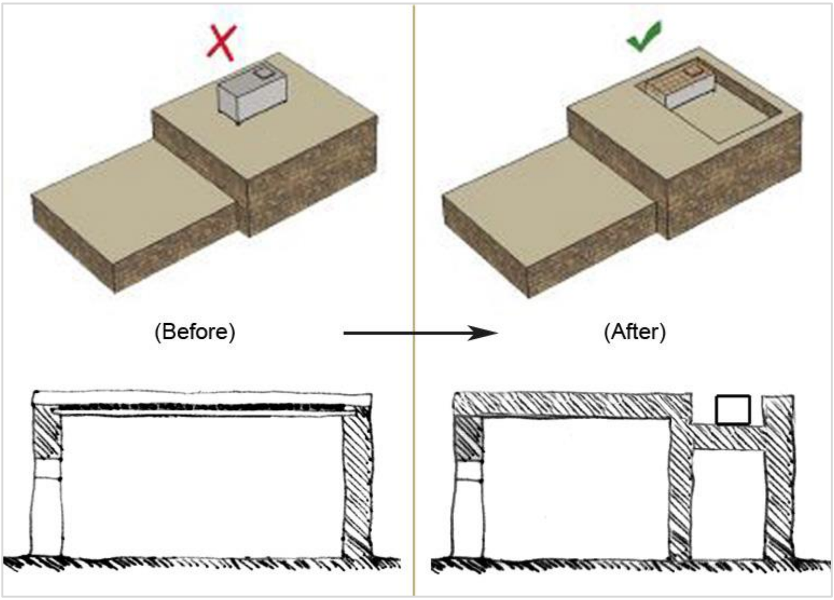


Figure 6.12: Recess in the roof that hides the water tanks (Author 2019)

The rain gutters are hidden in the external walls because they should not be exposed to the outside. It is not allowed by the RSCN to install elements on the external facades because they would ruin the harmony and general image of the village. Alternatively, stone gutters that are consistent with the village architecture were used to direct the rainwater away from the external wall faces (**Figure 6.13**). These interventions were required to meet the needs of transforming Dana's houses into hotel rooms and to complete the functionality of the added indoor facilities, including the bathrooms.

Figure 6.13: Prohibited rain gutters visible on the external walls (left); permitted gutters (right) (Author 2019)

Furthermore, new lighting shafts were created to provide more lighting and better ventilation (Naanaa 2019). The lighting shafts that were devised aimed to keep the inward orientation of buildings and maintain the privacy and visual image of the village while improving the lighting and ventilation of the indoor spaces. The addition of the lighting shafts succeeded in this respect, representing an approach to adapting the restored buildings with new uses that required more lighting and better ventilation. They were composed of a rectangular opening in the roof, a glass wall on one or two sides, stone walls on the other sides, and a paved or planted floor (**Figure 6.14**).

The lighting shafts were inspired by the work of Hasan Fathy and Rasem Badran, who demonstrated the significance of windcatchers in bioclimates such as that of Jordan. Windcatchers are used to catch wind from outside the building and transfer it into interior spaces (Badran 2003; Suleiman and Himmo 2012). Similarly, the introverted lighting shafts bring air and light from outside to the indoor area (Naanaa 2019). To achieve suitable natural lighting in each room, the RSCN claimed that the glass area, which brings the sunlight into the indoor spaces, should be no less than 2 m^2 per room, and the opening area in the roof should be no less than 1.5 m^2 for each room. Moreover, the rainwater drainage was treated in some shafts by rainwater soakaways and in others by planting floors to prevent flooding and waterlogging.

Figure 6.14: Shafts devised for lighting and ventilation (Archive, RSCN 2019)

Within the last few years, the RSCN claims that there have been no problems with the rainwater because the area of the roof openings is not large, and the average rainfall does not exceed 300 ml/year (Naanaa 2019). Nevertheless, some shafts are covered from the top with transparent sheets to prevent rainwater from entering them in winter. Security and safety bars were added to the roof opening to maintain privacy and safety (**Figure 6.15**). Artificial lighting was also added to the shafts to lighten them at night. This gives a distinguished light effect on the stone walls, which some tourists described as built-in candles (**Figure 6.16**). As a consequence, the shafts became one of the features and best attributes of the restored buildings, representing an example of how new interventions can add to the character of a village without disrupting it.

Figure 6.15: Shaft protected with security and safety bars (Archive, RSCN 2019)

Figure 6.16: Distinguishing effect of the light on the stone walls (Author 2019)

As a result of these interventions, the spatial arrangement of Dana's buildings was transformed from single-space houses formed of one multi-functional space to hotel rooms formed of multi-spaces, including bedrooms, bathrooms, and lighting shafts. At the same time, the RSCN kept the original indoor elements, such as the internal arch walls and built-in furniture (**Figure 6.17**). The internal arch walls are one of the main features of Dana's original buildings, which were used as a structural element to support the original roof.

Nevertheless, they lost their functional significance after the transformation of Dana's original roofs. Their restoration preserves the spatial arrangement of the indoor spaces and the visual appearance of the buildings.

Figure 6.17: Transformation of Dana's indoor spaces (Author 2019)

The approach adopted to restoring the internal arch wall was by removing the arch wall or any part of it after giving each piece a number for it to be rebuilt in the same place. A timber framework was used to support and reconstruct the internal arch walls. Furthermore, the original built-in furniture was restored as much as possible, such as stone shelves and juniper tree trunks. The furniture was built in close proportions to the original, including seats and shelves attached to the walls and floors of the interior space (**Figure 6.18**). In addition, wooden furniture was installed in colours that were the same or close to the colour of the village stone. Furniture was made of simple designs and natural materials, as plastic furniture (chairs and tables) is not allowed.

Figure 6.18: Permitted built-in furniture (Archive, RSCN 2019)

The conducted analysis revealed that key settings of Dana's building form were comprehensively conserved, including the building layout, proportion, and number of floors. Eventually, these settings received no changes (scale of impact value = 0), providing a major beneficial impact on the cultural heritage (attribute of impact value = +4). For instance, Dana's contiguous buildings in clusters were maintained, conserving the original form of Dana village. The analysis also revealed that some interventions were implemented to meet the requirements of transforming Dana's houses into hotel rooms. For instance, the indoor spatial arrangement was significantly modified, adding indoor facilities such as bathrooms and lighting shafts. Thus, the indoor spaces received moderate noticeable changes (scale of impact value = 3) that offered a major beneficial impact on the architectural heritage (attribute of impact value = +4).

Such interventions adapted the form of Dana's buildings and provided the essential requirements of hotel rooms while maintaining their layout and boundaries (external walls). In addition, changes such as recesses in the roofs and the addition of stone gutters allowed the urban block to be adapted to the architectural changes, including the addition of bathrooms. **Table 6.3** summarises the HIA of transforming the building form's key settings and the final results of calculating the severity/scale of impact and significance/attribute of overall impact. The results indicate that the transformation of the building forms included 'negligible' changes (score of impact scale/severity = 0.75), causing a major beneficial impact (attribute of impact value = +4) (**Figure 6.19**).

The RSCN adapted the indoor space of Dana's buildings to the requirements of the new use (hotel rooms) and users (tourists). This adaptation conserved the main indoor elements, while developing the spatial arrangement by adding the essential indoor facilities required for hotel rooms. The approach to transforming the indoor facilities left an imprint on the evolving form of Dana's vernacular buildings. Overall, unlike the transformation of Dana's roofs and walls, the transformation of Dana's building form provided a successful example of an adaptation that balances conservation with development because of the valid purpose of adding the new facilities and interventions.

Table 6.3: HIA score table of transforming Dana's building form (Author 2022)

Criteria of Assessment	Description		Significance Degree	Impact Scale/ Severity	Weighted Impact	Impact Attribute/ Significance	Weighted Attribute
Architectural Assessment							
Form							
Building layout	The restored buildings were superimposed over the outline of the original ones		0.08	0	0	+4	+0.32
Proportion	The restored buildings were rebuilt on the same footprint and at a similar height and proportions		0.045	0	0	+4	+0.18
Number of Indoor Spaces	Before: single-space houses formed of one multi-functional space (one space)		0.055	3	0.165	+4	+0.22
	After: hotel rooms formed of multi-spaces, including bedrooms, bathrooms, and lighting shafts (2-4 spaces)						
Added Indoor Spaces	To the side	-					
	Blend in	1-2					
	Added floor	-					
	Total	1-2					
Number of floors	Before: single-storey buildings		0.04	0	0	+4	+0.16
	After: single-storey buildings						
	Sum of Significance		0.22	Total Result	0.165	Total Result	+0.88
				Score of Impact Scale	0.75	Score of Impact Attribute	+4.00

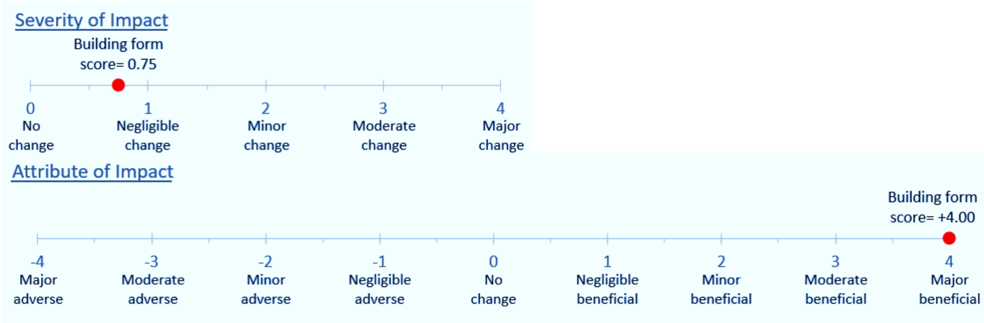


Figure 6.19: Severity of impact (top) and attribute of impact (bottom) of transforming the building form (Author 2022)

6.7 Transformation of Dana's Openings

Providing natural lighting and ventilation was one of the most critical issues in the transformation process of Dana's openings, especially the hotel rooms (Naanaa 2019). In the case of partial restoration, the structural openings were restored closely following the proportions of the original openings. On the other hand, in the case of total restoration, the structural openings were enlarged to provide more lighting and better ventilation, while keeping the original proportions to avoid any extraneous details that were inconsistent with the short stone lintels of the original openings (**Figure 6.20**).

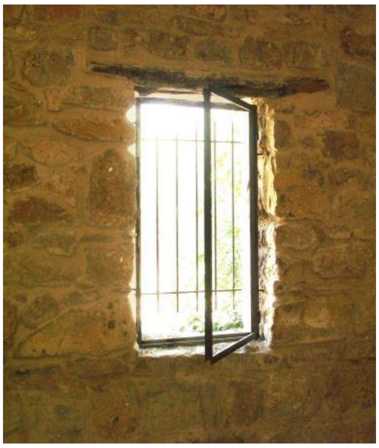


Figure 6.20: Enlarged window in a totally restored building (Author 2019)

However, this solution was not always possible because enlarging the window size while maintaining the original proportions depended on the original size and proportion of the windows and buildings. In each case of buildings, windows were proportionally enlarged up to a certain limit due to the different parameters of each building (Naanaa 2019). As a result, it was challenging to maintain the original window proportions while improving daylighting. In some buildings, therefore, the windows were enlarged with different proportions, or additional windows were added. Both solutions were somewhat problematic.

Changing proportions and adding windows are contradictory to the conservation of vernacular architecture (Šiožinytė and Antuchevičienė 2013, p. 876). This means that new types of windows and different facades not in-keeping with the original ones would appear. This was not a good solution, at least from an aesthetic point of view. Moreover, the doors were made of steel core and covered with an additional layer of juniper wood. Aluminium doors were prohibited for both the restored and new buildings (**Figure 6.21**).

Figure 6.21: Prohibited (left) and permitted (right) materials and colours of the new doors (Archive, RSCN 2019)

The RSCN claimed that enlarging the openings was insufficient to lighten and ventilate the buildings. Therefore, the lighting shafts were invented. However, enlarging the size of the openings reduced the significance of the addition of the lighting shafts and led to the loss of one of the main characteristics of Dana's architecture. Indeed, the approach of adding lighting shafts was sufficient to meet the requirement of the hotel rooms, irrespective of the enlargement of opening size. Therefore, combining the conservation of the small size of the openings and the addition of lighting shafts represents a compatible approach that provides a balance between conservation and development, rather than the adopted approach.

The analysis highlighted that the opening sizes and shapes were significantly modified as they received moderate noticeable changes (scale of impact value = 3). The openings were enlarged with the same or different proportions without considering factors such as privacy, solar radiation, and wind direction in both summer and winter. This caused a moderate adverse impact on the cultural heritage and thermal conditions (attribute of impact value = -3). For instance, enlarging opening sizes exposed the indoor spaces and threatened the privacy of occupants, which was the most vital force of the local community. Moreover, indoor thermal conditions became more exposed to solar radiations and outdoor conditions, leading to thermal comfort issues.

Other settings of Dana's openings were significantly modified, such as their frames and materials. The former was completely changed from wood to steel frames (scale of impact value = 4), causing moderate adverse impact (attribute of impact value = -3). Meanwhile, the latter was moderately changed, transforming the original timber doors into steel ones covered with timber cladding layer (scale of impact value = 3) and consequently causing moderate adverse impact (attribute of impact value = -3). Furthermore, settings such as windowpanes and windowsills received no changes (scale of impact value = 0), causing no impact on the architectural heritage (attribute of impact value

= 0). **Table 6.4** summarises the HIA of transforming the opening's key settings and the final results of calculating the severity and attribute of impact.

Table 6.4: HIA score table of transforming Dana's openings (Author 2022)

Criteria of Assessment	**Description**	**Significance Degree**	**Impact Scale/ Severity**	**Weighted Impact**	**Impact Attribute/ Significance**	**Weighted Attribute**
Architectural Assessment						
Openings						
Shape of Openings	Before: square or rectangular openings with horizontal lintel or semi-circular arches After: enlarged with the same or different proportions	0.02	3	0.06	-3	-0.06
Size of Openings	Before: relatively small due to the short stone lintels After: relatively bigger windows or additional ones were added	0.02	3	0.06	-3	-0.06
Window pane	Before: single glazed windows After: single glazed windows	0.01	0	0	0	0
Window sills	Before: N/A After: N/A	0.005	0	0	0	0
Opening Frame	Before: juniper wood frames After: steel frames	0.005	4	0.02	-3	-0.015
Door' s Material	Before: made of juniper wood After: made of steel and wood in the permitted colours	0.01	3	0.03	-3	-0.03
	Sum of Significance	0.07	Total Result	0.17	Total Result	-0.165
			Score of Impact Scale	2.43	Score of Impact Attribute	-2.36

The results highlight that the transformation of Dana's openings included 'minor-moderate' changes (score of impact scale = 2.43) that caused 'minor-moderate' adverse impact (score of impact attribute = -2.36) (**Figure 6.22**). Overall, as in the case of the transformation of Dana's walls, there was no valid reason for the transformation of the openings, especially after inventing the lighting shafts that kept the inward orientation while providing better lighting and ventilation. This indicates that the conservation of Dana's openings was neglected; they were enlarged without paying attention to their social and thermal significance, leading again to the loss of an essential part of the village's architectural heritage without any valid justification.

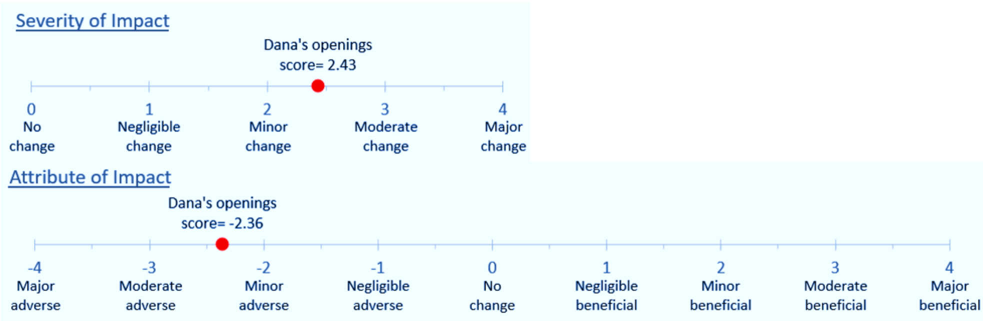


Figure 6.22: Severity of impact (top) and attribute of impact (bottom) of transforming Dana's openings (Author 2022)

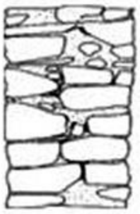
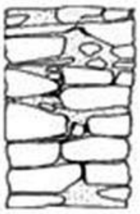
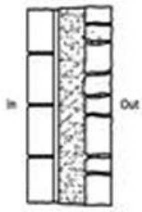
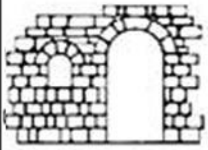
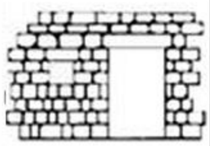
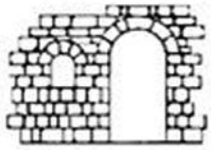
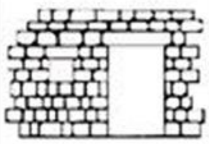
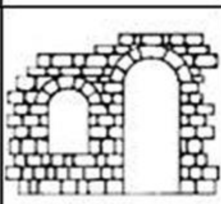
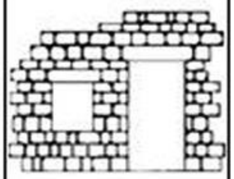
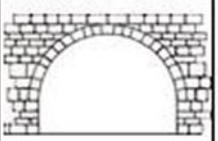
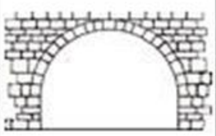
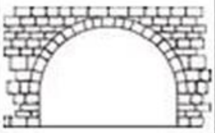
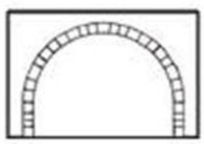
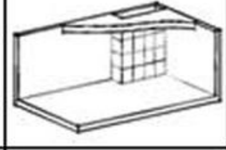
6.8 Overall Architectural Impact

The overall analysis of the architectural impact of the transformation of Dana village revealed that key settings of Dana's architectural heritage were comprehensively conserved, receiving no changes, such as the building layout and height. However, other architectural elements were altered as several changes were implemented in a way which violated certain conservation guidelines, including the transformation of the original roofs, walls, and openings. The implementation of these changes differed according to the type of restoration. **Table 6.5** illustrates the transformation of Dana's architectural elements, comparing them before and after the rehabilitation project. This includes transforming the construction methods and materials, openings, and indoor facilities.

Starting with the conservation of construction materials, the original ones should be conserved to preserve the village's authenticity and ensure the harmony of the restored buildings with the general characteristics of Dana (Abu Al Haija 2012). Therefore, the buildings should have been rebuilt using the original construction materials to preserve the buildings' authenticity and durability. However, the approach to all the restored buildings included removal of the original roof or any part of it and replacing it with a new one. The timber beams and clay roofs were replaced by concrete slabs due to their frequent need for maintenance and the limited availability of juniper wood and cane (score of impact scale = 3.81, score of impact attribute = -3.81).

These would be valid reasons for transforming the original roofs, but a more compatible solution should have been suggested in a way that adapts the roofs, not entirely replacing them. For instance, replace the clay layer with a compacted earth layer of 40 cm thickness topped with a waterproof fine-grained plaster (Al Haija 2012). Regarding the transformation of walls, some buildings were partially restored using the original method, while others were fully restored using new construction materials and methods. The transformation of the original walls had no valid justification as their construction materials were available and required basic experience, leading to the loss of an essential part of the village's architectural heritage (score of impact scale = 3.23, score of impact attribute = -2.33).

Table 6.5: Transformation of Dana’s architectural elements, compared before and after the rehabilitation project (Author 2020)

	Before	After		Impact	
		Partial Restoration	Total Restoration	Partial	Total
Roofs				Changed	Changed
Walls				Kept	Changed
Openings	 	 	 	Kept	Enlarged
Arch-walls			 	Kept Visually & Changed Function	Kept Visually & Changed Function Kept Visually & Changed Function
Lighting Shafts				No Addition	Added
Bathrooms				No Addition	Added

Unlike the transformation of Dana's roofs and walls, the transformation of Dana's building form provided a successful example of an adaptation that balances conservation with development. This is because of the valid purpose of adding new facilities such as bathrooms and lighting shafts while maintaining the building layout and height (score of impact scale/severity = 0.75, attribute of impact value = +4). On the other hand, the original windows were enlarged without considering factors such as privacy and thermal conditions.

Indeed, there was no valid reason for such transformation, especially after inventing the lighting shafts that kept the inward orientation and provided better lighting and ventilation (score of impact scale = 2.43, score of impact attribute = -2.36). **Table 6.6** highlights the HIA of transforming Dana's architectural heritage and the total results of calculating the score of impact severity/scale and overall impact significance/attribute. The results indicate that the transformation of Dana's architectural heritage included 'moderate' changes (score of impact scale/severity = 2.82) that caused 'negligible-minor' adverse impact (attribute of impact value = -1.42) (**Figure 6.23**).

As a result, the architectural heritage of Dana was transformed in a way that lost a significant part of its elements and settings, leading to the appearance of a new type of building with the similar visual appearance, but different characteristics and features. This showed a clear desire to conserve the buildings' facades, maintaining the surface materials as far as possible, following the facadism approach.

Table 6.6: HIA score table of transforming Dana's architectural heritage (Author 2022)

Criteria of Assessment	Significance Degree	Impact Scale/ Severity	Weighted Impact	Impact Attribute/ Significance	Weighted Attribute
Architectural Assessment					
Roof					
Type of Roof/ Thickness	0.06	3	0.18	-3	-0.18
Construction Materials	0.10	4	0.40	-4	-0.40
Construction Technique	0.07	4	0.28	-4	-0.28
Plaster	0.04	4	0.16	-4	-0.16
Painting	0.05	4	0.20	-4	-0.20
Sum of Significance	0.32	Total Result	1.22	Total Result	-1.22
		Score of Impact Scale	3.81	Score of Impact Attribute	-3.81
Exterior Walls					
Type of Wall/ Thickness	0.06	3	0.18	-3	-0.18
Construction Materials	0.10	3	0.30	-3	-0.30
Construction Technique	0.07	4	0.28	-4	-0.28
Façade Design	0.07	2	0.14	+3	0.21
Plaster	0.04	4	0.16	-4	-0.16
Painting	0.05	4	0.20	-4	-0.20
Sum of Significance	0.39	Total Result	1.26	Total Result	-0.91
		Score of Impact Scale	3.23	Score of Impact Attribute	-2.33
Form					
Building layout	0.08	0	0	+4	+0.32
Proportion	0.045	0	0	+4	+0.18
Number of Indoor Spaces	0.055	3	0.165	+4	+0.22
Number of floors	0.04	0	0	+4	+0.16
Sum of Significance	0.22	Total Result	0.165	Total Result	+0.88
		Score of Impact Scale	0.75	Score of Impact Attribute	+4.00
Openings					

Shape of Openings	0.02	3	0.06	-3	-0.06
Size of Openings	0.02	3	0.06	-3	-0.06
Windowpane	0.01	0	0	0	0
Windowsills	0.005	0	0	0	0
Opening Frame	0.005	4	0.02	-3	-0.015
Door’s Material	0.01	3	0.03	-3	-0.03
Sum of Significance	0.07	Total Result	0.17	Total Result	-0.165
		Score of Impact Scale	2.43	Score of Impact Attribute	-2.36
Total Architectural Impact					
Sum of Significance	**1.00**	**Total Result**	**2.82**	**Total Result**	**-1.42**
		Score of Impact Scale	**2.82**	**Score of Impact Attribute**	**-1.42**

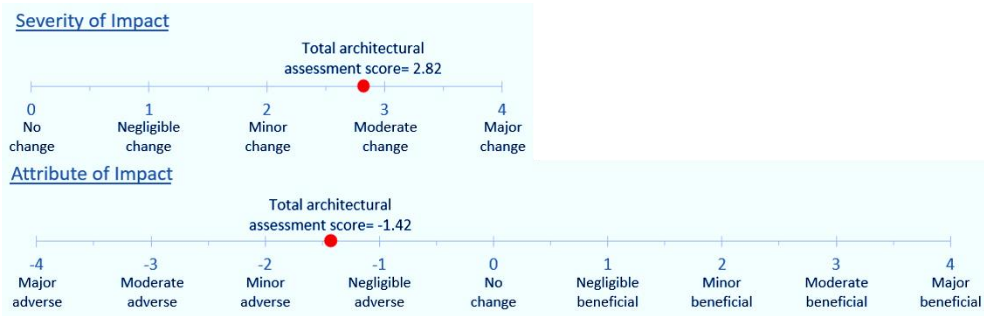


Figure 6.23: Severity of impact (top) and attribute of impact (bottom) of the total architectural transformation (Author 2022)

6.9 Discussion and Conclusions

The chapter aimed to explain the changes that occurred in Dana village after its transformation into tourist accommodations, seeking to assess their impacts. Therefore, a field survey was conducted to understand how the village had been transformed in order to evaluate the impacts of the transformation on the village’s heritage by comparing the buildings before and after the interventions. Making this comparison enabled the assessment of changing certain architectural features, with the evaluation of their validity and purposes, using the developed HIA score table.

It was observed that the transformation of Dana's original buildings involved different types of restoration according to their physical condition. For instance, buildings with a low level of deterioration required refurbishment work rather than a demolition and rebuild strategy. Others were totally or partially restored if they were completely ruined or have parts in disrepair (**Figure 6.24**). This concludes that generalising regulations might create problems and incompatibility in the restoration process because each building has its own situation and requirements. The most suitable restoration strategy should therefore be selected according to the physical conditions of buildings.

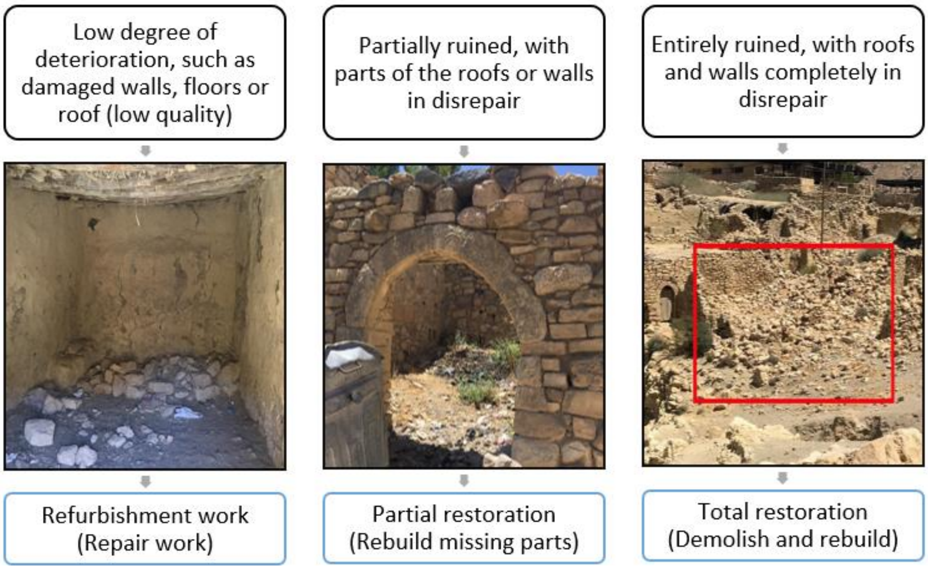


Figure 6.24: Types of restoration according to the different physical conditions of the buildings (Author 2021)

This was also highlighted by Orbaşli (2009), who argued that the different conditions of buildings made it essential to adopt different restoration strategies. In addition to the condition of the existing buildings, it was also observed that maintaining Dana's existing features and making changes depended on the requirements of tourists, in accordance with Orbaşli (2009) who stated that the adaptive reuse of existing buildings may require essential interventions and upgrading of indoor facilities. Accordingly, it is concluded that interventions should not be generic, but specific to each case. Different approaches that allow for interventions have been introduced to Dana, such as the enlargement of opening sizes and the addition of indoor facilities.

Regarding the former, it was challenging to conserve the original window proportions while improving daylighting and ventilation. In some buildings, therefore, windows were enlarged with different proportions or windows were added. The addition of windows is not always a way of addressing poor ventilation or daylighting, as some buildings have a short free facade that fronts the exterior. Moreover, the windows in Dana were proportionally enlarged up to a certain limit due to the different building parameters. Consequently, it is concluded that both solutions are problematic at least from an aesthetic point of view, as the new types of windows and different facades are not in keeping with the original ones (**Figure 6.25**).

This corresponds to Šiožinytė and Antuchevičienė (2013) who highlighted that changing proportions and adding windows are contradictory to the conservation of vernacular architecture. In contrast, the addition of indoor facilities was essential as they (bathrooms and lighting shafts) were vital for meeting the requirements of hotel rooms. This is in line with Orbaşli (2017) who stated that adding new indoor spaces is linked to addressing the shortcomings of the existing ones. Consequently, it is concluded that the indoor spaces of vernacular buildings adapt to the requirements of new uses by adding the essential indoor facilities required and removing unused spaces.

Figure 6.25: Original facade of a building in Dana before transformation (top), and new facade after transformation (bottom) (Archive, RSCN 2019)

The most significant intervention in Dana was the replacement of the construction materials. It was difficult to use the original ones due to their limited availability; the lack of local experience in using the original methods; and the lack of building skills necessary to repair vernacular structures. Therefore, new approaches were introduced. The comparison between the original (timber and clay) and new (concrete) roofs of Dana's buildings concludes that replacing the materials and methods led to the loss of an essential part of the village's architectural heritage (**Figure 6.26**). This is because the replacement was not a type of adaptation that involved modification to meet new needs, such as adding or removing certain elements. In contrast, entire roofs were removed and replaced by a new type with no connection to the original.

Figure 6.26: Replacement of the original timber roofs (left) with new reinforced concrete ones (right) (Archive, RSCN 2019)

Similarly, it is concluded that the transformation of Dana's original walls (thick stone masonry bearing ones) was not a type of adaptation that embraced modification, as they were completely removed and replaced with new thinner non-bearing ones with stone facings, which had no connection with the original (**Figure 6.27**). Removing the original roofs or walls and imposing new unrelated types offered new architectural models with different characteristics and features. In line with Foruzanmehr and Vellinga (2011), this unfortunately concludes that the interventions of Dana's rehabilitation project led to the loss of an essential part of the architectural heritage.

Figure 6.27: Replacement of the original bearing masonry walls (left) with thinner non-bearing ones (right) (Archive, RSCN 2019)

To sum up, the implementation of Dana's rehabilitation project and its adaptive reuse has affected the village's architectural heritage, which has lost a significant part of its vernacular architecture. The changes in the land use of the village and its connection with sustainable ecotourism development also had various impacts on the urban context. Therefore, the following chapter examines the approaches adopted for conserving the urban context and assesses their impact on Dana's urban heritage.

Chapter Seven: The Urban Impact of the Transformation of Dana Village

7.1 Introduction

The rehabilitation project of Dana village eventually made several changes that transformed not only the architectural characteristics of Dana but also its urban context. Therefore, after the assessment of the architectural impacts of transforming Dana into a tourist settlement in the previous chapter, this chapter aims to examine the approaches adopted for conserving the urban context and assesses their impact on Dana's urban heritage. Following the same methodology of the architectural assessment, qualitative and quantitative analyses were carried out, employing a combination of in-situ data collection methods, including the archival research, field survey, and interviews.

Afterwards, the developed HIA framework was used to assess the urban impact of transforming the village to accommodate tourists. On the basis of the framework's criteria, the urban assessment is mainly based on assessing the transformation of Dana's land use, urban fabric, and landscape. The urban fabric includes the urban configuration, skyline, street pattern, and infrastructure. The village before and after the rehabilitation project was compared to understand how it was transformed and to evaluate the impacts of the transformation, discussing the integrity of the changes in relation to the village heritage.

The analysis focuses on the adopted approaches that affected the urban form of the village, explaining how the settings of the original urban context were transformed and analysing the impact and consequences of the transformation. The main approach of the project was through the reuse of the vernacular buildings as hotel rooms to accommodate tourists. Consequently, new land use for the village was introduced after an in-depth analysis of the situation of the built environment, the hotels already in operation, the needs of the local community, and the requirements of ecotourism.

The survey showed that most buildings were reused as tourist accommodations, while others were reused as tourist facilities, such as cafes, shops, restaurants, and boutiques. Unfortunately, some buildings were closed and abandoned again with no use, again making them vulnerable to neglect and collapse. Moreover, new urban elements and buildings were built in the village, such as new hotels, workshops, roads, streets, and a bridge. Developing the infrastructure and establishing integrated potable water and sewage networks was also a part of the project.

As a result, this chapter provides a comprehensive urban assessment of the transformation of Dana village into a tourist settlement, including the assessment of Dana's land use, urban configuration, skyline, street pattern, infrastructure, and landscape.

7.2 Transformation of Dana's Land Use

The adaptive reuse of Dana is the adopted methodological approach that aimed to regenerate the abandoned vernacular settlement by reusing its buildings as hotel rooms to accommodate tourists. The adaptive reuse of the entire village guided the overall process of transformation and development. However, based on previous sustainable development practices in Jordan, several conflicts took place between the local community and local authorities due to the lack of faith in their real intentions (discussed in Chapter Four). Some changes in the land use created conflicts between the local community and the RSCN, leading to delays, cancellations, or changes of some proposed plans.

For instance, a new type of land use for the village was proposed after Dana had been completely abandoned and the locals had refused to return. Nevertheless, some representatives of the local community, including Sulieman Al-Khawaldeh, were against the proposed land use because they were afraid of losing their houses without adequate economic benefits, as happened in Umm Qais and Taybet Zaman villages.[29] Consequently, the land use was not implemented as proposed, with some uses changed to satisfy the desires of the local community. Therefore, the current land use is different from that proposed.

7.2.1 Proposed Land Use

Ammar Khammash engineering consulting office proposed a new land-use master plan, including all stages of the rehabilitation project (**Figure 7.1**). This proposal resulted from an in-depth analysis of the built environment situation, the hotels presently in operation, the needs of the local community, and the requirements of sustainable ecotourism development. The general aim was as far as possible to restore the original form of Dana's urban pattern and vernacular houses by adapting their uses into private, tourist, cultural, and other activities.

[29] Sulieman Al-Khawaldeh is the president of Dana and Al-Qadisiyyah local community cooperative.

Figure 7.1: Land-use master plan that illustrates the proposed new uses of the whole village (Archive, RSCN 2019)

Approximately 20% of Dana's buildings were private houses, 30% hotel rooms, while 50% were commercial shops and mixed-use buildings (commercial and residential). The proposed land-use plan divided the village into three categories: tourist accommodation and facilities, private residential use, and other services. The three categories were equally distributed in the north-eastern and north-western zones, while the southern zone contains just tourist accommodation and facilities and other services.

Other services, such as a mosque, shops, markets, and workshops, were allocated mainly on both sides of the village's main street to facilitate their accessibility. Tourist accommodation and facilities were allocated mostly near the hotels in operation and on the edge of Dana valley, providing a view over it. The private houses, that the local community will use, filled the remaining space between the other two categories. Besides the land-use master plan, a specific land-use plan was proposed for stage one of the rehabilitation project, showing the new uses of each restored building (**Figure 7.2**).

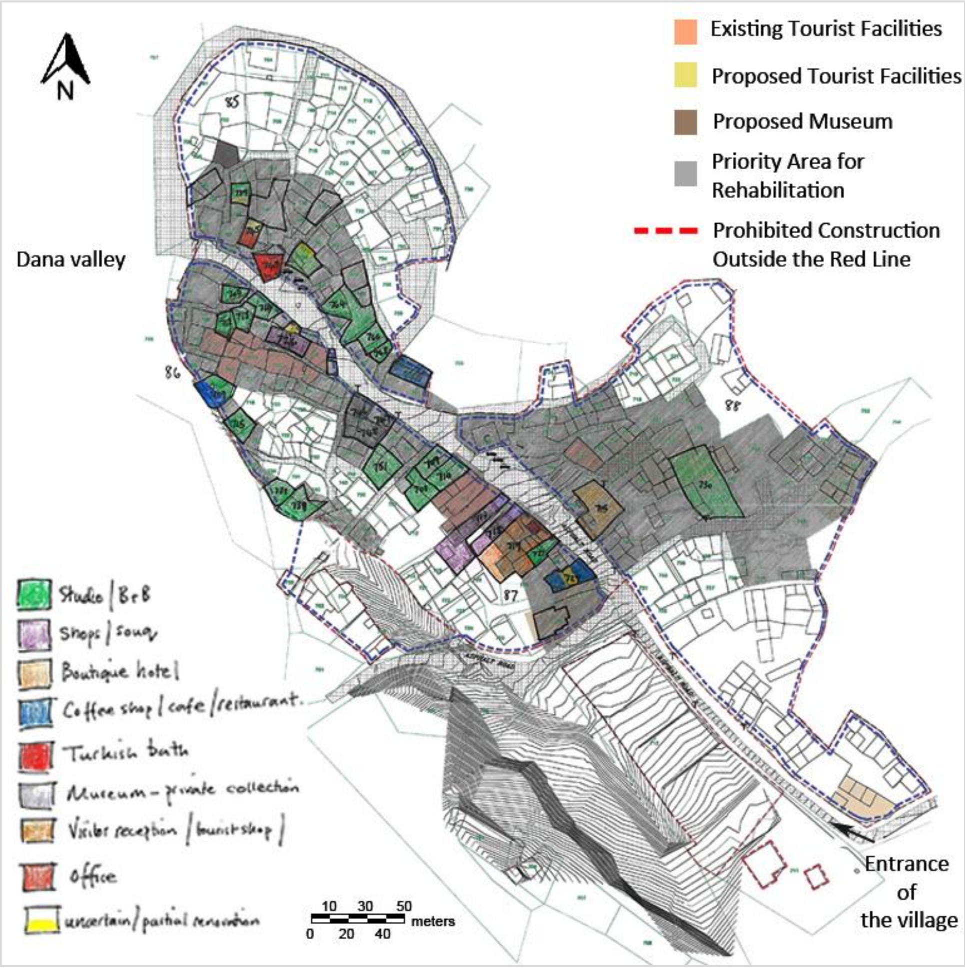


Figure 7.2: Specific land-use plan that shows the specific new use of each building restored in stage one (Archive, RSCN 2019)

Most buildings were reused as hotel rooms allocated near Dana hotel (in the upper part of the village) and Dana Tower hotel (in the lower part of the village). Other tourist facilities were proposed, such as a Turkish bath, cafe, restaurant, cafe shop, visitor centre, and museum. These facilities were distributed alongside the main street of the village. These changes in land use affected the existing Dana hotel, moving its main building to the opposite side of the main street and converting its use into commercial stores and workshops (**Figure 7.3**).

Figure 7.3: Proposed land use of the existing Dana hotel (Archive, RSCN 2019)

Al-Khawaldeh (2019) criticised such changes in land use, explaining that the distribution of the new uses was not designed according to the choices and preferences of the local community, who felt detached from the whole process. In addition to the lack of faith in the real intentions of the RSCN, these kinds of changes created further conflicts between the local community and the RSCN. As a result of these conflicts, some proposed facilities were not implemented, with their use changed to satisfy the desires of the local community. Therefore, it can be seen that the current land use is different from that proposed.

7.2.2 Current Land Use

The current land use in Dana village has not been implemented as proposed. Much time, effort, and money have been wasted on the proposed land-use plan because it is detached from the local community. The house owners changed some of the uses after the completion of the project. In fact, after completing the restoration of some houses, their owners received their properties, but used them in the way they thought appropriate, regardless of the proposed design. Therefore, differences emerged between the current situation of the village and the plans of the RSCN. For this reason, the field survey was conducted to produce a base map of the current situation of Dana village, with urban data such as a figure-ground plan and land-use plan.

Most of the restored buildings are used as tourist accommodations (hotel rooms), while few buildings were used as tourist facilities (other services for tourists, such as cafes, shops, restaurants, etc). Some houses are used for private use, with the family that owns the house using it for holidays or weekend breaks (**Figure 7.4**). Unfortunately, some restored buildings are closed up and abandoned again without being used, making them vulnerable to collapse again. The RSCN should thus have added some binding rules in the agreements with the locals, stating that every restored building should be used after the restoration process and emphasising the importance of not being closed or abandoned again.

Eventually, considerable changes to Dana's land use were applied, transforming the multi-functional and self-sufficient village formed mainly of residential houses into a tourist-related one formed mainly of hotel rooms. On the basis of ICOMOS's assessment scales, the transformation of Dana's land use led to moderate changes to the urban context (value of impact scale = 3), causing a moderate beneficial impact on Dana's urban heritage (score of impact attribute = +3).

Figure 7.4: Current land use of Dana village showing the current new use of each building that was restored at stage one (Author 2019)

Table 7.1 and **Figure 7.5** illustrate the HIA of transforming Dana's land use and the final results of calculating the severity of impact and the attribute of overall impact. The results conclude that the transformation of the land use led to significant socio-cultural and economic benefits, following the revival of the abandoned houses and reusing them as hotel rooms that bring income to the local owners. Overall, the adaptive reuse of Dana, presented in the current land use, reconciled the conservation of Dana's heritage with the recent tourism development.

Table 7.1: HIA score table of transforming Dana's land use (Author 2022)

Criteria of Assessment	Description	Significance Degree	Impact Scale/ Severity	Weighted Impact	Impact Attribute/ Significance	Weighted Attribute
Urban Assessment						
Land Use	Before: multi-functional and self-sufficient village, formed mainly of residential houses	0.20	3	0.60	+3	+0.60
	After: tourist village, formed mainly of hotel rooms					
	Sum of Significance	0.20	Total Result	0.60	Total Result	+0.60
			Score of Impact Scale	3.00	Score of Impact Attribute	+3.00

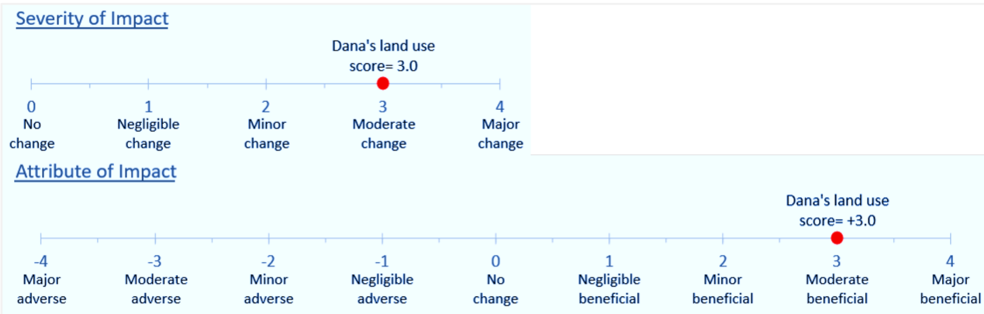


Figure 7.5: Severity of impact (top) and attribute of impact (bottom) of transforming Dana's land use (Author 2022)

Adapting to the new land use was challenging, as the RSCN implemented several changes to meet the requirement of the new uses and users. In addition to the architectural changes discussed in the previous chapter, several changes were implemented on the urban scale, transforming the urban fabric of Dana. The adopted approaches for transforming the village's vernacular settlement to accommodate tourists included improving public services, establishing the infrastructure, and adding new tourism facilities. As a result of these approaches, the urban fabric of the village was transformed, including the urban configuration and street pattern. The following sections further discuss the adopted approaches, showing their purposes and assessing their impacts.

7.3 Transformation of Dana's Urban Fabric

The transformation of Dana's urban fabric included transforming its urban configuration, street pattern, and infrastructure. Dana's urban configuration and street pattern are defined by the external walls of Dana's buildings that create the boundary of urban spaces and streets, starting from the main street to the secondary streets and then to the pedestrian roads. As the restored buildings were superimposed over the outline of the original ones and at a similar height, the street pattern, urban configuration, and skyline of Dana were maintained.

7.3.1 Urban Configuration

The RSCN built new buildings in the southern part of the village to promote ecotourism and ensure the presence of the RSCN in the village (**Figure 7.6**).[30] Consequently, the urban configuration of Dana has been expanded, maintaining the original one while adding the essential buildings required for tourism needs. The new buildings, which were built of new materials and with new methods of construction, were divided into three categories based on their function and purpose: accommodation, administration, and tourist facilities such as museums.

[30] The allowed building footprint of the new building in empty land is about 50% of the land area. In the case of an existing old building with less than 50% of the land area, the allowed building footprint of the new building is about 50% of the empty land area. Meanwhile, additions are not allowed if the existing old building area is more than 50% of the land area (Alhasan 2019).

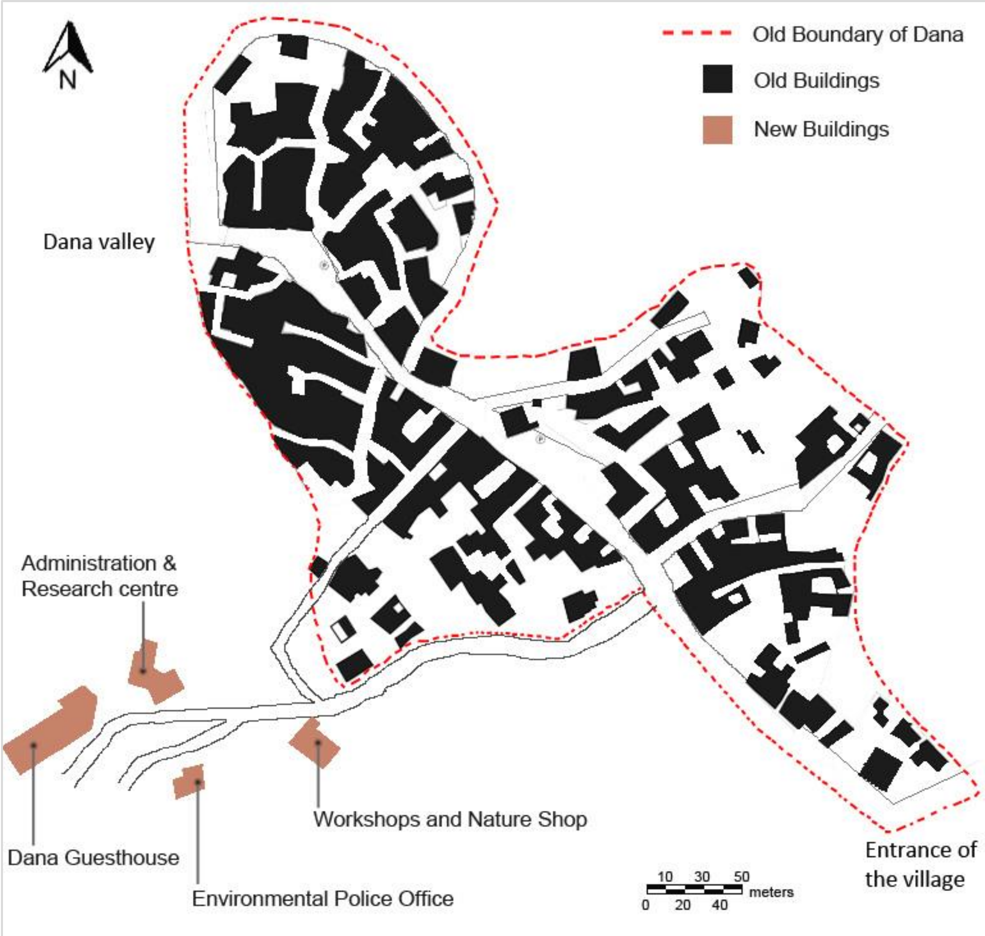


Figure 7.6: Current figure-ground plan of Dana village after the rehabilitation project (Author 2019)

Starting with buildings for tourist accommodation, Dana guesthouse is a new hotel established by the RSCN to accommodate tourists who are unlikely to stay in the restored hotel rooms.[31] It was built over the edge of Dana valley, offering a unique view over it. However, the hotel was constructed of a massive concrete block, introducing long, straight lines into the landscape composed of small, clustered units. The hotel's massive scale reflects the very poor adaptation to the scale of the urban block compared with the detached buildings. **Figure 7.7** shows how the guesthouse does not follow the site's

[31] The profits from this hotel are directly used by the RSCN to develop sustainable ecotourism and services in the village, and to conserve the wildlife of the reserve (Alhasan 2019).

topography over the edge of Dana valley. The beams, on which the balconies sit, create cavities below them, showing poor adaptation to the landscape.

Figure 7.7: Dana guesthouse over the edge of Dana valley (Author 2019)

Other buildings were constructed to establish a sustainable relationship between the implementation of ecotourism in the village and the involvement of its local community (Alhasan 2019). They spread awareness of the significance of the Dana Biosphere Reserve (DBR) and the role of locals and tourists in conserving its wildlife. This includes the administration and research centre and the Anis Almouasher centre. The centre is occupied by RSCN staff who produce plans and research that support their work in ecotourism and manage the village's conservation process. The centre also houses the village museum, which provides further information about the RSCN and DBR and its inhabitants, wildlife, environment, climate, and challenges.

New buildings for supporting the local community and providing services for the village were also constructed by the RSCN. For instance, the environmental police office was built to protect the environment of Dana and conserve the natural life of its biosphere reserve. They prevent illegal actions such as grazing and hunting in the biosphere. As the local community of Dana are mainly Bedouins, who use their lands for grazing, these restrictions on hunting and grazing affect their primary source of income. Therefore, providing alternative job opportunities to the local community has become the RSCN's responsibility.

The RSCN, consequently, built a fruit and herb drying workshop, a silver making workshop, and a nature shop to support the local community. Job opportunities for local Dana women were created at the fruit and herb drying workshop after its production was improved as a result of installing the water supply system in the village (Al-Khawaldeh 2019). The workshops provide a space where the women of Dana can dry fruits and herbs such as apricots, grapes, lemons, and rosemary, make fruit jams, and produce silver products and accessories. Afterwards, these products are sold at the nature shop to tourists at reasonable prices. These workshops are essential in preserving the intangible heritage of Dana village by encouraging its original productive activities.

The analysis highlighted that the restored buildings were superimposed over the outline of the original ones and at a similar height, maintaining Dana's urban configuration and skyline. Nevertheless, new buildings were built to adapt the village to the new uses and activities, which are entirely different from the original ones. It is not clear why the RSCN did not reuse some restored houses to accommodate these activities. The adaptive reuse of empty restored houses would have been a better solution, as reviving the original houses was the main aim of the project. The reuse of further restored buildings was limited to accommodate tourists (hotel rooms).[32] Moreover, the use of new construction materials and techniques offered few buildings of massive scales that are detached from Dana's vernacular architecture, showing poor adaptation.

To sum up, the skyline received no changes (scale of impact value = 0), causing no impact on the urban assets of Dana village (attribute of impact value = 0). Meanwhile, the urban configuration was slightly modified after receiving minor noticeable changes (scale of impact value = 2), such as constructing new buildings that expanded the village. Constructing new buildings while having empty restored houses expanded the original village and urban configuration without a sufficient purpose. This caused a moderate adverse impact on Dana's urban heritage and ecotourism development (attribute of impact value = -3) because such an approach reduced the potential of reusing more existing restored buildings that brings economic benefits to the local community.

Table 7.2 summarises the HIA of transforming Dana's urban configuration and skyline and the final results of calculating the severity and attribute of impact. The results highlight that the transformation of Dana's urban configuration and skyline included 'negligible-minor' changes (score of impact scale = 1.5) that caused 'minor-moderate' adverse impact (score of impact attribute = -2.25) (**Figure 7.8**). Overall, the RSCN failed to reconcile

[32] These hotels are mainly based on the lease concept, as agreements are signed with locals who own restored houses near the hotel main building. Consequently, the hotels run the restored houses, using them as tourist accommodation, with the profit from operating the houses shared between the hotel and the house owners. As a result of these agreements, the local community (the hotel founder, staff, and house owners) benefits financially, the restored buildings are protected from being abandoned again, and tourist accommodation is provided.

the preservation of vernacular settlements with the needs of tourist development because there is no valid purpose for adding the new buildings. This indicates that the addition of new buildings neglected the principles of ecotourism development, paying no attention to the social and economic benefits of reusing existing restored buildings and leaving an imprint on the developed urban fabric of Dana's vernacular settlement.

Table 7.2: HIA score table of transforming the urban configuration and skyline (Author 2022)

Criteria of Assessment	**Description**	**Significance Degree**	**Impact Scale/ Severity**	**Weighted Impact**	**Impact Attribute/ Significance**	**Weighted Attribute**
Urban Assessment						
Urban Configuration	The restored buildings were superimposed over the outline of the original ones, maintaining the original urban configuration while constructing new buildings that expanded the boundary of the village	0.30	2	0.60	-3	-0.90
Skyline	Before: single-storey houses After: single-storey houses at a similar height	0.10	0	0	0	0
	Sum of Significance	0.40	Total Result	0.60	Total Result	-0.90
			Score of Impact Scale	1.50	Score of Impact Attribute	-2.25

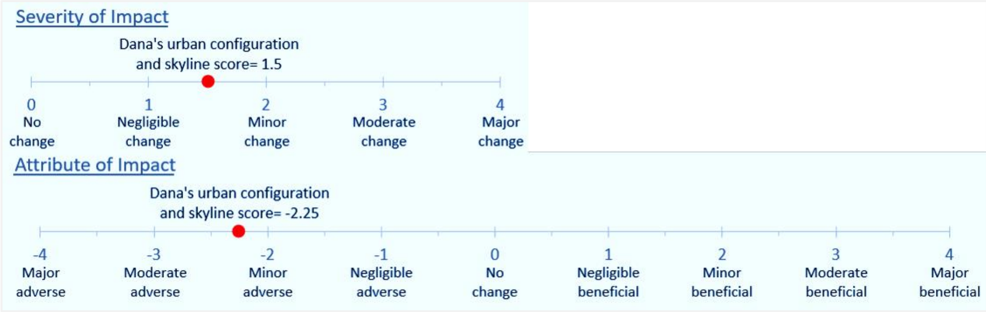


Figure 7.8: Severity of impact (top) and attribute of impact (bottom) of transforming Dana’s urban configuration and skyline (Author 2022)

7.3.2 Street Pattern and Infrastructure

The old streets, roads, and open spaces were maintained because the restored buildings were superimposed over the outline of the original ones, conserving the original street and road patterns of the village. However, the functionality of the roads and spaces were changed, as they are currently used for transportation purposes rather than social activities. Moreover, new streets and roads were opened to connect the new buildings with the whole village (**Figure 7.9**). The new street starts from the main street of Dana, passing the new RSCN buildings, and ends at the Dana guesthouse car park. Other pedestrian paths were also restored and paved.

A new bridge was also constructed to connect the old and new parts of the village over the surface and overland water runoff. Additionally, concrete drainage pipes were constructed under the new primary street for natural rainwater drainage (**Figure 7.10**). This drainage system was necessary because the added street and roads were placed over the rainwater runoff that flows downhill due to the steep slope and topography of the village (**Figure 7.11**). Developing the infrastructure was also an essential part of developing the village. Integrated potable water and sewage networks were installed under the built environment, including the original and restored buildings.

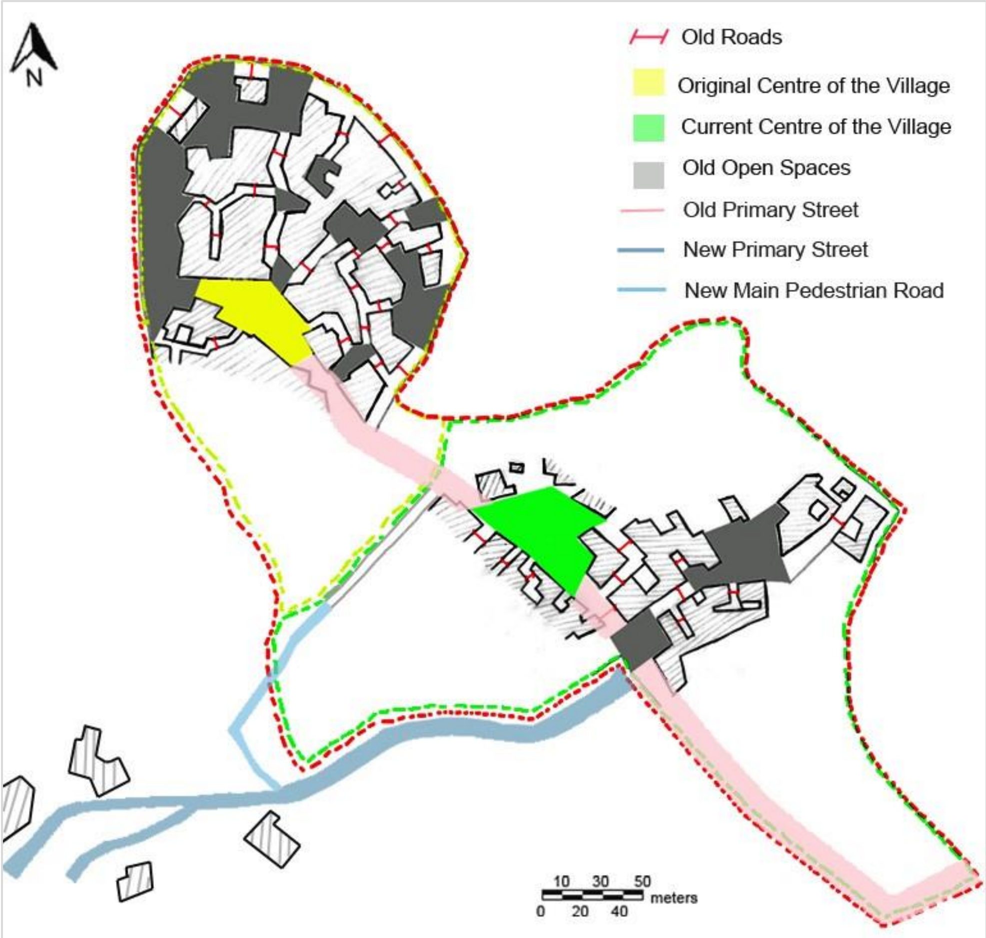


Figure 7.9: Old and new roads of Dana village (Author 2019)

Figure 7.10: New bridge to connect the old and new parts of the village over the surface and overland water runoff (left), Concrete drainage pipes under the new road for natural rainwater drainage (right) (Author 2019)

A wastewater and sewage treatment station was proposed to integrate with the village's infrastructure and sewage networks. Although the location of the station was outside the village, the owners of the agricultural lands and farms located near the station's proposed location opposed the scheme. They submitted a request to the municipality to reject the project because it would negatively affect their lands. Therefore, the addition of this station was cancelled after consideration of the locals' objections.

Figure 7.11: Rainwater flows downhill due to the steep slope and topography of the village (Author 2020)

The analysis revealed that an integrated infrastructure, such as potable water and sewage networks, was installed, being an essential part of the development process as they were not existed before (scale of impact = 4). Such a major change caused a major beneficial impact that adapted the village to the hotel room requirements (attribute of impact value = +4). Specifically, the addition of bathrooms necessitated connecting the village with a sewage network and water supply. As a result, this approach successfully balanced conservation and development because of the valid purpose of establishing the infrastructure.

Furthermore, the street pattern was slightly modified, receiving minor noticeable changes (scale of impact value = 2), such as opening new streets and roads. Opening these caused slightly significant benefits (minor beneficial impact) on Dana's urban heritage (attribute of impact value = +2), adapting the street pattern to the development process. Such an adaptation conserved the original street and road patterns while adding new ones to connect the new buildings with the original village. **Table 7.3** summarises the HIA of transforming Dana's street pattern and infrastructure and the final results of calculating the severity and attribute of impact.

Table 7.3: HIA score table of transforming the street pattern and infrastructure (Author 2022)

Criteria of Assessment	**Description**	**Significance Degree**	**Impact Scale/ Severity**	**Weighted Impact**	**Impact Attribute/ Significance**	**Weighted Attribute**
Urban Assessment						
Street Pattern	The old streets, roads, and open spaces were maintained because the restored buildings were superimposed over the outline of the original ones while opening new streets and roads to connect the new buildings with the whole village	0.20	2	0.40	+2	+0.40
Infrastructure	Before: lack of infrastructure and public services; for instance, the village had no sewage or electricity networks After: integrated potable water and sewage networks were installed under the built environment	0.10	4	0.40	+4	+0.40
	Sum of Significance	0.30	Total Result	0.80	Total Result	+0.80
			Score of Impact Scale	2.67	Score of Impact Attribute	+2.67

The results highlight that the transformation of Dana's street pattern and infrastructure included 'minor-moderate' changes (score of impact scale = 2.67) that caused 'minor-moderate' beneficial impact (score of impact attribute = +2.67) (**Figure 7.12**). Overall, the RSCN adapted the street pattern and infrastructure of the village to the requirements of sustainable ecotourism development, leaving an imprint on the evolving context of Dana's urban fabric.

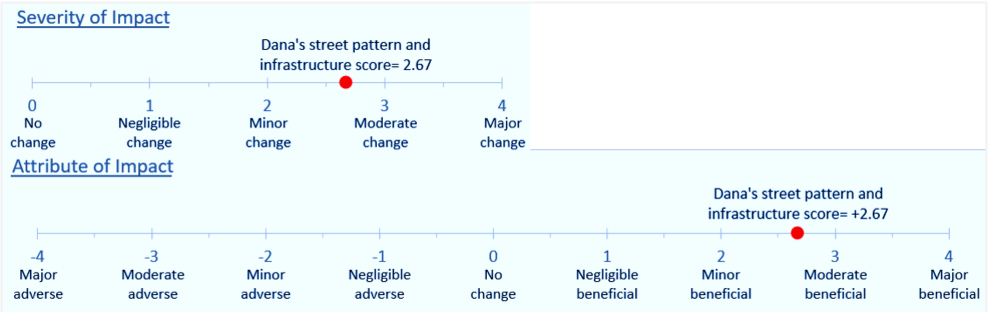


Figure 7.12: Severity of impact (top) and attribute of impact (bottom) of transforming Dana's street pattern and infrastructure (Author 2022)

7.4 Landscape

The significance of Dana village in the tourism sector comes mainly from its geographical location, which is near the DBR, the largest nature reserve in Jordan, which covers 320 square kilometres (Alhasan 2019). The reserve is attractive to tourists because of its landscape and topography, including a series of mountains and valleys, where the slope drops from 1500m above sea level to 50m below sea level (Al-Qawabah et al. 2003). Therefore, the reserve is ecologically diverse, providing various inhabitants.

For this reason, the rehabilitation project aimed to conserve the village landscape. For instance, vegetation was considered one of the essential elements that contributed to reviving the village. It was protected and conserved by encouraging locals to do further planting, taking into account the common and appropriate plants for Dana. The plants and trees that were appropriate for the nature of the village included figs, terebinth, carob, pomegranate, and oak. Furthermore, the village trees, especially the productive and large ones, were conserved to shade the roads, outdoor yards, or inner courtyards (**Figure 7.13**). The outdoor spaces, used for sitting or other outdoor activities, were also shaded using grape arbour or juniper tree canes. White or desert fabric sunshades were also used to provide shading.

Figure 7.13: The mosque's large trees that were conserved to shade its outdoor spaces (Author 2019)

However, it is not allowed to build canopies made of iron pipes or any other industrial materials. Enclosing the sun-shaded areas by adding glass walls or facades to the sunshades is also prohibited. The traditional public spaces, such as gardens, yards and roads, are essential elements that were conserved because they contribute to providing the natural lighting and ventilation for the buildings in the village. Moreover, the project took into account the consistency of any added element with its surroundings and prevented the addition of any elements that distorted the general view of the village. For instance, to maintain the general image of the village, it is not allowed to put refrigerators and other electrical devices in public places.

Eventually, Dana's landscape was slightly changed, and the settings were hardly affected after receiving negligible changes (scale of impact value = 1). The visual appearance was virtually unchanged as the changes were very minor and limited to the addition of few banners and public services such as electric and lighting poles. This caused a minor beneficial impact on Dana's urban heritage and ecotourism development (attribute of impact value = +2), adapting the landscape to the development process. Such an adaptation conserved the landscape while adding new elements to provide better public services.

Table 7.4 summarises the HIA of transforming Dana's landscape and the final results of calculating the severity and attribute of impact. The results highlight that the transformation of Dana's landscape included 'negligible' changes (score of impact scale = 1.00) that caused 'minor' beneficial impact (score of impact attribute = +2.00) (**Figure 7.14**). Overall, the RSCN adapted the landscape of the village to the requirements of sustainable ecotourism development, leaving an imprint on the evolving context of Dana's urban heritage.

Table 7.4: HIA score table of transforming Dana's landscape (Author 2022)

Criteria of Assessment	Description	Significance Degree	Impact Scale/ Severity	Weighted Impact	Impact Attribute/ Significance	Weighted Attribute
Urban Assessment						
Landscape	Before: multi-functional and self-sufficient village, formed mainly of residential houses After: tourist village, formed mainly of hotel rooms	0.10	1	0.10	+2	+0.20
	Sum of Significance	0.10	Total Result	0.10	Total Result	+0.20
			Score of Impact Scale	1.00	Score of Impact Attribute	+2.00

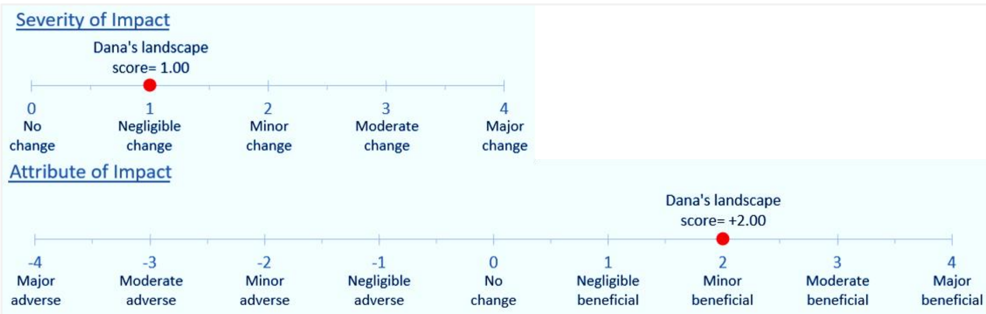


Figure 7.14: Severity of impact (top) and attribute of impact (bottom) of transforming Dana's landscape (Author 2022)

7.5 Overall Urban Impact

The overall analysis of the urban impact of the transformation of Dana village revealed that the approaches adopted to restoring the urban context necessitated certain changes to transform the local village into a tourist settlement. For instance, key urban settings were altered or added, including Dana's land use and infrastructure. Regarding the former, considerable changes to the land use were observed, leading to moderate changes to the urban context. Such transformation caused significant socio-cultural and economic benefits, following the revival of the abandoned houses and reusing them as hotel rooms that brings income to the local owners (score of impact scale = 3.00, score of impact attribute = +3.00).

Regarding the latter, the addition of bathrooms necessitated connecting the village with a sewage network and water supply. Therefore, the addition of new infrastructure that was not existed before caused a major beneficial impact that adapted the village to the hotel room requirements (score of impact scale = 4.00, score of impact attribute = +4.00). On the other hand, other key settings of Dana’s urban heritage were maintained while receiving negligible or minor changes, such as the urban configuration, street pattern, and landscape. The urban configuration of the village was conserved, as the stone bearing walls of each urban block were either fully or partially restored. Even if the walls were partially destroyed, their presence created the boundary of space and conserved the urban configuration.

However, new buildings were constructed while having empty restored houses, leading to expanding the original village without a sufficient purpose. This caused a moderate adverse impact on Dana’s urban heritage and ecotourism development (score of impact scale = 2.00, score of impact attribute = -3.00). In contrast, the conservation of the external walls maintained the street and road patterns of the village, adapting the street pattern to the development process. Such an adaptation conserved the original street and road patterns while adding new ones to connect the new buildings with the original village (score of impact scale = 2.00, score of impact attribute = +2.00).

Table 7.5 highlights the HIA of transforming Dana's urban heritage and the total results of calculating the score of impact severity/scale and overall impact significance/attribute. The results indicate that the transformation of Dana's urban heritage included 'minor' changes (score of impact scale/severity = 2.10) that caused 'negligible' beneficial impact (attribute of impact value = +0.70) (**Figure 7.15**). Apart from adding new buildings, the RSCN succeeded in adapting the urban context of the village to the implementation of sustainable ecotourism development, without losing its original morphology.

Table 7.5: HIA score table of transforming Dana's urban heritage (Author 2022)

Criteria of Assessment	**Significance Degree**	**Impact Scale/ Severity**	**Weighted Impact**	**Impact Attribute/ Significance**	**Weighted Attribute**
Urban Assessment					
Land use	0.20	3	0.60	+3	+0.60
Urban configuration	0.30	2	0.60	-3	-0.90
Skyline	0.10	0	0.00	0	0.00
Street pattern	0.20	2	0.40	2	+0.40
Infrastructure	0.10	4	0.40	4	+0.40
Landscape	0.10	1	0.10	2	+0.20
Total Urban Impact					
Sum of Significance	**1.00**	**Total Result**	**2.10**	**Total Result**	**+0.70**
		Score of Impact Scale	**2.10**	**Score of Impact Attribute**	**+0.70**

Approaches were adopted that balanced the conservation of the urban context with developing the village to accommodate tourists. The addition of infrastructure, streets, and roads left an imprint on the evolving urban context of Dana's vernacular settlement, developing the original village to meet the requirements of tourism. As a result, the urban context of Dana village was adapted to the implementation of sustainable ecotourism development, without losing its original urban heritage and morphology.

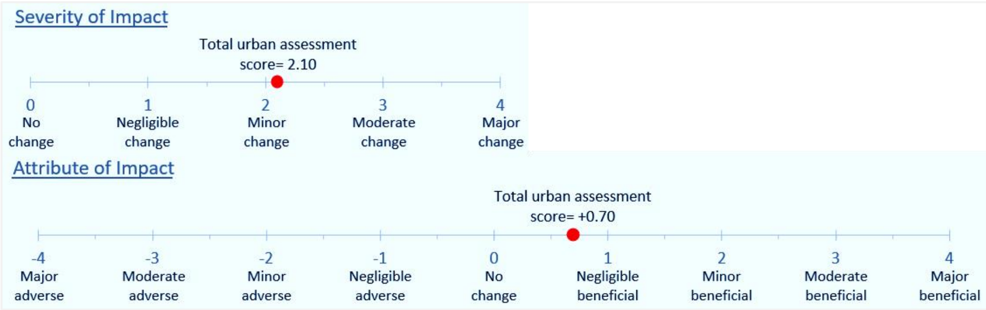


Figure 7.15: Severity of impact (top) and attribute of impact (bottom) of the total urban transformation (Author 2022)

7.6 Discussion and Conclusions

The ecotourism development of Dana guided and influenced the urban conservation in a way that responds to tourist demands rather than local needs. This is concluded from the conflicts which took place between the local community and authorities, ending with delays or cancellation of some of the proposed plans, such as that of land use. The local community was afraid of losing their houses without adequate economic benefits, as had been the case in previous developments, such as Umm Qais and Taybet Zaman villages (Alhasan 2019).

This situation was highlighted by other researchers, such as Orbaşli (2000), who stated that conservation approaches moved from being community-initiated to tourism-inspired. For instance, facade-based approaches have emerged, focusing on restoring the historical image of buildings rather than the cultural authenticity of settlements. Indeed, the objectives of conservation have changed from the continuity of cultural heritage to more external and aesthetic qualities, following the trend of reconstructing heritage buildings and reshaping local cultures (Orbaşli 2000). This was observed in the old town of Quebec in Canada, which was largely reconstructed, but still gives the experience of its former self that tourists are attracted to and enjoy.

The trend of reconstructing heritage was also observed in Dana, as most of its restored buildings were demolished and rebuilt, following the facadism practice in order to give the same external appearance. In line with Pedersen (2002), the comparison between Dana's proposed development plans and its current situation concludes that overlooking the rights and needs of the host communities lead to conflicts with the local authorities. Such conflicts could delay, cancel, or change the proposed development plans (as observed in the changes to the proposed land use in Dana).

It was also observed that the urban configuration of Dana was expanded to meet the requirements of sustainable ecotourism development. The expansion maintained the original urban configuration, while adding the buildings essential for tourism needs. The RSCN claimed that the new buildings were built to adapt the village to the new uses and activities, which are entirely different from the original ones (Alhasan 2019). However, it is not clear why the RSCN did not reuse some restored houses to accommodate such activities. The adaptive reuse of empty restored houses would have been a better solution, as reviving the original ones was the main aim of the project.

This concludes that this approach failed to reconcile the preservation of the vernacular settlement with the needs of tourist development because there is no valid purpose for adding the new buildings. Constructing new buildings while there were empty restored houses expanded the original village and urban configuration without a sufficient purpose, leaving an imprint on the developed urban morphology. Furthermore, comparing Dana before and after the rehabilitation project highlighted that the village's infrastructure was developed, including the repair of roads and urban spaces and the addition of a water supply and sewage network.

The old roads and open spaces were maintained and repaired, conserving the original street patterns of Dana, while roads were built to connect the new buildings with the whole village. However, the analysis of the tourists' behaviour highlighted that the functionality of the roads and open spaces changed after the village became a site for tourist accommodation. It was observed that tourists used the roads for gathering and transportation purposes, whereas the local community used them to take part in recreational activities and as public spaces for socialising and transportation throughout the day.

The same was found by Urry (1992), who highlighted that tourists consider streets as a stage show to explore and to view building facades that have become the defining element of urban spaces. MacCannell (2013) added that the urban spaces and streets in tourist villages are used in different ways by locals and tourists. This has led to more emphasis being put on the external appearance of buildings when conserving the urban heritage in order to maintain a desired image for tourists.[33] In summary, it is concluded that the development of infrastructures is an essential part of the adaptation to the requirements of hotel rooms. Integrated potable water, wastewater, and sewage networks needed to be developed in the built environment of Dana, in both the original and restored buildings.

Following the architectural and urban assessment, an assessment of the thermal impact of the village transformation is also essential. Therefore, the following chapter investigates the impact of interventions on the thermal performance of Dana's buildings. A comparison study is conducted between the thermal performance (temperature and humidity) of the original buildings and the rebuilt buildings to assess their thermal integrity.

[33] This approach was taken during the post-war period in Germany, where historic facades covered the modern concrete structures. This retained the established images of buildings, while providing different structures, internal spaces and dimensions (Soane 2013).

Chapter Eight: A Comparison Study between the Thermal Performance of the Original and Rebuilt Vernacular Buildings

8.1 Introduction

Following the urban and architectural analysis of the transformation of Dana village into a tourist settlement, the study aims to assess the impact of this transformation on the thermal performance of the settlement buildings. As explained in the previous chapters, the original construction materials were replaced, the building envelopes changed, openings were enlarged, and lighting shafts were added. These changes would be expected to have had an impact on the thermal performance of the buildings. This chapter seeks to evaluate this impact by comparing the performance of the settlement's original buildings with those that have been transformed.

In many cases, the transformation of vernacular buildings compromises their thermal performance, with the replacement of the construction material being the main contributor to such a compromise (Nicol, Humphreys and Roaf 2012). New materials with lower thermal capacity than the vernacular ones reduce the efficiency of the building envelope in resisting heat transfer (Weber and Yannas 2013). Therefore, this chapter aims to assess the effectiveness of the transformation strategies of Dana village by analysing the thermal performance of both the original and rebuilt vernacular buildings. As a result, it identifies which type is more effective in providing thermal comfort in summer and winter, while highlighting the effect of the transformation on thermal performance.

This chapter analyses the impact of the original vernacular principles on the thermal performance of the original buildings, including their construction materials, opening sizes, and vernacular form. It then assesses the impact of the transformation of the vernacular principles, demonstrating the effect of the new building envelopes, construction materials, and opening sizes. To achieve this aim, monitoring of the internal and external conditions of a representative case study was conducted, with Dana hotel selected for this purpose, as it consists of both original and rebuilt rooms. The physical variables (air temperature and relative humidity) were monitored in both types of room. The recorded data are then interpreted in this chapter, with the aim of mainly comparing the results from the original vernacular rooms with those from the rebuilt ones.

The chapter starts with the documentation of the original and rebuilt parts of the hotel. This focuses on the physical features, including the hotel form, layout, orientation, windows, and doors. Subsequently, the field survey and thermal monitoring details are illustrated, showing the placement and adjustment of the data loggers. Preparatory work was then undertaken after the thermal monitoring, with management of the recorded data in such a way to facilitate its interpretation. This included calculating the mean indoor temperature, daily diurnal swing, decrement factor, time lag, outdoor running mean temperature, and comfort temperature. The analysis then began according to the recorded physical variables, relating them to the physical features of the buildings and the thermal properties of the building envelopes.

The variation in the indoor temperatures throughout the day and the provision of thermal comfort represent the assessment criteria of the study. These were first analysed within the original and rebuilt parts of Dana hotel separately. A statistical method was used to analyse the monitored physical variables in order to assess the thermal performance. This illustrated the fluctuations in the recorded data (air temperature and relative humidity) throughout the day, from day to day, and from room to room. A comparison was then made between the final results of both parts. This comparison was used as an evaluation method to assess the transformation of Dana's original vernacular buildings within the thermal context.

8.2 Case Study of Dana Hotel

Dana hotel, established in the late 1980s, was selected as a representative case study of Dana village to conduct thermal monitoring in both the original and rebuilt rooms. The hotel was selected due to the availability of both original and rebuilt rooms in close proximity to each other, the high demand for the rooms, and the owner's authorisation to conduct thermal monitoring in the occupied rooms. Moreover, it has no cooling or heating systems, but split units (devices) in either type of room.

As this chapter aims to assess the old and new building envelopes and their ability to perform thermally, monitoring the internal and external physical measurements should be sufficient to express the efficiency of the building envelope in resisting heat transfer.[34] Monitoring of the internal and external temperatures enables them to be analysed according to the building design, with evaluation of how successful the building is thermally, without the presence of occupants. This section presents the data collected on the documentation and thermal monitoring of Dana hotel. To define the physical

[34] As the chapter focuses on the monitored physical variables, the subjective measurement (thermal sensation and preferences) and adaptive behaviour will be dealt with in the next chapter. In addition, measuring the energy use of the hotel and personal variables are beyond the scope of this research.

features of the original and rebuilt parts of the hotel, archival research and building documentation were undertaken. The documents relating to the rebuilt part were collected from the Royal Society for the Conservation of Nature (RSCN).

Monitoring relied considerably on the author's survey of the original part of the hotel. As we have seen in Chapter 5 which represented the first attempt to document the original part of the village, this section documents the original part of Dana hotel. The documents include the hotel layout, orientation, spatial arrangement, indoor spaces, facilities, materials, opening types, number of openings, and orientation. Following the documentation, this section explains the thermal monitoring process conducted to measure the physical variables of Dana hotel, including the indoor air temperature (°C), outdoor temperature (°C), and relative humidity (%). These variables were monitored in occupied spaces regardless of subjective responses in order to provide data about the hotel rooms with little involvement from the occupants. The monitored physical variables were then interpreted in accordance with the building form and envelope.

8.2.1 Dana Hotel Documentation

The physical variables of the indoor spaces depend mainly on the building design (Alzoubi and Almalkawi 2019, p. 17). Therefore, Dana hotel was documented to investigate the physical features of the monitored spaces. The documentation represents a primary step in assessing the thermal performance of the original and rebuilt parts of the hotel by identifying their physical characteristics. Both parts are located in the centre of the village, near the village mosque (**Figure 8.1**).

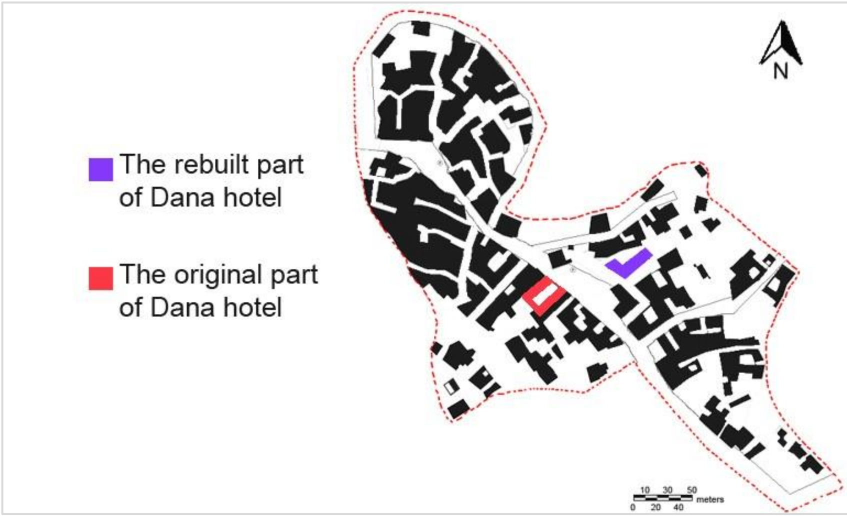


Figure 8.1: Location of the original and rebuilt parts of Dana hotel in the centre of the village (Author 2020)

The original part represents the main building of the hotel, containing the dining room, kitchen, and gathering spaces. The building type follows that of courtyard houses, formed of 12 single-storey rooms, surrounding the central courtyard on three sides. The entrance wall encloses the fourth side, identifying the building's rectangular courtyard (**Figure 8.2**). In fact, the courtyard is used as a multi-functional space for recreational activities and gatherings. In this arrangement, the external walls are less exposed to the outdoor climatic conditions, increasing the building envelope's thermal insulation.

The monitored rooms are attached to each other and the adjacent buildings from behind. They have one free wall that faces the courtyard, giving low significance to heat loss and gain due to the low exposure to the outdoor conditions. Moreover, due to the narrow streets and spaces between the buildings, neighbouring houses shade each other and reduce the heat gain through walls by radiation (Philokyprou et al. 2013). This shows how the original occupants adapted their houses to the climatic conditions (warm summer and cold winter).

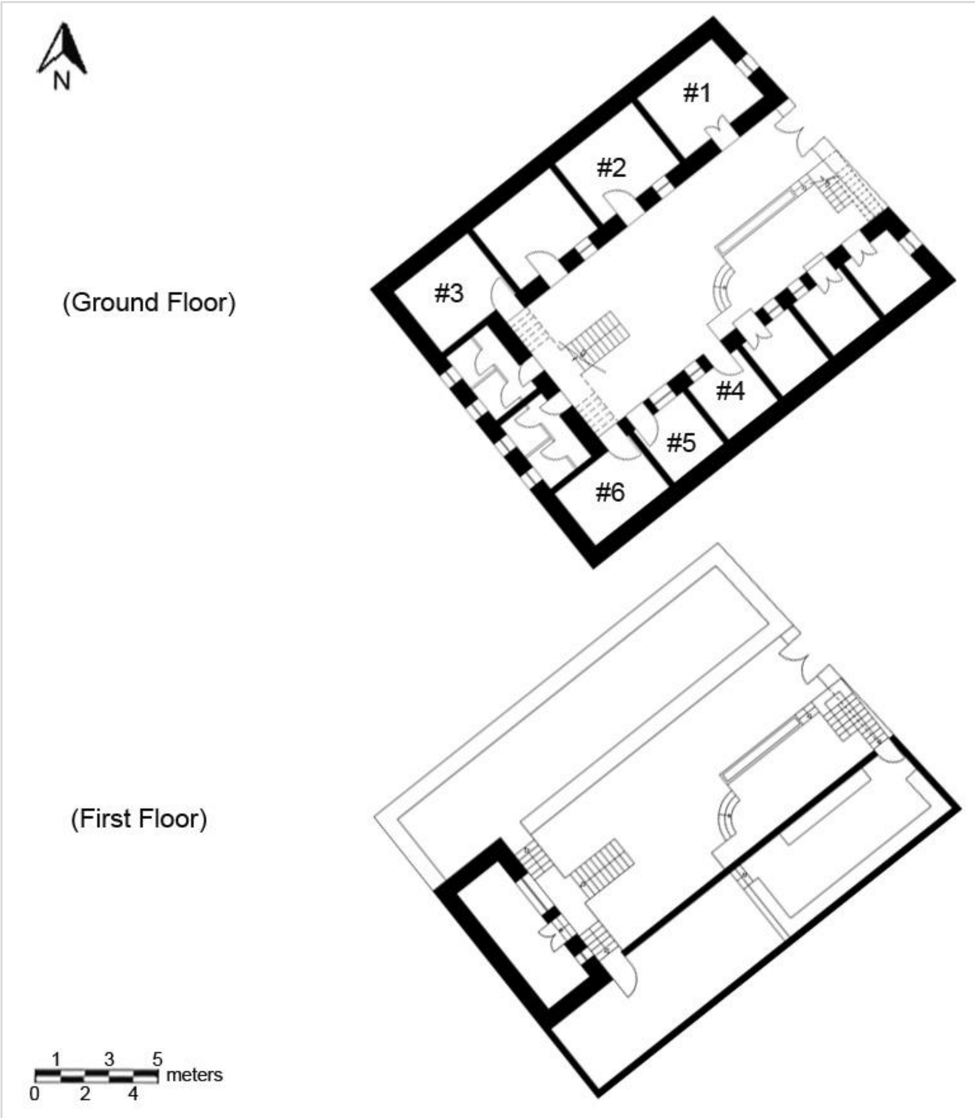


Figure 8.2: Ground floor plan (top) and first floor plan (bottom) of the original part of Dana hotel (Author 2020)

The original houses were attached to each other, sharing partition walls. This layout is useful in regions with hot and cold climatic conditions, as it minimises the exposure of the building envelope to the outdoor environment, which consequently reduces heat transfer (Bodach, Lang and Hamhaber 2014; Philokyprou et al. 2017). Moreover, the additional floor must have had an impact on the thermal performance of rooms #4, #5, and #6 because they are no longer exposed to solar radiation. It was built on the southern part of the building in the 1990s to be used as a dining room (**Figure 8.3**).

Figure 8.3: Additional floor on the southern part of the original Dana hotel (Author 2019)

All the rooms are used as hotel rooms, combined with separate toilets situated opposite the entrance. The rooms have one door and one window which face the courtyard, with the inward orientation maximising privacy. This type of building could be described as multi-small unit houses arranged around a courtyard as the shared space. Therefore, tourists' sequential order of movement would be from Dana's main street (public space) to the central courtyard (semi-private space) and ending in their private hotel rooms (private space).

Scattered around the settlement, the rebuilt parts of the hotel consist of single-storey rooms that are different in size and attached to each other. The rebuilt rooms previously formed a single and multi-functional space that directly faced the outdoor public areas (as discussed in Chapter 3). The sequential order of movement takes place from public spaces (outdoor roads) directly to private spaces. Currently, there are six en-suite hotel rooms composed of a bedroom, private bathroom, and kitchenette, showing different indoor facilities and organisation compared with the original ones (**Figure 8.4**). Also, lighting shafts were added to rooms #8, #9, and #10 to enhance air movement, ventilation, and lighting (**Figure 8.5**).

Figure 8.4: Ground floor plan (top) and first floor plan (bottom) of the rebuilt part of Dana hotel (Archive, RSCN 2019, adapted by the author 2020)

The rebuilt part of the hotel is not attached to other buildings, being a free unit exposed to the outdoor conditions. It represents a different type of buildings which is separate and not contiguous in clusters. The monitored rooms have either two or three free walls, showing more exposure and giving more significance to heat loss and gains compared to the original rooms. Furthermore, an additional floor was built on the short side of the building in

2003 (**Figure 8.6**), which has been used as a kitchen and dining room for the hotel since November 2019. These were moved from the original part due to the excessive heat experienced in the kitchen. This additional floor protects room #7 from solar radiation, creating a potential difference in its indoor temperature from the other rebuilt rooms.

Figure 8.5: Lighting shaft, room #8 (Author 2019)

Figure 8.6: Additional floor on the short side of the rebuilt part of Dana hotel (Author 2019)

8.2.2 Monitoring the Indoor and Outdoor Environment

The thermal monitoring conducted recorded the internal and external conditions of Dana hotel, including the air temperature and relative humidity. The outdoor conditions were measured in order to relate the indoor ones to the local climate. **Table 8.1** shows the climate of Dana village each month, including the average temperature (°C), minimum temperature (°C), and maximum temperature (°C). Dana has a cold climate in winter, reaching a minimum in January with an average temperature of 5.6°C. It has a temperate to warm climate in summer, reaching an average maximum of 21.7°C in August (CLIMATE-DATA.ORG 2020).

Table 8.1: Dana monthly temperature (°C) (CLIMATE-DATA.ORG. Retrieved June 21, 2020)

Tair	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Avg	5.6	6.6	9.6	13.2	16.5	19.6	21.1	21.7	19.4	16.7	11.7	7.4
Min	1.5	1.8	4.3	7.4	10.2	12.6	14.6	15.2	12.7	10.4	6.5	2.7
Max	9.8	11.4	14.9	19.1	22.9	26.7	27.7	28.3	26.2	23	17	12.2

To monitor the thermal conditions of the hotel, 10 data loggers were installed in ten rooms for two separate months, namely August 2019 and January 2020, representing the warmest and coldest months of the year. The monitored spaces included six original rooms and four rebuilt ones. Tinytag loggers were adjusted to record the air temperature and relative humidity every 15 minutes, which were placed at 1.5m above the floor level following guidance from the hotel owners (**Figure 8.7**).

Figure 8.7: Location of the data loggers in the original rooms (top) and rebuilt rooms (bottom) (Author 2020)

8.3 Preparatory Work

Following the field survey and thermal monitoring, the readings of the physical variables were uploaded onto a computer for analysis.[35] Having the internal and external temperatures recorded enabled assessment of the thermal efficiency of the old and new building envelopes. The preparatory calculations were made according to the following assessment criteria:

1. The variation in indoor temperatures is a criterion that expresses the efficiency of the building envelope in providing less fluctuations and more stable indoor temperatures. To this end, the mean values of the indoor and outdoor air temperatures were calculated to provide a basic indication of temperature variation in each room (**Appendix B**).

[35] The preparatory work was first conducted to manage the recorded data and arrange them in a way that facilitated the subsequent analysis. Therefore, the collected data were transferred to Microsoft Excel spreadsheets for analysis and calculations.

Moreover, the diurnal swings were calculated to indicate the daily variations, expressing the thermal mass of the buildings (**Appendix C**).[36]

2. The efficiency of the old and new building envelopes in resisting heat transfer was the second criterion. For this, the decrement factor (f) and time lag (ƫ) were calculated to practically highlight whether the building envelopes had high or low thermal conductivity (**Appendix D)**.[37]
3. The ability of the original and rebuilt rooms to provide thermal comfort is the third assessment criterion. For this purpose, the comfort temperatures were calculated, setting the adaptive comfort criteria to be compared with the hourly mean temperature (**Appendix E**).[38]

8.3.1 Calculating the Mean Values

The data loggers were adjusted to record the internal and external air temperature and humidity every 15 minutes. Therefore, the mean values of

[36] The daily diurnal swings in indoor air temperature represent the difference between the maximum and minimum recorded temperatures. They were calculated to show the daily variation in each room. The diurnal swing depends mainly on the building's thermal mass. In fact, an insufficient level of such mass may increase the diurnal swings in indoor temperature, raising the peak daytime temperature (Nicol, Humphreys and Roaf 2012, p. 78).

[37] Time lag and decrement factor are very important characteristics to determine the heat storage capabilities of any material. The time it takes for the heat wave to propagate from the outer surface to the inner surface is named as time lag and the decreasing ratio of its amplitude during is named as decrement factor' (Asan 2006, p. 616). check original highlighted text if this is a quote

[38] The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) defines thermal comfort as 'The state of mind which expresses satisfaction with the thermal environment' (Nicol, Humphreys and Roaf 2012, p. 44). The comfort temperature equations in both the European standard (BSEN15251) and ASHRAE standard are almost the same but differ in the calculation method of the mean outdoor temperature. In the BSEN15251 standard, the outdoor temperature is represented as the outdoor running mean temperature. In contrast, in the ASHRAE standard, the prevailing mean outdoor temperature is used.

these measurements were calculated first for each hour, then for each day, and finally for the whole monitoring period.[39] This step was repeated when analysing each space in both seasons. Through these measurements, the daily mean temperatures and relative humidity were calculated for each original and rebuilt room. **Tables 8.2** and **8.3** summarise the calculated values, highlighting the overall maximum, minimum, and mean temperatures in the original and rebuilt rooms in the different seasons.

Table 8.2: Indoor air temperatures (°C) in the original rooms, highlighting that the mean indoor temperature of the original spaces is always higher than the mean outdoor temperature in summer and winter (Author 2020)

	Tout		**Room #1**		**Room #2**		**Room #3**		**Room #4**		**Room #5**		**Room #6**	
	Jan	**Aug**	**Jan**	**Aug**	**Jan**	**Aug**	**Jan**	**Aug**	**Jan**	**Aug**	**Jan**	**Aug**	**Jan**	**Aug**
Mean	6.1	24.7	7.6	26	9.7	26.6	5.6	27	7.9	24.9	6.1	24.8	7.7	27.5
Min.	-0.9	16.3	4	23.4	5.4	22.6	2.1	24.6	6.7	21.9	2.4	21.7	5.6	23.3
Max.	20.4	36.5	11.5	29.2	16.8	33.8	9.7	29.8	9.8	27.2	10.2	27.2	10.3	35

Table 8.3: Indoor air temperatures (°C) in the rebuilt rooms, indicating that the mean indoor temperature of the rebuilt rooms was close to the mean outdoor temperature in summer, but was always higher in winter (Author 2020)

	Tout		**Room #7**		**Room #8**		**Room #9**		**Room #10**	
	Jan	**Aug**	**Jan**	**Aug**	**Jan**	**Aug**	**Jan**	**Aug**	**Jan**	**Aug**
Mean	6.1	24.7	7.1	25.2	9.4	24.2	8.8	25.8	7.4	26.3
Min.	-0.9	16.3	4.5	23.6	6.9	22.5	5.9	23	4.2	23.6
Max.	20.4	36.5	9.9	27.1	13.7	26	16.5	28.3	17	29.7

[39] The mean value of a specific physical measurement is an essential statistic when analysing data (Nicol, Humphreys and Roaf 2012, p. 125). After calculating the mean air temperature over a given time, it is possible to plot how the recorded data are scattered around the mean value, giving an indication of the temperature variation around the mean.

8.3.2 Calculating the Decrement Factor (f) and Time Lag (ŧ)

The decrement factor and time lag were calculated for each space to practically analyse the efficiency of the building envelope in resisting heat transfer. They were calculated using equations (1) and (2) respectively (Toure et al. 2019, p. 3; Asan 2006, p. 616).

$$f = \frac{\text{Ti.max} - \text{Ti.mean}}{\text{To.max} - \text{To.mean}} \quad (1)$$

where (Ti.max) is the maximum indoor temperature (C°), (Ti.mean) is the mean indoor temperature (C°), (To.max) is the maximum outdoor temperature (C°), and (To.mean) is the mean outdoor temperature (C°). The closer the decrement factor is to zero means that the building envelope is more effective at resisting thermal swings and heat transfer.

$$ŧ = t(\text{Ti.max}) - t(\text{To.max}) \quad (2)$$

where t(Ti.max) is the time the indoor temperature reaches the maximum (hours), and t(To.max) is the time when the outdoor temperature is at its maximum (hours). The higher the time lag, the higher the thermal mass of the building envelope, leading to better heat transfer resistance.

8.3.3 Calculating the Comfort Temperature

This study adopts the BSEN15251 approach and uses the outdoor running mean temperature to calculate the comfort temperature. It should be noted that the air temperature is used rather than the operative temperature, based on the assumption that both values are equal under the monitored conditions. Moreover, the comfort temperature values in the study were calculated for still air, as none of the spaces or rooms has fans. However, in summer, occupants ask for fans, raising the comfort temperature and bringing it closer to the mean indoor temperature. The outdoor running mean temperature was first calculated using the following equation (McCartney and Nicol 2002, p. 624; CEN 2007; Nicol, Humphreys and Roaf 2012, p. 38).

$$T\text{rm} = \alpha T\text{rm} - 1 + (1 - \alpha)T\text{od} - 1 \tag{3}$$

where (T_{rm}) is the outdoor running mean temperature (C°); T_{rm-1} is the outdoor running mean temperature of the previous day (C°); T_{od-1} is the mean outdoor temperature of the previous day; and α is a constant between 0 and 1 that express how quickly the running mean responds to the mean outdoor temperature, assumed to be 0.8 for this study.

Subsequently, the comfort temperature was calculated using equation (4), developed according to the CEN standard to calculate the comfort temperature in buildings (Nicol and McCartney 2001; Nicol, Humphreys and Roaf 2012, p. 57). People can feel comfortable within a range of temperatures (Nicol and Humphreys 2007). Therefore, the comfort range was calculated depending on the required building category, using equations 5, 6, and 7 for categories I, II, and III respectively.

$$T\text{comf} = 0.33T\text{rm} + 18.8 \tag{4}$$

$$T\text{comf} = 0.33T\text{rm} + 18.8 \pm 2 \tag{5}$$

$$T\text{comf} = 0.33T\text{rm} + 18.8 \pm 3 \tag{6}$$

$$T\text{comf} = 0.33T\text{rm} + 18.8 \pm 4 \tag{7}$$

The comfort temperature, as a base of comparison between the original and rebuilt rooms, varied from 25.7°C to 27.4°C in summer and from 19.6°C to 21.8°C in winter. The comfort range was divided into three categories depending on closeness to the comfort temperature. This study considers category I (±2K), with a high level of expectation, to provide comfort in buildings that have cooling and heating systems. Its comfort temperatures vary from 23.7°C to 29.4°C in summer and from 17.6°C to 23.8°C in winter.

Category II (±3K), which has a normal level of expectation, is required to provide comfort in buildings that have no cooling or heating systems, but split units (devices), such as the case of Dana's buildings. The comfort temperatures for this category vary from 22.7°C to 30.4°C in summer and from 16.6°C to 24.8°C in winter. In addition, the study considered category III (±4K), which has an acceptable level of expectation, to provide comfort in free-running buildings with no cooling or heating devices or systems. For this category, the comfort temperatures vary from 21.7°C to 31.4°C in summer and from 15.6°C to 25.8°C in winter.

8.4 Original Dana Hotel Rooms

8.4.1 Building Envelope

As this chapter seeks to assess the thermal performance of Dana hotel, it is essential to analyse the building envelope. Variations in indoor temperatures are influenced mainly by this envelope, including the construction materials, opening sizes and orientation (Philokyprou and Michael 2012; Fernandes et al. 2015; Toe and Kubota 2015; Alzoubi and Almalkawi 2019). Therefore, the analysis began with the original building envelope, including its construction materials, thermal conductivity, opening sizes, and orientation.

8.4.1.1 Construction Materials

To begin, the R-values and U-values were determined to evaluate the materials' thermal capacity.[40] For better thermal insulation and less heat transfer (loss or gain), materials with higher R-values and lower U-values are more recommended, as they offer better thermal insulation (Zheng, Mark and Youmans 2011). The original part of Dana hotel was built mainly of stone, juniper wood, cane, and a mixture of clay and straw. **Table 8.4** shows the thermal properties of the original building envelope (exterior walls, floors, and roofs). According to the table, the U-values in the original buildings are close to zero, equalling 1.307W/m^2 K for the exterior walls, 0.367W/m^2 K for the ground floor, and 0.481W/m^2 K for the roof. This suggests that the original building envelope is efficient in resisting heat transfer.

8.4.1.2 Opening Sizes and Orientation

The glazed area to the floor area ratio was calculated to determine the extent to which the rooms were exposed to outdoor conditions (**Table 8.5**). It was observed that the original rooms have small windows that face the central courtyard. Apart from privacy reasons, the small size and high position of the openings extract hot air from the indoor spaces as it rises, due to its lower density (Philokyprou, Michael and Thravalou 2013).

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[40] The R-value represents the resistance of heat transfer, while the U-value represents the efficiency of heat transfer through a specific thickness of a specific material (Zheng, Mark and Youmans 2011, p. 2).

Table 8.4: Thermal properties of the original construction materials (Alzoubi and Almalkawi 2019, p. 18, adapted by the Author 2020)

Type	Materials	Thickness (cm)	Thermal Conductivity (W/m K)	R-Value (m^2 K/W)	U-Value (W/m^2 K)
Exterior Wall	Stone	70	5	0.14	**1.307**
	Mixture of clay and straw	10	0.16	0.625	
Ground Floor	Earth	50	1.4	0.357	**0.367**
	Gravel jeer	45	0.38	1.184	
	Base course stone	10	1.51	0.066	
	Sand	45	0.42	1.071	
	Cement mortar	2.5	0.931	0.027	
	Terrazzo tile	2.5	1.2	0.021	
Roof	Juniper wood	5	0.17	0.294	**0.481**
	Cane	3	0.056	0.536	
	Mixture of clay and straw	20	0.16	1.25	

In fact, the openings act as valves that control the airflow and movement, while opening windows improves the indoor air movement, making the occupants feel cooler (Philokyprou, Michael and Thravalou 2013). Furthermore, the small number of small windows protects the indoor spaces from direct solar gains in the summer, while offering good ventilation and cooling at night (Sözen and Gedík 2007; Michael et al. 2017). On the other hand, the small windows reduce heat loss in winter and allow solar gains due to the low winter sun (**Figure 8.8**).

Table 8.5: Dimensional records of the monitored spaces in the original part of Dana hotel (Author 2020)

Original Space	Area (m^2)	Height (m)	Window Area (m^2)	Window Orientation	Glazing / Floor Area Ratio
#1 Hotel room	17.35	2.80	0.72 (0.85*0.85)	NE	**4.1%**
#2 Hotel room	17.40	2.80	0.80 (0.80*1.00)	SE	**4.6%**
#3 Hotel room	16.65	2.80	N/A	-	**0%**
#4 Hotel room	9.45	2.80	0.49 (0.70*0.70)	NW	**5.2%**
#5 Hotel room	9.45	2.80	0.88 (0.80*1.10)	NW	**9.3%**
#6 Kitchen	14.20	2.80	N/A	-	**0%**

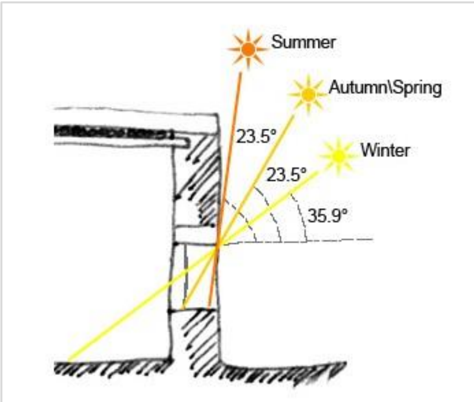

Figure 8.8: Small windows that allows solar gains in winter and prevents summer ones (Author 2020)

Analysis of the original opening sizes and construction materials now enables discussion of the variation in indoor temperatures in the original rooms. As this chapter aims to assess the efficiency of the building envelope in providing less fluctuations and more stable temperatures, the monitored air temperatures were analysed in relation to the original building envelope.

8.4.2 Variation in Indoor Temperature throughout the Day

The discussion relates the indoor temperatures to the outdoor temperature, illustrating the efficiency of the building envelope and opening sizes in resisting heat transfer and providing less fluctuation. The mean indoor temperature of the original spaces is always higher than the mean outdoor temperature in summer and winter (**Table 8.6**). The overall fluctuation in air temperatures in the different original spaces in the different seasons is illustrated in **Figure 8.9**. Moreover, a typical week of fluctuating air temperatures is illustrated in **Figure 8.10** to provide a more detailed analysis.

Table 8.6: Indoor air temperatures (°C) in the original rooms (Author 2020)

	Tout		Room #1		Room #2		Room #3		Room #4		Room #5		Room #6	
	Jan-Feb	July-Aug	Jan-Feb	July-Aug	Jan-Feb	July-Aug	Jan-Feb	July-Aug	Jan-Feb	July-Aug	Jan-Feb	July-Aug	Jan-Feb	July-Aug
Mean	6.1	24.7	7.6	26	9.7	26.6	5.6	27	7.9	24.9	6.1	24.8	7.7	27.5
Min.	-0.9	16.3	4	23.4	5.4	22.6	2.1	24.6	6.7	21.9	2.4	21.7	5.6	23.3
Max.	20.4	36.5	11.5	29.2	16.8	33.8	9.7	29.8	9.8	27.2	10.2	27.2	10.3	35

In summer, the indoor temperatures follow the outdoor temperature profile but with a significant time lag. In all the rooms, the indoor temperature is higher than the outdoor except around noon. In fact, the indoor temperature is low at night, dropping in the early morning to the minimum and then rising rapidly until the afternoon, reaching its maximum value. However, the maximum indoor temperature is always lower than the outdoor temperature around noon due to the thermal mass in all the spaces except for the kitchen (space #6) due to the high internal heat gains from cooking.

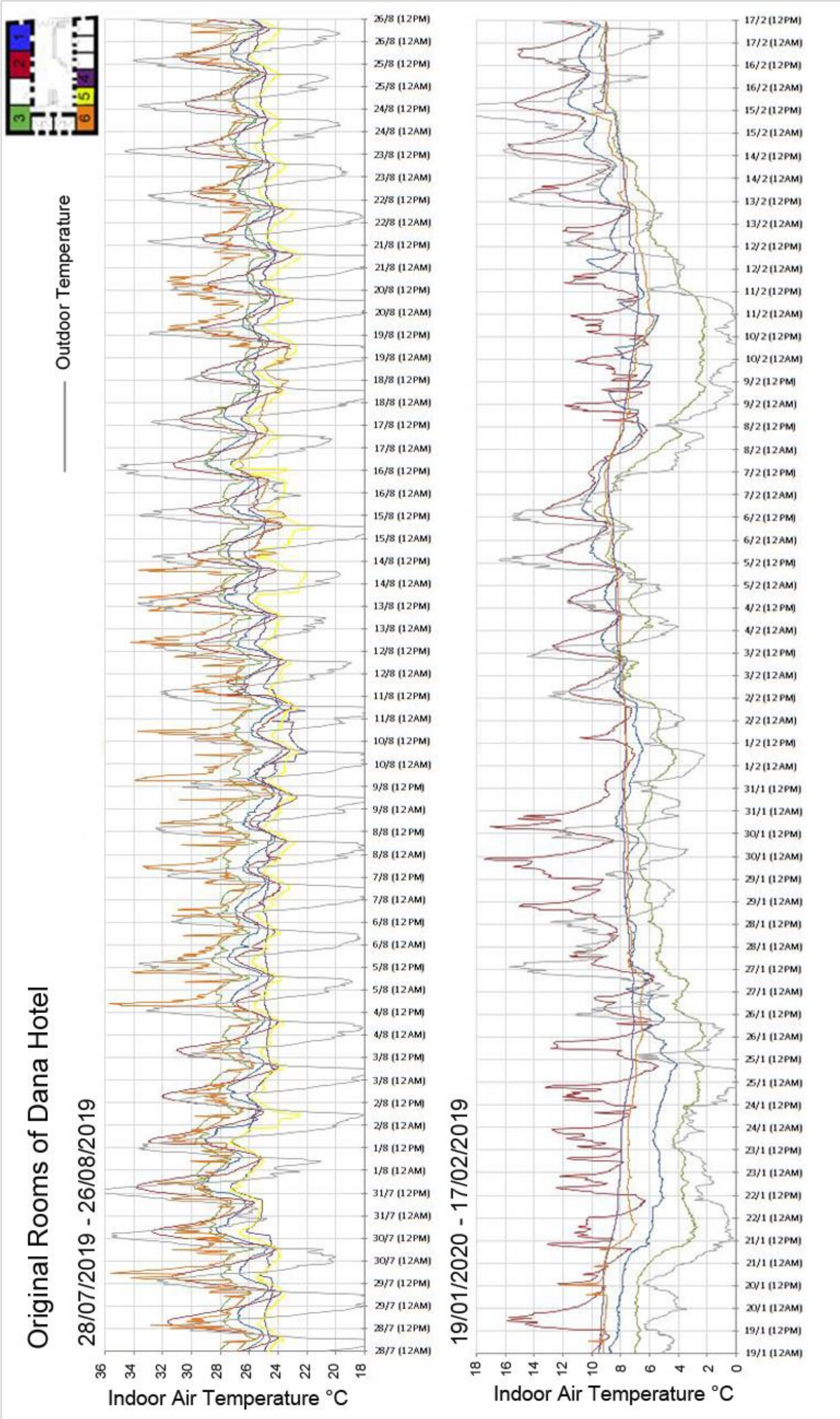

Figure 8.9: Variation in the indoor air temperature in the original rooms in summer (left) and winter (right) (Author 2020)

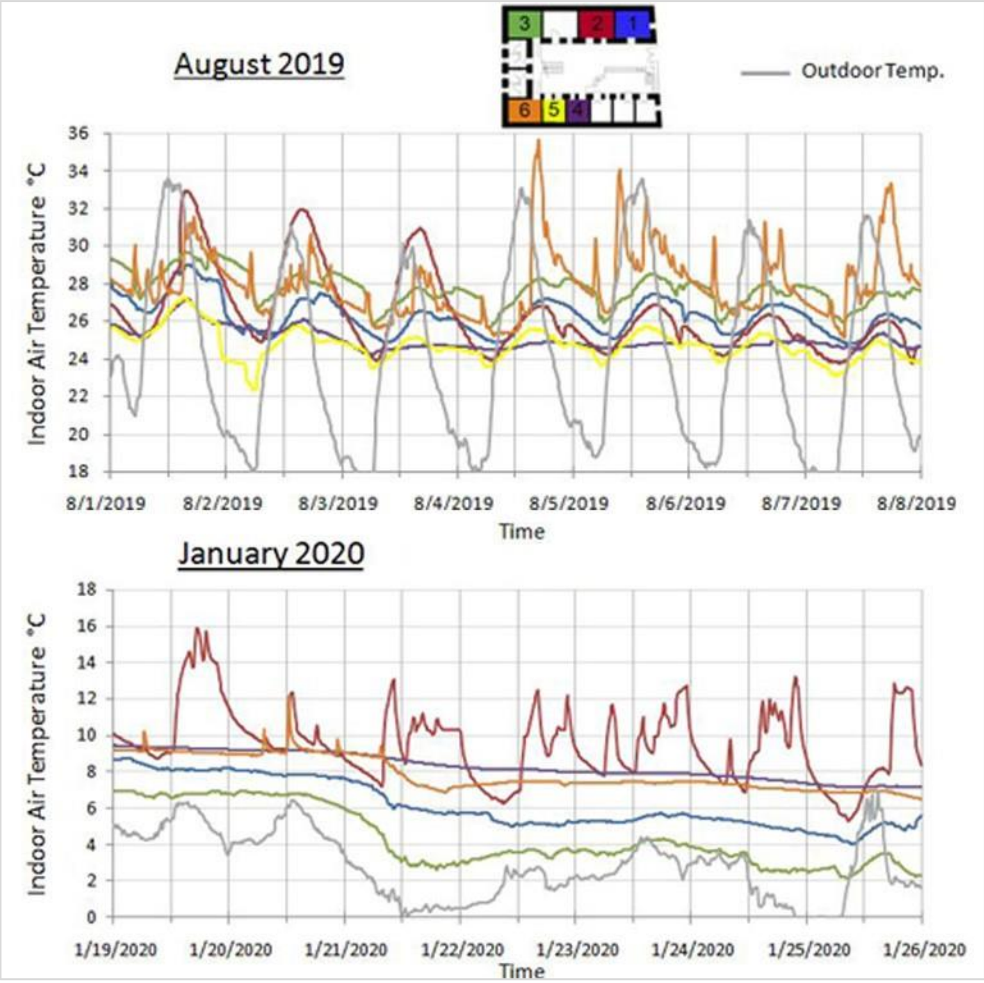

Figure 8.10: Variation in indoor air temperature in the original rooms in a typical week in summer (top) and winter (bottom) (Author 2020)

The high thermal mass of the original thick masonry walls reduces heat transfer to indoor spaces, preventing heat from reaching indoors in the afternoon, which is the hottest part of the day, and can reach 36°C (Philokyprou and Michael 2012). The high thermal mass demonstrates a thermal lag of 14 hours. Indeed, the external face of the walls heats up when the outdoor temperature rises. The heat is then absorbed and stored by the masonry walls, moving slowly inwards from the outside (Toe and Kubota 2015).

Most of the absorbed heat returns outside when it is cooler due to the high thermal mass of the original walls, while some heat reaches the indoor space in the evening. Storing the absorbed heat and releasing it into the indoor spaces in the evening explains the noticeable gap between the indoor and outdoor temperatures. Therefore, the night-time temperature difference between indoors and outdoors, which sometimes approaches 10°C, is greater than during the day. Moreover, the daily variation is noticeable in some spaces more than others due to different functions and occupancy hours. Therefore, the diurnal swing values were calculated, illustrating the difference between the highest and lowest temperatures each day.

Smaller variations and less significant fluctuations over the day were noticed in rooms #1, #3, #4, and #5, varying from 0.25°C to 4°C. This was because the thermal inertia of the thick stone walls and clay roofs results in small fluctuations in the indoor temperature. The high thermal inertia of the original materials increases their capacity to store heat and then to emit it outdoors when the temperature is lower (Rapoport 1969; Philokyprou, Michael and Thravalou 2013). However, a lower indoor temperature was noticed in rooms #4 and #5 because their roofs are not exposed to outdoor conditions, having an additional floor above them.

On the other hand, the roofs of rooms #1 and #3 are exposed to outdoor conditions and solar radiation, leading to the absorption of heat and its transfer to indoor spaces. Furthermore, the diurnal swing values in rooms #2 and #6 are more significant and variable, ranging from 4°C to 9.7°C. The absence of windows in room #6 raises the indoor temperature, storing the heat indoors without efficient airflow or ventilation. Also, the room is used as a kitchen, explaining the excessive indoor temperature which jumps above the outdoor temperature most of the time due to heat produced from the cooking.

This highlights that the function of spaces plays an essential role in affecting the indoor temperature, depending mainly on the heat produced from activities and occupants. Therefore, the kitchen showed similar fluctuations and temperatures to rooms #4 and #5 when it was out of service for maintenance between the 15th and 19th of August. In the case of room #2, it was observed that its roof had been replaced with a concrete one (**Figure 8.11**), which created the difference in the thermal performance. The new concrete roof failed to resist heat transfer due to its lower capacity to do so compared with the original clay roofs. Therefore, the indoor temperature of room #2 shows more fluctuation, reaching higher points compared with the other original hotel rooms.

(Room #2) (Room #1)

Figure 8.11: Different types of roofs in the original part of Dana hotel; concrete roof in room #2 (left) and clay roof in room #1 (right) (Author 2019)

As expected, it was observed that the variation in the indoor temperatures was influenced mainly by the building envelope, including the construction materials, opening sizes and orientation. Having different construction materials or opening sizes causes a different pattern of variations within the original part of Dana hotel as seen in room #2. In fact, the calculated decrement factor highlights that the highest decrement factor was recorded in rooms #2 and #6 due to their higher indoor temperatures, while the lowest decrement factor was recorded in space #4 (**Figure 8.12**). Excluding the special case of the kitchen, this confirms that the original building envelope is more efficient in resisting heat transfer and thermal swing.

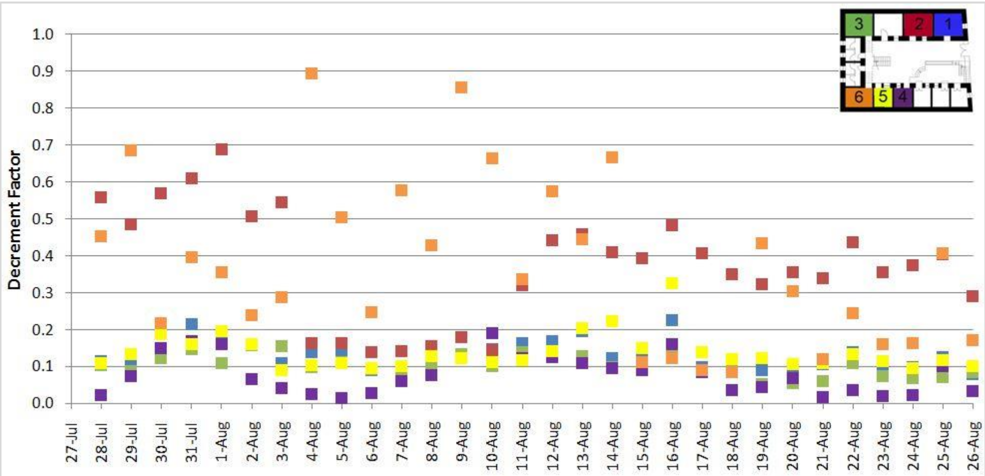

Figure 8.12: Decrement factor of the original rooms, July-August 2019 (Author 2020)

A different pattern of variations is noticed in winter, with lower temperatures. The indoor temperature follows the profile of the outdoor one in room #3, being the coldest of the other original rooms. In fact, the indoor temperature does not rise with higher outdoor temperatures but falls with lower outdoor ones. This is because the sun does not enter this room due to the absence of windows. Moreover, room #3 was not occupied during the winter monitoring period, so showing minor variations in temperature.

Similarly, rooms #6 and #4 were also unoccupied, but had higher temperatures due to reduced heat losses from their roofs, which were not exposed to the cold outdoor conditions. Room #1 showed similar behaviour to room #3 until it started to be occupied on 8th February. Higher fluctuations are evident during room occupation, with warmer conditions in the morning due to the eastern window that introduces solar gains, but still with small diurnal swing values, varying from 0.1°C to 3°C. On the other hand, daily variation is more noticeable in room #2, with more significant and variable diurnal swing values, ranging between 2.4°C and 8°C. It has the highest decrement factor due to its concrete roof which has a low thermal capacity (**Figure 8.13**).

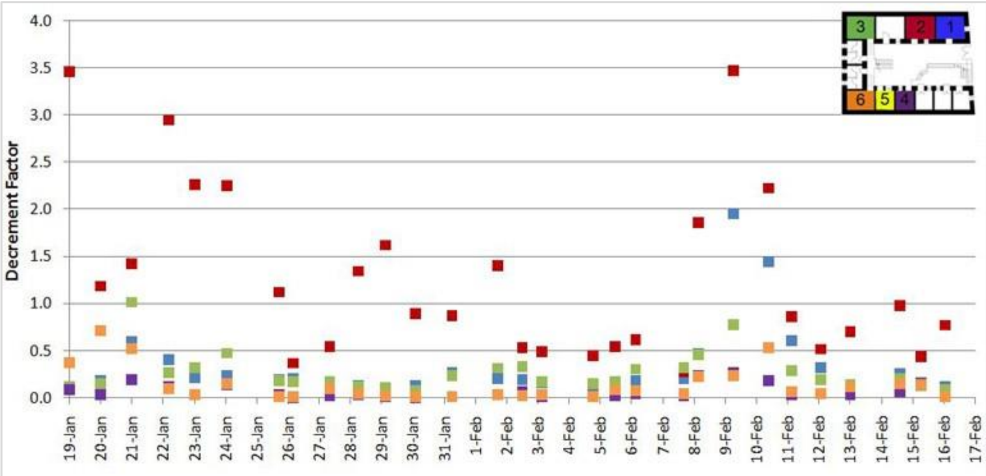

Figure 8.13: Decrement factor of the original rooms, Jan-Feb 2020 (Author 2020)

The indoor temperature reaches its maximum in the afternoon and minimum at midnight. This is because when the outdoor temperature reaches its maximum near noon, the concrete roof of room #2 transfers the absorbed heat to the indoor space after a short time due to its lower thermal capacity. On the other hand, the lowest decrement factor was recorded in rooms #4 and #6 due to their lower exposure to outdoor conditions, as they have an additional floor above them.

8.4.3 Thermal Comfort

Thermal comfort was investigated through the adaptive thermal comfort standards BSEN15251 (Nicol et al. 2012). The analysis showed that the hourly indoor temperatures of the original rooms were distributed within the three thermal comfort ranges in summer, apart from rooms #2 and #6, which experienced overheating (**Figure 8.14**). This shows that the indoor thermal conditions are warmer than the comfort temperatures, suggesting that the occupants are warmer than they would prefer to be. With the original rooms operating with no cooling system but fans in July-August most of the time, comfort category II is required to provide thermal comfort.

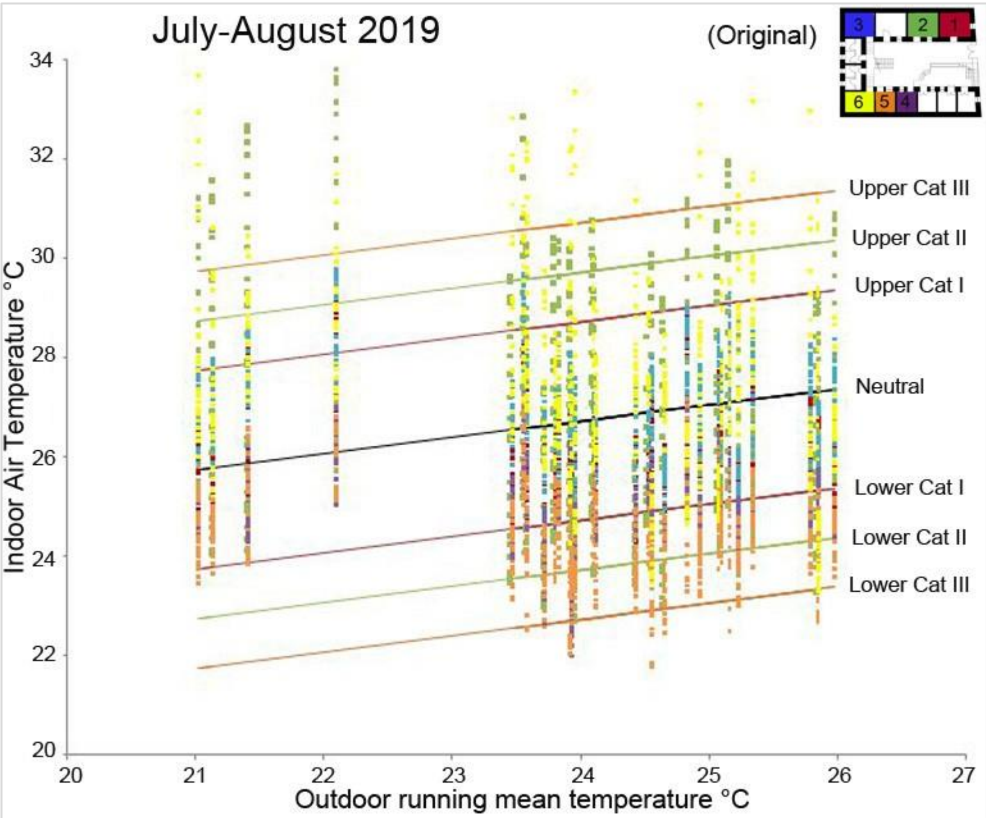

Figure 8.14: Hourly indoor temperatures in the original rooms compared to the outdoor running mean temperature July-August 2019, based on the BSEN15251 adaptive comfort criteria (Author 2020)

The comparison of the hourly indoor air temperatures with BSEN15251 adaptive thermal comfort standards for category II highlights that only rooms #2 and #6 experienced overheating, at 13.42% and 12.29% of the hours above the Cat II comfort range (**Table 8.7**). However, overheating does not appear to be an issue in rooms #4 or #5, although a small risk of overheating was highlighted in room #1, with conditions exceeding Cat II for 0.42% of the 708 hours monitored (3 hours from 28/07/2019 to 26/08/2019). Potential overheating was also observed in room #3, with the conditions exceeding Cat II for 1.84% of the 708 hours monitored (13 hours from 28/07/2019 to 26/08/2019).

Table 8.7: Distribution of hours that rooms are below, within, or above Category II, BSEN15251, July-August 2019 (Author 2021)

	Hours below Cat II	**Hours within Cat II**	**Hours above Cat II**	**% Hours below Cat II**	**% Hours within Cat II**	**% Hours above Cat II**
#1	2	703	3	0.28%	99.29%	0.42%
#2	60	553	95	8.47%	78.11%	13.42%
#3	0	695	13	0.00%	98.16%	1.84%
#4	30	679	0	4.24%	95.90%	0.00%
#5	202	506	0	28.53%	71.47%	0.00%
#6	23	598	87	3.25%	84.46%	12.29%

On the other hand, what can be considered cold discomfort was noticed in the original rooms, apart from room #3. Although most of the time they were within the comfort range of Cat II, different percentages of cold discomfort hours were below Cat II, ranging from 0.28% in room #1 to 28.53% in room #5. Overall, 100% of the hourly indoor temperatures lay within the comfort ranges in rooms #1, #3, #4, and #5; most temperatures lay within the comfort range of category I, while others lay within the other two comfort categories. Therefore, the desired thermal comfort was achieved in the original hotel rooms in summer. However, 85% of the hourly indoor temperatures lay within the comfort ranges in rooms #2 and #6, whereas 15% were above the upper limit of comfort, resulting in overheated conditions.

Overheating in room #2 was due to the transformation of the original roof, with the clay roof replaced by a concrete one, but the original walls and opening sizes kept. In addition, the absence of windows and the high internal heat gains from cooking in the kitchen (room #6) led to overheating of the indoor thermal conditions. The large area of the central courtyard plays a significant role in enhancing the efficiency of the original rooms in providing thermal comfort. The courtyard cools down the indoor temperature in summer as it is shaded by the surrounding walls, preventing the warming of the rooms from solar gains (Philokyprou, Michael and Thravalou 2013).

The addition of plants, pergolas, and trees also helps provide shading and cooling by evaporation from the plants' green leaves. Consequently, the cooled air becomes heavier and falls, while the hot air (extracted from the indoor spaces) rises, driving the cool air into indoor spaces as cool breezes (Philokyprou et al. 2013). Similarly, the cool night air enters the indoor spaces through open windows after the hot air rises and goes outside, removing the stored heat from the rooms. Combining the shading and night cooling methods reduces the indoor temperature, providing cooler conditions which are closer to comfortable temperatures (Michael et al. 2017).

In winter, 100% of the hourly mean indoor temperatures are below the lower comfort limit, resulting in cold conditions. This shows that the indoor temperatures are lower than the comfort temperature, suggesting that occupants must be much colder than they would prefer to be (**Figure 8.15**). Therefore, all the original rooms fail to provide thermal comfort in winter.

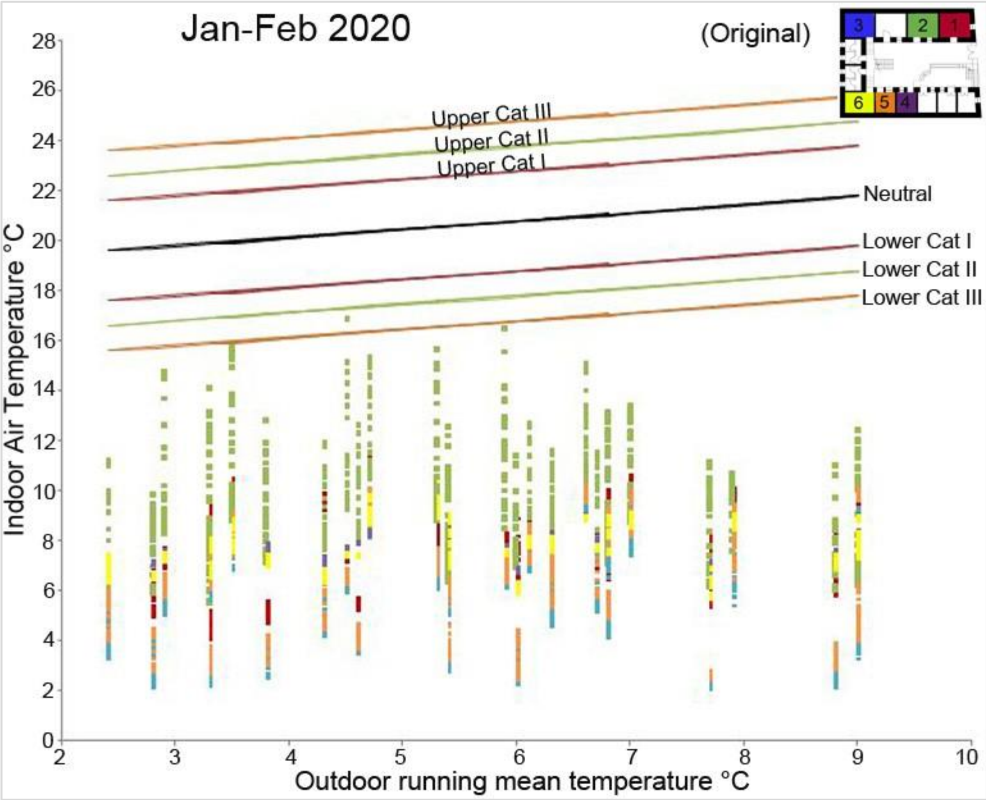

Figure 8.15: Hourly indoor temperatures in the original rooms compared to the outdoor running mean temperature, Jan-Feb 2020, based on the BSEN15251 adaptive comfort criteria (Author 2020)

8.5 Rebuilt Rooms of Dana Hotel

8.5.1 Building Envelope

8.5.1.1 Construction Materials

The rebuilt part of Dana hotel was built mainly of stone, concrete, hollow concrete block, and cement mortar. **Table 8.8** shows the materials used for the rebuilt building envelope (exterior walls, floor, and roof), their thickness, and thermal properties. The calculated U-values are relatively high, equal to 3.356W/m^2 K for the exterior walls, and 1.096W/m^2 K and 3.257W/m^2 K for the ground floor and roof respectively. These figures highlight that the rebuilt building envelope does not resist heat transfer efficiently, demonstrating high thermal transfer due to the material's high thermal conductivity.

8.5.1.2 Opening Sizes and Orientation

The addition of lighting shafts and the enlargement of the external windows increased the glazing area of the rebuilt rooms, exposing the indoor spaces to outdoor conditions. The ratio of the glazed to floor area was calculated for the rebuilt rooms to determine the extent to which they were exposed to the outdoor conditions. **Table 8.9** shows the dimensions of the monitored rebuilt spaces, the area of the openings (lighting shafts and windows), their orientation, and the glazing to floor area ratio. Analysis of the new opening sizes and construction materials enables discussion of the variation in indoor temperatures in the rebuilt rooms.

As this chapter aims to assess the efficiency of the building envelope in providing less fluctuations and more stable temperatures, the monitored air temperatures are analysed in relation to the new building envelope.

Table 8.8: Thermal properties of the new construction materials (Alzoubi and Almalkawi 2019, p. 18, adapted by the Author 2020)

Type	Material	Thickness (cm)	Thermal Conductivity (W/m K)	R-Value (m^2 K/W)	U-Value (W/m^2 K)
Exterior Walls	Stone	20	5	0.040	**3.356**
	Concrete	10	1.7	0.059	
	Hollow concrete block	15	0.833	0.180	
	Cement mortar	2.5	1.3	0.019	
Ground Floor	Earth	50	1.4	0.357	**1.096**
	Base-course stone	15	1.5	0.10	
	Asphalt insulation	5	1.2	0.042	
	Reinforced concrete	10	1.28	0.078	
	Sand	10	0.40	0.25	
	Cement mortar	2.5	0.39	0.064	
	Terrazzo tiles	2.5	1.20	0.021	
Roof	Cement mortar	2.5	0.93	0.027	**3.257**
	Concrete	15	1.7	0.088	
	Asphalt insulation	2	1.2	0.017	
	Reinforced concrete	20	1.28	0.156	

Table 8.9: Dimensional records of the monitored spaces in the rebuilt part of Dana hotel (Author 2020)

Rebuilt Part	Space Type	Area (m^2)	Height (m)	Window Area (m^2)	Window Orientation	Shaft Area (m^2)	Glazing / Floor Area Ratio
#7 Hotel room	Bedroom	40.3	3.10	0.78 (0.65*1.20)	SW	N/A	**4.8%**
				0.78 (0.65*1.20)	SW		
				0.38 (0.50*0.75)	NW		
	Bathroom	6.50	2.40	0.25 (0. 5*0. 5)	NE		
#8 Hotel room	Bedroom	32.4	3.50	-	-	7.35 (2.10*3.50)	**22.7%**
	Bathroom	3.50	2.80	0.65 (0. 65*1.00)	NW	-	
#9 Hotel room	Bedroom	14.3	3.10	0.84 (0. 70*1.20)	NW	1.56 (0.60*2.60)	**16.8%**
	Bathroom	3.00	2.40	-	-	3.12 (1.30*2.40)	
#10 Hotel room	Bedroom	19.3	3.10	0.84 (0. 70*1.20)	NW	2.08 (0.80*2.60)	**15.1%**
	Bathroom	3.50	2.40	-	-	2.88 (1.20*2.40)	

8.5.2 Variation in Indoor Temperature throughout the Day

The mean indoor temperature of the rebuilt spaces is close to the mean outdoor temperature in summer, while it is always higher in winter (**Table 8.10**). The overall fluctuations in the air temperatures in the different rebuilt spaces in different seasons is illustrated in **Figure 8.16**. Moreover, a typical week of fluctuations in air temperatures is illustrated in **Figure 8.17** in order to provide a more detailed analysis.

Table 8.10: Indoor air temperatures (°C) in the rebuilt rooms

	Tout		**Room #7**		**Room #8**		**Room #9**		**Room #10**	
	Jan-Feb	**July-Aug**	**Jan-Feb**	**July-Aug**	**Jan-Feb**	**July-Aug**	**Jan-Feb**	**July-Aug**	**Jan-Feb**	**July-Aug**
Mean	6.1	24.7	7.1	25.2	9.4	24.2	8.8	25.8	7.4	26.3
Min.	-0.9	16.3	4.5	23.6	6.9	22.5	5.9	23	4.2	23.6
Max.	20.4	36.5	9.9	27.1	13.7	26	16.5	28.3	17	29.7

In the summer, the profile of the indoor and outdoor temperatures is different from the original rooms, as the indoor temperatures do not follow the outdoor temperature profile. The indoor temperature is higher than the outdoor temperature at night and lower during the day. The average indoor temperature of the rebuilt spaces, which varies between 24.2°C and 26.3°C, is close to the average outdoor temperature of 24.7°C. The indoor temperature reaches the maximum in the afternoon and minimum in the morning, providing cooler temperatures when it is the warmest outside and vice versa. The fluctuation in the indoor temperatures is small, showing less variation compared with the ones recorded in the original rooms.

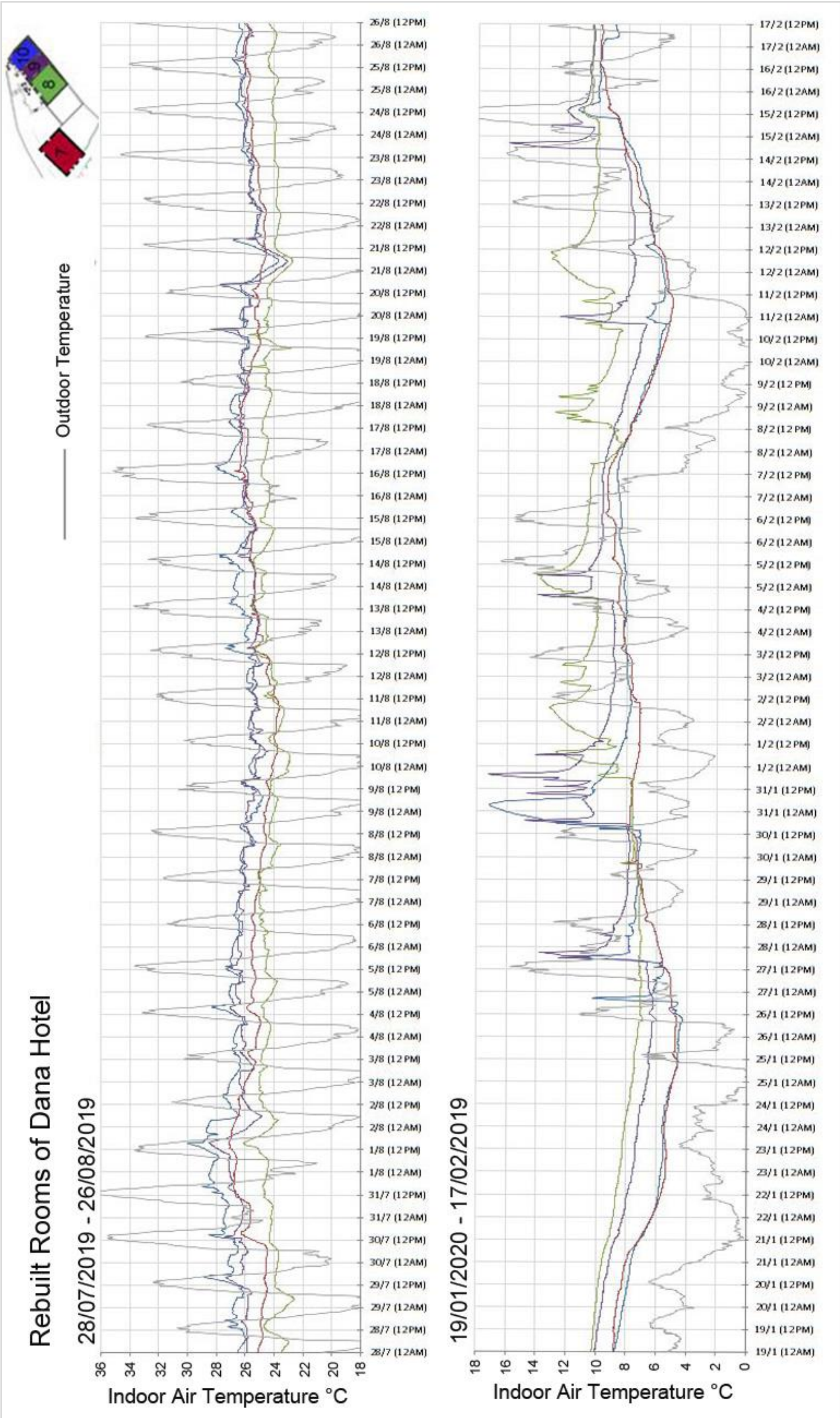

Figure 8.16: Variation in the monitored indoor air temperature in the rebuilt rooms in summer (left) and winter (right) (Author 2020)

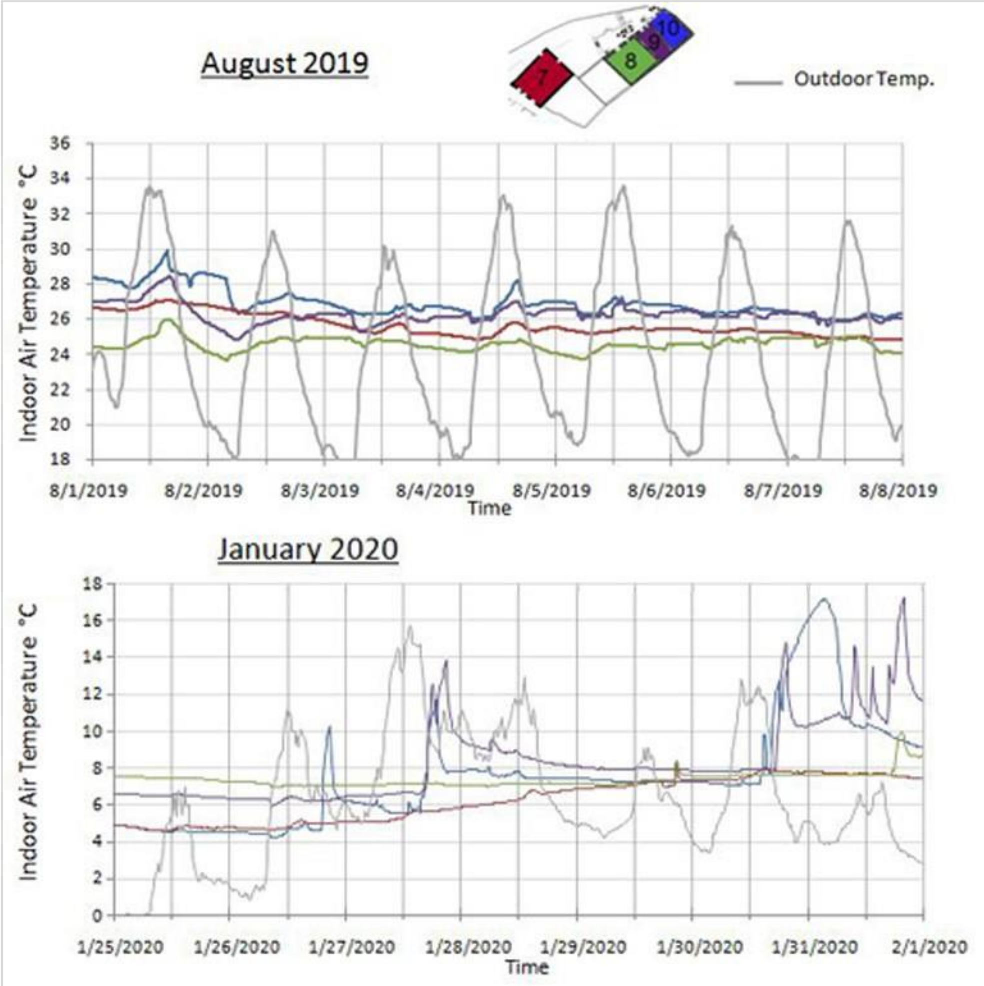

Figure 8.17: Variation in the indoor air temperature in the rebuilt rooms in a typical week in summer (top) and winter (bottom) (Author 2020)

The daily variation is hardly noticeable in all the spaces, despite the different occupancy hours. Therefore, the calculated diurnal swing values are small, varying from 0.2°C to 3.1°C in all the rooms. Moreover, all rooms show almost similar small decrement factor values, ranging from 0.01 to 0.24, with an average of 0.07 (**Figure 8.18**). The calculated decrement values highlight that the building envelope of the rebuilt rooms is efficient in resisting heat transfer and thermal swing in summer. This includes the total impact of the building envelope, including its materials, opening sizes, and orientation.

The enlargement of the windows and the addition of lighting shafts helps to provide cooler conditions in the rebuilt rooms. In terms of the enlargement, the windows enhance air movement due to their bigger size and do not allow solar gains due to their northern orientation. The addition of lighting shafts provides internal windows that enhance the air movement and facilitate ventilation for cooling. Although room #7 does not have a lighting shaft, it has cool conditions as it has three windows compared to the one in the other rooms.

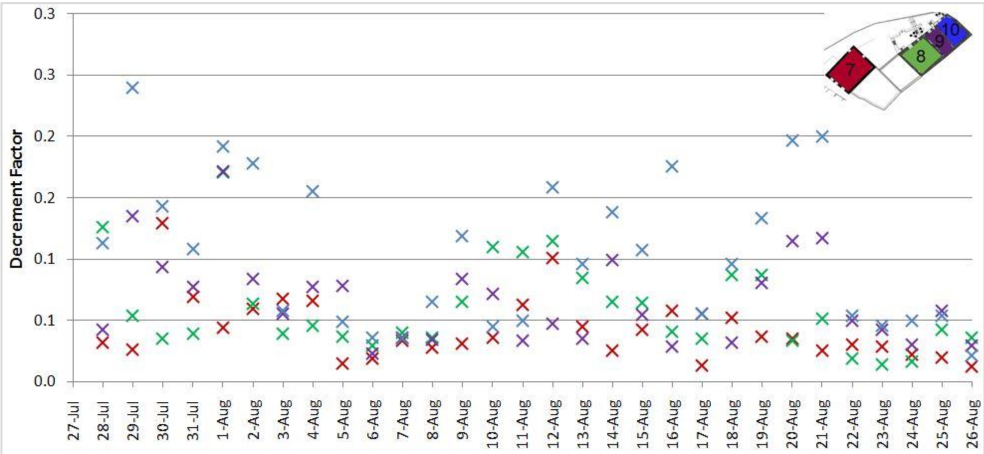

Figure 8.18: Decrement factor of the rebuilt rooms, July-August 2019 (Author 2020)

It was also observed that room #8 has slightly colder conditions than rooms #9 and #10, although they have the same building envelope, opening sizes, and orientation. This is because room #8 is bigger, thus increasing the heat transfer area and reducing the density of furniture in it (**Figure 8.19**). The lower the density of furniture, the more free space there is for heat to disperse and for the room to cool down (Dave 2011). Moreover, rooms #7 and #8 have approximately the same area, but the former is slightly warmer as it has southwest-facing windows that introduce solar gains, warming up the indoor conditions in the afternoon.

Figure 8.19: Different sizes of rooms #8 and #9 (Author 2019)

A different pattern of variation is noticed in winter, as more obvious fluctuations are seen, separate from the changes in the outdoor temperature. The indoor temperature is higher than the outdoor temperature most of the time. In fact, on some days the difference between the outdoor temperature and indoor temperature some days approaches 6°C when the outdoor temperature is very cold. The daily variation is sometimes noticeable in certain spaces more than others. The diurnal swing varies from 0.1°C to 8.7°C, showing small values in rooms #7 and #8 due to the unoccupancy period. However, the diurnal swing values in rooms #9, and #10 are more pronounced and more variable, in line with the occupancy hours.

The lowest decrement factor was therefore recorded in rooms #7 and #8, being unoccupied most of the time due to the lower demand in winter (**Figure 8.20**). Higher decrement values are noticed in winter, highlighting that the building envelope of the rebuilt rooms is less efficient in resisting heat transfer and thermal swing in winter. Also, higher decrement values are noticed in spaces #9 and #10 reaching 3.61 due to their higher indoor temperature resulting from the occupants' adaptive behaviour.

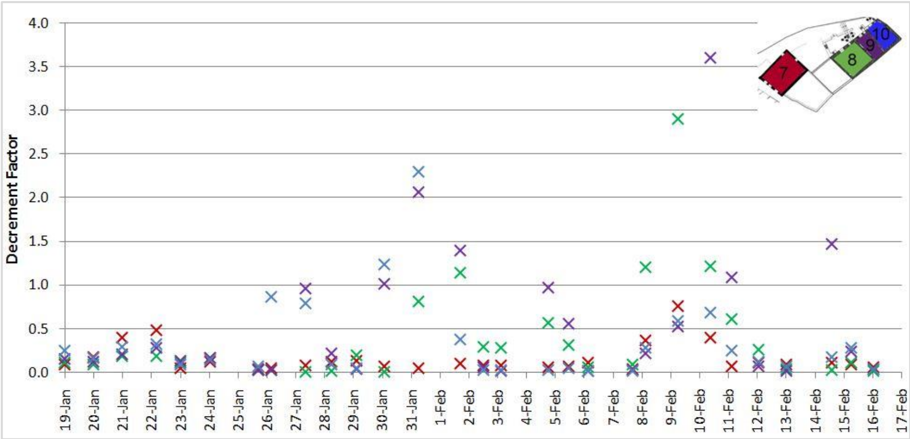

Figure 8.20: Decrement factor of the rebuilt rooms, Jan-Feb 2020 (Author 2020)

8.5.3 Thermal Comfort

In summer, 100% of the hourly indoor temperatures were distributed within the BSEN15251 adaptive comfort range, suggesting that the occupants felt comfortable with the indoor temperature. Most of these temperatures lay within the category I comfort range, with others lying within categories II and III (**Figure 8.21**). Therefore, desired thermal comfort was achieved in the rebuilt rooms in summer. With these rooms operating with no cooling system but fans in July-August for most of the time, category II comfort was required to provide thermal comfort.

Comparing the hourly indoor air temperatures with BSEN15251 adaptive thermal comfort standards for category II shows that overheating does not appear to be an issue in any of the rebuilt rooms (**Table 8.11**). However, there is a small risk of overheating in room #10, with the conditions exceeding Cat II for 0.28% of the 708 hours monitored (2 hours from 28/07/2019 to 26/08/2019). Although most of the time they are within the comfort range of Cat II, some percentages of cold discomfort hours are below Cat II, ranging from 0.14% in room #9, to 20.06% in room #7. In winter, 100% of the hourly mean indoor temperatures are below the lower limit of comfort, resulting in cold conditions. This highlights that the indoor temperatures are uncomfortably cold, and that all the rebuilt rooms fail to provide thermal comfort in winter (**Figure 8.22**).

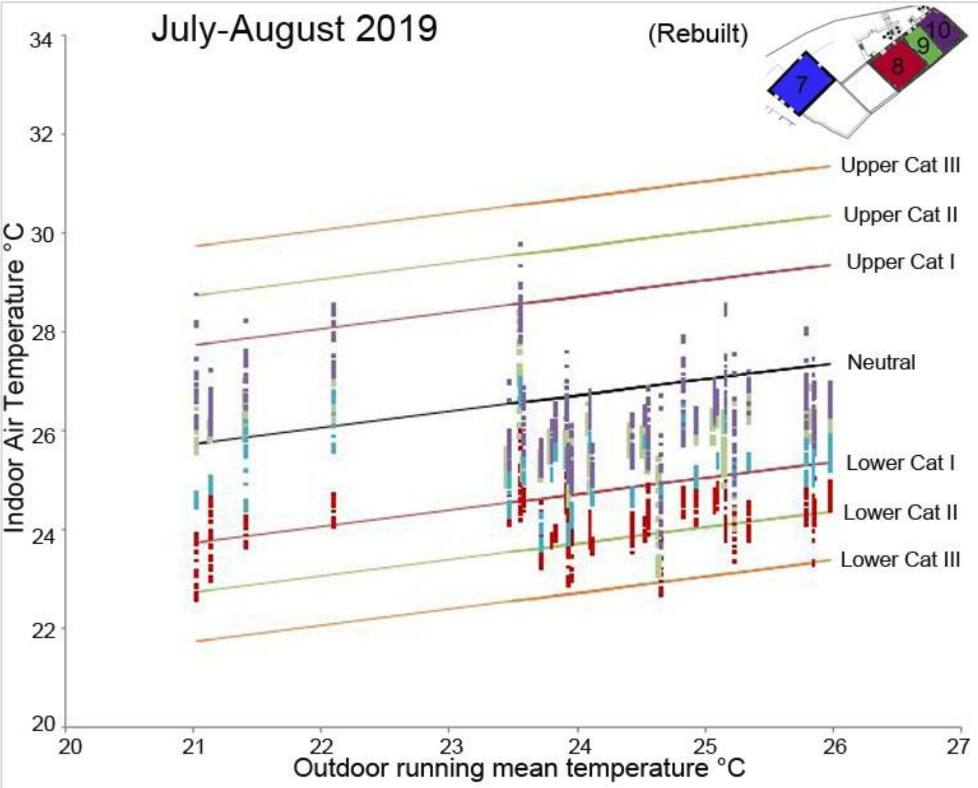

Figure 8.21: Hourly indoor temperatures in the rebuilt rooms compared to the outdoor running mean temperature for July-August 2019, based on the BSEN15251 adaptive comfort criteria (Author 2020)

Table 8.11: Distribution of hours in which different rooms are below, within, or above Category II, BSEN15251, July-August 2019 (Author 2021)

	Hours below Cat II	Hours within Cat II	Hours above Cat II	% Hours below Cat II	% Hours within Cat II	% Hours above Cat II
#7	142	567	0	20.06%	80.08%	0.00%
#8	10	698	0	1.41%	98.59%	0.00%
#9	1	707	0	0.14%	99.86%	0.00%
#10	4	702	2	0.56%	99.15%	0.28%

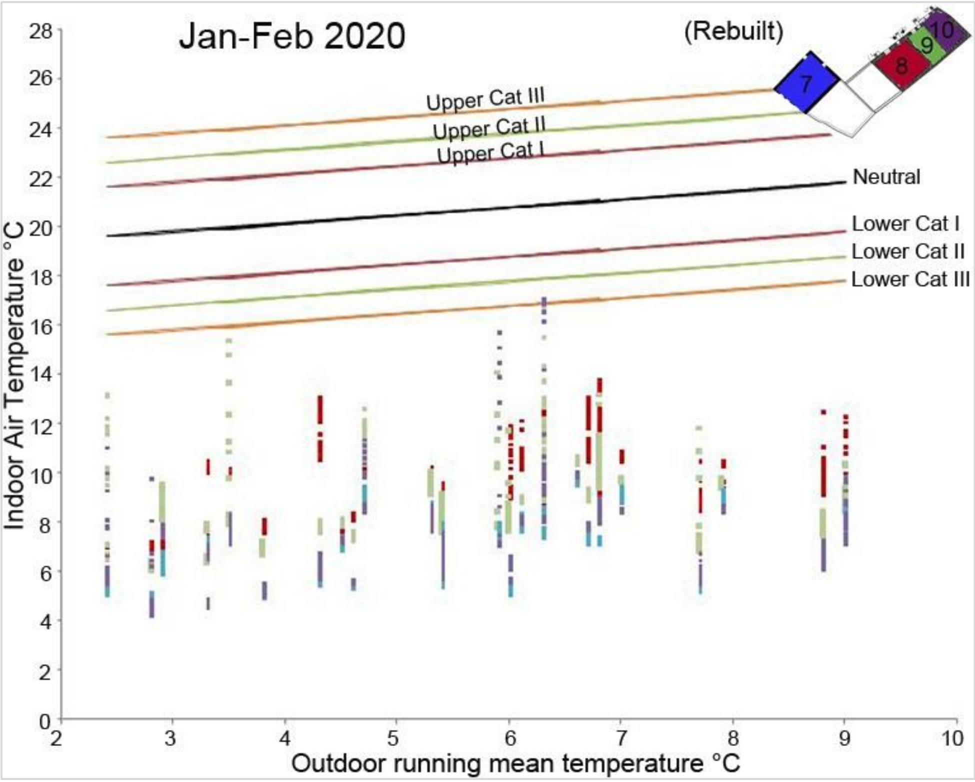

Figure 8.22: Hourly indoor temperatures in the rebuilt rooms compared to the outdoor running mean temperature for Jan-Feb 2020, based on the BSEN15251 adaptive comfort criteria (Author 2020)

8.6 Comparison between the Original and Rebuilt Rooms

8.6.1 Building Envelope

8.6.1.1 Construction Materials

Using local and natural materials in vernacular architecture plays an essential role in improving thermal performance (Oliver 2007; Tawayha, Braganca and Mateus 2019, p. 7). The original materials used for Dana hotel's original rooms were taken from natural resources such as stone, clay, juniper wood, and cane. The analysis highlighted that these, combined with the thick envelope, improve the thermal resistance of the original rooms due to their high thermal mass and low thermal conductivity. The calculated U-values highlight that the building envelope of the original part of the hotel resists thermal transfer more than the rebuilt part.

The new materials such as concrete and steel were utilised for the rebuilt rooms, with no consideration of their thermal properties. More specifically, the thermal resistance of the original walls and floors is approximately three times that of the rebuilt ones as their U-values are equal to one-third of those of the rebuilt ones. In addition, the U-value of the original roof is almost one-sixth of that of the rebuilt one, showing far better thermal resistance performance (**Figure 8.23**).

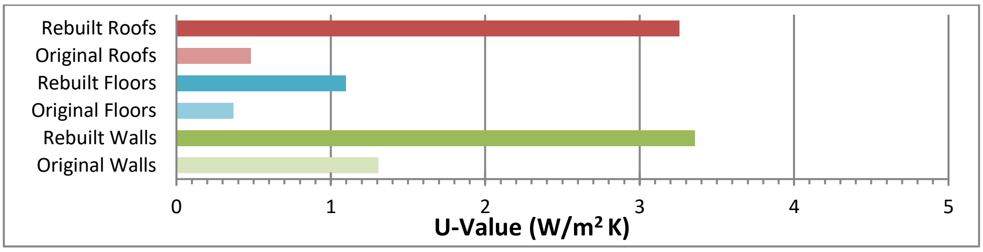

Figure 8.23: Comparison between the U-values of the original and rebuilt building envelope (Author 2020)

However, the decrement factor shows opposite results, suggesting that changing the opening sizes and orientation also significantly regulates the indoor temperature. Starting with the summer, in the original rooms the decrement factor varies from 0.01 to 0.89, with an average of 0.20. In comparison, it ranges from 0.01 to 0.24, with an average of 0.07, in the rebuilt rooms (**Figures 8.24 and 8.25**). Therefore, the decrement values are lower in the rebuilt rooms than in the original ones, showing more efficiency in resisting heat transfer and reducing temperature swings.

The calculated time lag values are almost the same for both the original and rebuilt rooms, showing the same ability to delay heat transfer. In fact, the time lag ranges from 0 to 14 hours, with an average of 4.10 hours in the original rooms in summer. On the other hand, it varies from 0 to 14 hours, with an average of 5.33 hours, in the rebuilt rooms (**Figures 8.26 and 8.27)**.

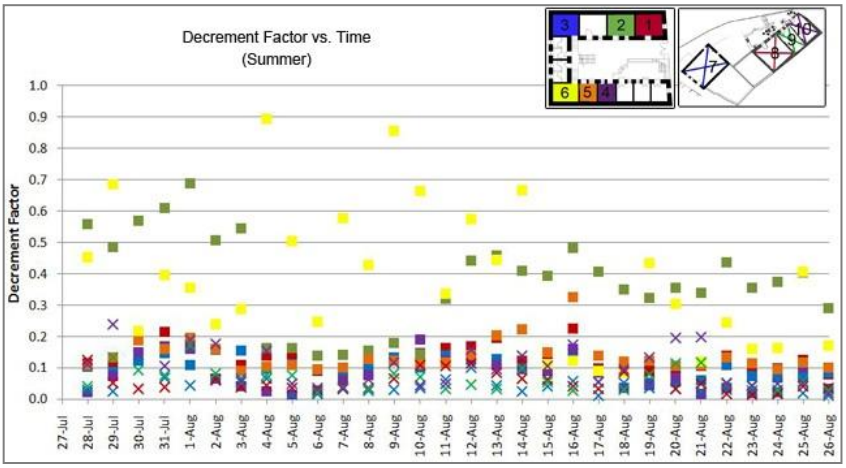

Figure 8.24: Decrement factor of the original and rebuilt rooms, July-August 2019 (Author 2020)

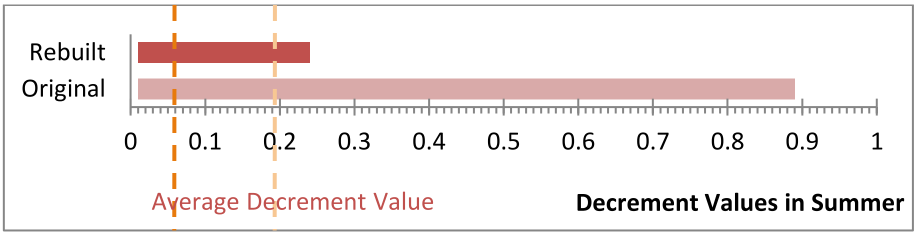

Figure 8.25: Comparison between the summer decrement values of the original and rebuilt rooms (Author 2020)

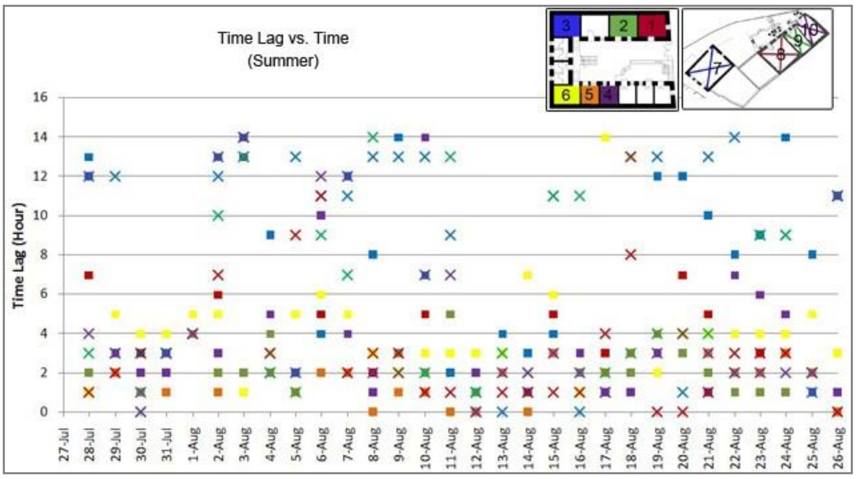

Figure 8.26: Time lag of the original and rebuilt rooms, July-August 2019 (Author 2020)

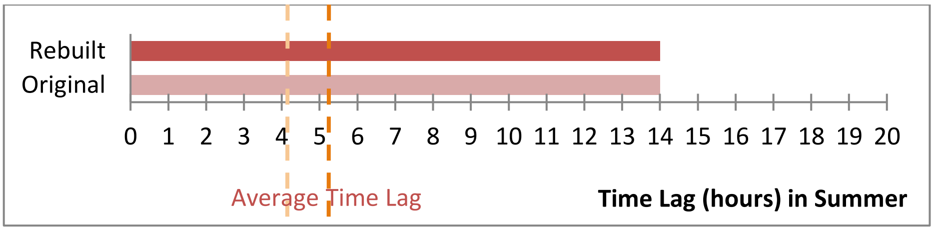

Figure 8.27: Comparison between the summer time lag of the original and rebuilt rooms (Author 2020)

In winter, the calculated decrement values are almost the same in both the original and rebuilt rooms, showing the same efficiency in resisting heat transfer and reducing temperature swings. Specifically, in the original rooms the decrement factor varies between 0.01 and 3.48, with an average of 0.38. At the same time, in the rebuilt rooms it ranges from 0.01 to 3.61, with an average of 0.35 (**Figures 8.28 and 8.29**).

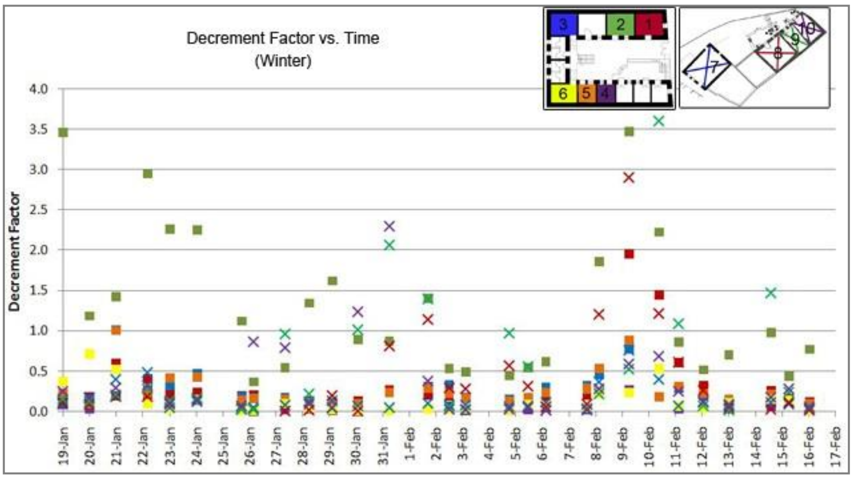

Figure 8.28: Decrement factor of the original and rebuilt rooms, Jan-Feb 2020 (Author 2020)

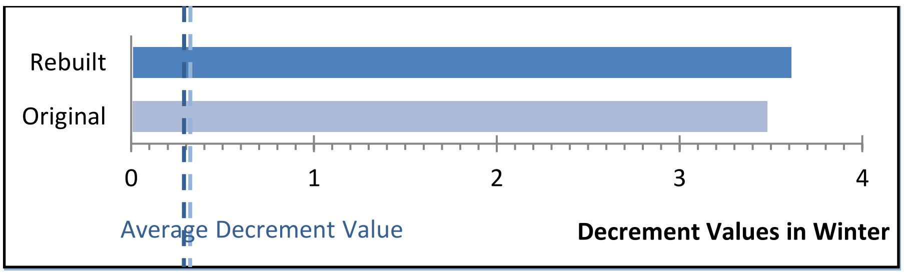

Figure 8.29: Comparison between winter decrement values of the original and rebuilt rooms (Author 2020)

Similarly, the calculated time lag values are also the same in both the original and rebuilt rooms, showing the same ability to delay heat transfer. In the original rooms, these range from 0 to 16 hours, with an average of 7 hours, whereas in the rebuilt rooms they vary between 0 and 16 hours, with an average of 8.7 hours (**Figures 8.30 and 8.31)**.

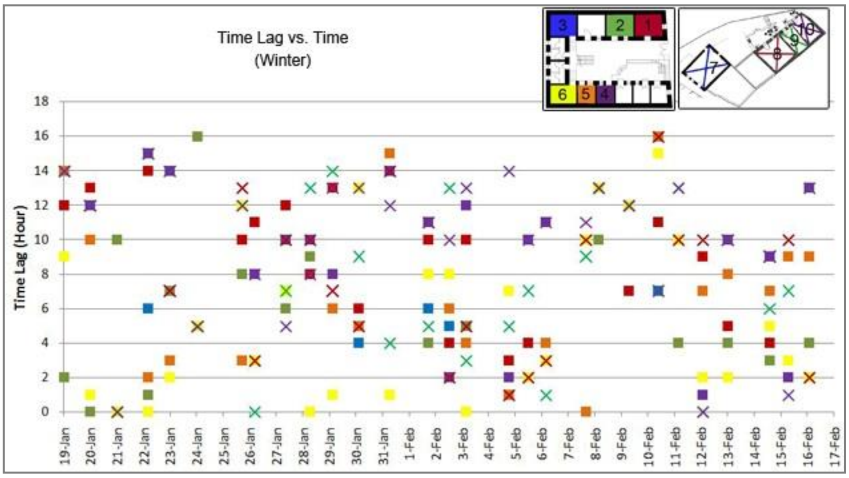

Figure 8.30: Time lag of the original and rebuilt rooms, Jan-Feb 2020 (Author 2020)

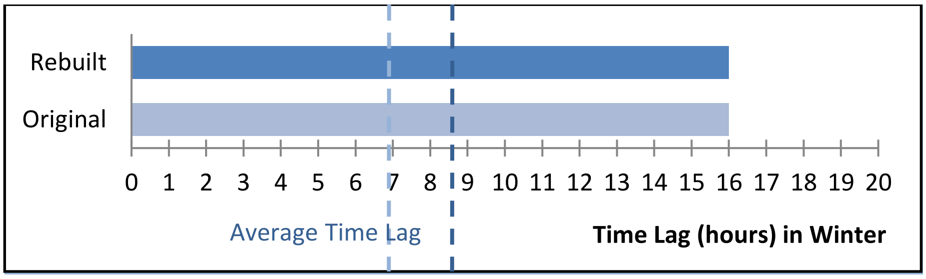

Figure 8.31: Comparison between the winter time lag of the original and rebuilt rooms (Author 2020)

The external walls of the rebuilt rooms are not as thick as those of the original rooms and are built from different materials. Although the new walls do not provide the same thermal mass as the original ones, they do offer the same time lag and lower decrement values. This suggests that the adopted changes in the rebuilt rooms work together to adapt to the weather in Dana as a whole system, including the replacement of the building envelope, the addition of lighting shafts, and the enlargement of the northern windows. Replacing the building envelope without increasing the opening sizes would disable the whole system, as observed in room #2. The replacement of the original roof, while keeping the original opening sizes, failed to adapt to the outdoor conditions, providing higher decrement factors and more temperature variations.

8.6.1.2 Opening Sizes

The original rooms of Dana hotel have small openings to reduce the climatic influence on the indoor thermal conditions. They reduce heat loss in winter and prevent solar gains in summer. Indeed, the size, number, and orientation of the openings greatly influence the building's thermal performance (Fernandes et al. 2015). The original hotel rooms have small windows and thick walls that prevent solar gains in summer, and control heat gain and loss efficiently, and they benefit from night ventilation and breezes which cool down the indoor spaces. Furthermore, small windows reduce heat loss and allow solar gains in winter.

On the other hand, bigger and more numerous windows were used in the rebuilt rooms, changing their compatibility to meet the requirements of the local climate. The ratio of glazing to floor area is higher in the rebuilt rooms, ranging from 4.8% to 22.7%, with an average of 14.9%. At the same time, it ranges from 0% to 9.3%, with an average of 3.9% in the original rooms (**Figure 8.32**). This highlights that the indoor spaces of the rebuilt rooms are more exposed to outdoor conditions, suggesting that heat transfer is lower in the original rooms due to the small window area.

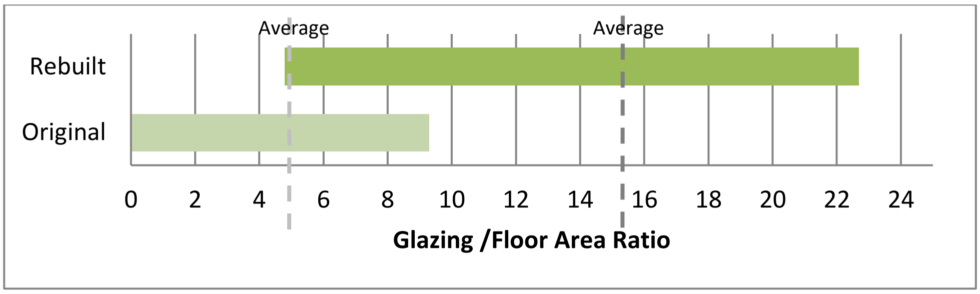

Figure 8.32: Comparison between the glazing to floor area ratio in the original and rebuilt rooms (Author 2020)

However, the orientation of the rebuilt room openings reduces the impact of their size because direct solar gain is the main contributor to affecting the indoor temperature. For instance, the greater the solar gains from the southern facade and its openings, the higher the indoor temperatures will become. Meanwhile, the lower these gains, the lower the indoor temperature become. Therefore, the inward and northern orientation of the windows and lighting shafts of the rebuilt rooms reduces the impact of greater exposure in summer (Philokyprou, Michael and Thravalou 2013). They do not contribute solar gains as they are always shaded from the sun. Indirect solar gain is available from other facades and the roof. However, these are not sufficient to warm the indoor spaces of the original and rebuilt rooms (Michael et al. 2017).

8.6.2 Variation in Indoor Temperature throughout the Day

The pattern of the indoor temperature variation is different in the original and rebuilt rooms. In the summer, the indoor temperatures range from 22°C to 35°C in the original rooms, but from 23°C to 29°C in the rebuilt ones (**Figure 8.33**), so are higher in the original rooms. Moreover, the indoor temperature fluctuates more in the original rooms, leading to a higher diurnal swing than in the rebuilt rooms, which show steadier indoor temperatures. In fact, the diurnal swing in the original rooms varies between 0.25°C and 9.7°C, while in the rebuilt rooms it ranges from 0.2°C to 3.1°C (**Figure 8.34)**.

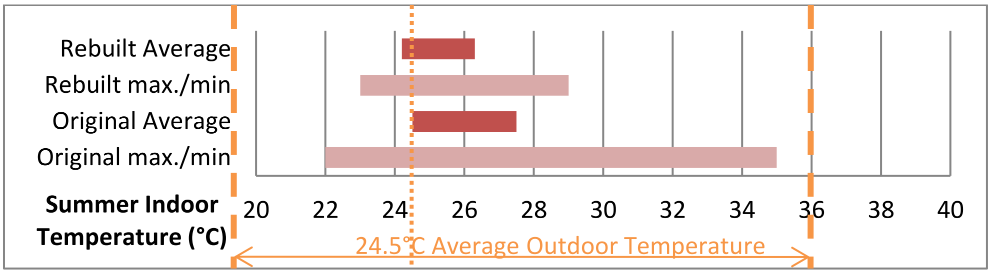

Figure 8.33: Comparison between the indoor temperatures of the original and rebuilt rooms, July-August 2019 (Author 2020)

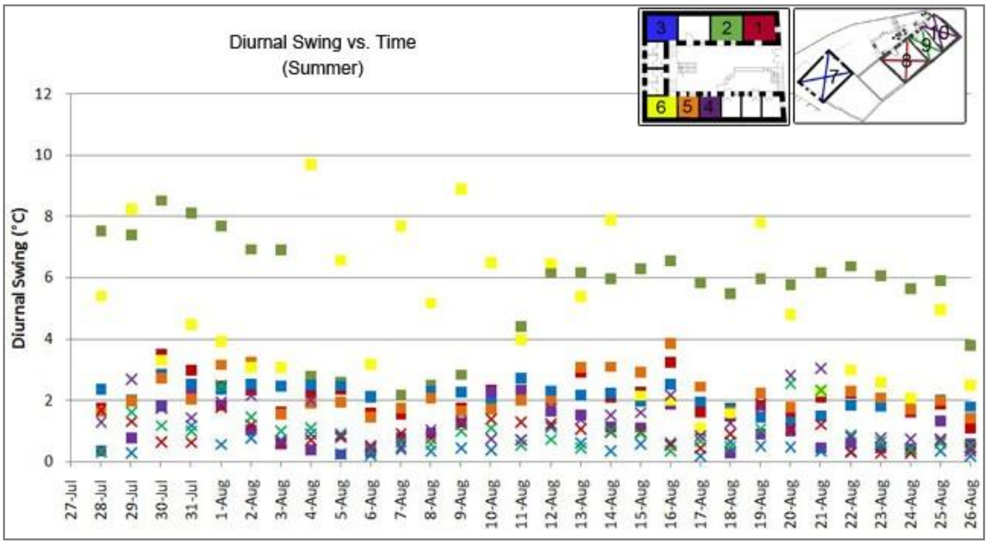

Figure 8.34: Comparison between the diurnal swing values in the original and rebuilt rooms, July-August 2019 (Author 2020)

In winter, the indoor temperatures vary from 2°C to 17°C in the original rooms, and from 4°C to 17°C in the rebuilt rooms (**Figure 8.35**). The recorded indoor temperatures are either the same in both types of room or slightly higher in the rebuilt rooms. Moreover, the diurnal swing values are almost the same in both room types. The diurnal swing in the original rooms varies between 0.1°C and 8°C, while it ranges from 0.1°C to 8.7°C in the rebuilt rooms (**Figure 8.36)**. However, the daily variation and fluctuation differ due to varying occupancy hours.

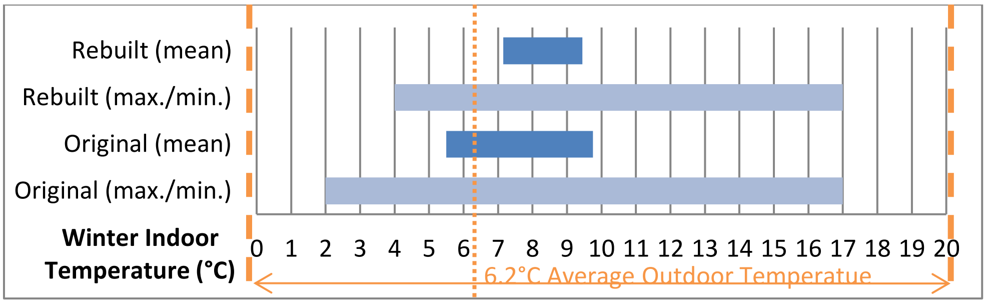

Figure 8.35: Comparison between the indoor temperatures of the original and rebuilt rooms, Jan-Feb 2020 (Author 2020)

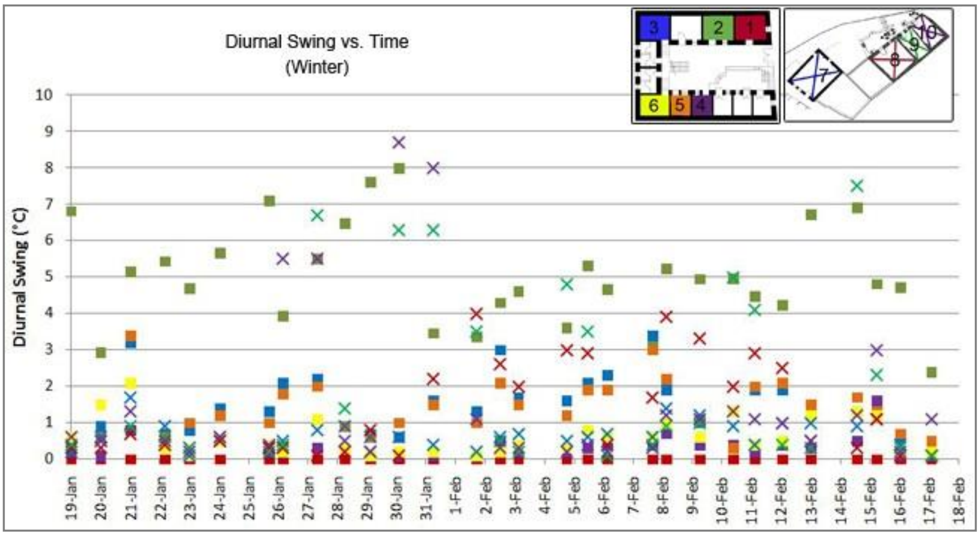

Figure 8.36: Comparison between the diurnal swing values in the original and rebuilt rooms, Jan-Feb 2020 (Author 2020)

In summary, the variation in the indoor air temperatures compared using the box plot shows the mean, extreme, and outlier values in each space of the original and rebuilt parts of Dana hotel (**Figures 8.37 and 8.38**). In the summer, the indoor temperature is steadier in the rebuilt rooms, with less variation. On the other hand, the original spaces perform differently, as some spaces, such as #2 and #6, show less consistency compared with the other original spaces. More extreme values are noticed in the original spaces; however, they are closer to the mean value in the rebuilt ones. This highlights that the rebuilt rooms provide stable indoor temperatures, although they do not provide the same thermal mass due to the effect of the opening sizes and orientation.

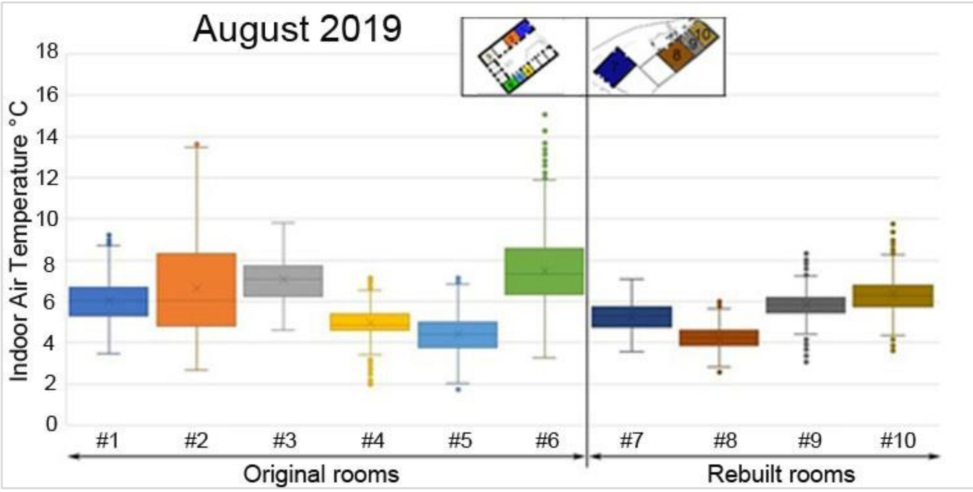

Figure 8.37: Box plot showing the mean, extreme, and outlier values of the indoor air temperature in the original and rebuilt rooms, July-August 2019 (Author 2020)

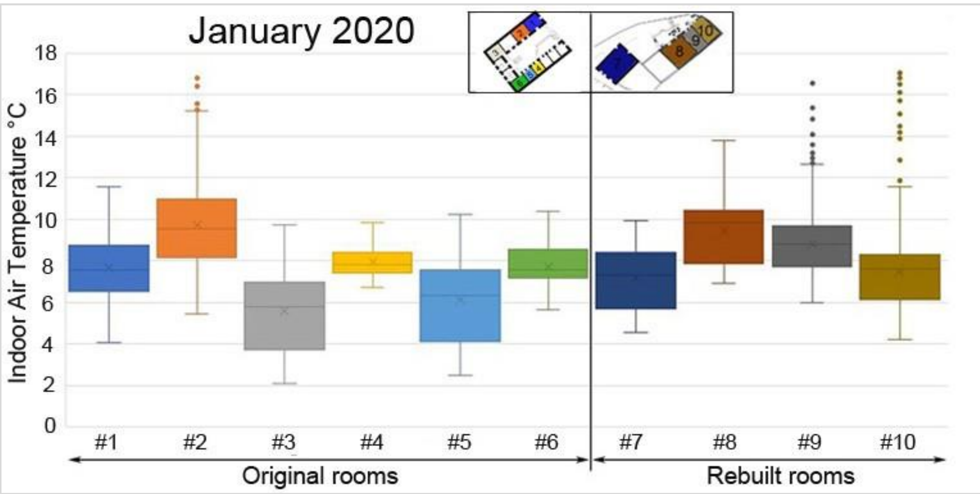

Figure 8.38: Box plot showing the mean, extreme, and outlier values of the indoor air temperature in the original and rebuilt rooms, Jan-Feb 2020 (Author 2020)

In fact, the external walls of the original rooms are thicker and have higher thermal storage compared to those of the rebuilt rooms, improving the resistance to heat gain in summer and heat loss in winter. Moreover, the original rooms of the hotel have small openings to reduce the climatic influence on indoor thermal conditions. Such small openings, combined with the thick walls, prevent solar gains in summer, limit heat gains and losses, and allow ventilation, which cools down the indoor spaces at night. They also allow solar gains and reduce heat loss in winter, protecting the indoor spaces from cold, strong winds. In winter, the original rooms perform differently, as some rooms, such as #4 and #6, show less variation in the indoor temperature compared with the other original spaces as they were unoccupied at the time.

On the other hand, the addition of lighting shafts and the enlargement of the northern windows allow the rebuilt rooms to adapt to outdoor conditions in summer. Bigger and more numerous windows were used in the rebuilt rooms, adjusting their compatibility to meet the requirements of the local climate. However, the orientation of these openings reduced the impact of their size in summer because direct solar gain is the main contributor to indoor temperatures.

Therefore, the inward and northern orientation of the windows and the lighting shafts of the rebuilt rooms reduced the impact of greater exposure in the summer, thus preventing solar gains. Moreover, the rebuilt rooms kept some passive cooling strategies, such as adding plants and trees in front of them, which enhance the cool breezes at night. In winter, however, the greater exposure caused thermal losses, leading to low indoor temperatures and high temperature variations.

8.6.3 Variation in Mean Indoor Temperature and Relative Humidity

The interaction between the mean indoor temperature and relative humidity was investigated through the monitoring time, showing their mutual effect in different spaces. Rooms #2, #3, and #6 were selected to represent the original rooms because they recorded the maximum and minimum indoor temperature and relative humidity values. Rooms #9 and #10 were selected to represent the rebuilt rooms for the same reason. The mean indoor temperature of the representative original and rebuilt rooms in relation to relative humidity in summer is illustrated in **Figure 8.39.**

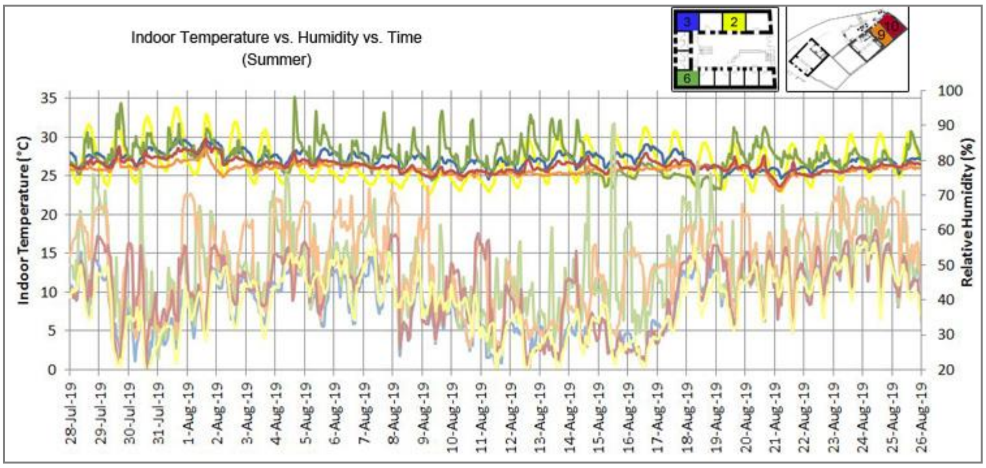

Figure 8.39: Variation in hourly mean indoor temperature and relative humidity of representative original and rebuilt rooms, July-August 2019 (Author 2020)

In the original rooms, the indoor temperature varied between 22°C and 35°C, while the humidity ranged from 17% to 90%. The highest indoor temperature (35°C) and highest relative humidity (90%) were recorded in space #6 due to its function as a kitchen. Meanwhile, the lowest indoor temperature (22°C) and the lowest relative humidity (17%) are recorded in space #2. The daily variation (fluctuation) in indoor temperature and relative humidity was most noticeable in space #6, followed by spaces #2 and #3, respectively.

Vegetation in the central courtyard plays a vital role in solving thermal issues. It is considered a natural thermal controller that shades the building envelope and reduces high temperatures and changes in humidity (Philokyprou, Michael and Thravalou 2013, p. 9). Moreover, it controls the airflow, affecting the building's ventilation and air quality. In the rebuilt rooms, the indoor temperature varied from 23°C to 29°C, while relative humidity ranged from 19% to 72%. The highest indoor temperature (29°C) was recorded in space #10, and the highest relative humidity (72%) in space #9. In addition, the lowest indoor temperature (23°C) was recorded in space #9, and the lowest relative humidity (19%) in space #10. Daily variation (fluctuation) in the indoor temperature was hardly noticeable in either space, while the daily variation in relative humidity was noticeable in space #9 more than in space #10.

In winter, in the original rooms the indoor temperature varied from 2°C to 17°C, with humidity ranging from 27% to 100% (**Figure 8.40)**. The highest indoor temperature (17°C) was recorded in space #2, and the highest relative humidity (100%) in space #3. Meanwhile, the lowest indoor temperature (2°C) was recorded in space #3, and the lowest relative humidity (27%) in space #6. The daily variation (fluctuation) in relative humidity was most noticeable in spaces #3 and #6, and least so in space #2.

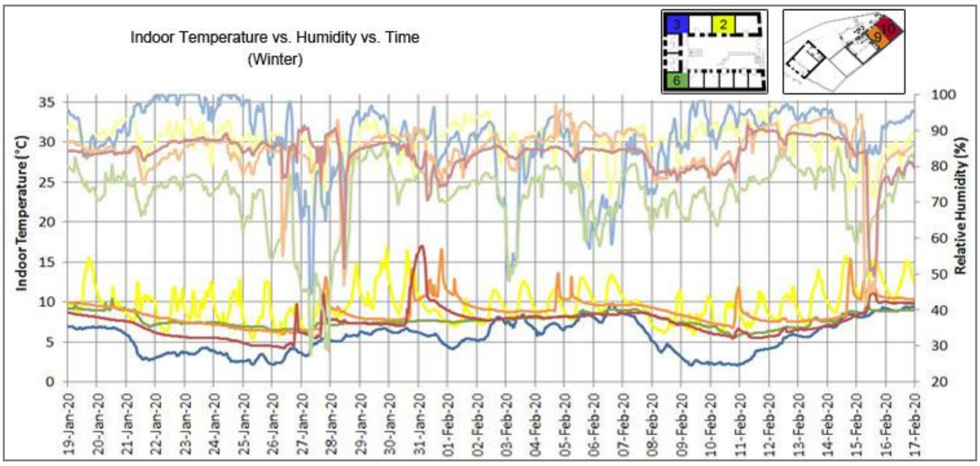

Figure 8.40: Variation in hourly mean indoor temperature and relative humidity of representative original and rebuilt rooms, Jan-Feb 2020 (Author 2020)

In the rebuilt rooms, the indoor temperature varied from 4°C to 17°C, while relative humidity ranged from 41% to 97%. The highest indoor temperature (17°C) was recorded in space #10, and the highest relative humidity (97%) in space #9. In addition, the lowest indoor temperature (4°C) was recorded in space #10, and the lowest relative humidity (41%) in space #9. The daily variation (fluctuation) in the indoor temperatures and relative humidity was very similar in both spaces. Most days, this variation was barely noticeable due to the hours of unoccupancy hours of the rooms. In contrast, on some days the spaces showed more variation when they were occupied, due to the occupants' adaptive behaviour.

The analysis highlights that the indoor temperature and relative humidity patterns are different in the original and rebuilt rooms. In the summer, in the original rooms the relative humidity varied between 17% and 90%, with a range of 73%. In comparison, in the rebuilt rooms it varied from 19% to 72%, with a range of 53% (**Figure 8.41)**. Therefore, the original rooms are slightly more humid than the rebuilt ones. The poor ventilation from the small opening sizes is a main reason behind the higher relative humidity in the original rooms. Having low air movement raises the relative humidity because the air remains still, raising the opportunity to absorb water vapour. Therefore, the better ventilation and higher velocity of airflow reduce the impact of higher relative humidity, improving the air quality (Melikov, Kaczmarczyk and Sliva 2008).

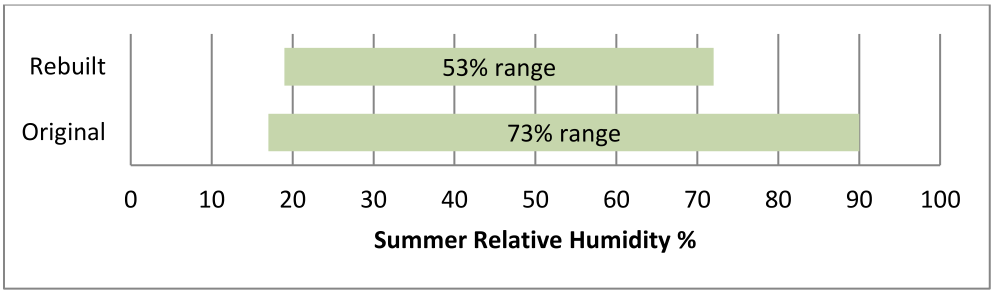

Figure 8.41: Comparison of the relative humidity in the original and rebuilt rooms, July-August 2019 (Author 2020)

On the other hand, in winter similarities in the indoor temperature of the two types of room were found, with the recorded indoor temperatures almost the same. Furthermore, in the original rooms relative humidity varied between 27% and 100%, with a range of 73%, while in the rebuilt rooms it varied from 41% to 97%, with a range of 56% (**Figure 8.42**). Both rooms are humid in winter due to their low air temperature because when the temperature drops, the air cannot hold more water vapour, increasing the relative humidity.

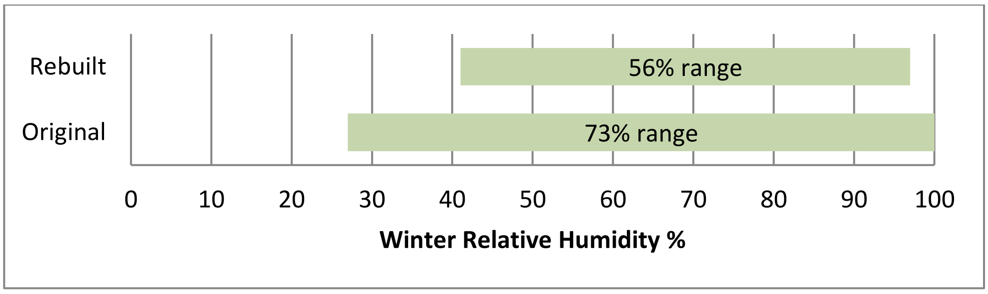

Figure 8.42: Comparison of the relative humidity in the original and rebuilt rooms, Jan-Feb 2020 (Author 2020)

Despite the differences between the original and rebuilt rooms identified by the summer and winter monitoring, some general similarities were also noticed. For instance, in all the rooms the indoor temperature rises during the day, reaching its maximum in the afternoon, dropping at night, before reaching its minimum in the early morning. Due to the inverse relationship between indoor temperature and relative humidity, humidity is low when the indoor temperature is high, and vice versa. Therefore, relative humidity rises at night until it reaches its maximum value in the early morning, then drops during the day until it reaches its minimum value in the afternoon.

8.6.4 Thermal Comfort

With the original and rebuilt rooms operating with no cooling system but fans in July and August for most of the time, category II comfort was required to provide thermal comfort. The analysis highlights that both types of room provide thermal comfort in summer. However, this is slightly better in the rebuilt rooms, which avoid higher indoor temperatures (**Figure 8.43**). Observing the distribution of the percentage hours within the different categories of the BSEN15251 adaptive model (**Figure 8.44**), all the original and rebuilt rooms are within the comfort category (Cat II) for most of the time, ranging from 71.47 % of the monitored hours in room #5, to 99.86% in room #9. However, higher Cat II percentages of hours are evident in the rebuilt rooms, ranging from 80.08% to 99.86%, while in the original rooms the range was from 71.47% to 99.29.

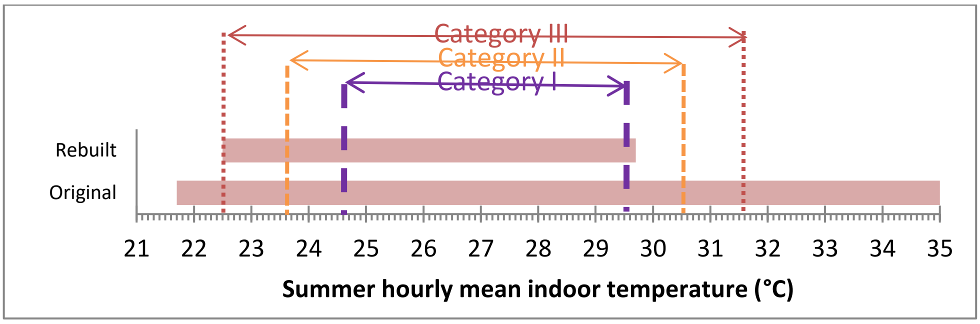

Figure 8.43: Comparison between summer hourly indoor temperature in the original and rebuilt rooms in relation to the BSEN15251 adaptive comfort criteria (Author 2020)

In fact, each room in the original part of Dana hotel behaves differently. Overheating is experienced for 13% and 12% of the time in rooms #2 and #6 respectively. This is attributed to the fact that room #6 is used as a kitchen and room #2 has had its roof converted to a concrete one. On the other hand, overheating does not appear to be an issue in any of the rebuilt rooms. Overall, cold discomfort is more noticeable in the original rooms, being below Category II for 29%, 8.5%, 4.24%, and 3.25% of the time in rooms #5, #2, #4, and #6 respectively. However, cold discomfort is only observed in room #7 of the rebuilt rooms.

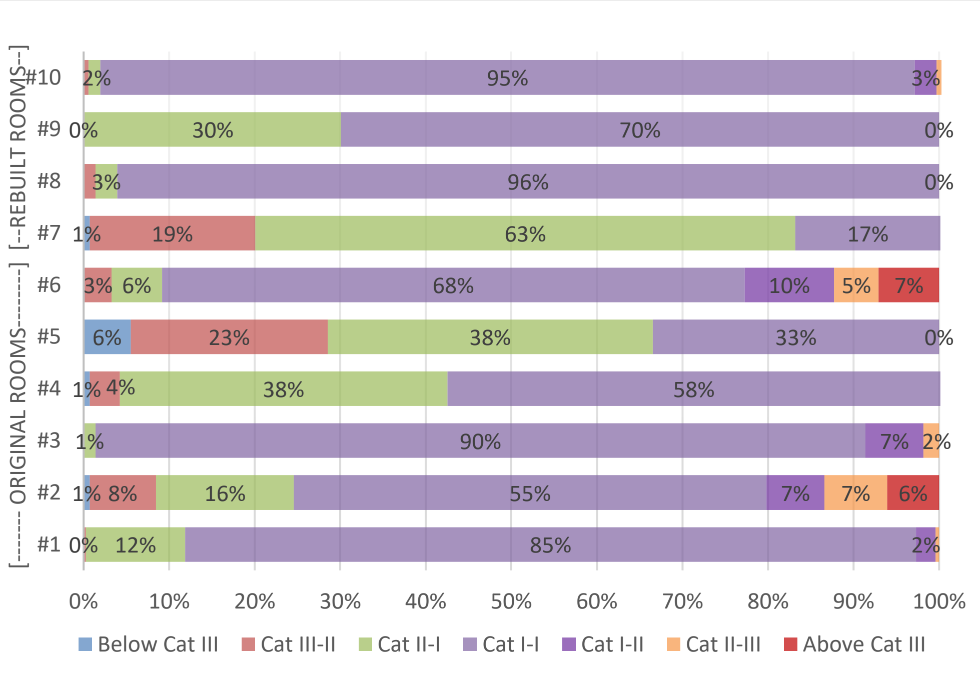

Figure 8.44: Distribution of percentage hours within the different categories of the BSEN15251 adaptive model, July-August 2019 (Author 2021)

On the other hand, different results were obtained in winter. The analysis highlights that neither the original nor rebuilt rooms provide thermal comfort. Their hourly indoor temperatures are very low, lying entirely outside the Cat II comfort range (**Figure 8.45**). The analysis of the thermal performance of the original and rebuilt rooms shows that the RSCN was more concerned about providing thermal comfort in the summer months because Dana is a summer tourist destination. The focus on the summer is also because winters in the region are normally shorter than summers.

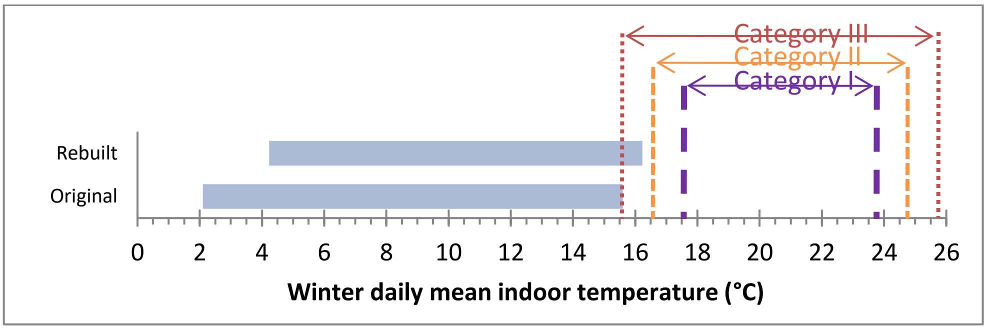

Figure 8.45: Comparison between winter daily mean indoor temperature in the original and rebuilt rooms in relation to the BSEN15251 adaptive comfort criteria (Author 2020)

8.7 Discussion and Conclusions

The study aimed to assess the effectiveness of the transformation approaches in terms of the building's thermal performance, including their efficiency in providing comfort in summer and winter. The analysis of the monitored indoor temperature and that calculated to be comfortable demonstrate that the passive and heavyweight buildings, built of local materials and operating with no heating or cooling systems, provide thermal comfort during the summer. This is in line with other research, which shows that using local natural materials in vernacular architecture plays an essential role in improving thermal performance (Tawayha, Braganca and Mateus 2019).

Weber and Yannas (2013) and Priya et al. (2012) stated that the advantages of using local construction materials in improving the thermal performance of vernacular buildings include the low conductivity of heat transfer, which provides stable indoor temperatures. Therefore, as the rebuilt rooms were constructed of new contemporary materials, the U-value of the original and new building envelope were determined to theoretically assess their efficiency in resisting heat transfer, considering the materials used for the external walls, floor, and roof, and their thickness. The calculated U-values conclude that the building envelope of the original rooms of the hotel resists heat transfer better than the rebuilt rooms, confirming the results of previous studies (Singh, Mahapatra and Atreya 2010; Philokyprou et al. 2013; Weber and Yannas 2013).

This indicates that the new building envelope does not resist heat transfer efficiently due to the high thermal conductivity of the materials. Accordingly, it is concluded that the use of local natural materials in vernacular architecture plays an essential role in improving thermal performance. However, together with the materials, the building design also influences the resulting indoor conditions, including the thermal mass, opening sizes and orientation (Rapoport 1969; Fernandes et al. 2015). Therefore, monitoring of the internal thermal conditions was undertaken to show the total impact of the building design. The analysis of the indoor and outdoor temperatures in Dana concludes that the high thermal mass of the original thick masonry walls reduces heat transfer to indoor spaces, preventing it from reaching the interior in the afternoon, which is the hottest pat of the day.

This is in line with other research, which stated that high thermal mass improves indoor temperature stability, reduces daily fluctuation, and increases the time lag (Philokyprou and Michael 2012; Toe and Kubota 2015). Nevertheless, the results show that although the rebuilt buildings do not provide the same thermal mass and heat resistance as the original ones, they offered stable indoor temperatures due to the effect of their opening sizes and orientation. The analysis also reveals that changing the construction materials while maintaining the opening sizes fails to provide stable indoor temperatures (as observed in room #2, which had its roof transformed while keeping the opening sizes).

Overall, although the new construction materials provide higher U-values and less thermal resistance, the rebuilt rooms experience lower temperatures in summer, with lower diurnal swings, thus contradicting previous studies (Singh, Mahapatra and Atreya 2010; Philokyprou et al. 2013; Weber and Yannas 2013; Tawayha, Braganca and Mateus 2019). Changing the opening sizes while considering their orientation overcomes the shortcomings of the new building envelope, adapting the rebuilt buildings to Dana's climate as a whole system, as changing the opening sizes and orientation also significantly regulates the indoor temperature. It is concluded that the rebuilt rooms provide comfortable thermal conditions only when the changes that constitute the overall restoration approach are made together.

The analysis concludes that if one of the changes was not implemented, the approach as a whole would fail to perform successfully, as seen in room #2. The same conclusion was drawn by Fethi and Roaf (1984) within a relevant context, who found that if any of the passive heating or cooling strategies changed dramatically, the success of the overall thermal performance would put into question. In summary, the analysis of the monitoring shows different behaviour between the original and rebuilt parts of Dana hotel in summer, while similar behaviour is seen in winter (**Table 8.12**).

The indoor temperatures are higher in the original rooms, which also show more variation in summer. Furthermore, both the original and rebuilt rooms provide thermal comfort in summer, with the rebuilt ones offering slightly better comfort. These results conclude that the adopted changes in the rebuilt rooms, including the replacement of the building envelope, the addition of lighting shafts, and the enlargement of the northern windows, all help the new building envelope to adapt to the climate of Dana.

Table 8.12: Results of the practical assessment, comparing the thermal conditions of the original and rebuilt rooms in the summer and winter (Author 2020)

	Summer		**Winter**	
	Original	Rebuilt	Original	Rebuilt
Indoor Temperature	Higher Temperature	Lower Temperature	Almost the Same	Almost the Same
Relative Humidity	More Humid	Less Humid	More Humid	Less Humid
Difference between Indoor and Outdoor Temperature	Lower	Higher	Almost the Same	Almost the Same
Diurnal Swing	Higher	Lower	Almost the Same	Almost the Same
Decrement Value	Higher	Lower	Almost the Same	Almost the Same
Time Lag	Almost the Same	Almost the Same	Almost the Same	Almost the Same
Thermal Comfort	Provide Thermal Comfort	Provide Slightly Better Thermal Comfort	Do not Provide Thermal Comfort	Do not Provide Thermal Comfort

After assessing the thermal impact of Dana hotel's transformation, a comprehensive analysis of the impact of the transformation process is conducted from the researcher's point of view. However, it is also essential to analyse the impact of Dana's transformation from the occupants' point of view. Discussing the comfort responses and adaptive behaviour of occupants would help identify challenges and suggest potential solutions for the original and rebuilt building. Therefore, the following chapter evaluates the performance of both the original and rebuilt rooms from the occupants' point of view, using a Post Occupancy Evaluation survey (POE).

Chapter Nine: Post Occupancy Evaluation of the Original and Rebuilt Rooms of Dana Hotel

9.1 Introduction

After analysing the thermal environment of Dana hotel in the previous chapter, this chapter provides the subjective responses of the hotel occupants while the thermal measurements were recorded. Post Occupancy Evaluation (POE) was used to evaluate the hotel's original and rebuilt rooms with reference to the occupants' satisfaction with the built and thermal environment. POE is a type of field survey used to evaluate building performance based on the occupants' point of view. It highlights the significance of their perceptions and behaviour of their overall comfort experience (Nicol and Roaf 2005).

The aim of this chapter requires the involvement of the hotel occupants as they were used as participants, with their observations used to identify the issues and challenges in relation to both the original and rebuilt rooms. Therefore, a POE survey was conducted through interviews, and the participants (occupants of Dana hotel) asked about their experience, perceptions, feelings, and point of view during their occupancy. The results were used to assess the efficiency of the original and rebuilt parts of the hotel in providing satisfaction and comfort. More specifically, the survey obtained tourists' feedback on the built and thermal environment of the original and rebuilt rooms, which underwent some changes during the rehabilitation project to adapt them to the new uses, needs, and users.

The chapter starts by analysing the tourists' satisfaction with the built and thermal environment of Dana hotel. Previous studies have identified several factors that contribute to overall satisfaction with the built environment, including satisfaction with the indoor facilities (Leaman and Bordass 2001), indoor physical conditions (Veitch et al. 2007; Thomas 2010), and opening sizes (Bluyssen, Aries and Dommelen 2011). Furthermore, four environmental factors contribute to the overall thermal comfort, including the air temperature, radiant temperature, humidity, and air movement (Veitch et al. 2007). Therefore, tourists were asked to rate their satisfaction with the indoor facilities, indoor physical conditions, opening sizes, and overall built environment. They were also asked to rate their feelings about the indoor thermal environment and their overall thermal comfort, providing data on their thermal sensation, thermal preference, air movement sensation, air movement preference, humidity sensation, humidity preference, and overall thermal comfort.

The occupants' responses were used to reveal any issues or challenges regarding the original and rebuilt rooms of the hotel. Analysis of tourists' demands and adaptation to the built and thermal environment shows that the issues were mainly related to the building's construction materials, opening sizes, form, and thermal controls. These issues included the issue of affordability, durability, privacy, daylighting, ventilation, facilities, and thermal controls. Consequently, potential solutions are suggested for improving tourists' satisfaction and comfort in both the original and rebuilt rooms.

As a result of this POE study, the issues concerning the original and rebuilt rooms are established, and recommendations and potential solutions are suggested. This will help to assess development projects in vernacular settlements, concerning the conservation of vernacular architecture and its reconciliation with the requirements of the new uses and users of Dana. The results will also provide lessons for future development projects to ensure better practices and avoid existing problems by appraising the successful restoration attempts, identifying existing challenges, and suggesting potential solutions.

9.2 Post Occupancy Evaluation Survey

9.2.1 Respondents' Background

A randomly selected convenience sample was adopted due to the unknown and changing nature of the study's target population (tourists from different regions and social backgrounds staying at Dana hotel).[41] Moreover, as the POE survey was conducted in only August and January, some subgroups of the target population were not present and interviewed. Therefore, convenience sampling was used due to the potential of under-representation of some absent subgroups of the target population. Consequently, a sufficient sample was selected to indicate their satisfaction with the built and thermal environment.

Observation of the interviewed tourists was used to reveal the challenges and problems regarding the original and rebuilt rooms of the hotel. The qualitative findings are supported by the frequency of occupants' responses regarding their satisfaction with the hotel. Twenty-two interviews were administered in the original part of the hotel, and 23 in the rebuilt part. The interviews were

[41] A convenience sample reflects the population which was available and to which there was access at a specific time, representing a convenient source of data for the researcher (Baxter, Courage and Caine 2015).

conducted on-site, with tourists from different regions and backgrounds. In total, 45 POE interviews were conducted: 32 in summer, but only 13 in winter due to the smaller number of tourists. The analysis revealed that 19 male (42%) and 26 female (58%) occupants were interviewed in the two parts of the hotel (**Table 9.1**).

Table 9.1: Gender and Age Category Distribution (Author 2020)

	Gender (Frequency/Percentage distribution)		**Age Category** (Frequency/Percentage distribution)						
	Male	**Female**	**1= (18-25)**	**2= (26-35)**	**3= (36-45)**	**4= (46-55)**	**5= (+65)**	**Mean**	**SD**
Original	9 (41%)	13 (59%)	3 (13.6%)	18 (81.8%)	1 (4.6%)	0	0	**1.9**	**0.4**
Rebuilt	10 (43%)	13 (57%)	8 (34.8%)	11 (47.8%)	4 (17.4%)	0	0	**1.8**	**0.7**

The age category distribution shows that most tourists were aged between 18 and 35 (**Figure 9.1**).[42] A further breakdown revealed that 45% of occupants were from Jordan, while 35% were European and 20% from the Arab region. Over 90% of the occupants stayed in the hotel for 8 to 9 hours per day, in most cases from 10 pm to 7 am. All the occupants had used their rooms for no more than three days when the interviews were conducted.

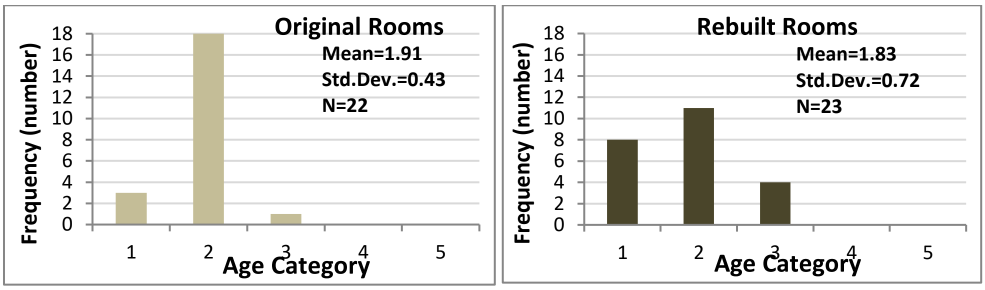

Figure 9.1: Age category distribution in both the original (left) and rebuilt (right) rooms of Dana hotel (Author 2020). 1=(18-25), 2=(26-35), 3=(36-45), 4=(46-55), 5=(65+).

[42] The interviewees were all over 18 in order to comply with the terms of the ethical approval granted by the University of Kent.

9.2.2 Occupants' Responses regarding the Built Environment

Dana hotel consists of both original and rebuilt rooms and is located in the centre of the village. It is formed of a main building (the original rooms) and several hotel rooms spread across the village (rebuilt rooms). As the POE survey aimed to evaluate tourists' satisfaction with the built environment, they were asked to rate their satisfaction with their stays in both parts of the hotel. A 5-point scale (from 1 = very dissatisfied to 5 = very satisfied) was used to indicate satisfaction with the built environment of the two types of room, including the overall satisfaction and the satisfaction with the indoor facilities, indoor physical conditions, and opening sizes.

The analysis of the occupants' responses regarding their overall satisfaction with the built environment revealed that almost 70% were 'neutral' or satisfied with the original rooms. This percentage rose to almost 85% in the rebuilt rooms, showing that the tourists were slightly more satisfied with the rebuilt rooms (**Figure 9.2**). As overall satisfaction depends mainly on satisfaction with the indoor facilities, indoor physical conditions, and opening sizes, the correlation between these factors was investigated for both types of room to show their significance.

The correlation coefficient between two variables lies between zero and one, indicating the strength of their correlation (Nicol and McCartney 2001).[43] It was observed that the correlation of all the factors was stronger in the original

[43] The correlation is weaker when the correlation coefficient is closer to zero, and stronger when it is closer to one. Furthermore, the square of the correlation coefficient indicates the proportion of the values of one variable that varies due to a change in another variable. For instance, the correlation value between indoor air temperature and relative humidity in UK free-running buildings is 0.52 (Nicol and McCartney 2001). This means that 0.27 of the variation of the relative humidity is due to the variation of the indoor air temperature.

rooms than in the rebuilt ones. More specifically, the correlation between overall satisfaction and satisfaction with indoor facilities was very strong in the original rooms ($r = 0.85$, $p < 0.05$), but much weaker in the rebuilt rooms ($r = 0.40$, $p < 0.05$). This suggests that occupants satisfied with the original rooms' indoor facilities were also satisfied with the overall built environment.

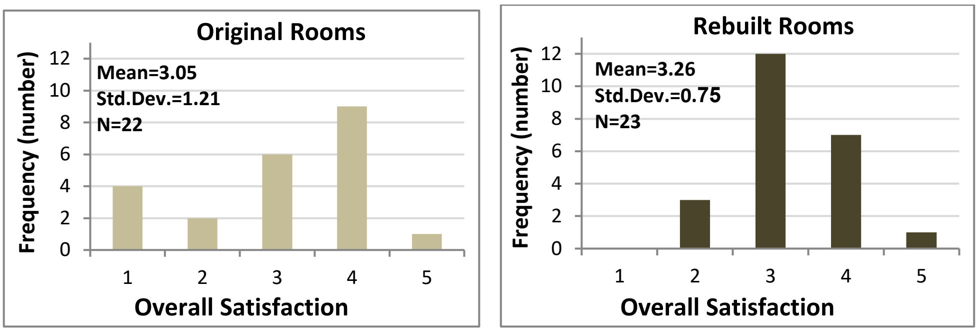

Figure 9.2: Distribution of the overall satisfaction with both the original (left) and rebuilt (right) rooms of Dana hotel (Author 2020). 1=very dissatisfied, 2= dissatisfied, 3=neutral, 4=satisfied, 5=very satisfied.

Similarly, a strong correlation exists between overall satisfaction and satisfaction with indoor conditions in the original rooms ($r = 0.88$, $p < 0.05$) but is weaker in the rebuilt rooms ($r = 0.50$, $p < 0.05$). This suggests that occupants dissatisfied with the indoor conditions of the original rooms were also dissatisfied with the overall built environment (**Table 9.2**). Furthermore, analysis of the correlation between overall satisfaction and opening size satisfaction revealed that it was the least important factor affecting overall satisfaction. The correlation is the weakest among the factors, equal to 0.67 and 0.52 in the original and rebuilt rooms respectively. To sum up, the tourists were less satisfied with the overall built environment of the original rooms because they were less satisfied with their indoor facilities and conditions.

Table 9.2: Correlation between overall satisfaction and other satisfaction factors (indoor facilities, indoor conditions, and opening sizes) (Author 2020)

	Coefficient of Correlation (r) ($p < 0.05$)		
	Overall satisfaction vs indoor facility satisfaction	**Overall satisfaction vs indoor condition satisfaction**	**Overall satisfaction vs opening size satisfaction**
Original Rooms	0.85	0.88	0.67
Rebuilt Rooms	0.40	0.50	0.52

9.2.3 Occupants' Responses regarding the Thermal Environment

In addition to evaluating the tourists' satisfaction with the built environment, the POE survey aimed to evaluate their thermal comfort. Consequently, they were asked to rate this, relating it to their sensations of indoor temperature, humidity, and air movement. A 7-point scale (from 1 = very uncomfortable to 7 = very comfortable) was used to indicate the overall thermal comfort votes in the original and rebuilt rooms of Dana hotel.

Figure 9.3 shows that 56% of the occupants felt either 'slightly comfortable' or 'comfortable' in both types of room. However, more occupants felt 'slightly uncomfortable' in the original rooms (25%) compared with those in the rebuilt rooms (12%). Overall, the occupants' responses regarding thermal comfort in summer are virtually identical in both the original and rebuilt parts of the hotel. However, there is a slight shift toward the 'comfortable' part of the scale in the rebuilt rooms, where the mean of the thermal comfort responses is higher than in the original rooms (original = 4.63 < rebuilt = 4.81).

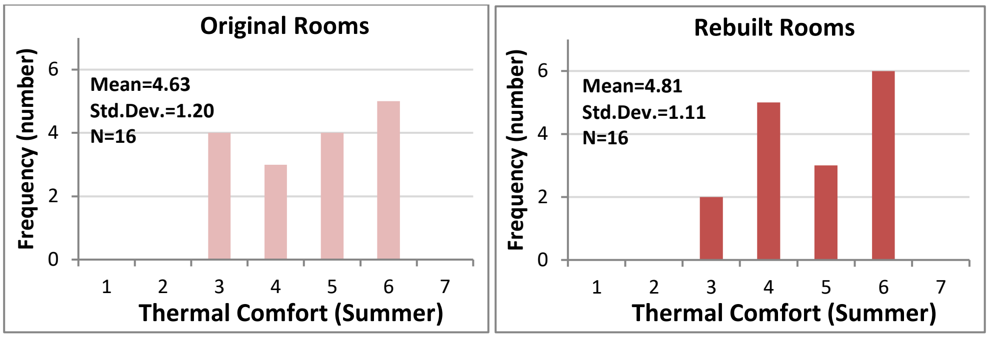

Figure 9.3: Distribution of the thermal comfort votes in summer in the original (left) and rebuilt (right) rooms of Dana hotel (Author 2020). 1=very uncomfortable, 2= uncomfortable, 3=slightly uncomfortable, 4=neutral, 5=slightly comfortable, 6= comfortable, 7=very comfortable.

In winter, 66% of the occupants' responses indicated they were uncomfortable in the original rooms, compared with 42% in the rebuilt rooms. In addition, only 7% of the occupants' responses are 'slightly comfortable' and only in the rebuilt rooms (**Figure 9.4**). Overall, the occupants were more likely to be uncomfortable in the original rooms because the mean of the thermal comfort responses is lower (original = 3.00 < rebuilt = 3.71).

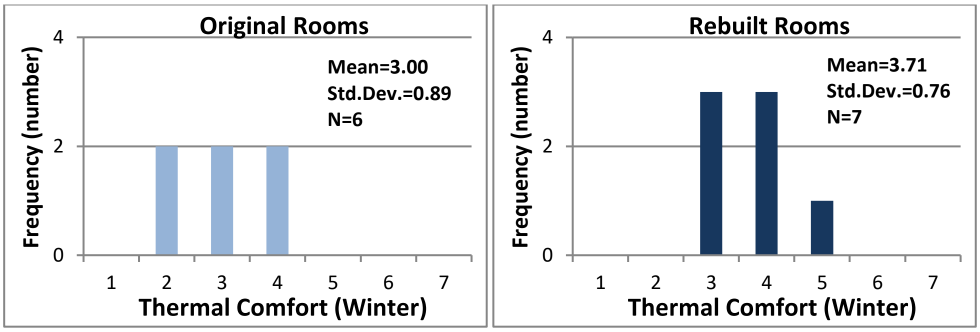

Figure 9.4: Distribution of the thermal comfort scores in winter in the original (left) and rebuilt (right) rooms of Dana hotel (Author 2020). 1=very uncomfortable, 2= uncomfortable, 3=slightly uncomfortable, 4=neutral, 5=slightly comfortable, 6= comfortable, 7=very comfortable.

The analysis of the correlation between thermal comfort and thermal sensation revealed that a good correlation was found between thermal sensation and thermal comfort in summer ($r = -0.64$, $p < 0.05$) in the rebuilt rooms. This suggests that the occupants who felt warmer in the rebuilt rooms in summer feel uncomfortable with the thermal conditions. Furthermore, the analysis of the correlation between humidity and thermal comfort revealed that there was a good correlation in the rebuilt rooms in summer ($r = -0.65$, $p < 0.05$). This suggests that occupants who felt more humidity in the rebuilt rooms in summer did not feel comfortable in their thermal environment. On the other hand, occupants who felt dryer are likely to be comfortable with the thermal conditions (**Table 9.3**).

Table 9.3: Correlation (r-value) between overall thermal comfort and different sensations (thermal sensation, humidity, and air movement) (Author 2020)

	Coefficient of Correlation (r) (p < 0.05)					
	Thermal comfort vs thermal sensation		**Thermal comfort vs humidity**		**Thermal comfort vs air movement**	
	Summer	Winter	Summer	Winter	Summer	Winter
Original rooms	0.17	0.80	0.43	0.30	-0.17	0.00
Rebuilt rooms	-0.64	0.52	-0.65	-0.52	0.41	-0.65

* Hidden cells are statistically not significant.

9.2.4 Occupant's Overall Responses

The analysis of the occupants' overall responses was used to bring to the surface the issues and challenges of the original and rebuilt rooms in Dana hotel. In addition to rating their satisfaction and thermal comfort, tourists were asked open questions to explain their perception of the building's attributes, their adaptive behaviour, and the use of thermal controls. Occupants were first asked about the building's best and worst attributes, and whether they served their needs or needed to be changed. They were then asked about their adaptive behaviour to achieve comfort when the thermal conditions were uncomfortable and whether they used any thermal controls.

The analysis of the occupants' overall responses included quantitative analysis of their votes on the built and thermal environments, and qualitative analysis of the open questions discussed. Several issues derived from the discussion of the occupants' responses, including the issue of affordability, durability, privacy, daylighting, ventilation, facilities, and thermal controls. The overall analysis shows that these issues are mainly related to the building's construction materials, opening sizes, form, and thermal controls.

1. **Issues related to construction materials:**
    1. Durability
    2. Affordability
    3. Thermal sensation
2. **Issues related to opening sizes:**
    1. Daylighting
    2. Ventilation
    3. Privacy
    4. Thermal sensation
3. **Issues related to buildings form:**
    1. Facilities and amenities
    2. Thermal issues
4. **Issues related to thermal controls**

9.3 Issues Related to Construction Materials

9.3.1 Durability

The tourists' perception of the durability of the construction materials was discussed by analysing their satisfaction with the indoor physical conditions.

The analysis revealed that 55% were satisfied with the original rooms (**Figure 9.5**). Their satisfaction was mainly based on the antiquity and originality of the thick stone walls, timber roofs, and wooden doors. One of the satisfied tourists said that the original rooms represented the way of constructing rural settlements in the past, with the use of local materials and construction techniques. He added that these elements attracted tourists the most in rural settlements such as Dana village.

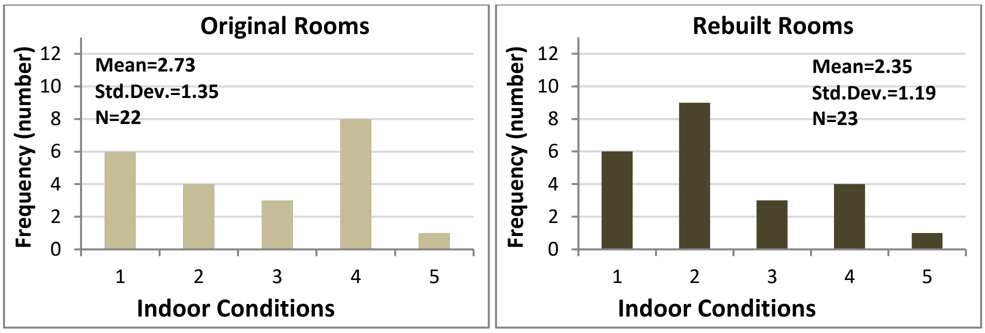

Figure 9.5: Distribution of the indoor condition satisfaction votes in the original (left) and rebuilt (right) rooms of Dana hotel (Author 2020). 1=very dissatisfied, 2= dissatisfied, 3=neutral, 4=satisfied, 5=very satisfied.

For most occupants, the original construction materials and their visual impact represented the durability and sustainability of the original hotel rooms. They emphasised the durability of the original vernacular materials, mentioning the quality of the stone used for the external walls. They claimed that these durable masonry walls expressed the aesthetic and cultural values of the original vernacular architecture. However, the dissatisfied tourists (45%) revealed that the original roof condition was a serious concern. Some might have been satisfied with the original room facilities, but not with the indoor conditions. They stated that they wished the original part of the hotel had been renovated with brighter rooms and better finishing. For instance, most of the tourists dissatisfied with the indoor conditions in the original rooms complained about the bad condition of the roof, emphasising the need for frequent maintenance. One of the dissatisfied tourists said that ‘it needs maintenance because there is a water leakage from the roof in my room’ (**Figure 9.6**).

Figure 9.6: Water leakage from the roof of one of the original rooms (Author 2020)

Tourists suggested changing the original roof to make the rooms look cleaner and brighter. However, this was very difficult to undertake due to the non-availability of original skills, proper tools, trained craftsmen, and certain original materials such as cane and juniper wood. Previously, to overcome this issue, local families removed the roof layer (the mixture of clay and straw) every year when winter ended and replaced it with a new one.

However, the operators of Dana hotel claimed that this strategy was time-consuming as they were looking for a permanent solution to avoid the annual replacement of the roof. Therefore, they covered the original roof with a concrete layer to protect it from the climatic conditions (Al-Khawaldeh 2019). However, due to the weak water insulation of concrete, this is still an issue of concern for many tourists. Therefore, rather than making changes, regular maintenance might be enough to improve the indoor conditions.

On the other hand, the rebuilt rooms are mainly concrete structures, replacing the original ones with concrete and steel. The new materials are commonly synthetic ones that are not local, durable, or sustainable because they are hard to reuse or recycle in Jordan (Al-Khawaldeh 2019). Therefore, a higher percentage of dissatisfaction (65%) was identified in the rebuilt rooms compared with the original ones. One of the dissatisfied tourists said that 'the finishing of the rebuilt rooms was below all standards'. For instance, the walls were damp with slight efflorescence in the lower area (peeling walls). Most of the dissatisfied tourists suggested that the walls should be repainted as there are several paint peeling marks.[44]

This problem indicates that the new construction materials were not suitable for dealing with the humidity and salt walls. On the other hand, the original materials (in the original rooms) were more able to absorb water vapour and keep the surface temperature above the dew point temperature. With reference to previous successful practices that solved this problem, efficient construction materials that resist humidity should be used to reduce dampness, keeping the surface temperature of the materials at ±15°c of the dew point temperature (McMullan 2017). Waterproof coating should also be applied to resist water pressure and have damp-free walls. Protection against damp also includes the incorporation of maximising daylight penetration and providing adequate air movement (Philokyprou et al. 2017).

[44] Peeling marks and mould growth appear when the surface temperature is close to or drops below the dew point temperature due to the high relative humidity (Straube 2002; McMullan 2017). The dew point temperature is the air temperature when it is fully saturated with water vapour and can no longer hold it, leading to the condensation of water vapour into liquid water (Hardy 1998).

In summary, frequent maintenance should be performed to improve tourists' satisfaction with the indoor physical conditions. On the other hand, the tourists (35%) satisfied with the rebuilt rooms attributed their satisfaction to the stone-arches, interior masonry walls, and lighting shafts. Indeed, some mentioned 'the wide and spectacular arch' and 'the unique lighting shaft' as the best attributes of the rebuilt rooms. They added that the inner shaft and its masonry walls gave the feeling of small courtyards, emphasising the beautiful stone impression of the shaft when the lights were on during the night.

9.3.2 Affordability

Most houses were restored in the village to provide affordable accommodation for tourists. The affordability of staying at Dana hotel was one of the reasons for selecting its rooms for accommodation, as all the tourists pointed out. The original rooms, which cost 15-25 JD (15.35-25.55£), are cheaper than the rebuilt rooms, which cost 60-70 JD (60.75-70.10£), because of the different facilities and conditions provided (Al-Khawaldeh 2019). However, some tourists complained about the room prices, stating that they were high for their condition and facilities. Indeed, they would not mind paying more if the rooms were in a better condition and additional facilities and services were available.

Further interviews indicated the challenges of the recent restoration work in the village and its impact on the room costs. Dana's rehabilitation project forced the hotel operators to increase the costs of the rebuilt hotel rooms because of the provision of further facilities. Indeed, the cost of restoring the houses in Dana affected their prices, including the cost of the adopted materials, which depended mainly on the cost of transportation, accessibility, and mechanical properties (Philokyprou, Michael and Thravalou 2013). The original construction materials of the hotels in Dana were cheaper because they were local, natural, not imported from outside the country, and were not manufactured or processed (Al-Khawaldeh 2019).

On the other hand, the cost of changing the original construction materials was a big concern for the RSCN, as they aimed to provide cost-effective accommodation that is durable and sustainable. The concepts of affordable and sustainable housing are rarely considered together. The relationship between sustainability and affordability is inverse; more sustainability usually means less affordability (Friedman 2012). Therefore, the maintenance costs and durability were the main concerns in restoring Dana’s houses, in the attempt to provide affordable and durable solutions to reduce the cost of maintenance, including replacing the mechanical and electrical fixtures, paintwork, and fixing the roofs.

9.3.3 Thermal Sensation

The analysis in chapter 8 highlighted that the properties of the construction materials used in the original and rebuilt rooms of the hotel are different in terms of their density, heat transfer, and thermal conductivity. It was concluded that the changes in the materials have a big impact on thermal performance. Therefore, the occupants’ responses regarding the thermal conditions of the original and rebuilt rooms were analysed to establish their different sensations and preferences in summer and winter.

9.3.3.1 Occupants' Responses in Summer

The analysis of the occupants' responses regarding the thermal sensation and preferences in summer revealed that their votes had very similar mean values for both the original and rebuilt parts of the hotel. Specifically, 84% of the occupants perceived that they were 'neither cool nor warm' or 'slightly warm' in the two parts of the hotel. However, more occupants felt neutral in the rebuilt rooms, with 62% of the responses being on the 'neither cool nor warm' point of the scale, while this figure was 50% in the original rooms (**Figure 9.7)**. Overall, most occupants felt 'neither cool nor warm' in both types of rooms. However, a few occupants of the original rooms felt cooler and so preferred warmer conditions.

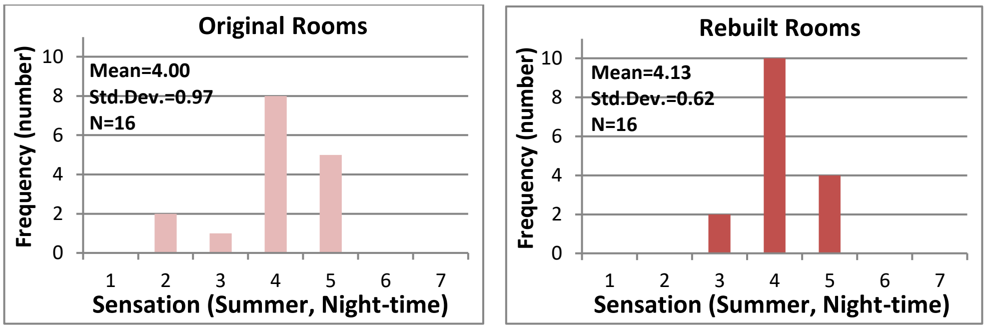

Figure 9.7: Distribution of the thermal sensation votes in summer in the original (left) and rebuilt (right) rooms of Dana hotel (Author 2020). 1=cold, 2=cool, 3=slightly cool, 4=neither cool nor warm, 5=slightly warm, 6=warm, 7=hot.

This indicates the high thermal mass of the original masonry thick walls, which reduces heat transfer to indoor spaces. High thermal mass slows down heat transfer, as the heat is absorbed and stored by the masonry walls, and only slowly moves inwards from outside. Some heat reaches the indoor space, while most returns outside when it is cooler in the evening. However, the external walls of the rebuilt rooms are not as thick as the original ones and built from different materials, providing less thermal mass and weaker ability to resist heat transfer. Furthermore, the calculated U-values in chapter 8 show that the construction materials of Dana hotel's original rooms resisted thermal transfer more than those of the rebuilt rooms (**Table 9.4**).

Table 9.4: U-values of the building envelope of Dana hotel's original and rebuilt rooms (Author 2020)

	U-values (W/m2 K)		
	Walls	**Floor**	**Roof**
Original rooms	1.307	0.367	0.481
Rebuilt rooms	3.356	1.096	3.257

The thermal preference votes accordingly revealed that 90% of the original room occupants and 100% of the rebuilt room ones preferred either 'no change' or a 'cooler' environment. Meanwhile, 10% of the occupants preferred to feel warmer in just the original rooms **(Figure 9.8)**. In addition, the occupants' responses regarding their humidity sensation and preferences in summer show that the original rooms were slightly dryer than the rebuilt ones. Consequently, occupants in the original rooms preferred more humid conditions. More specifically, around 81% of the occupants perceived the rebuilt rooms to be 'neither dry nor humid'.

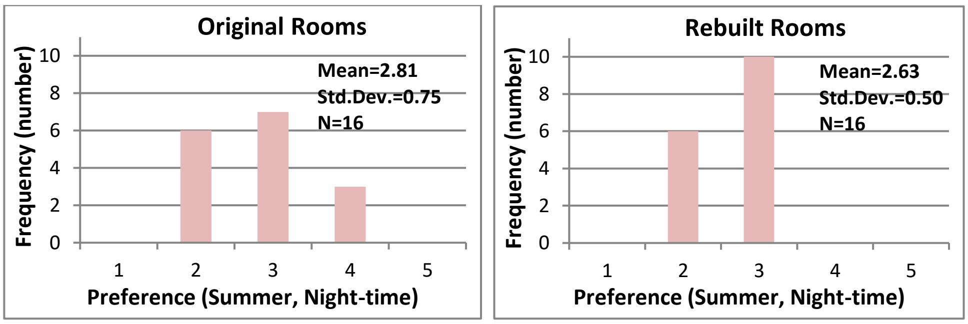

Figure 9.8: Distribution of the thermal preference votes in summer in the original (left) and rebuilt (right) rooms of Dana hotel (Author 2020). 1=much cooler, 2=cooler, 3=no change, 4=warmer, 5=much warmer.

Occupants felt dryer in the original rooms, with 43% of the responses on the 'dry' and 'slightly dry' points of the scale, while the figure was less than 10% in the rebuilt rooms (**Figure 9.9)**. Accordingly, the thermal preference votes revealed that 93% of the rebuilt room occupants and 56% of those in the original rooms did not require changes to the rooms' humidity. In addition, 44% of the occupants preferred a more humid environment in the original rooms **(Figure 9.10**). This indicates that both the original and rebuilt rooms provided cooling strategies that kept the indoor temperature within an acceptable range.

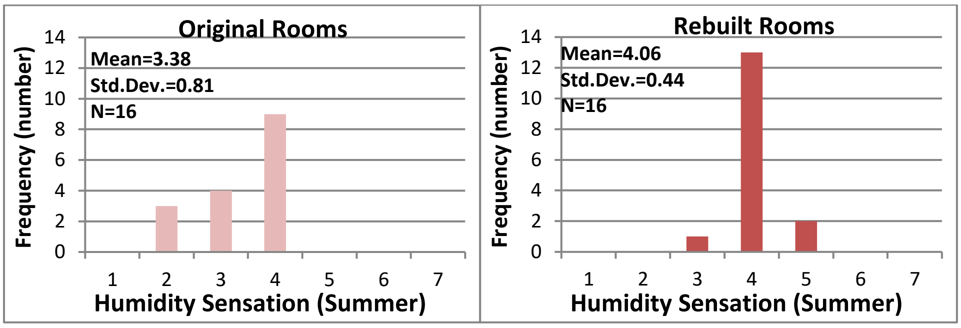

Figure 9.9: Distribution of the humidity sensation votes in summer in the original (left) and rebuilt (right) rooms of Dana hotel (Author 2020). 1=very dry, 2=dry, 3=slightly dry, 4=neither dry nor humid, 5=slightly humid, 6=humid, 7=very humid

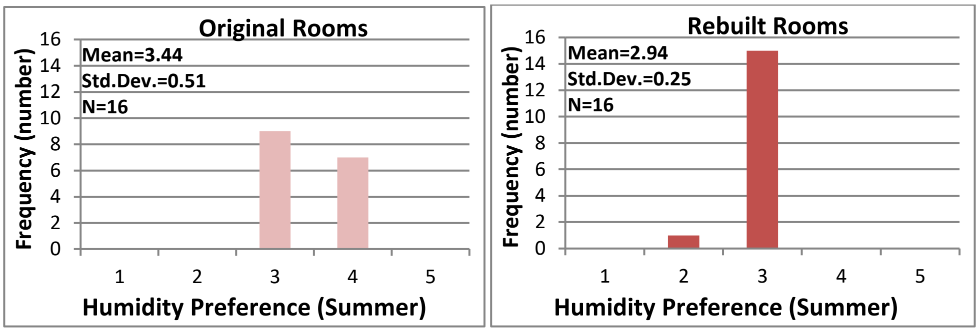

Figure 9.10: Distribution of the humidity preference votes in summer in the original (left) and rebuilt (right) rooms of Dana hotel (Author 2020). 1=much dryer, 2=dryer, 3=no change, 4=more humid, 5=much more humid

9.3.3.2 Occupants' Responses in Winter

In winter, the occupants' responses regarding their thermal sensation show a noticeable shift toward the cold end of the scale. 100% of the responses are on the 'cold', 'cool', or 'slightly cool' parts of the scale in both parts of the hotel. However, occupants feel colder in the original rooms, with 66% of the responses showing they perceived themselves to be 'cold', while in the rebuilt rooms, 57% of the occupants felt 'slightly cool' (**Figure 9.11)**.

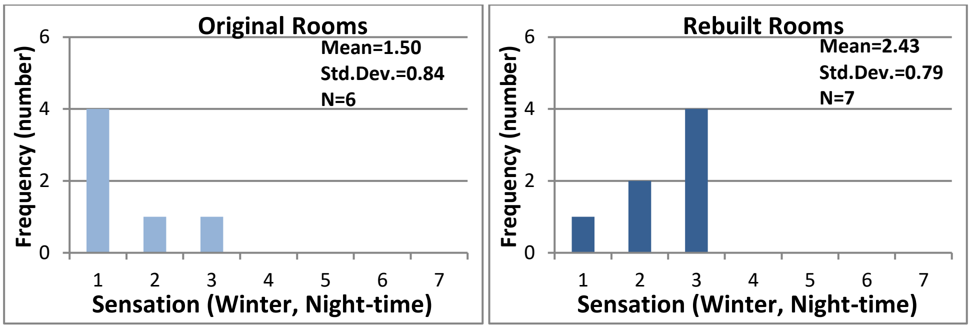

Figure 9.11: Distribution of the thermal sensation votes in winter in the original (left) and rebuilt (right) rooms of Dana hotel (Author 2020). 1=cold, 2=cool, 3=slightly cool, 4=neither cool nor warm, 5=slightly warm, 6=warm, 7=hot

The thermal preference votes accordingly reveal that 100% of the occupants of both the original and rebuilt rooms wanted to feel either 'warmer' or 'much warmer'. However, in the original rooms, 66% of the occupants wanted to feel 'warmer', while 85% of those in rebuilt rooms wanted to feel 'much warmer' **(Figure 9.12**). Overall, the occupants' responses regarding their thermal sensation and preferences in winter show that they felt slightly colder in the original rooms, and therefore preferred much warmer thermal conditions.

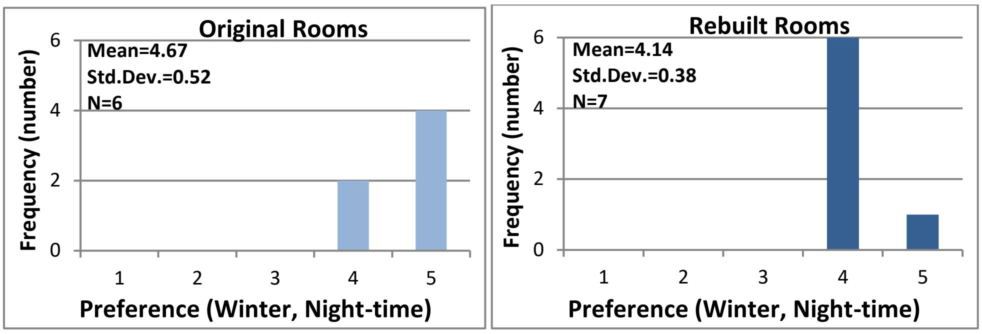

Figure 9.12: Distribution of the thermal preference votes in winter in the original (left) and rebuilt (right) rooms of Dana hotel (Author 2020). 1=much cooler, 2=cooler, 3=no change, 4=warmer, 5=much warmer

The occupants' responses regarding their humidity sensation and preferences in winter show that they felt more humid in the original rooms and preferred dryer conditions. Specifically, there was an obvious shift toward feeling more humid in the original rooms, as 100% of the responses were on the humid part of the scale. In addition, 57% of the occupants felt 'neither dry nor humid' in the rebuilt rooms, while the other 43% felt either 'slightly humid' or 'humid' **(Figure 9.13**). The thermal preference votes consequently reveal that 100% of the occupants in the original rooms preferred to feel dryer, while 85% of those in the rebuilt rooms did not need any changes **(Figure 9.14**).

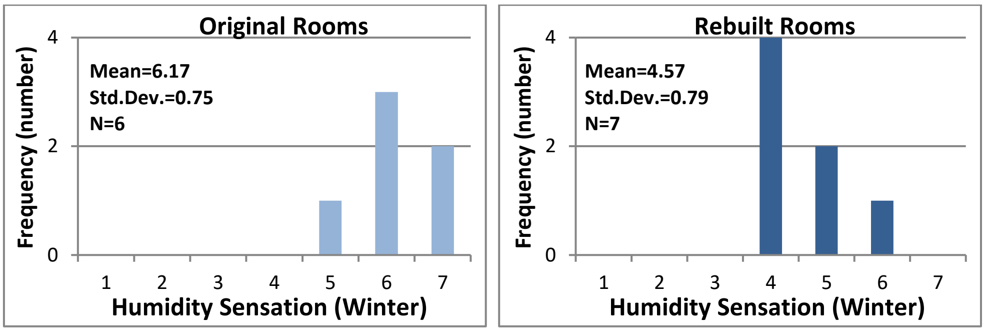

Figure 9.13: Distribution of the humidity sensation votes in winter in the original (left) and rebuilt (right) rooms of Dana hotel (Author 2020). 1=very dry, 2=dry, 3=slightly dry, 4=neither dry nor humid, 5=slightly humid, 6=humid, 7=very humid

The overall analysis revealed that the indirect solar gain from the walls and roofs was not enough to warm up the indoor spaces of the original and rebuilt rooms. Moreover, the direct solar gain was limited in both types of room. The original rooms have small windows and thick walls that prevent sunlight from entering the indoor spaces. Meanwhile, the northern windows of the rebuilt rooms do not face the sun and so are always shaded. However, as the direct solar gain from windows is a main contributor to providing thermal comfort in winter, occupants were also asked about their satisfaction with the opening sizes, leading to other issues related to the opening sizes and their orientation.

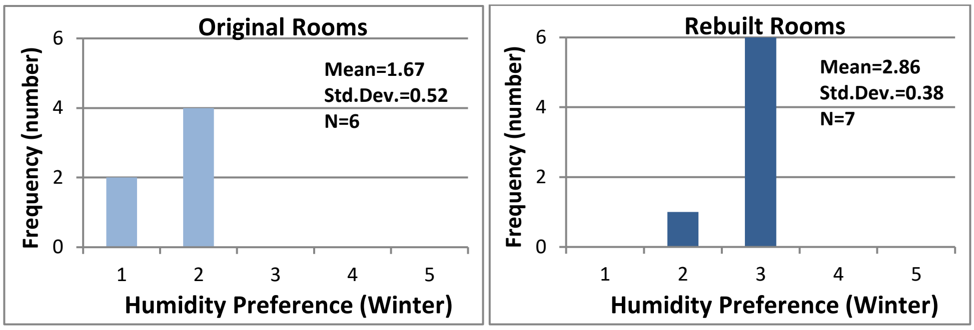

Figure 9.14: Distribution of the humidity preference votes in winter in both the original (left) and rebuilt (right) rooms of Dana hotel (Author 2020). 1=much dryer, 2=dryer, 3=no change, 4=more humid, 5=much more humid

9.4 Issues Related to Opening Sizes

The analysis of the tourists' satisfaction with the opening sizes (window area and number of windows) revealed that 50% of the responses lay on the dissatisfied part of the scale in the original rooms. 25% of occupants were neither satisfied nor dissatisfied, and the other 25% were satisfied with the area of the openings in the original rooms (**Figure 9.15**). The dissatisfied tourists agreed that due to the small ratio of openings and the rooms' thick walls, it was very dim inside the rooms during the daytime, and they needed to turn the lights on to be able to see.

The windows of the original rooms of Dana hotel face the internal courtyard in order to provide privacy and security, while the windows that face the street are relatively small. In general, the original windows are rectangular in shape, limited in number, and small due to construction limitations, privacy purposes, and security reasons. The short width of the windows resulted from construction limitations and their structural weakness, meaning they cannot carry the load of the masonry bearing wall. Moreover, as sometimes the room windows are unable to ventilate the room, doors may have to be kept open for better ventilation and lighting. However, the windows of the rebuilt rooms are larger to meet the requirements of the new uses and users of these rooms.

The responses regarding the rebuilt rooms approximately mirror those of the original rooms, being more satisfied with the opening sizes. Most respondents (48%) were satisfied, whereas 26% of occupants were dissatisfied in the rebuilt rooms, with some wanting bigger windows towards the spectacular view. At the same time, other dissatisfied tourists complained about the large size of the bathroom windows. They suggested that they should be smaller and higher above the floor to provide privacy, as they were more likely to be for the bedroom space, not for the bathroom (**Figure 9.15**).

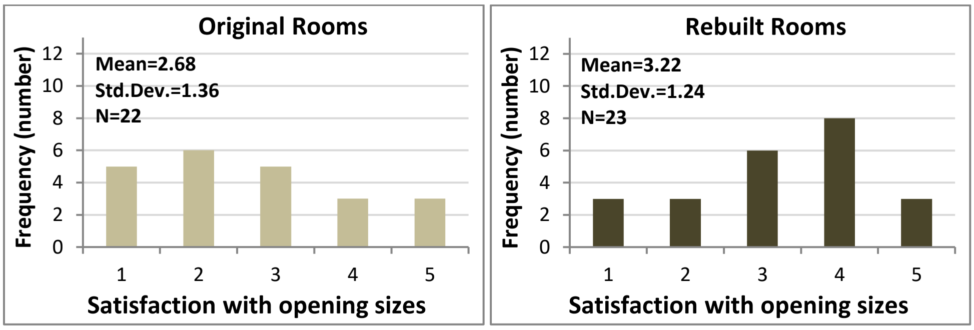

Figure 9.15: Distribution of the opening size satisfaction votes in the original (left) and rebuilt (right) rooms of Dana hotel (Author 2020). 1=very dissatisfied, 2= dissatisfied, 3=neutral, 4=satisfied, 5=very satisfied.

Enlarging windows and devising new lighting shafts in the rebuilt rooms helped improve the tourists' satisfaction with the opening sizes. The lighting shaft brings sunlight into the indoor spaces and provides better ventilation.

Indeed, many tourists mentioned the need for good daylighting and natural ventilation, which depends on the window orientation, size, and location. This raises the hypothesis that satisfaction with the opening sizes is affected by satisfaction with ventilation and daylighting of the spaces.

9.4.1 Daylighting

A 5-point scale (from 1 = very dim to 5 = very bright) was used to indicate the daylighting votes in the original and rebuilt rooms of Dana hotel. The analysis of occupants' responses revealed that 100% felt the original rooms to be 'very dim' or 'dim'. This shows that the minimal daylighting in the original vernacular buildings was one of the features that conflicted with the new needs of the hotel guests. Therefore, the original rooms need transformation to adapt to the new needs, raising the problem of reconciling the preservation of opening sizes with the requirements of tourists.

The rehabilitation project attempted to solve the issue of daylighting by applying several solutions to the restored buildings, such as enlarging the size of the windows; increasing the number of windows; and adding internal lighting shafts. As a result, there was a noticeable shift toward the 'bright' end of the scale in the rebuilt rooms. 70% of occupants felt the daylighting to be 'neutral', while the other 30% felt it to be 'bright' (**Figure 9.16**). This was because the glazing ratio to the floor area was higher at the rebuilt rooms due to the larger size of the windows and the addition of the lighting shaft. This shows that their indoor spaces are more exposed to outdoor conditions and that the level of daylighting is lower in the original rooms due to the small window area.

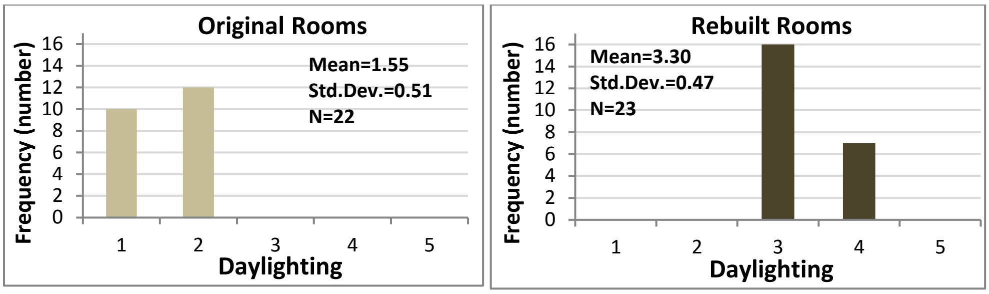

Figure 9.16: Distribution of the daylighting votes in the original (left) and rebuilt (right) rooms of Dana hotel (Author 2020). 1=very dim, 2=dim, 3=neutral, 4=bright, 5=very bright.

Accordingly, the daylighting preference votes revealed that 70% of the original room occupants and 13% of those in the rebuilt rooms preferred brighter indoor spaces. The remaining occupants preferred 'no change' in the original (30%) and rebuilt (87%) rooms (**Figure 9.17**). Overall, the occupants' responses regarding daylighting show divergent mean values in the two types of room. All the occupants of the original rooms felt them to be dimmer compared to the brighter feeling of the rebuilt rooms.

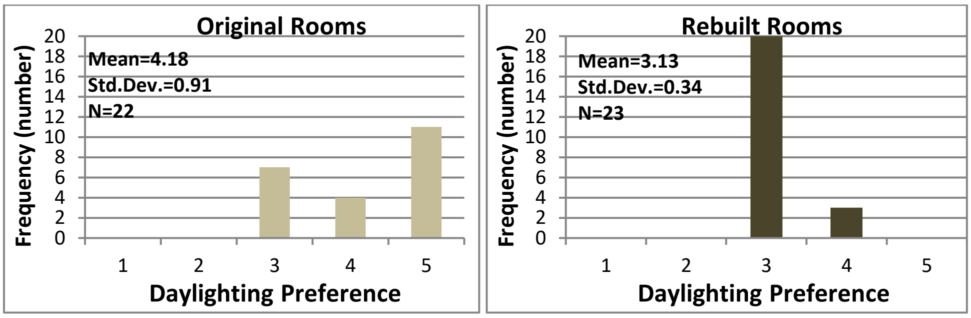

Figure 9.17: Distribution of the daylighting preference votes in the original (left) and rebuilt (right) rooms of Dana hotel (Author 2020). 1=much dimmer, 2=dimmer, 3=no change, 4=brighter, 5=much brighter.

9.4.2 Ventilation

The analysis of occupants' responses related to ventilation in both types of room revealed that they all lay on the 'good ventilation' part of the scale in both summer and winter. The responses in summer show approximate mean values in both the original and rebuilt rooms (**Figure 9.18**). However, the rebuilt rooms provide a slightly better perception of ventilation due to their lower density and bigger windows. Indeed, the analysis revealed that ventilation is affected by the density (the ratio of the number of occupants to the occupied area) of each room; more ventilation is needed at rooms with higher density.[45]

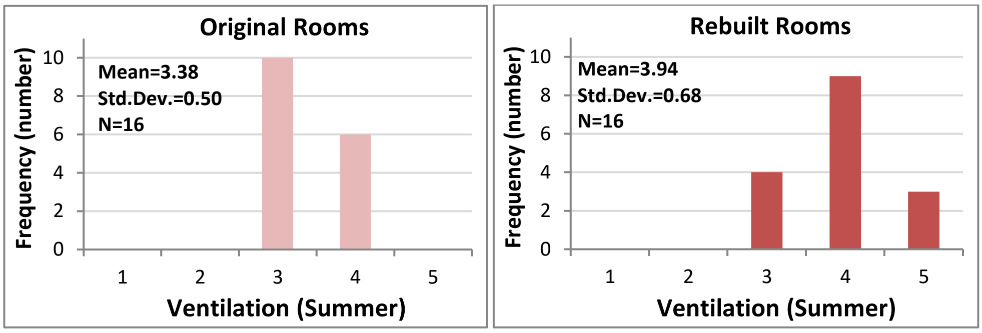

Figure 9.18: Distribution of the ventilation votes in summer in the original (left) and rebuilt (right) rooms of Dana hotel (Author 2020). 1=very bad, 2=bad, 3=neither bad nor good, 4=good, 5=very good.

Previously, some families lived together at a single multi-functional space, suggesting a high density of occupants. This density was maintained in the original rooms, ranging from 21% to 23%. However, the density in each room was reduced in the rebuilt rooms due to the tourists' different requirements (**Figure 9.19**). The calculated density in the rebuilt rooms ranged from 8% to 11%, leading to better ventilation due to the lower density and bigger windows. The analysis highlighted that the ventilation perception is also affected by occupants' thermal sensation in addition to the window size and room density.

For instance, occupants require better ventilation when they feel warmer, which explains the 'very good ventilation' perception of the occupants of the

[45] The perception of density is affected by the number of occupants in each space, building's typology, form, and window size and location (Dave 2011; Bradecki et al. 2017).

rebuilt rooms. These occupants would be satisfied with the ventilation in summer because it provided a slightly cooler indoor temperature compared with the original rooms. In addition, occupants' perception of ventilation would be almost the same in winter in both the original and rebuilt rooms because they both have similar cold conditions. Specifically, occupants' votes in winter were on the 'good ventilation' part of the scale, and the mean values of the ventilation responses were almost equal for both types of room (**Figure 9.20**).

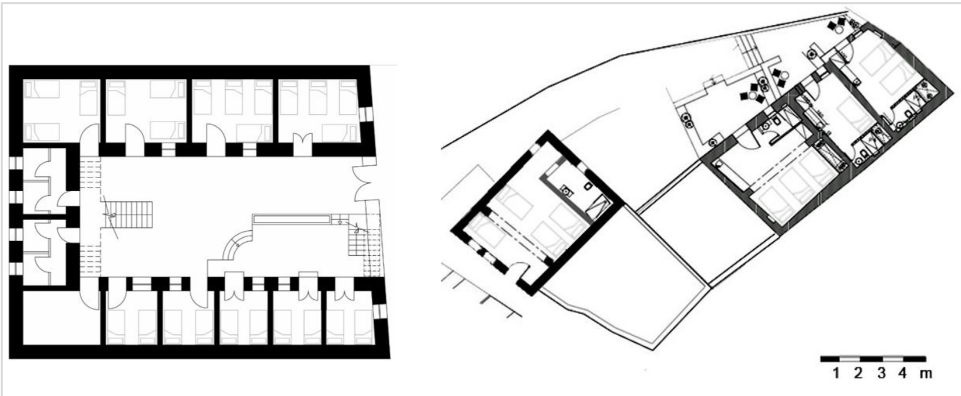

Figure 9.19: Number of beds in the original rooms (left) compared that in the rebuilt rooms (right) (Author 2020)

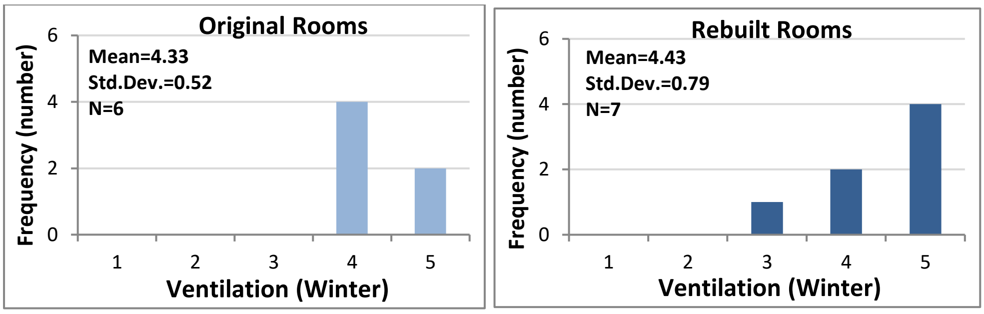

Figure 9.20: Distribution of the ventilation votes in winter in the original (left) and rebuilt (right) rooms of Dana hotel (Author 2020). 1=very bad, 2=bad, 3=neither bad nor good, 4=good, 5=very good.

9.4.3 Privacy

The privacy factor was one of the most repeated issues that tourists mentioned during their interviews.[46] It is connected to several tangible factors such as the house typology, indoor spaces and circulation, as well as the size, number, and location of openings. Previously, providing privacy was essential for local families to perform their daily activities comfortably. Being comfortable means the ability to move around the house with the assurance no one from outside can see inside. Otherwise, women would also wear dignified clothing in their houses (Tawayha, Braganca and Mateus 2019).

The original requirement of privacy was considered in the original part of the hotel. Several vernacular elements and features were applied to enhance privacy, such as the courtyard (introverted form) and small windows. The courtyard represents an intermediate space that connects outdoor spaces to the private indoor spaces. In particular, the sequential order of movement occurs from a public space (outdoor roads) to a semi-private space (courtyard) and ends in a private space (indoor room). Moreover, windows face the central courtyard, showing their inward orientation to provide privacy. This

[46] Privacy is one of the most significant cultural factors that should be conserved in vernacular houses (Qtaishat, Emmitt and Adeyeye 2020). The purpose of conservation is to preserve the compatibility between the overall surrounding environment and the restored buildings, taking into consideration the buildings' cultural values and significance (Waked 2008, p. 265). The cultural context is the most vital and effective force that guides and controls society in the region (Tawayha, Braganca and Mateus 2019). It is formed mainly according to the locals' religious beliefs, as religion is a very effective and controls all aspects of their daily life, including their food, clothing, behaviour, and housing. Accordingly, the cultural context should be considered in any rehabilitation project to avoid any negative impact on the restored building (Tawayha, Braganca and Mateus 2019). Otherwise, new buildings that are detached from the local community would fail to provide sustainable solutions for locals.

aimed to enhance visual and acoustic privacy, as it minimises the possibility of being heard or seen from outside.

However, this kind of privacy is not provided in the rebuilt part of the hotel. Although internal shafts were added to emphasise the introverted form of the vernacular houses, the external windows were enlarged, exposing the indoor spaces to the outside. The issue of privacy was a repeated concern of the tourists in the rebuilt rooms due to the large, low windows without blinds. The windows either have no curtains or ones that do not fully cover them. With people walking past outside, most occupants felt exposed and needed more privacy.

For instance, occupants in room #8 (a rebuilt room) stated that the bathroom window did not have a curtain, making it uncomfortable to use during both the day and night. They added that the window was big for a bathroom and should have been smaller and placed higher to respect the privacy of the space. In some cases, they used some of their personal belongings to cover the window. Similarly, other tourists emphasised that 'I had to use my towel to cover the bathroom window from inside for more privacy because I could not change my clothes with the lights turned on. Otherwise, everyone can see from outside'. Overall, curtains or blinds should be added to the windows to provide privacy.

9.4.4 Thermal Sensation

The analysis of the occupants' responses regarding air movement revealed that in summer they felt 'neutral' or 'little' air movement in both the original and rebuilt rooms. However, more occupants felt neutral in the original rooms, with 75% of the responses on the 'neutral' point of the scale, while this figure was 50% in the rebuilt rooms (**Figure 9.21**). Although most of the occupants felt neutral, the air movement preference votes revealed that 44% of the original room occupants and 68% of the rebuilt room ones would have preferred more air movement. Meanwhile, the other occupants preferred no change in the air movement (**Figure 9.22**).

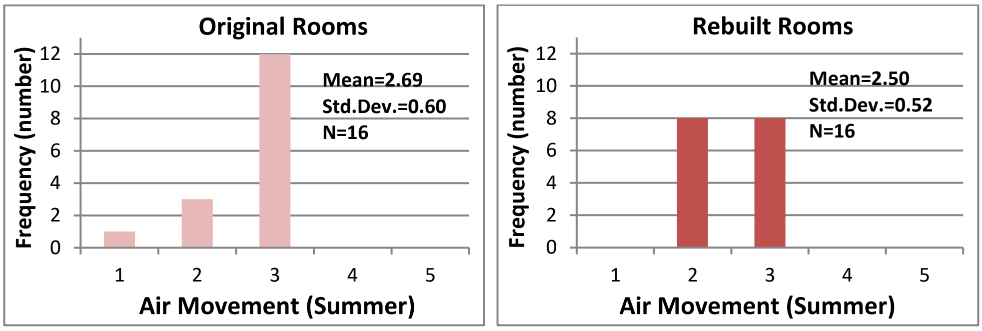

Figure 9.21: Distribution of the air movement sensation votes in summer in the original (left) and rebuilt (right) rooms of Dana hotel (Author 2020). 1=very little, 2=little, 3=neutral, 4=much, 5=very much

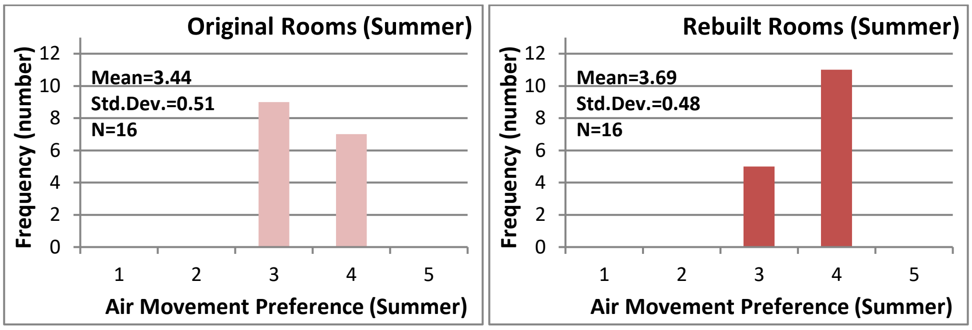

Figure 9.22: Distribution of the air movement preference votes in summer in the original (left) and rebuilt (right) rooms of Dana hotel (Author 2020). 1=much less, 2=less, 3=no change, 4=more, 5=much more

Overall, the occupants' responses related to the air movement sensation and preferences in summer show approximate mean values of the responses in both the original and rebuilt rooms. The occupants felt either neutral or less air movement in both parts of the hotel. However, more occupants in the rebuilt rooms felt little air movement and would have preferred more. It was observed that the preferences for air movement were affected by the occupants' thermal sensation. Fewer occupants preferred more air movement in the original rooms because they felt slightly cooler. Having small openings reduces the climatic influence on the indoor thermal conditions, preventing solar gain in summer.

The design of the original windows controls heat gain and loss efficiently as the rooms benefit from night ventilation and breezes in the summer to cool the indoor spaces. The small size and high position of the openings extract the hot air from indoor spaces, as this rises up due to its low density. Therefore, open windows in summer improve the indoor air movement, meaning occupants feel cooler. Moreover, cooling is caused as a result of evaporation from the green leaves of the plants in the courtyard. Consequently, the cooled air becomes heavier and descends, while the hot air (extracted from indoor spaces) rises, driving the cool air into the indoor spaces as cool breezes.

Similarly, the night cool air enters the indoor spaces through open windows after the hot air goes outside and rises, removing the stored heat in the room during the daytime. In winter, the responses also show close mean values in both the original and rebuilt rooms. As in summer, 80% of the respondents felt 'neutral' in both types of room in winter. However, few occupants felt 'much' air movement in either type of room (**Figure 9.23**). Accordingly, the thermal preference votes show that almost 75% of the occupants in both the original and rebuilt rooms preferred 'no change' in the air movement (**Figure 9.24**).

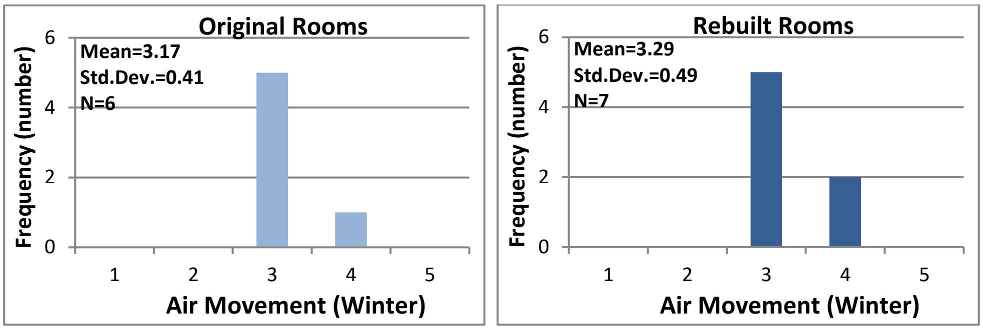

Figure 9.23: Distribution of the air movement sensation votes in winter in the original (left) and rebuilt (right) rooms of Dana hotel (Author 2020). 1=very little, 2=little, 3=neutral, 4=much, 5=very much

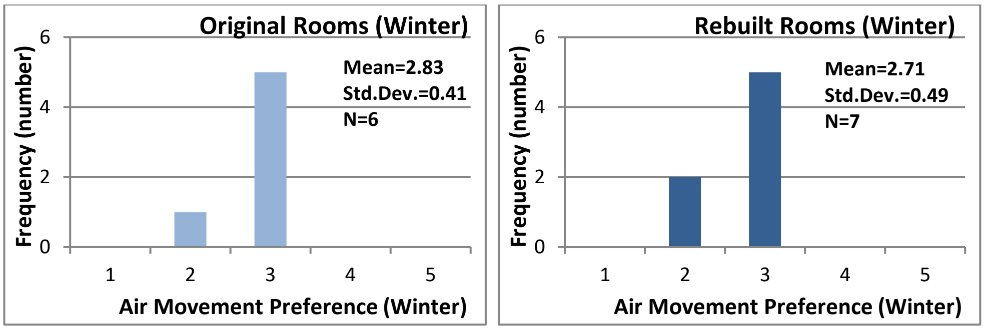

Figure 9.24: Distribution of the air movement preference votes in winter in the original (left) and rebuilt (right) rooms of Dana hotel (Author 2020). 1=much less, 2=less, 3=no change, 4=more, 5=much more

Overall, the occupants felt neutral air movement at both parts of Dana hotel. However, a few occupants felt 'much' air movement and would have preferred less. Despite the different size of the windows, the mean values are approximate because most occupants used their rooms during the night-time, most likely from 10 pm to 7 am. Cool breezes and night ventilation were provided in both types of room regardless of the opening sizes due to the northern orientation of the rebuilt rooms and the original rooms' inward orientation.

9.5 Facility and Amenity Issues

The analysis of the tourists' satisfaction with the indoor facilities revealed that at least 75% were satisfied with the original rooms' indoor facilities because the rooms met their expectations (they did not ask for more) (**Figure 9.25**). One of the satisfied tourists said that 'for me as a tourist, I just need a place to sleep in, no matter its quality or services'. Another tourist commented that 'I don't look for a 5-star hotel. I came here to explore the culture and to live in the same way they do. I eat their food and sleep in the same room they used to occupy'.

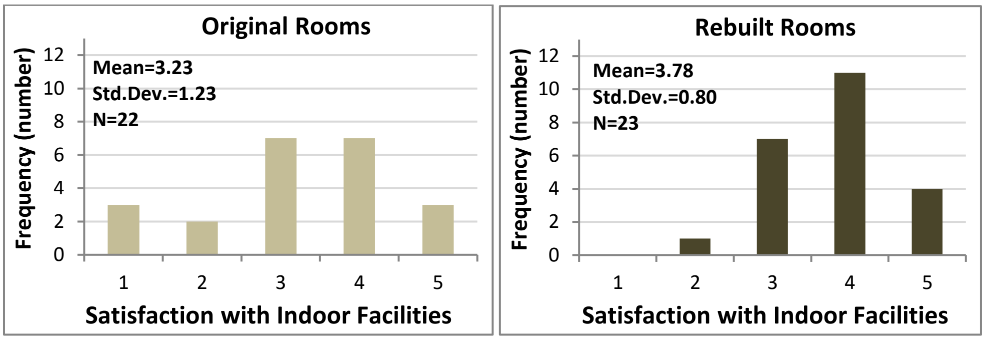

Figure 9.25: Distribution of the indoor facility satisfaction votes in the original (left) and rebuilt (right) rooms of Dana hotel (Author 2020). 1=very dissatisfied, 2= dissatisfied, 3=neutral, 4=satisfied, 5=very satisfied.

Originally, the vernacular houses were built by the locals according to their needs, culture, and possibilities, as well as to the availability of local materials. The houses were built without architects or any control/legal limitations from the government. In Dana hotel, the courtyard is one of the most important facilities in the hotel's original part. It is an open semi-public space that was created for thermal and privacy purposes. Privacy was one of the main cultural aspects for creating the courtyard, which represents the introverted formation of houses. Therefore, it became the heart and most active space in the vernacular houses.

As a result, the courtyard of the original part of Dana hotel was conserved and underwent no changes due to its social, cultural, and environmental significance, and many tourists mentioned that it is the best attribute of the original part of Dana hotel. On the other hand, several alterations were made to the original part of the hotel but were kept to a minimum.[47] They were implemented by unspecialised craftsmen, most likely local people, and were required to adapt to the new hotel uses and users. For instance, two rooms on the ground floor were transformed into toilets, which were not provided in the original vernacular houses. This was done by adding internal partitions, covered with ceramic tiles, and installing a drainage system and water supply.

Furthermore, supply systems were installed to the original rooms before re-plastering the internal walls, such as adding new electrical systems and fixtures to provide electricity and artificial lighting when needed. The entire building was then connected to the public sewage and water systems. Following the reuse and refurbishment works of the original part, most tourists claimed that the original rooms were very basic, clean, and suitable for staying in the village. As their indoor space is formed of a single-space used for resting and sleeping, they share facilities such as a toilet, sink, and shower located in the shared bathroom area (two sections: one for males and one for females).

Some tourists claimed that ‘although the hotel was full, we never waited for a long time; maximum 5-10 minutes. Due to the good service and the constant cleaning, the bathroom area was clean enough, with plenty of hot and cold

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[47] The main aim of the rehabilitation project of Dana village was to revive the abandoned houses by reusing them to accommodate tourists. The process adopted certain interventions and alterations in the original and rebuilt parts of Dana hotel, including changing the facilities and amenities. The transformation of Dana’s vernacular houses into hotel rooms was accompanied by minimum changes and alterations to the houses in good condition. However, more changes were made to houses in bad condition, as they were rebuilt with consideration of the new needs of the tourists. These changes included the addition of bathrooms, kitchenettes, and lighting shafts.

water'. At least 90% of tourists staying in the original rooms wanted to experience the original vernacular buildings and lifestyle. Therefore, for the tourists who are not into traditional accommodation, the original rooms might not have suited their needs. They might have preferred the rebuilt rooms or the new RSCN hotel.

The analysis revealed that the room prices also played an essential role in the satisfaction with the indoor facilities. One of the tourists stated that 'compared with the money I have paid, yes I am satisfied. But in general, I prefer to have a private bathroom rather than sharing it with others.' On the other hand, the dissatisfied tourists (25%) mostly stayed in the original rooms due to their strict budget or the hotels being fully booked, meaning they had no options, especially in August. One of the dissatisfied tourists commented that 'it was hard to live in this room because I don't have my private bathroom'.

In the rebuilt rooms, there was an obvious shift toward the satisfied side of the scale. More than 90% of the tourists were satisfied with the rebuilt rooms' indoor facilities, as they have a bathroom and lighting shafts that bring sunlight into the indoor spaces. The satisfied tourists claimed that the rebuilt rooms were comfortable, simple, and clean. They also said that the rooms preserved the village's charming original characteristics and mentioned the conserved original arches that added a simple charm to the indoor space.

However, fewer than 10% of the tourists were dissatisfied with the indoor facilities of the rebuilt rooms. Some of them attributed their dissatisfaction to the poor planning of the facilities. For instance, the glass wall of the shaft that faces the shower area was a big concern, especially in winter, because the glass surface was very cold, cooling the toilets down (**Figure 9.26**). The dissatisfied tourists also claimed that the rebuilt buildings should have been constructed better because the finishes were not ideal, suggesting a significant correlation with the indoor physical conditions. For instance, although private bathrooms are provided, they are sometimes in bad conditions, affecting the tourists' satisfaction with the indoor facilities. Some tourists complained that the bathroom pipes were leaking, so adequate water pressure was not available.

Figure 9.26: The glass wall of the shaft that faces the shower area in one of the rebuilt rooms (Author 2019)

9.6 Thermal Control Issues

This section investigates the occupants' perception of thermal controls that tourists could use to be thermally comfortable by changing the indoor thermal conditions. They were asked if they had used any of the building controls in order to record their interaction with the room they stayed in, such as opening/closing windows, using heating/cooling devices, or opening/closing blinds. A 5-point scale (from 1 = too little control to 5 = too much control) was used to indicate the level of control within the original and rebuilt rooms of Dana hotel.

The analysis highlighted that 65% of the responses perceived ‘neither little nor much’ level of control in both types of room in summer. All the other responses were ‘little’ and ‘too little’ level of control in the original rooms, while only 20% of responses perceived ‘much’ control in the rebuilt rooms (**Figure 9.27**). The mean value of the responses for the level of control is lower in the original rooms in summer, highlighting the fact that the occupants found a higher level of control in the rebuilt rooms. The original room occupants pointed out the low level of control in summer related to the small window area, claiming they needed to open both the window and door to feel cooler by enhancing the air movement.

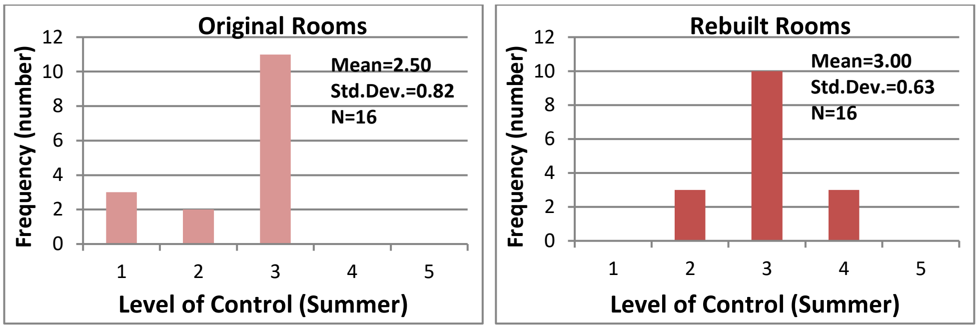

Figure 9.27: Distribution of the level of control votes in summer in the original (left) and rebuilt (right) rooms of Dana hotel (Author 2020). 1=too little control, 2=little control, 3=neither little nor much, 4=much control, 5=too much control

They added that they feel secure when keeping their door (which faces the courtyard) open due to the location of the rooms within the main building. However, no one in the rebuilt rooms kept their doors open due to security reasons, as the rooms are scattered around the village, and their doors face the outside directly. Furthermore, the rebuilt rooms’ occupants attributed the high level of control in summer to the lighting shafts. They claimed that they kept both the wall and shaft windows open to bring a few cool breezes indoors, enhancing the cross ventilation. However, fans are provided and used by the occupants of both types of room who still feel warm after using the rooms' thermal controls.

In winter, 16% of the respondents perceived a 'too little' level of control in the original rooms. In addition, 84% and 100% perceived either a 'little' or 'neither little nor much' level of control in the original and rebuilt rooms respectively (**Figure 9.28**). The occupants' responses regarding the level of control in winter show almost equal mean values in both the original and rebuilt rooms. Most occupants perceived a neutral to a little level of control in both types of room. They claimed that although they kept their room window closed, they did not feel warmer. Therefore, gas heaters were provided and used, but they were not a good solution for some occupants as they felt it was dangerous to sleep when the gas heaters are on, and with the windows closed.

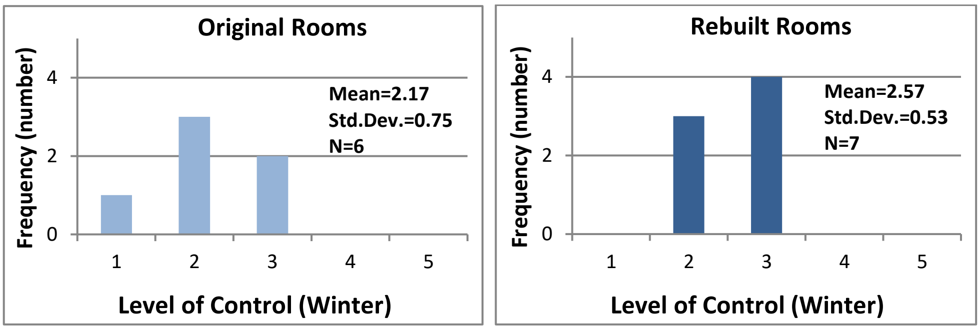

Figure 9.28: Distribution of the level of control votes in winter in the original (left) and rebuilt (right) rooms of Dana hotel (Author 2020). 1=too little control, 2=little control, 3=neither little nor much, 4=much control, 5=too much control

Furthermore, the percentage of respondents indicating 'little level of control' increased in the original and rebuilt rooms in winter compared to summer. This might have been due to occupants' thermal sensation, as they felt colder in winter and so needed a greater level of control. Therefore, the correlation between the level of control and thermal sensation was analysed, showing their mutual effect. A clear link was found between thermal sensation and level of control in the original rooms in summer ($r = 0.59$, $p < 0.05$). This suggests that respondents who felt warmer in the summer in the original rooms perceived a low level of control and would have preferred a higher level of control (**Table 9.5**).

Table 9.5: Correlation between the level of control and thermal sensation in summer and winter (Author 2020)

	Level of control vs thermal sensation (r-value)	
	Summer	Winter
Original rooms	0.59	-0.48
Rebuilt rooms	0.17	0.51

* Hidden cells are statistically not significant.

The respondents were also asked to indicate their satisfaction with the level of control (from 1 = very dissatisfied to 5 = very satisfied). The analysis revealed that 65% of the respondents were neither satisfied nor dissatisfied (neutral) in both the original and rebuilt rooms in summer. On the other hand, 30% of respondents were satisfied with the rebuilt rooms' level of control, while the same percentage were dissatisfied with the original rooms (**Figure 9.29**). In winter, most respondents (62%) were satisfied with the level of control in the rebuilt rooms, while 50% were dissatisfied with the original rooms (**Figure 9.30**).

Overall, the occupants' responses regarding their satisfaction with the level of control in summer and winter show different mean values in both the original and rebuilt rooms. Specifically, occupants were most likely to be satisfied with the rebuilt rooms' level of control but dissatisfied with the original rooms. Furthermore, the percentage of dissatisfaction increased in the rebuilt rooms in winter compared with summer due to the lower level of control; occupants needed more control to improve the cold thermal conditions. The correlation between the level of control and the satisfaction with this level of control was investigated and showed a mutual effect.

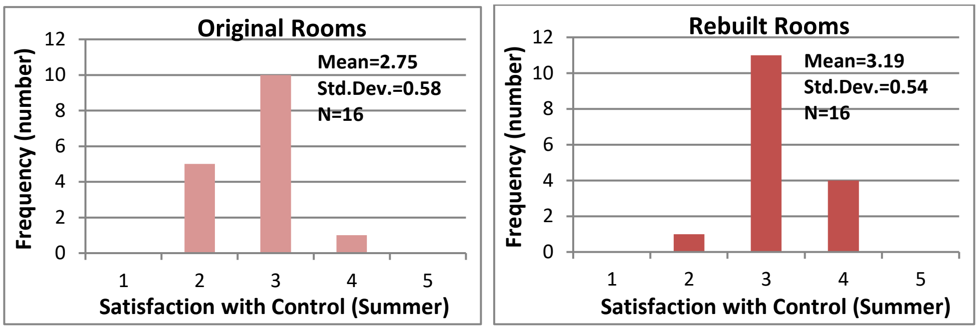

Figure 9.29: Distribution of the satisfaction with the level of control votes in summer in the original (left) and rebuilt (right) rooms of Dana hotel (Author 2020). 1=very dissatisfied, 2= dissatisfied, 3=neutral, 4=satisfied, 5=very satisfied

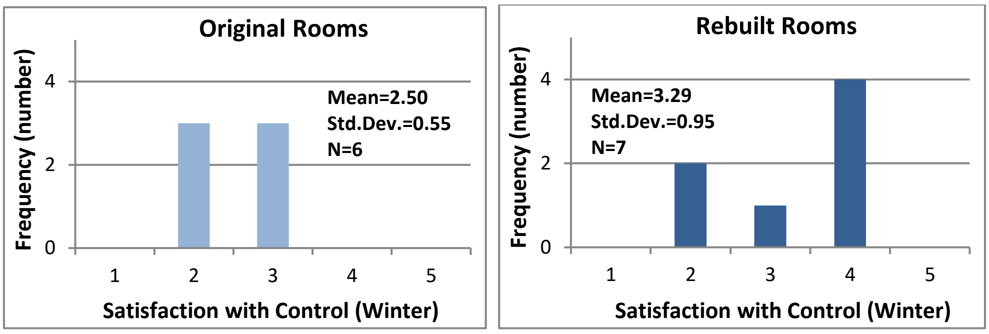

Figure 9.30: Distribution of the satisfaction with the level of control votes in winter in the original (left) and rebuilt (right) rooms of Dana hotel (Author 2020). 1=very dissatisfied, 2= dissatisfied, 3=neutral, 4=satisfied, 5=very satisfied

The analysis revealed a strong correlation in summer in the original ($r = 0.85$, $p < 0.05$) and rebuilt rooms ($r = -0.78$, $p < 0.05$). This suggests that occupants who were satisfied with the level of control felt less warm in the original rooms in summer. However, those who felt warmer in summer perceived a low level of control and were not satisfied in this respect in the rebuilt rooms. Similarly, a strong correlation was found in winter in the rebuilt rooms in ($r = 0.94$, $p < 0.05$) (**Table 9.6**). This suggests that respondents who felt cold in the rebuilt rooms were not satisfied with the level of control, perceiving a low level of control but preferring a higher one.

Table 9.6: Correlation between the level of control and satisfaction with the level of control in summer and winter (Author 2020)

	Level of control vs satisfaction with the level of control (r-value)	
	Summer	Winter
Original rooms	0.85	-0.73
Rebuilt rooms	-0.78	0.94

* Hidden cell is statistically not significant.

Being dissatisfied with the level of control means that occupants still felt uncomfortable with the thermal environment after using the building's thermal controls. Therefore, they behaved in their own personal ways to adapt to the thermal environment. This behaviour plays an essential role in expressing their thermal sensation and explaining their satisfaction with the level of control. The occupants' adaptive behaviour might be in the form of changing their clothes, posture, place, or/and activities (metabolic rate).[48] The analysis of this behaviour revealed that some occupants who felt warm in summer attributed their behaviour to the warm conditions, even after using the room's thermal controls.

In addition, other occupants could not use the controls for various reasons, such as the mosquito issue that limits the opening of windows. Moreover, other occupants who had mosquito nets over their beds could not use the fans because they disturbed the nets. Consequently, they behaved in various ways to cool themselves down. For instance, some occupants said they took a cool

[48] Adaptive behaviour is 'How occupants behave in their building to adapt to the thermal environment factors' (Nicol, Humphreys and Roaf 2012, p. 157).

shower before going to bed to cool their bodies down, while others slept without a blanket and wearing light clothes to feel cooler. Moreover, two of the original room occupants, who could not sleep in such warm indoor conditions, said they took their mattress and put it on the roof to sleep outside. Respondents added that hotel staff had informed them that people in Dana were used to taking such action on warm nights. They said that 'it was a night to remember as it was very quiet and the weather was cool outside, and we both enjoyed it'.

However, in winter, most occupants were uncomfortable in both the original and rebuilt rooms, even after using the thermal controls. The weather was chilly, and the rooms were still very cold, especially at night when the rooms were occupied. The rebuilt room occupants complained about the location of the shower near the glass side of the shaft, which enhanced the heat transfer, making it hard to take a shower in such cold conditions. Some occupants used a towel in the rebuilt rooms to cover the window from inside to prevent the heat loss due to its large area and the absence of blinds. Therefore, all occupants wore warm clothes and covered themselves with a warm blanket.

9.7 Original and Rebuilt Rooms' Challenges and Potential Solutions

The results of analysing the tourists' satisfaction with the built environment and their thermal comfort helped identify the issues and challenges facing the original and rebuilt rooms of Dana hotel. The issues were related to the transformation of the original vernacular elements. The restored houses underwent several changes to adapt to the new uses and users of the village. These changes were the result of the different village population (new users), facility needs (new needs), financial limitations, and maintenance requirements. As discussed, these changes led to several challenges, such as a lack of durability, affordability, privacy, daylighting, and ventilation. These issues were the result of the need for new facilities, the replacement of construction materials, and the changes in opening sizes.

First, the construction materials used in the original rooms of Dana hotel were local, natural, and sustainable. They were not imported and were not manufactured or processed. The original rooms were mainly built of stone, clay, and juniper wood. The analysis of the thermal performance (Chapter 8) highlighted that these materials improved the rooms' thermal performance and enhanced their sustainability due to their low thermal conductivity as well as using passive techniques to adapt to the climatic conditions. However, the construction materials used in the rebuilt rooms were quite different. They were mainly synthetic materials that were not local, durable, or sustainable because they are hard to reuse or recycle in Jordan. The thermal analysis also highlighted that the rebuilt rooms' concrete structures have poor thermal performance if no insulation materials are applied, due to their high thermal conductivity.

Furthermore, as the form of the original buildings was mainly the result of the socio-cultural context of the village, most occupants claimed that the original rooms were aesthetically unique referring to their characteristics that adapted to the socio-cultural and bioclimatic context. For instance, privacy was a significant factor that was taken into consideration. Therefore, most of the original buildings were introverted with small external openings. Moreover, houses with a courtyard (similar to the original part of Dana hotel) were built to respond to the privacy needs in particular and other socio-cultural and environmental needs in general.

However, the analysis of the POE survey highlighted that the issue of privacy was a repeated concern of the tourists in the rebuilt rooms due to the large, low windows without blinds. This is because the rebuilt buildings depended mainly on the financial situation and funds of the USAID, leading to the neglect of other important aspects that needed to be conserved. For instance, the USAID used concrete structures instead of timber ones as they became the construction trend in Jordan and were widely used after the 1980s, becoming cheaper and more affordable. Overall, the project stakeholders gave priority to reducing the cost of the restoration process in order to be able to restore more houses.

In most cases, they restored houses at a low cost, paying no attention to conserving their social and cultural identity, with the rebuilt rooms of Dana hotel being cases in point. As a result, the new opening sizes raised several issues related to the socio-cultural values and environmental context. The buildings' openings were given high consideration when the original buildings were built, in terms of their size, number, orientation, and location. The original openings were limited in number and small in order to provide privacy and adapt to the climatic conditions as a passive strategy. The limited openings were intended to control heat loss and gain. They were also oriented to collect sunlight in winter and provide a cool breeze in summer.

On the other hand, the openings of the rebuilt rooms were enlarged without considering factors such as privacy, solar radiation, and wind direction in both summer and winter. Considering the privacy and thermal issues, high windows would be a solution to provide privacy and enhance the natural daylighting in indoor spaces. They would offer night ventilation when the other windows are closed for safety purposes. In addition to adjusting the opening sizes and positions, adding water elements in public or semi-private areas (courtyards or yards) offers evaporation cooling that also reduces the heat in summer. This method was used traditionally by watering plants and courtyards to enhance the evaporation cooling (Philokyprou et al. 2013).

Vegetation also plays a vital role in solving thermal issues. It is considered to be a natural thermal controller that shades the building envelope, reduces high temperatures and reduces changes in humidity (Philokyprou, Michael and Thravalou 2013, p. 9). Vegetation controls the airflow, affecting the buildings' ventilation and air quality. The kind of trees used plays an important role in benefiting from the airflow and sunlight. For instance, deciduous trees are efficient near the southern facade because they provide shading and prevent sun radiation in summer. However, they allow solar radiation into the building in winter to warm up the indoor spaces. On the other hand, evergreen trees are efficient by the side of facades that are exposed to strong winds.

These trees work as a barrier that prevents winds and protects buildings from undesirable cold winds in winter and hot dry winds in summer (Philokyprou, Michael and Thravalou 2013). **Table 9.7** highlights the challenges of the original and rebuilt rooms of Dana hotel and suggests potential solutions with an explanation of their purposes. The suggested solutions could be applied to the occupied original and restored buildings. They could also be considered when the other vernacular houses of Dana village are restored in order to avoid the same challenges and problems.

Table 9.7: Challenges and problems of the original and rebuilt rooms of Dana hotel, combined with potential solutions and the reasons behind these solutions (Author 2021)

Type of Issue	**Original Rooms**		
	Challenges	**Solution**	**Reason**
Durability/ construction materials	• Water leakage from the original roof. • Poor condition of the original roof.	• Rebuild the original roof every year. • Perform frequent maintenance.	• To prevent rainwater from leaking into indoor spaces. • To improve the aesthetic aspect of the original rooms.
Room area/ opening sizes/ ventilation	• Some occupants felt the ventilation is lacking due to the small size of the windows combined with high density of occupants. Furthermore, the small size of single openings led to limited ventilation.	• Reduce the density and number of occupants in rooms that have more than three occupants. • When possible, add one more window to offer cross ventilation, keeping their small size.	• To achieve better ventilation because less density means better ventilation. • The area of rooms must be compatible with the number of occupants.
Form/ opening sizes/ thermal comfort	• Some occupants felt warm in summer due to the small window areas and little air movement.	• Add vegetation and green elements in the courtyard.	• To provide healthy conditions and thermal comfort because green plants are considered as an evaporative cooling element.
	Rebuilt Rooms		
	Challenges	**Solution**	**Reason**
Thermal comfort/ construction materials	• Occupants are more likely to be uncomfortable with the thermal conditions in winter.	• Use new efficient insulation materials. • Use finishing materials with light colours.	• To improve the indoor thermal conditions. • To reduce heat transfer, heat gain in summer and heat loss in winter.

Thermal comfort/ opening sizes	• Occupants are more likely to be uncomfortable with the thermal conditions in winter.	• The orientation of windows should be considered to benefit from the southern sunlight in winter and northerly winds in summer. Therefore, enlarge northern windows and keep the southern windows small. • The window position should be high to allow the sunlight to penetrate deeper inside the room in winter and enhance ventilation in summer. • Add screens such as 'Mashrabiya' to windows on the southern facades.	• To improve thermal performance in summer and winter. • The 'Mashrabiya' blocks sunlight in summer (avoiding heating) and cold winds in winter (avoiding cooling).
Privacy/ opening sizes	• Windows are big and low, exposing the indoor space. • No curtains or blinds are provided. • Some bathroom windows are big and low.	• Add curtains or blinds to the external windows. • Add screens such as 'Mashrabiya', as was the case in in vernacular architecture. • The original number of windows (few) and location (high) should have been maintained. • Bathroom windows should be small and high.	• To provide privacy after the windows were enlarged. • The restored rooms should conserve the socio-cultural context, such as privacy. • Rooms should be compatible with the locals' culture and beliefs.

Durability/ construction materials	• The finishing at the rebuilt rooms is below all standards. • The walls are damp with slight efflorescence in the lower area (peeling walls).	• Repaint peeling walls. • Apply waterproof coating. • Maximise daylight penetration. • Provide adequate air movement.	• To produce damp-free walls that resist water pressure and humidity.
Sustainability/ materials	• The adopted construction materials are not durable because they are hard to reuse or recycle in Jordan.	• Use construction materials that are local and derived from nature. • Use construction materials that can be reused and recycled. • Use construction materials that are available and cheap.	• To enhance the durability and sustainability of the vernacular buildings. • To provide affordable structures because natural, local materials are cheaper than imported and synthetic ones.
New facilities/ thermal comfort/ privacy	• Poor planning of the addition of lighting shafts and bathrooms.	• The glass walls of the lighting shaft should only face the bedding area.	• To enhance thermal comfort in winter because when the shaft's glass wall faces the shower area, the glass surface will cool the bathroom down. • To provide privacy, as some occupants felt exposed and did not feel comfortable taking a shower.

9.8 Discussion and Conclusions

After analysing the thermal environment of Dana hotel, the study focused on the subjective responses of the hotel occupants using POE tool to evaluate the hotel's original and rebuilt rooms in terms of the occupants' satisfaction with the built and thermal environment. The employment of the POE was challenging in Dana because all the original inhabitants have changed into tourists from different regions and social backgrounds, following the transformation of houses into tourist accommodation. The new uses and users of the village represent the key challenge to reconciling the conservation of vernacular architecture with the new tourist requirements that are mainly linked to their satisfaction with the built and thermal environment.

Tourists are used as participants to identify the issues and challenges of both the original and rebuilt rooms. The occupants' conditions and behaviour were recorded and analysed to provide useful feedback on their occupation of both the original and rebuilt rooms of the hotel. The survey obtained tourist feedback on the built and thermal environment of the original and rebuilt rooms, which underwent various changes during the rehabilitation project to adapt to the new uses, needs, and users. The analysis of the POE survey concludes that those staying in the original vernacular rooms felt more satisfied with the indoor physical conditions (55% of the surveyed residents were satisfied) than those in the rebuilt ones (35%).

The residents' satisfaction is mainly based on the antiquity and originality of the construction materials, emphasising the durability of the stone used for the external walls. Most tourists agree that the original vernacular buildings were aesthetically unique due to their characteristics that adapted to the socio-cultural and bioclimatic context. This finding corresponds to those of previous studies, such as Eyüce (2007), Memmott and Keys (2015), Chiesa and Grosso (2017), and Al-Sallal (2017). Subsequently, it is concluded that tourists are mainly attracted to the way of constructing rural settlements and the use of local materials and construction techniques that reflect the buildings' antiquity and originality, such as the thick stone walls, timber roofs, and wooden doors.

The data from the POE survey also reveals that those staying in the rebuilt rooms felt more satisfied with the opening sizes (75% satisfaction) than those in the original ones (50%). The analysis highlights that the tourists' satisfaction with the opening sizes is influenced by the ventilation and daylighting, which depend mainly on the window orientation, size, and location. Unlike the rebuilt rooms, the minimal daylighting and ventilation in the original rooms is one of the features that conflicted with the new tourist needs. This confirms the efficiency of certain interventions, such as enlarging the windows and adding lighting shafts, showing that they improved daylighting, air movement, and indoor thermal conditions.

Although internal shafts were added, while emphasising the introverted form of the vernacular houses, the external windows were enlarged, exposing the indoor spaces to the outside. Therefore, the issue of privacy became a repeated concern of the tourists in the rebuilt rooms due to the large, low windows without blinds. This is noted from the POE survey and confirmed by data gathered from observations. It was noticed, for instance, that some residents used towels to cover the windows for more privacy. This concludes that adding lighting shafts while maintaining the original opening sizes would have been a better solution for transforming the vernacular houses into hotel rooms and meeting the needs of the tourists.

In addition to evaluating the tourists' satisfaction with the built environment, the POE survey aimed to identify the challenges of the thermal environment. Tourists' overall thermal comfort was discussed in relation to their sensation of the indoor temperature, humidity, and air movement. The analysis of occupants' responses regarding the thermal environment highlights that those in the original vernacular rooms were more comfortable thermally than those in the rebuilt ones. This concludes that the original local construction materials and the original building design plays an essential role in improving thermal performance, including the thermal mass, opening sizes and orientation.

Furthermore, the correlation analysis reveals clear links between thermal comfort, thermal sensation, and satisfaction with the level of control in the buildings. If tourists are uncomfortable with the thermal environment after using the building's thermal controls, they are more likely to be dissatisfied with the level of control. For instance, those who feel warm in the summer perceive a low level of control and would prefer a higher level. On the other hand, the correlation between overall satisfaction with the built environment and satisfaction with indoor facilities, indoor conditions, and opening sizes is stronger in the original rooms than in the rebuilt ones. This suggests that occupants dissatisfied with the indoor facilities, indoor conditions, and/or opening sizes of the original rooms are also dissatisfied with the overall built environment.

As a result of this chapter, the issues related to the original and rebuilt rooms are identified, such as facilities and amenities, construction materials and techniques, durability and sustainability, affordability, privacy, opening sizes, daylighting, and ventilation. Potential solutions are also suggested to help make recommendations and provide lessons for future development projects to ensure better practices and avoid existing problems. So far, through the lens of the theoretical assessment framework, a comprehensive analysis of the impact of the transformation process is conducted from the researcher and occupants' point of view. As this thesis aimed to develop an integrated assessment framework to assess the transformation of vernacular settlements into tourist accommodations, the following chapter critically appraises the employed methodology within the context of the theoretical framework.

Chapter Ten: Conclusions and Future Recommendations

10.1 Introduction

The thesis investigated the problem of assessing the transformation of vernacular settlements into tourist accommodations in the era of climate change, emphasising the need to assess such transformations against sustainability. Climate change has become a global concern over the recent decades, resulting in adverse impacts on natural resources, human societies, and environments across every region, including the middle east (Turner et al. 2005). It impinges on the sustainable development of developing countries, such as Jordan, compounding the pressure on the environment (I.P.O.C. 2001, p. 8). Therefore, the world is moving towards more sustainable approaches to reduce the impact of climate change, raising the significance of assessing any activity against sustainability, including heritage conservation activities.

However, assessing heritage conservation against sustainability has not been attempted before as their study is usually conducted separately by researchers from different disciplines. This raised the significance of conducting an interdisciplinary study that combines heritage conservation and sustainability. Therefore, this thesis aimed to develop an interdisciplinary assessment framework that combines the assessment of heritage conservation and thermal performance of vernacular buildings when transformed into tourist accommodations, considering the thermal environment as a key parameter of sustainability. To this end, it investigated the existing Heritage

Impact Assessment (HIA) frameworks and thermal assessment methodologies.[49]

The HIA focuses on the cultural attributes of the architectural and urban heritage.[50] This assessment is essential to evaluate the extent to which the transformation respected the cultural identity of heritage buildings/sites (ICOMOS 2011; Seyedashrafi et al. 2017). Meanwhile, the thermal assessment is concerned with the climatic context to evaluate the extent to which the transformed buildings provide thermal comfort.[51] Dealing with each assessment separately does not lead to an integrated evaluation of whether the performed transformations are proper or not from all the architectural, urban, and thermal perspectives. The combination of these perspectives in one assessment framework overcomes this limitation, enabling local authorities to evaluate the transformation of different heritage assets.

This thesis, therefore, expanded on previous studies, developing a more integrated and interdisciplinary assessment framework to evaluate the impact of transforming vernacular settlements into tourist accommodations, identify challenges, and recommend actions to improve such transformations (**Figure 10.1**). The framework represents the first attempt to combine architectural

[49] The existing HIA frameworks include internationally developed ones by the World Heritage Centre (WHC 2008) and ICOMOS (2011). They also include scholarly developed ones by Seyedashrafi et al. (2017) and Faria (2020).
[50] The cultural attributes include the building's form and design; materials; use and function; techniques; location, and other forms of intangible heritage (UNESCO 2012, p. 22).
[51] The typical technical approach for the thermal assessment is monitoring the physical variables, e.g., temperature and humidity, to assess the performance of buildings in terms of daily variations and thermal comfort (Bozonnet, Doya and Allard 2011; Soebarto and Bennetts 2014). Besides, post occupancy evaluation surveys take the viewpoint of occupants in the thermal assessment by rating their comfort (Nicol and Roaf 2005).

and urban assessments with the thermal assessment while considering occupants as an integral part of the overall assessment process.[52] Synthesising existing assessment frameworks in the literature, this new assessment framework was tested in Dana village, which was the main case study of this thesis.[53]

Overall, this thesis contributes to the field of heritage conservation by providing an integrated framework for assessing the transformation of vernacular settlements against heritage conservation and sustainability. This final chapter concludes this thesis by critical appraising the employed methodology drawing on the case study findings and in the context of the theoretical framework. The following section discusses the findings derived from Dana and the novelty of the employed methodology, comparing them with the ones of other studies. This chapter also highlights the study limitations and provides a list of recommendations for future studies.

[52] For instance, Steele and Badran (2005), Asquith and Vellinga (2006), and Seyedashrafi et al. (2017) focused on the architectural and urban assessments; Bozonnet, Doya and Allard (2011) and Soebarto and Bennetts (2014) focused on the thermal assessment; Leaman, Stevenson and Bordass (2010) and Pereira, Rodrigues and Rocha (2016) focused on POEs.

[53] This study overlaps the frameworks established by Faria (2020) and Del and Tabrizi (2020); with the significance/weight values, established by Del and Tabrizi (2020) to give each assessment criterion a value of impact; with ICOMOS's HIA matrix (2011) to evaluate the established assessment criteria. Moreover, the study uses the technical approaches of Soebarto and Bennetts (2014) and Nicol, Humphreys and Roaf (2012) to assess the thermal performance and impact. Finally, the occupant's point of view is investigated through a POE survey in accordance with Leaman and Bordass (2001) and Nicol and Roaf (2005).

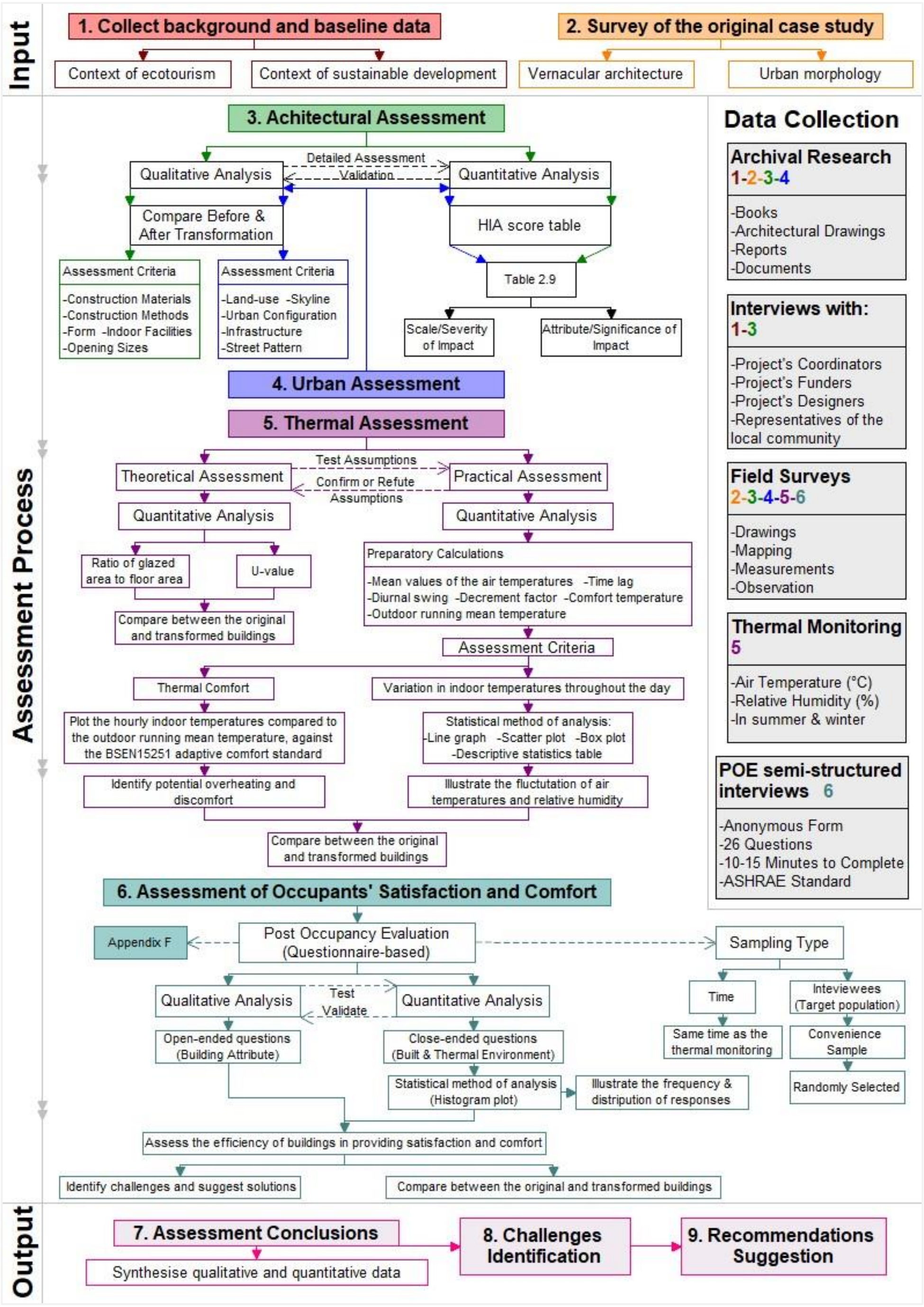

Figure 10.1: Integrated Assessment Framework (Author 2022)

10.2 Integrated Assessment Framework

The literature review (Chapter 2) demonstrated the limitations of separate investigations of the conservation and environmental (climate adaptation) aspects of new developments in vernacular settlements. It was found that the evaluation of whether the performed development approaches are adequate for the village's heritage conservation and sustainability requires combining both disciplines in one assessment framework. This study employed this combination to overcome the limited and sometimes problematic evaluations conducted in either discipline. For instance, Waked (2008) investigated the performed changes to some heritage buildings, such as covering courtyards with transparent all-glass roofs. He highlighted that the assessment focused on the cultural purposes of courtyards and found that such change kept the introverted orientation and respected the occupants' privacy. However, overlooking the thermal assessment of this change that caused excessive heating in summer was problematic and led to insufficient evaluation.

The present study overcame the above shortcoming by developing an alternative, holistic assessment process that consists of four phases: the architectural assessment, urban assessment, thermal assessment, and assessment of occupants' satisfaction and comfort. The assessment of transforming each heritage asset from the four perspectives offered better understanding than the one gained from each perspective alone. This is concluded from testing the framework on Dana village. For instance, the assessment of Dana revealed that transforming the building envelope caused adverse impacts on Dana's architectural heritage, beneficial impact on its urban heritage, better thermal comfort and performance, and improved satisfaction of occupants. The combination of these evaluations in a single assessment process helps maintain the beneficial changes and avoid the adverse ones, taking into consideration the four assessment phases.

The first phase of assessing the impact of transforming vernacular buildings into tourist accommodations is the architectural assessment that focuses on the architectural heritage assets, such as the form and structure of buildings. This study adopted the typical technical approach for such assessment, which surveys buildings/settlements and compares the original (unaltered) and restored (altered) buildings, in accordance with other studies (Steele and Badran 2005; Asquith and Vellinga 2006; Lawrence 2006; Oliver 2007). The qualitative approach of this assessment examined what took place during the development of Dana and evaluated the compatibility between the adopted changes, cultural identity, and the current needs of the occupants. It was found that the original construction materials were replaced, the building envelopes changed, openings were enlarged, and lighting shafts were added.

However, depending on the results of the qualitative assessment is limited since it provides subjective interpretations that vary from researcher to researcher. Therefore, this study also employed the quantitative approach of assessment, using the HIA model established by ICOMOS (2011) due to the absence of locally developed ones, in correspondence to Seyedashrafi et al. (2017). This provided objective detailed assessments that validated the results of the qualitative analysis and determined the impact of changes/transformations according to internationally well-established assessment criteria. However, Seyedashrafi et al. (2017) overlooked the value-based approach that many scholars have adopted in the conservation and assessment process, such as Eriksson et al. (2014), Jokilehto (2016), and Faria (2020).

Such an approach brought to the surface the significance of recognising the inherent value of the building attributes and their impact on the conservation process. The criteria for selecting the ‘significance/weight values’ varied in the literature because there is no universally standard that details how heritage 'significance/weight values' should be determined (De la Torre 2013; Eriksson et al. 2014, p. 138). For instance, Jokilehto (2016) and the Energy Efficiency for EU Historic Districts' Sustainability (EFFESUS) system developed various categorisations of the level of heritage values (Eriksson et al. 2014). However, these values are considered flexible rather than absolute, requiring the users to determine the significance value based on several parameters.

This study aimed to adopt absolute 'significance/weight values' to avoid the varying determination of values, in accordance with Faria (2020), who employed the Portuguese assessment model that is locally developed using specific 'significance/weight values' and 'assessment matrix'. However, as this thesis is concerned with the middle eastern region, it employed different 'significance/weight values' and ICOMOC's HIA model. In correspondence to Del and Tabrizi (2020), this study depended on the frequency of investigating the building attributes in the literature to establish their significance values since valuable attributes are prioritised in the conservation study as their impact on conservation is more significant.

Overall, this study overlapped the relevant HIA frameworks (ICOMOS 2011; Del and Tabrizi 2020; Faria 2020) to develop a more integrated HIA framework that overcomes the shortage of each. Assessing Dana village using the developed framework determined the 'scale/severity of impact' and 'attribute/significance of impact', taking into account the form of changes being direct or indirect, reversible or irreversible, permanent or temporary, visual or/and physical. It was concluded that the transformation of Dana's roofs (major adverse impact with a score of -3.81), walls (minor-moderate adverse impact with a score of -2.33), and openings (minor-moderate adverse impact with a score of -2.36) caused adverse impacts due to the comprehensive changes to their key settings without sufficient purposes. Removing the original roofs or walls and imposing new unrelated types offered new architectural models with different characteristics and features, in line with Foruzanmehr and Vellinga (2011).

In contrast, the transformation of Dana's form caused major beneficial impact with a score of (+4.00) as it conserved the main indoor elements, while developing the spatial arrangement by adding the essential indoor facilities required for hotel rooms. This is in line with Orbaşli (2009) who stated that the adaptive reuse of existing buildings requires essential interventions and upgrading of indoor facilities. With the roofs and walls having the highest 'significance/weight value', the overall architectural impact was adverse with a score of (-1.42). As a result, the framework enabled the assessment of Dana's key heritage settings, architectural components (roofs, walls, form, and openings) and the overall architectural impact.

The assessment process proceeded with the urban assessment that evaluates the impact of transforming vernacular settlements into tourism-related ones, focusing on the main characteristics of the urban heritage, such as land use, urban fabric, and landscape. For the urban assessment, this study conducted qualitative and quantitative assessments, in accordance with Seyedashrafi et al. (2017), following the same methodology as the architectural assessment for developing the HIA framework. However, it was found that discussing the urban attributes was not detailed enough, including only the urban fabric, skyline, and land use (Del and Tabrizi 2020).

Therefore, this study went into more detail with the urban assessment criteria and suggested their 'significance/weight values'. The urban fabric criterion was divided into more detailed aspects, including the urban configuration, street pattern, and infrastructure. Assessing the urban context of Dana using the developed HIA framework revealed that the only adverse impact was caused by the transformation of Dana's urban configuration (score of impact attribute = -2.25). This is because new buildings were constructed while having empty restored houses, leading to expanding the original village without a sufficient purpose. The adaptive reuse of empty restored houses would have been a better solution, as reviving the original houses was the main aim of the project.

In contrast, the transformation of Dana's land use (moderate beneficial impact with a score of +3.00), street pattern (minor beneficial impact with a score of +2.00), infrastructure (major beneficial impact with a score of +4.00), and landscape (minor beneficial impact with a score of +2.00) had beneficial impacts. Regarding the development of Dana's infrastructure, the addition of bathrooms necessitated connecting the village with a sewage network and water supply. Therefore, the addition of new infrastructure that was not existed before caused a major beneficial impact that adapted the village to the hotel room requirements. This in line with Smith (1989) who stated that facilities and services should be provided, and infrastructure development is required when a settlement is transformed into a tourist destination.

Overall, it was found that the transformation of Dana's urban context caused beneficial impacts (attribute of impact value = +0.70) due to the addition of infrastructure, streets, and roads that left an imprint on the evolving urban context, developing the original village to meet the requirements of tourism. The beneficial impacts, highlighted in the architectural and urban assessments, concluded that transforming vernacular settlements into tourist accommodations required essential interventions and upgrading certain aspects, such as indoor facilities and infrastructures. In line with Orbaşli (2017), performing such interventions was vital for meeting the requirements of hotel rooms and addressing the shortcomings of the existing buildings. However, interventions should not outweigh the original values and features as observed in transforming Dana's roofs and in correspondence to Vellinga (2017).

The third phase of the assessment process is the thermal assessment, which is considered complementary to the architectural evaluation, as it is affected by the building form and envelope. It evaluates the impact of transforming the original features of vernacular buildings on their thermal behaviour. This study adopted the typical technical approach for such assessment, which monitors the physical variables, e.g., temperature and humidity, to assess the performance of buildings in terms of daily variations and thermal comfort, in accordance with Bozonnet, Doya and Allard (2011) and Soebarto and Bennetts (2014). Moreover, Post Occupancy Evaluation (POE) surveys were employed to take the viewpoint of occupants in the thermal assessment by rating their comfort, in correspondence to Nicol and Roaf (2005).

Such an approach enhanced the understanding of the relationship between occupants and the buildings they occupy (Leaman, Stevenson and Bordass 2010). Meanwhile, to assess the impact of changing the building parameters after transforming vernacular buildings into hotel rooms, this study also adopted the approach of Weber and Yannas (2013) who compared the thermal conditions of vernacular and contemporary buildings to figure out which building provides better thermal comfort. However, this comparison does not represent the comparison between original and restored buildings because it neglects the fact that the restored buildings have emerged from the original ones, whereas contemporary buildings have no connection with vernacular buildings. Therefore, this study overcame this shortcoming by undertaking the comparisons between original (unaltered) and restored (altered) buildings.

The assessment of Dana using this approach provided findings that contradict previous studies. For instance, it was concluded that although the original external walls are thicker and have higher thermal storage compared to the new external walls, the rebuilt rooms provided less fluctuations in the indoor temperatures than the original rooms, contradicting previous studies which stated that the high thermal mass improves indoor temperature stability and reduces daily fluctuations (Philokyprou and Michael 2012; Toe and Kubota 2015). Similarly, although the new construction materials provide higher U-values and less thermal resistance than the traditional materials, the rebuilt rooms experienced lower temperatures in summer, with lower diurnal swings than the rebuilt rooms.

This contradicts previous studies that emphasised the advantages of using traditional construction materials in improving the thermal performance of vernacular buildings and providing stable indoor temperatures. (Singh, Mahapatra and Atreya 2010; Philokyprou et al. 2013; Weber and Yannas 2013). The results brought back to the surface the discussion of the factors that control indoor thermal conditions. It was concluded that the adopted changes in the rebuilt rooms, including the replacement of the building envelope, the addition of lighting shafts, and the enlargement of the northern windows, all helped the new building envelope to adapt to the climate of Dana. As a result, the employed methodology that combined the typical technical methodology (thermal monitoring and POE) and the comparison approach formed a sufficient assessment approach for illustrating the influence of the adopted changes on providing stable indoor thermal conditions and thermal comfort.

The last phase of the assessment process is evaluating the occupants' satisfaction and comfort, considering occupants as an integral part of the overall (architectural, urban, and thermal) assessment process. In accordance with Leaman and Bordass (2001) and Nicol and Roaf (2005), this study employed POEs using semi-structured interviews. Rather than conducting several interviews with each interviewee over an extended period of time to illustrate how responses change over time, in line with Nicol and Roaf (2005), this study conducted the interviews once with each interviewee to demonstrate how the responses change from building to building.

Unfortunately, occupancy hours or periods become limiting at this stage. Therefore, this study randomly selected the occupants who were available and to whom there was access at a specific time. Furthermore, in line with most POEs (Veitch et al. 2007; Wongbumru and Dewancker 2016), this study employed qualitative and quantitative analyses, overlapping their findings to reveal the extent to which buildings are efficient in providing satisfaction and comfort. Relating the POE results to the attributes of Dana's original and transformed buildings revealed that the satisfaction and comfort of occupants were context-dependent and varied with the different attributes of buildings. This represented the fruitful step of the POE survey as it identified the issues and challenges of the monitored buildings, and consequently, solutions were suggested.

As a result, it was found that the framework is workable and provides comprehensive assessment and useful results and conclusions. This contributes to future development projects to ensure better practices and avoid existing problems.

10.3 Limitations of the Work

The nature of the study is subject to several limitations, some of which have been discussed in the previous chapters. The restrictions were partly due to the type of data collected on-site and the available resources. For instance, the few works on the application of ecotourism in Jordan focus on its role in conserving natural and cultural resources, overlooking its role in conserving vernacular settlements. This shortcoming was overcome by assessing ecotourism as a methodological approach that guides the transformation process of vernacular settlements. Furthermore, due to the researcher's limited time and budget, a simple measurement survey (level I) was conducted to measure the temperature of the occupied spaces, regardless of the subjective responses and all the factors needed to calculate the heat exchange between a person and the environment.

The results of the thermal assessment also cannot be representative or generalised because the monitoring was conducted in a restricted number of rooms due to the limited number of data loggers and restricted access to other occupied rooms. However, the results indicated the possible thermal performance of similar original and restored hotel rooms. In addition, as the occupancy of rooms is a key factor in analysing thermal performance, the results of the winter monitoring are worth further investigation, maybe by monitoring more occupied hotel rooms in winter. Similarly, as the POE survey was conducted only in August and January, some subgroups of the target population were not present and interviewed.

The underrepresentation of some subgroups of the target population (who were not fully representative) led to the data not being representative of all the relevant age categories, limiting the ability to generalise the results of the interviews. Therefore, convenience sampling was used due to the unknown and changing nature of the study's target population (tourists from different regions and social backgrounds staying in Dana hotel). Such sampling reflected the population which was available and to whom access was possible at a specific time, representing a convenient source of data for the researcher.

Furthermore, as the limitations of the study were partly due to the type of data collected on-site, the assessment of the socio-economic impact was not investigated. The socio-economic impact of development projects includes that of imposing ecotourism activities on the social life and economic development of the local community. The socio-economic impact was not investigated due to time and travel limitations, which hampered the ability to meet the different categories of the local community that work in Dana. Therefore, such investigation is recommended for future research.

10.4 Recommendations for Future Work

This thesis offers a stepping-stone to the process of assessing the transformation of heritage buildings/sites by developing an integrated assessment framework. Further studies could apply such a framework to assess the development of other heritage or historic sites that belong to an extensive geographical spectrum of different countries. Such application advances the understanding of the current situation of other heritage/historic sites, facilitates further comparisons between the different development approaches, and improves the theoretical knowledge. Consequently, further studies could define and explain the good and bad practices in existing tourism development approaches. Furthermore, testing the developed framework on other case studies in the middle east improves its validity and applicability to other forms of development projects.

Further studies could improve the developed framework, making it more comprehensive and detailed by discussing additional aspects of transforming vernacular settlements into tourist accommodations. The improvement could expand the developed framework by including further assessment criteria related to the intangible cultural heritage, economic development, and heritage/tourism management strategies. For instance, the socio-economic impact of tourism development was not investigated in this study due to time and travel limitations that hampered the ability to meet the different community groups of Dana.

Therefore, this could be covered in future studies by explaining the impact of ecotourism activities on the social life and economic development of the host community. Future studies can also expand the developed framework by including thermal simulation modelling to allow a more detailed thermal analysis, showing the efficiency of the building envelopes and their components in resisting heat transfer. This would advance the thermal performance analysis, providing detailed results of the variation in the temperature of each element throughout the day.

Further studies could also develop the assessment conclusions and explore how tourism development could better help regenerate heritage settlements. This study highlights that the critical challenges in finding a delicate balance between conservation and development occurred because of the adopted decision-making process that eliminated the local communities. Therefore, further studies could seek to improve HIA frameworks in a way that provides useful decision-making supplementary tools. This could be done by developing specific recommendations for similar future development projects, which could help local authorities and policymakers regulate such initiatives. Consequently, they would be able to adopt financially and environmentally suitable development strategies that conserve the architectural heritage, avoiding trial and error methods and unnecessary rework.

To conclude, this thesis provides a step forward in finding an improved balance between heritage conservation and tourism development in heritage settlements. It demonstrates possible approaches to transforming vernacular settlements into tourist destinations and develops an integrated framework for assessing the architectural, urban, and thermal impact of such transformation. The framework could be applied to similar development projects in the region. However, there is still a need to reform the current development approaches and to better conserve our heritage buildings/sites for more sustainability.

Bibliography

Abu Al Haija, A.H. (2012). Jordan: Guidelines for Urban and Architectural Heritage Conservation: Umm Qais Case Study. *International Journal of Architectural Heritage*, 6(1), pp.62–85.

Al Haija, A.A. (2011). Jordan: Tourism and conflict with local communities. *Habitat International*, 35(1), pp.93–100.

Al Haija, A.A. (2012). Alienation of Traditional Habitats and Shelters in Jordanian Villages. *Open House International*, 37(1), pp.83–92.

Al-Asad, M., Khammash, A., and Lyons, B. (1997). *Old Houses of Jordan*. London: Kegan Paul.

Alhasan, O. (2019). Face to Face Interview with the Head of ecotourism/ facilities development at the RSCN (Appendix A).

Ali, H., Zoubi, H. and Badarneh, S. (2010). *Energy efficient design for thermally comforted dwelling units in hot arid zone: case of vernacular buildings in Jordan.* In Proceeding of the International Conference on Technology and Sustainability in the Built Environment. 3-6 January, 2010. Riyadh, Saudi Arabia, pp. 279-304.

Al-Khawaldeh, S. (2019). Face to Face Interview with the president of Dana and Al-Qadisiyyah local community cooperative (Appendix A).

Almatarneh, R. (2013). Sustainability lessons learnt from traditional architecture: a case study of the old city of As-Salt, Jordan. *IOSR Journal Of Environmental Science, Toxicology And Food Technology*, 5(3), pp.100–109.

Almeida, C.P., Ramos, A.F. and Silva, J.M. (2018). Sustainability assessment of building rehabilitation actions in old urban centres. *Sustainable Cities and Society*, 36, pp.378–385.

Al-mughrabi, A. (2007). Ecotourism: A sustainable approach of tourism in Jordan. (Unpublished master’s thesis). *Tucson: University of Arizona.*

Al-Qawaba'a, M. (2008). Learning from Nature and Culture to Manage Nature Reserves: Experience from Dana Biosphere Reserve, Jordan. In: Lee, C., Schaaf, T. (eds) The Future of Drylands (pp. 115-121). *Springer, Dordrecht.*

Al-Qawabah, M. S., Johnson, C., Ramez, H., and Al-Fattah, M. Y. A. (2003). *Assessment and evaluation methodologies report: Dana Biosphere Reserve, Jordan.* In Sustainable Management of Marginal Drylands (SUMAMAD). Proceedings of the second international workshop for sustainable management of marginal drylands (SUMAMAD). 29 November - 2 December, 2003. Shiraz, Islamic Republic of Iran, pp. 70-79.

Al-Sallal, K. A. (2017). Learning sustainability from Arab gulf vernacular architecture. In *Mediterranean green buildings and renewable energy* (pp. 885-897). Springer, Cham.

AlSayyad, N. (2001). Global norms and urban forms in the age of tourism: manufacturing heritage, consuming tradition. *Consuming tradition,* *manufacturing heritage: Global norms and urban forms in the age of tourism*, pp.1-33.

AlSayyad, N. (2004). The end of tradition, or the tradition of endings?. In *The End of Tradition?* (pp. 12-39). Routledge.

AlSayyad, N. (2006). *Cinematic urbanism: A history of the modern from reel to real*. New York: Routledge.

Alzoubi, H. and Malkawi, A. (2019). A Comparative Study for the Traditional and Modern Houses in Terms of Thermal Comfort and Energy Consumption in Umm Qais City, Jordan. *Journal of Ecological Engineering*, 20(5), pp.14–22.

Anna-Maria, V. (2009). Evaluation of a sustainable Greek vernacular settlement and its landscape: Architectural typology and building physics. *Building and Environment*, 44(6), pp.1095–1106.

Appendino, F. (2017). Balancing Heritage Conservation and Sustainable Development – The Case of Bordeaux. *IOP Conference Series: Materials Science and Engineering*, 245(6), p.062002. IOP Publishing.

Asan, H. (2006). Numerical computation of time lags and decrement factors for different building materials. *Building and Environment*, 41(5), pp.615–620.

Asquith, L., and Vellinga, M. (Eds.). (2006). *Vernacular architecture in the 21st century: Theory, education and practice*. Taylor and Francis.

Assi, E. (2008). *Memory and place*. In: 16th ICOMOS General Assembly and International Symposium: 'Finding the spirit of place – between the tangible and the intangible'. 29 sept – 4 oct 2008. Quebec, Canada, pp.1-12.

Avrami, E. (2009). Heritage, values, and sustainability. In *Conservation: Principles, dilemmas and uncomfortable truths* (pp. 177-183). Routledge.

Badran, A.A. (2003). Performance of cool towers under various climates in Jordan. *Energy and Buildings*, 35(10), pp.1031–1035.

Baglioni, E. (2014). Jordanian vernacular architecture. In *Vernacular Architecture: Towards a Sustainable Future* (pp. 125-130). CRC Press.

Ballesteros, E. R., and Ramírez, M. H. (2007). Identity and community—Reflections on the development of mining heritage tourism in Southern Spain. *Tourism management*, *28*(3), pp.677-687.

Baxter, K., Courage, C., and Caine, K. (2015). *Understanding your users: a practical guide to user research methods*. Morgan Kaufmann.

Bernard, H. R. (2017). *Research methods in anthropology: Qualitative and quantitative approaches*. Rowman & Littlefield.

Blangy, S. and Mehta, H. (2006). Ecotourism and ecological restoration. *Journal for Nature Conservation*, 14(3-4), pp.233–236.

Blondeau, P., Spérandio, M. and Allard, F. (1997). Night ventilation for building cooling in summer. *Solar Energy*, 61(5), pp.327–335.

Bluyssen, P.M., Aries, M. and van Dommelen, P. (2011). Comfort of workers in office buildings: The European HOPE project. *Building and Environment*, 46(1), pp.280–288.

Bodach, S., Lang, W. and Hamhaber, J. (2014). Climate responsive building design strategies of vernacular architecture in Nepal. *Energy and Buildings*, 81, pp.227–242.

Böhringer, C. and Jochem, P.E.P. (2007). Measuring the immeasurable — A survey of sustainability indices. *Ecological Economics*, 63(1), pp.1–8.

Bordass, B. (2004). Learning more from what we build. In *Designing Better Building* (pp. 41-52). Routledge.

Bourdier, J. P., and AlSayyad, N. (1989). *Dwellings, settlements, and tradition: Cross-cultural perspectives*. Lanham: University Press of America.

Bozonnet, E., Doya, M., & Allard, F. (2011). Cool roofs impact on building thermal response: A French case study. *Energy and Buildings*, *43*(11), pp. 3006-3012.

Bradecki, T., Swoboda, J., Nowak, K., and Dziechciarz, K. (2017, October). Models for Experimental High Density Housing. In *IOP Conference Series: Materials Science and Engineering*, 245(5), p. 052025. IOP Publishing.

Brand, L. A. (2000). Resettling, reconstructing and restor(y)ing: Archaeology and tourism in Umm Qays. *Middle East Report*, (216), pp.28-31.

Brand, L. A. (2001). Displacement for development? The impact of changing state–society relations. *World development*, *29*(6), pp.961-976.

Braun, A., Veršić, Z., and Vidović, T. (2011). *The Reconstruction of the French Pavilion at the Student Centre in Zagreb from the Aspect of Energy Efficiency.* In International Conference on Energy Management in Cultural Heritage, 6-8 April 2011. Dubrovnik, Croatia, pp.1-12.

Bronner, S. J. (2006). Building tradition: control and authority in vernacular architecture. In *Vernacular Architecture in the 21st Century* (pp. 41-63). Taylor and Francis.

Brown, R., and Maudlin, D. (2012). Concepts of vernacular architecture. *The SAGE Handbook of Architectural Theory*, pp.340-368.

Bryman, A. (2006). Integrating quantitative and qualitative research: how is it done?. *Qualitative research*, *6*(1), pp.97-113.

Bryman, A. (2016). *Social research methods*. Oxford university press.

Buckley, K., Cooke, S., & Fayad, S. (2016). Using the historic urban landscape to re-imagine Ballarat: The local context. In *Urban heritage, development and sustainability* (pp. 93-113). Routledge.

Burtenshaw, P. (2013). *The economic capital of archaeology: Measurement and management* (Doctoral dissertation, UCL (University College London)).

Burtenshaw, P., & Palmer, C. (2014). Archaeology, local development and tourism—a role for international institutes. *Bulletin for the Council for British Research in the Levant*, *9*(1), pp.21-26.

Cade, M. (2008). Renewable energy for historic buildings. *Context*, (103), pp.15-17.

Cantacuzino, S. (1989). *Re-architecture: old buildings/new uses*. Abbeville Press.

Chandel, S.S., Sharma, V. and Marwah, B.M. (2016). Review of energy efficient features in vernacular architecture for improving indoor thermal comfort conditions. *Renewable and Sustainable Energy Reviews*, 65, pp.459–477.

Chang, T.C. and Teo, P. (2009). The Shophouse Hotel: Vernacular Heritage in a Creative City. *Urban Studies*, 46(2), pp.341–367.

Chappells, H., & Shove, E. (2005). Debating the future of comfort: environmental sustainability, energy consumption and the indoor environment. *Building Research & Information*, *33*(1), pp.32-40.

Chatelard, G. (2003). Conflicts of interest over the Wadi Rum reserve: were they avoidable? A socio-political critique. *Nomadic Peoples*, 7(1), pp.138-158.

Chiesa, G., and Grosso, M. (2017). An environmental technological approach to architectural programming for school facilities. In *Mediterranean green buildings and renewable energy* (pp. 701-715). Springer, Cham.

Chun, H. K., Hasan, A. S., and Noordin, N. M. (2005). *An influence of colonial architecture to building styles and motifs in colonial cities in Malaysia*. In 8th International Conference of the Asian Planning Schools Association. 12 - 14 sept 2005. Penang, Malaysia, pp.1-13.

Clavir, M. (2012). *Preserving what is valued*. ubc Press.

Cohen, L., Manion, L., & Morrison, K. (2007). *Research methods in education*. Routledge.

Cole, R. J., Robinson, J., Brown, Z., & O'shea, M. (2013). Re-contextualizing the notion of comfort. In *Comfort in a Lower Carbon Society* (pp. 25-38). Routledge.

Comer, D. C. (2012). The tourism juggernaut: a retrospective on profit and preservation at Petra. In *Tourism and Archaeological Heritage Management at Petra* (pp. 169-187). Springer, New York, NY.

Comité Européen de Normalisation (CEN). (2007). *Indoor Environmental Input Parameters for Design and Assessment of Energy Performance of Buildings Addressing Indoor Air Quality, Thermal Environment, Lighting and Acoustics; EN 15251; CEN: Brussels, Belgium.*

Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications.

Cutaia, F. (2016). The use of landscape indicators in environmental assessment. In *Strategic environmental assessment: integrating landscape and urban planning* (pp. 29-43). Springer, Cham.

Dabaieh, M., Makhlouf, N. N., & Hosny, O. M. (2016). Roof top PV retrofitting: A rehabilitation assessment towards nearly zero energy buildings in remote off-grid vernacular settlements in Egypt. *Solar Energy*, *123*, pp. 160-173.

Daher, R. F. (1999). Gentrification and the politics of power, capital and culture in an emerging Jordanian heritage industry. *International Association for the Study of Traditional Environments (IASTE)*, 10(2) pp.33-45.

Daher, R.F. (2005). Urban Regeneration/Heritage Tourism Endeavours: The Case of Salt, Jordan 'Local Actors, International Donors, and the State.' *International Journal of Heritage Studies*, 11(4), pp.289–308.

Dave, S. (2011). Neighbourhood density and social sustainability in cities of developing countries. *Sustainable Development*, 19(3), pp.189–205.

De la Torre, M. (2013). Values and heritage conservation. *Heritage & Society*, *6*(2), pp.155-166.

Del, M. S. T. T., & Tabrizi, S. K. (2020). A methodological assessment of the importance of physical values in architectural conservation using Shannon entropy method. *Journal of Cultural Heritage*, 44, pp.135-151.

Dominici, G., and Guzzo, R. (2010). Customer satisfaction in the hotel industry: A case study from Sicily. *International journal of marketing studies*, *2*(2), pp.3-12.

Dudley, N., and Phillips, A. (2006). *Forests and Protected Areas: Guidance on the use of the IUCN protected area management categories* (Vol. 12). Gland, Switzerland: IUCN.

Eid, E. (2013). *The state of Jordan's birds report*. The Royal Society for the Conservation of Nature (RSCN), Amman.

Eid, E., Boulad, N., Al Share, T., Abed, O., & Hageer, Y. (2013). Population density of the Blanford's fox, Vulpes cana in Jordan. *Vertebrate Zoology*, *63*(2), pp.241-245.

El Asmar, J.P. and Taki, A.H. (2014). Sustainable rehabilitation of the built environment in Lebanon. *Sustainable Cities and Society*, 10, pp.22–38.

Climate-Data.org (2020). *Dana climate: Average Temperature, weather by month, Dana weather averages* [Online]. Available at: https://en.climate-data.org/asia/jordan/dana/dana-459275/#temperature [Accessed 21 June. 2020].

Engin, N., Vural, N., Vural, S. and Sumerkan, M.R. (2007). Climatic effect in the formation of vernacular houses in the Eastern Black Sea region. *Building and Environment*, 42(2), pp.960–969.

Eriksson, J., & Lindqvist, J. E. (2019). Lime render, shrinkage cracks and craftsmanship in building restoration. *Journal of Cultural Heritage*, 37, pp. 73-81.

Eriksson, P., Hermann, C., Hrabovszky-Horváth, S., & Rodwell, D. (2014). EFFESUS methodology for assessing the impacts of energy-related retrofit measures on heritage significance. *The Historic Environment: Policy & Practice*, *5*(2), pp.132-149.

Eyüce, A. (2007). Learning From the Vernacular: Sustainable Planning and Design. *Open House International,* 32(4), pp.9–22.

Farajat, S. (2012). The participation of local communities in the tourism industry at Petra. In *Tourism and archaeological heritage management at Petra* (pp. 145-165). Springer, New York, NY.

Faria, A. L. V. (2020). *Assessment Model for Vernacular Limestone Buildings Using Microsoft Excel®: The Case of Serra de Santo António.* Covilhã, Portugal: University of Beira Interior. PhD Thesis.

Fathy, H. (1973). *Architecture for the poor: an experiment in rural Egypt*. Chicago; London: University of Chicago Press.

Feilden, B. (2007). *Conservation of historic buildings*. Routledge.

Fernandes, J. E. P., Dabaieh, M., Mateus, R., and Bragança, L. (2014). *The influence of the Mediterranean climate on vernacular architecture: a comparative analysis between the vernacular responsive architecture of southern Portugal and north of Egypt*. In World Sustainable buildings (SB14) conference. 30 Oct 2014. Barcelona, Spain, pp.1-7.

Fernandes, J., Mateus, R., Bragança, L., and Correia da Silva, J. J. (2015). Portuguese vernacular architecture: The contribution of vernacular materials and design approaches for sustainable construction. *Architectural Science Review*, 58(4), pp.324-336.

Fethi, I. and Roaf, S. (1984). *The traditional house in Baghdad–some socio-climatic considerations.* In The Arab House: Proceedings of the Colloquium held in the University of Newcastle upon Tyne. 15 – 16 March 1984. Newcastle upon Tyne, UK, pp.41-49.

Fitch, J. M. (1990). *Historic preservation: Curatorial management of the built world*. University of Virginia Press.

Foruzanmehr, A., and Vellinga, M. (2011). Vernacular architecture: questions of comfort and practicability. *Building Research and Information,* 39(3), pp.274-285.

Fraser, D. (1968). *Village planning in the primitive world*. London: Studio Vista.

Friedman, A. (2012). *Fundamentals of sustainable dwellings*. Washington, DC: Island Press.

Galán-Marín, C., López-Cabeza, V. P., Rivera-Gómez, C., and Rojas-Fernández, J. M. (2018). On the influence of shade in improving thermal comfort in courtyards. *Multidisciplinary Digital Publishing Institute Proceedings*, 2(22), p.1390.

Garcia-Esparza, J. A. (2014). Revitalization of architectural and ethnological heritage: Recovery of vernacular building techniques in a 19th-century winery. *International Journal of Architectural Heritage*, *8*(1), pp.140-159.

Garcia-Esparza, J. A. (2015). Epistemological paradigms in the perception and assessment of vernacular architecture. *International Journal of Heritage Studies*, *21*(9), pp.869-888.

Geros, V., Santamouris, M., Karatasou, S., Tsangrassoulis, A. and Papanikolaou, N. (2005). On the cooling potential of night ventilation techniques in the urban environment. *Energy and Buildings,* 37(3), pp.243–257.

Gherardi, F., Kapridaki, C., Roveri, M., Gulotta, D., Maravelaki, P. N., & Toniolo, L. (2019). The deterioration of Apuan white marble in contemporary architectural context. *Journal of Cultural Heritage*, *35*, pp.297-306.

Givoni, B. (1998). *Climate considerations in building and urban design*. John Wiley and Sons.

Glassie, H. (1990). Architects, vernacular traditions, and society. *International Association for the Study of Traditional Environments (IASTE)*, 1(2), pp.9-21.

Goring-Morris, A. N. (2006). Early Village Life at Beidha, Jordan: Neolithic Spatial Organization and Vernacular Architecture. *Journal of the Royal Anthropological Institute*, 12(3), pp.675-677.

Graham, L. T., Gosling, S. D., & Travis, C. K. (2015). The psychology of home environments: A call for research on residential space. *Perspectives on Psychological Science*, 10(3), pp.346-356.

Gram-Hanssen, K. (2010). Residential heat comfort practices: understanding users. *Building Research & Information*, *38*(2), pp.175-186.

Gražulevičiūtė, I. (2006). Cultural heritage in the context of sustainable development. *Environmental Research, Engineering and Management*, *3*(37), pp.74-79.

Greene, J.A. (1999). Preserving which past for whose future? The dilemma of cultural resource management in case studies from Tunisia, Cyprus and Jordan. *Conservation and Management of Archaeological Sites*, 3(1-2), pp.43–60.

Guarasci, B.L. (2018). The architecture of environment: Building houses along the Great Rift Valley in Jordan. *International Journal of Middle East Studies*, 50(3), pp.513-536.

Haddad, N. A., and Fakhoury, L. A. (2016). Towards developing a sustainable heritage tourism and conservation action plan for Irbid’s historic core. *Archnet-IJAR: international journal of architectural research*, 10(3), pp.36-59.

Haddad, N. A., Jalboosh, F. Y., Fakhoury, L. A., and Ghrayib, R. (2016). Urban and rural Umayyad house architecture in Jordan: A comprehensive typological analysis at Al-Hallabat. *ArchNet-IJAR: International Journal of Architectural Research*, 10(2), pp.87-112.

Hamid, G. M., and Eltahir, M. M. (2014). Transformation of Vernacular Housing by the Displaced: Greater Khartoum, Sudan. *ISVS e-journal*, 3(1), pp.30-41.

Hoes, P., Hensen, J. L., Loomans, M. G., de Vries, B., & Bourgeois, D. (2009). User behavior in whole building simulation. *Energy and buildings*, 41(3), pp.295-302.

Holtorf, C. (2012). The heritage of heritage. *Heritage and Society*, *5*(2), pp.153-174.

Hong, S. H., Gilbertson, J., Oreszczyn, T., Green, G., Ridley, I., & Warm Front Study Group. (2009). A field study of thermal comfort in low-income dwellings in England before and after energy efficient refurbishment. *Building and environment*, 44(6), pp.1228-1236.

Hussein, M.H., Barlet, A. and Semidor, C. (2010). Socio-Environmental Dimensions of Private Outdoor Spaces in Contemporary Palestinian Housing. *Open House International*, 35(2), pp.67–76.

I.P.O.C. (2001). *Climate change 2007: Impacts, adaptation and vulnerability*. Genebra, Suíça.

ICOMOS International Committee on Cultural Tourism. (1993). *Tourism at World Heritage Cultural Sites: The Site Manager's Handbook*. World Tourism Organization.

ICOMOS. (1999). *Charter on the built vernacular heritage*. Consultato all'indirizzo: ciav. icomos. org.

ICOMOS. (2003). *Charter on Principles for The Analysis, Conservation and Structural Restoration of Architectural Heritage*. Ratified by the ICOMOS 14th General Assembly in Victoria Falls, Zimbabwe, pp.27-31.

International Council on Monuments and Sites. (2011). *Guidance on Heritage Impact Assessments for Cultural World Heritage Properties*.

Jacobs, J. M. (2004). Tradition is (not) modern: Deterritorializing globalization. In *The End of Tradition?* (pp. 40-55). Routledge.

Jigyasu, R. (2013). Long-term cultural impacts of disaster decision-making: The Case of Post Earthquake Reconstruction in Marathwada, India. *ArchNet-IJAR: International Journal of Architectural Research*, 7(3), p.14.

Jokilehto, J. (2016). Heritage values and valuation. *Conversaciones. Revista de conservación*, (2), 7-18.

Jokilehto, J., 2007. Conservation concepts. In *Conservation of ruins* (pp.3-9). Routledge.

Ju, S.R., Kim, B.M. and Ariffin, S.I. (2015). Continuation and Transformation of Traditional Elements in Colonial Vernacular Houses in Kampong Bharu, Malaysia. *Journal of Asian Architecture and Building Engineering*, 14(2), pp.339–346.

Ju, S.R., Omar, S. and Ko, Y.E. (2012). Modernization of the Vernacular Malay House In Kampong Bharu, Kuala Lumpur. *Journal of Asian Architecture and Building Engineering*, 11(1), pp.95–102.

Kadowaki, S. (2006). Ground stone tools and implications for use of space and social relations at 'Ain Abu Nukhayla, a PPNB settlement in southern

Jordan. *Domesticating space: construction, community, and cosmology in the Late Prehistoric Near East*, pp.53-64.

Kafafi, Z. A. (2006). Domestic Activities at the Neolthic Site,'Ain Ghazal. *Domesticating Space. ex oriente, Berlin*, pp.81-90.

Kamaruddin, T., Hamid, R. A., and Abd Ghani, S. (2020, May). Social aspect implementation in sustainable construction. In *IOP conference series: materials science and engineering*, 849(1), p. 012036. IOP Publishing.

Kana'an, R. and McQuitty, A. (1994). The Architecture of Al-Qasr on the Kerak Plateau: An Essay in the Chronology of Vernacular Architecture. *Palestine Exploration Quarterly*, 126(2), pp.127–153.

Keizikas, A., Andriušytė, A., and Šiožinytė, E. (2012). Research of Some Aspects of Relation Between Ecology and Energy Efficiency In Tradtional Architecture. *Evolution of Science and Technology/Mokslo ir technikos raida*, *4*(1), pp.47-61.

Kempton, W., & Lutzenhiser, L. (1992). Introduction to special issue on social and cultural aspects of cooling. *Energy and Buildings*, *18*(3-4), pp. 171-176.

Khammash, A. (1986). *Notes on village architecture in Jordan*. Univ. Art Museum, University of Southwestern Louisiana.

Khammash, A. (1995). *Notes on Village Architecture in Jordan.* University Art Museum, University of Southwestern Louisiana. ISBN 0-936819-4.

Kolokotroni, M. and Aronis, A. (1999). Cooling-energy reduction in air-conditioned offices by using night ventilation. *Applied Energy*, 63(4), pp.241–253.

Laefer, D.F. and Manke, J.P. (2008). Building Reuse Assessment for Sustainable Urban Reconstruction. *Journal of Construction Engineering and Management*, 134(3), pp.217–227.

Landorf, C. (2009). Managing for sustainable tourism: a review of six cultural World Heritage Sites. *Journal of Sustainable Tourism*, *17*(1), pp.53-70.

Lawrence, R. J. (2006). Learning from the Vernacular. In *Vernacular Architecture in the 21st Century* (pp.110-127). Oxon: Taylor and Francis.

Leaman, A., & Bordass, B. (2001). Assessing building performance in use 4: the Probe occupant surveys and their implications. *Building Research & Information*, 29(2), pp.129-143.

Leaman, A., & Bordass, B. (2007). Are users more tolerant of 'green' buildings?. *Building Research & Information*, 35(6), pp.662-673.

Leaman, A., and Bordass, B. (2001). Assessing building performance in use 4: the Probe occupant surveys and their implications. *Building Research and Information*, *29*(2), pp.129-143.

Leaman, A., Stevenson, F., & Bordass, B. (2010). Building evaluation: practice and principles. *Building Research & Information*, 38(5), pp.564-577.

Lowenthal, D. (1996). *Possessed by the Past: The Heritage Crusade and the Spoils of History*. New York, Free Press.

Lu, J., and Nepal, S. K. (2009). Sustainable tourism research: An analysis of papers published in the Journal of Sustainable Tourism. *Journal of sustainable Tourism*, 17(1), pp.5-16.

MacCannell, D. (2013). *The tourist: A new theory of the leisure class*. University of California Press.

Machado, M. V., La Roche, P. M., Mustieles, F., and De Oteiza, I. (2000). The fourth house: the design of a bioclimatic house in Venezuela. *Building Research and Information*, 28(3), pp.196-211.

Macleod, D. V. (2004). *Tourism, globalisation, and cultural change: An island community perspective* (Vol. 2). Channel View Publications.

Maffi, I., and Daher, R. (2000). *Patrimony and heritage conservation in Jordan*. CERMOC.

Mansour, O. E., and Radford, S. K. (2014, October). Green Building Perception Matrix, A Theoretical Framework. In *Proceedings of the Annual Architectural Research Symposium in Finland* (pp.40-52).

Marchand, T. H. (2006). Endorsing indigenous knowledge: the role of masons and apprenticeship in sustaining vernacular architecture–the case of Djenné. In *Vernacular Architecture in the 21st Century* (pp.64-80). Taylor and Francis.

McCartney, K.J. and Nicol, J.F. (2002). Developing an adaptive control algorithm for Europe. *Energy and Buildings*, 34(6), pp.623–635.

McGranahan, G., and Satterthwaite, D. (2002). The environmental dimensions of sustainable development for cities. *Geographical Association*, 87(3), pp.213-226.

McMullan, R. (2017). *Environmental science in building*. Bloomsbury Visual Arts.

McQuitty, A. (2005). Focus on Islam II: The rural landscape of Jordan in the seventh-nineteenth centuries AD: the Kerak Plateau. *antiquity*, *79*(304), pp.327-338.

Melikov, A. K., Kaczmarczyk, J., and Sliva, D. (2008). *Impact of air movement on perceived air quality at different level of relative humidity.* In 11th International Conference on Indoor Air Quality and Climate. 17 – 22 Aug 2008. Copenhagen, Denmark, p.1037.

Memmott, P., and Keys, C. (2015). Redefining architecture to accommodate cultural difference: Designing for cultural sustainability. *Architectural Science Review*, 58(4), pp.278-289.

Michael, A., Heracleous, C., Thravalou, S., and Philokyprou, M. (2017). Lighting performance of urban vernacular architecture in the East-Mediterranean area: field study and simulation analysis. *Indoor and Built Environment*, 26(4), pp.471-487.

Michael, A., Philokyprou, M., and Argyrou, C. (2014, November). Documentation and evaluation of the positive contribution of natural ventilation in the rural vernacular architecture of Cyprus. In *Proceedings of the Euro-Mediterranean Conference* (pp.310-320). Springer, Cham.

Mitcham, C. (2005). Thinking re-vernacular building. *Design Issues*, 21(1), pp.32-40.

Mualam, N., & Alterman, R. (2020). Architecture is not everything: A multi-faceted conceptual framework for evaluating heritage protection policies and disputes. *International Journal of Cultural Policy*, 26(3), pp.291-311.

Myers, D., Smith, S. N., & Shaer, M. (2010). *A didactic case study of Jarash Archaeological Site, Jordan: stakeholders and heritage values in site management.* Los Angeles: Getty Conservation Institute.

Naanaa, M. (2019). Face to Face Interview with the Head of the RSCN (Dana branch).

Nicol, F., and Humphreys, M. (2007). Maximum temperatures in European office buildings to avoid heat discomfort. *Solar Energy*, 81(3), pp.295-304.

Nicol, F., and Roaf, S. (2005). Post-occupancy evaluation and field studies of thermal comfort. *Building research and information*, 33(4), pp.338-346.

Nicol, F., Humphreys, M., and Roaf, S. (2012). *Adaptive thermal comfort: principles and practice*. Routledge.

Nicol, J. F., & Roaf, S. (2017). Rethinking thermal comfort. *Building Research & Information*, 45(7), pp.711-716.

Nicol, J.F. and McCartney, K. (2001). *Final report of Smart Controls and Thermal Comfort (SCATs) Project.* Report to the European Commission of the Smart Controls and Thermal Comfort project.

Niemi, T. M., & Smith, A. M. (1999). Initial results of the southeastern Wadi Araba, Jordan geoarchaeological study: implications for shifts in Late Quaternary aridity. *Geoarchaeology*, 14(8), pp.791-820.

O'leary, Z. (2004). *The essential guide to doing research*. London: Sage.

Oliver, P. (2003). *Dwellings: the vernacular house worldwide*. London: Phaidon.

Oliver, P. (2007). *Built to meet needs: Cultural issues in vernacular architecture*. Routledge.

Oliver, P. (1969). *Shelter and society*. New York: FA Praeger.

Oliver, P. (1997). *Encyclopedia of vernacular architecture of the world* (Vol. 3). Cambridge: Cambridge University Press.

Orbaşli, A. (2000). Is tourism governing conservation in historic towns?. *Journal of architectural conservation*, 6(3), pp.7-19.

Orbasli, A. (2002). *Tourists in historic towns: Urban conservation and heritage management*. Taylor and Francis.

Orbasli, A. (2007). Training conservation professionals in the Middle East. *Built Environment*, 33(3), pp.307-322.

Orbasli, A. (2009). *Re-using existing buildings towards sustainable regeneration*. School of Architecture: place and Culture Identity Group Working Paper, Oxford Brookes University: Oxford, UK.

Orbaşli, A. (2013). Archaeological site management and local development. *Conservation and Management of Archaeological Sites*, 15(3-4), pp.237-253.

Orbaşli, A. (2017). Conservation theory in the twenty-first century: slow evolution or a paradigm shift?. *Journal of Architectural Conservation*, 23(3), pp.157-170.

Ornelas, C., Guedes, J. M., and Breda-Vázquez, I. (2016). Cultural built heritage and intervention criteria: A systematic analysis of building codes and legislation of Southern European countries. *Journal of Cultural Heritage*, *20*, pp.725-732.

Ortega, J., Vasconcelos, G., Rodrigues, H. and Correia, M. (2019). A vulnerability index formulation for the seismic vulnerability assessment of vernacular architecture. *Engineering Structures*, 197, p.109381.

Pedersen, A. (2002). *Managing tourism at world heritage sites: A practical manual for world heritage site managers*. UNESCO World Heritage Centre.

Pereira, N., Rodrigues, R., & Rocha, P. (2016). Post-occupancy evaluation data support for planning and management of building maintenance plans. *Buildings*, *6*(4), p.45.

Philokyprou, M., and Michael, A. (2012). Evaluation of the Environmental Features of Vernacular Architecture. A Case Study in Cyprus. *International Journal of Heritage in the Digital Era*, *1*(1_suppl), pp.349-354.

Philokyprou, M., Michael, A., and Thravalou, S. (2013, June). Assessment of the bioclimatic elements of vernacular architecture. The historic centre of Nicosia, Cyprus. In *Conference Proceedings, Le Vie dei Mercanti XI Forum Internazionale di Studi, Aversa, Capri* (pp. 13-15). Consorzio Universitario BENECON.

Philokyprou, M., Michael, A., Malaktou, E., and Savvides, A. (2017). Environmentally responsive design in Eastern Mediterranean. The case of vernacular architecture in the coastal, lowland and mountainous regions of Cyprus. *Building and Environment*, 111, pp.91-109.

Philokyprou, M., Michael, A., Thravalou, S., and Ioannou, I. (2013). Evaluation of sustainable design elements in the historic centre of Nicosia, Cyprus. *Vernacular heritage and earthen Architecture*, 4, pp.631-637.

Pickard, R. (2001). *Policy and law in heritage conservation* (Vol. 1). Taylor and Francis.

Pissourios, I. A. (2013). An interdisciplinary study on indicators: A comparative review of quality-of-life, macroeconomic, environmental, welfare and sustainability indicators. *Ecological indicators*, 34, pp.420-427.

Preiser, W. F., & Vischer, J. C. (2006). The evolution of building performance evaluation: An introduction. In *Assessing building performance* (pp.3-14). Routledge.

Priya, R. S., Sundarraja, M. C., Radhakrishnan, S., and Vijayalakshmi, L. (2012). Solar passive techniques in the vernacular buildings of coastal regions in Nagapattinam, TamilNadu-India–a qualitative and quantitative analysis. *Energy and Buildings*, 49, pp.50-61.

Qtaishat, Y., Emmitt, S., and Adeyeye, K. (2020). Exploring the socio-cultural sustainability of old and new housing: Two cases from Jordan. *Sustainable Cities and Society*, *61*, p.102250.

Quagliarini, E., & Lenci, S. (2010). The influence of natural stabilisers and natural fibres on the mechanical properties of ancient Roman adobe bricks. *Journal of cultural heritage*, 11(3), pp.309-314.

Rapoport, A. (1969). *House Form and Culture*. New Jersey: Prenrice Hall. Inc. Englewood Cliffs.

Rapoport, A. (1976). Sociocultural aspects of man-environment studies. In *The Mutual Interaction of People and Their Environment* (pp.7-35). De Gruyter Mouton.

Rapoport, A. (1990). *The meaning of the built environment: A nonverbal communication approach*. University of Arizona Press.

Ratti, C., Raydan, D., and Steemers, K. (2003). Building form and environmental performance: archetypes, analysis and an arid climate. *Energy and buildings*, 35(1), pp.49-59.

Richmond, A., Bracker, A., & Bracker, A. L. (2009). *Conservation: principles, dilemmas and uncomfortable truths*. Routledge.

Rijal, H. B., Tuohy, P., Humphreys, M. A., Nicol, J. F., Samuel, A., & Clarke, J. (2007). Using results from field surveys to predict the effect of open windows on thermal comfort and energy use in buildings. *Energy and buildings*, 39(7), pp.823-836.

Robert, P. (1989). *Reconversions= Adaptations, new uses for old buildings*. Editions du Moniteur.

Robinson, O. C. (2014). Sampling in interview-based qualitative research: A theoretical and practical guide. *Qualitative research in psychology*, 11(1), pp.25-41.

RSCN. (2009). *The annual report 2009.* [Online]. Amman: The Royal Society for the Conservation of Nature. Available from: https://www.rscn.org.jo/sites/default/files/pdf_report/RSCN%20Annual%20Report%202009.pdf [Accessed 10 October 2018].

RSCN. (2010). *The annual report 2010.* [Online]. Amman: The Royal Society for the Conservation of Nature. Available from: https://www.rscn.org.jo/sites/default/files/pdf_report/RSCN%20Annual%20Report%202010.pdf [Accessed 10 October 2018].

RSCN. (2011). *The annual report 2011*. [Online]. Amman: The Royal Society for the Conservation of Nature. Available from: https://www.rscn.org.jo/sites/default/files/pdf_report/RSCN%20Annual%20Report%202011.pdf [Accessed 10 October 2018].

Rudofsky, B., 1964. *Architecture without architects.* New York: Doubleday.

Saljoughinejad, S., and Sharifabad, S. R. (2015). Classification of climatic strategies, used in Iranian vernacular residences based on spatial constituent elements. *Building and Environment, 92*, pp.475-493.

Santamouris, M., Sfakianaki, A., and Pavlou, K. (2010). On the efficiency of night ventilation techniques applied to residential buildings. *Energy and Buildings*, 42(8), pp.1309-1313.

Saunders, M., Lewis, P., & Thornhill, A. (2009). *Research methods for business students*. Harlow, Essex: Pearson education.

Sayigh, A., and Marafia, A. H. (1998). Vernacular and contemporary buildings in Qatar. *Renewable and Sustainable Energy Reviews*, *2*(1-2), pp.25-37.

SERBESCU, A. (2009). On Change and Adaptation: Rural inhabitation during the Romanian post-socialist transition. *International Association for the Study of Traditional Environments (IASTE)*, 12(1), pp.37-50.

Seyedashrafi, B., Ravankhah, M., Weidner, S., & Schmidt, M. (2017). Applying heritage impact assessment to urban development: world heritage property of Masjed-e Jame of Isfahan in Iran. *Sustainable Cities and Society*, 31, pp.213-224.

Shaw, B. (2004). History at the water's edge. In *Waterfronts in post-industrial cities* (pp.168-180). Taylor and Francis.

Shehadeh, N., & Ananbeh, S. (2013). The impact of climate change upon winter rainfall. *American Journal of Environmental Sciences*, *9*(1), pp.73-81.

Simpson, K. (2001). Strategic planning and community involvement as contributors to sustainable tourism development. *Current issues in Tourism*, 4(1), pp.3-41.

Simpson, M. C. (2008). Community benefit tourism initiatives—A conceptual oxymoron?. *Tourism management*, 29(1), pp.1-18.

Simpson, M. C. (2009). An integrated approach to assess the impacts of tourism on community development and sustainable livelihoods. *Community development journal*, 44(2), pp.186-208.

Singh, M. K., Mahapatra, S., and Atreya, S. K. (2010). Thermal performance study and evaluation of comfort temperatures in vernacular buildings of North-East India. *Building and environment*, 45(2), pp.320-329.

Singh, M. K., Mahapatra, S., and Atreya, S. K. (2011). Solar passive features in vernacular architecture of North-East India. *Solar Energy*, 85(9), pp.2011-2022.

Šiožinytė, E., and Antuchevičienė, J. (2013). Solving the problems of daylighting and tradition continuity in a reconstructed vernacular building. *Journal of civil engineering and management*, 19(6), pp.873-882.

Soane, J. (2013). The renaissance of cultural vernacularism in Germany. In *Building a New Heritage: Tourism, Culture and Identity in the New Europe* (pp.159-177). Routledge.

Soebarto, V., & Bennetts, H. (2014). Thermal comfort and occupant responses during summer in a low to middle income housing development in South Australia. *Building and environment*, 75, pp.19-29.

Sözen, M. Ş., and Gedík, G. Z. (2007). Evaluation of traditional architecture in terms of building physics: old Diyarbakir houses. *Building and Environment*, 42(4), pp.1810-1816.

Statistical Department of Jordan Annual report (2009), *Statistical Department Press*, Amman.

Steele, J., and Badran, R. (2005). *The architecture of Rasem Badran: narratives on people and place*. New York, NY: Thames and Hudson.

Stevenson, F., & Rijal, H. B. (2010). Developing occupancy feedback from a prototype to improve housing production. *Building Research & Information*, 38(5), pp.549-563.

Straube, J. F. (2002). Moisture in buildings. *ASHRAE journal*, 44(1), pp.15-19.

Strike, J. (1994). *Architecture in conservation: managing development at historic sites*. Routledge.

Suleiman, S., and Himmo, B. (2012). Direct comfort ventilation. Wisdom of the past and technology of the future (wind-catcher). *Sustainable cities and society*, 5, pp.8-15.

Szczepanowska, H. M. (2013). *Conservation of cultural heritage: key principles and approaches*. Routledge.

Tarawneh, Z., Elgaali, E., & Hamdi, M. R. (2008). Severity of droughts in arid regions. *Jordan Journal of Civil Engineering*, 2(3), pp.228-237.

Tawayha, F. A., Braganca, L., and Mateus, R. (2019). Contribution of the vernacular architecture to the sustainability: A comparative study between the contemporary areas and the old quarter of a Mediterranean city. *Sustainability*, 11(3), p.896.

The International Ecotourism Society (TIES) (2015). *TIES Announces Ecotourism Principles Revision*. [Online]. Amman: The International Ecotourism Society. Available from: https://ecotourism.org/news/ties-announces-ecotourism-principles-revision/ [Accessed 09 April. 2020].

Thomas, L. E. (2010). Evaluating design strategies, performance and occupant satisfaction: a low carbon office refurbishment. *Building Research and Information*, 38(6), pp.610-624.

Toe, D. H. C., and Kubota, T. (2015). Comparative assessment of vernacular passive cooling techniques for improving indoor thermal comfort of modern terraced houses in hot–humid climate of Malaysia. *Solar Energy*, 114, pp.229-258.

Toure, P. M., Dieye, Y., Gueye, P. M., Sambou, V., Bodian, S., and Tiguampo, S. (2019). Experimental determination of time lag and decrement factor. *Case Studies in Construction Materials*, 11, e00298.

Turner, J., Colwell, S. R., Marshall, G. J., Lachlan-Cope, T. A., Carleton, A. M., Jones, P. D., ... & Iagovkina, S. (2005). Antarctic climate change during the last 50 years. *International journal of Climatology*, 25(3), 279-294.

Tweed, C., and Sutherland, M. (2007). Built cultural heritage and sustainable urban development. *Landscape and urban planning*, 83(1), pp.62-69.

UNESCO Institute for Statistics. (2009). *THE 2009 UNESCO FRAMEWORK FOR CULTURAL STATISTICS (FCS)*. [Online]. Montreal, Canada: UNESCO Institute for Statistics (UIS). Available from: http://uis.unesco.org/sites/default/files/documents/unesco-framework-for-cultural-statistics-2009-en_0.pdf [Accessed 10 March. 2020].

UNESCO World Heritage Centre (2021). *State of conservation (SOC)*. [Online] Available from: https://whc.unesco.org/?cid=171&l=en&&action=list&id_threats=8&&, [Accessed 07 August. 2022].

UNESCO World Heritage Committee (2013). *Convention concerning the protection of the world cultural and natural heritage (Phnom Penh): In response to the World Heritage Committee decision WHC-13/37 COM/20.* Paris: UNESCO Pub.

UNESCO. (2012). *Operational guidelines for the implementation of the World Heritage Convention*. [Online]. Paris: UNESCO World Heritage Centre. Available from: http://whc.unesco.org/archive/opguide12-en.pdf [Accessed 09 August. 2022].

United Nation World Tourism Organization (UNWTO) (2009). *Guidelines for policymaking and planning*. [Online]. Available from: http://www.unwto.org/sdt/fields/en/policy/ [Accessed 11 October. 2019].

Urry, J. (1992). The tourist gaze and the Environment'. *Theory, Culture and Society*, 9(3), pp.1-26.

Van Hoof, J., and Van Dijken, F. (2008). The historical turf farms of Iceland: Architecture, building technology and the indoor environment. *Building and environment*, 43(6), pp.1023-1030.

Veillon, R., & UNESCO World Heritage Centre. (2014). *State of conservation of world heritage properties. A statistical analysis (1979–2013)*. [Online]. Paris: UNESCO Pub. Available from: https://whc.unesco.org/document/134872 [Accessed 09 August. 2022].

Veitch, J. A., Charles, K. E., Farley, K. M., and Newsham, G. R. (2007). A model of satisfaction with open-plan office conditions: COPE field findings. *Journal of Environmental Psychology*, 27(3), pp.177-189.

Vellinga, M. (2017). A conversation with architects: Paul Oliver and the anthropology of shelter. *Architectural Theory Review*, 21(1), pp.9-26.

Vellinga, M., Oliver, P., and Bridge, A. (2007). *Atlas of vernacular architecture of the world*. Routledge.

Verma, P. and Raghubanshi, A.S. (2018). Urban sustainability indicators: Challenges and opportunities. *Ecological Indicators*, 93, pp.282–291.

Vinas Munoz, S. (2011). *Contemporary theory of conservation*. London: Routledge

Virtudes, A., Barroso, D., Almeida, F., Quaresma, J., Fernandes, M., Conde, S., & Mateus, T. (2017). Monitoring the assessment of vernacular buildings using an ICT method. *J. Civ. Eng. Archit. Res*, 4(2), pp.1904-1912.

Vischer, J. (2002). Post-occupancy evaluation: A multifaceted tool for building improvement. In *Learning from our buildings: A state-of-the-practice summary of post-occupancy evaluation* (pp.23-34). National Academies Press.

Waked, F. A. (2008). Conservation and Rehabilitation of Traditional Buildings: A Case Study From Northern Jordan. *Jordanian scientific journals, Yarmouk University*, 24(2), pp.655-666.

Walston, S. (1978). The preservation and conservation of Aboriginal and Pacific cultural material in Australian museums. *ICCM bulletin*, 4(4), pp.9-21.

Weber, W., and Yannas, S. (2013). *Lessons from vernacular architecture*. London: Routledge.

Wight, P.A. (2002). Supporting the Principles of Sustainable Development in Tourism and Ecotourism: Government's Potential Role. *Current Issues in Tourism*, 5(3-4), pp.222–244.

Wilhite, H., Nakagami, H., Masuda, T., Yamaga, Y., & Haneda, H. (1996). A cross-cultural analysis of household energy use behaviour in Japan and Norway. *Energy policy*, 24(9), pp.795-803.

Wongbumru, T., & Dewancker, B. (2016). Post-occupancy evaluation of user satisfaction: a case study of "old" and "new" public housing schemes in Bangkok. *Architectural Engineering and Design Management*, 12(2), pp. 107-124.

Wood, M. (2002). *Ecotourism: Principles, practices and policies for sustainability*. UNEP.

World Heritage Centre (2008). *Enhancing our heritage toolkit, assessing management effectiveness of natural World Heritage sites*. [Online]. Paris: World Heritage Centre (WHC). Available from: https://whc.unesco.org/document/100750 [Accessed 09 August. 2022].

Wu, S. R., Fan, P., and Chen, J. (2016). Incorporating culture into sustainable development: A cultural sustainability index framework for green buildings. *Sustainable Development*, 24(1), pp.64-76.

Yin, R. K. (1984). *Case Study Research: Design and Methods* (1st ed.). SAGE Publications.

Yung, E. H., and Chan, E. H. (2012). Implementation challenges to the adaptive reuse of heritage buildings: Towards the goals of sustainable, low carbon cities. *Habitat International*, 36(3), pp.352-361.

Zallio, M., & Clarkson, P. J. (2022). The Inclusion, Diversity, Equity and Accessibility audit. A post-occupancy evaluation method to help design the buildings of tomorrow. *Building and Environment*, 217, p.109058.

Zhao, J., Li, W., Luo, H., & Miao, J. (2010). Research on protection of the architectural glazed ceramics in the Palace Museum, Beijing. *Journal of cultural heritage*, 11(3), pp.279-287.

Zheng, Y., Mark, B., and Youmans, H. (2011). A Simple Method to Calculate Vehicle Heat Load. *SAE Technical Paper 2011-01-0127* [Online], Available from: https://saemobilus.sae.org/content/2011-01-0127 [Accessed 11 April. 2020].

Zimmerman, A., & Martin, M. (2001). Post-occupancy evaluation: benefits and barriers. *Building research & information*, 29(2), pp.168-174.

Appendices

Appendix A: Face to face interviews with Osama Alhasan, Malik Naanaa, and Sulieman Al-Khawaldeh.

Appendix B: Excel sheet sample of calculating the mean values of the indoor and outdoor air temperatures.

Appendix C: Excel sheet sample of calculating the diurnal swings.

Appendix D: Excel sheet sample of calculating the decrement factor (f) and time lag (ȶ).

Appendix E: Excel sheet sample of calculating the comfort temperatures.

Appendix F: Post occupancy evaluation questionnaire.

Appendix A: Transcribed Interviews

A.1: Interview with Osama Alhasan, head of ecotourism/ facilities development at the RSCN.

Q: Who is the RSCN? The Royal Society for the conservation of nature is an NGO organisation that operates through ecotourism activities in all of Jordan's protected areas with the aim of protecting wildlife and support for natural conservation programs by making an income that the organisation spends on itself. It was founded in 1966 after king Hussein requested its establishment, as he called a British team by the royal court to conduct a survey of the entire territory of Jordan in the early 1960s. The team evaluated the places that should be considered reserves, as 19 sites were converted into nature reserves.
Q: What are the goals of the RSCN? The RSCN works with ecotourism for three main goals, including: 1) Support nature conservation programs. The RSCN directly uses the profit from ecotourism to develop sustainable ecotourism and services and conserve wildlife. 2) Provide alternative job opportunities for the sake of the local people instead of their work in the nature reserves as they were prevented from using the place they were living in. These jobs are called natural protection-based jobs. For instance, women work with handcraft, and men work as eco-guides and rangers, and the organisation aims to make the local community employees support them financially. 3) Spread awareness and value of the importance of the natural heritage existing in the region.
Q: Does the RSCN receive funding from international and local organisations? Yes, of course. The RSCN first started working on the Dana biosphere reserve in 1994 after funding was obtained because the concept of conservation changed globally, receiving more attention in 1992, when the (ICN), (UNESCO), and other international organisations met at the Earth Day in Rio de Janeiro, Brazil. After this nation, funds were distributed through the RSCN, and Jordan was one of the first countries to receive these funds in 1994. Among the outputs of this nation is that the idea of the nature conservation concept has been changed, as nature protection was based on fenced protected areas, eliminating any human activities. After 1992, the concept of socio-economic development was introduced to local communities within the conservation activities. The local communities become partners to protect rather than isolate them, so the focus has become

on the development of local communities and their involvement in conservation by creating alternative jobs for them.

Q: What kind of activities were held in Dana by the RSCN?

Dana village has undergone several restoration efforts because of its historical, ecological, architectural, and heritage significance. Many local families began to move out of the village to the Qadisiyah urban area, seeking better job opportunities, services, schools, and housing, and a better quality of life. They felt isolated in their mountainous village, away from main roads and transportation. By 1990, the village was semi-abandoned and had begun to gradually die.

Among the activities carried out in Dana, the concept of ecotourism was introduced, and activities to attract tourists and market the concept of ecotourism were held, where tourist facilities have been built as required. Previously, there was a Dana guest house, which included only nine rooms designed by Ammar Khamash and was expanded in 2016 by adding 15 additional rooms designed by Ammar Khamash. The number of Eco-lodges should be at a minimum according to the principles of ecotourism (fewer people, higher quality, and more money).

In 1994, 20% of buildings were in good condition, only taking into consideration if the buildings were used or occupied. Even if there were no problems with the roofs and walls, their integrity would be affected over time due to their abandonment. Not only would the integrity of roofs and walls be affected, but also that of the plaster, pavement, doors, and windows. The village was almost abandoned after the local community immigrated to Al-Qadisyah. However, they still owned their houses in addition to the agricultural activities in their lands as they were constantly coming to Dana for farming. The RSCN works with the local community on economic and social development projects as they take and sell their products such as dry apricots, jams, and herbs, and this project is still relevant now.

1994 - 1996 The RSCN obtained funding from the ‘Friends of Dana’ Association, which is one of the groups donated by the women of the local community in Amman. Accordingly, the RSCN repaired some houses, such as simple treatments for the roof, adding concrete layers with the aim of housing people in their homes and not using it for tourism purposes. At that time, there were two main bodies in Dana, and they were Dana hotel which is related to the friends of Dana and Dana tower hotel related to a private party.

Furthermore, the friends of Dana funded the renovation of Dana’s Mosque, which was built in 1958, and a minaret was added. They also funded the local community to be able to renovate their own houses. At that time, the RSCN noticed that Dana started to lose its architectural heritage due to the unplanned restoration practices. For instance, some residents built

additional floors, breaking the skyline of the village, which is constructed mainly of single-storey houses. In 2009, the RSCN received funding from USAID to restore Dana village, and a proposal was designed. The RSCN received the fund to restore Dana's houses as required because after the RSCN revitalised the tourism activities in Dana biosphere reserve, the local community of Dana operated their buildings for tourism purposes, endangering the architectural heritage of the village. Therefore, the RSCN collaborated with Ammar Khammash engineering consulting office to design a proposal for adjusting and controlling the rehabilitation of Dana.
Q: How did the local community of Dana respond to the rehabilitation project? The local community in Dana was worried about being victims of the project. The village was already abandoned before the rehabilitation project. The local community decided by themselves to move out, leaving their properties abandoned. There were no attempts to relocate them, but on the contrary, the RSCN implemented several sustainable development plans to encourage locals to return to their village. Several conflicts arose between the local authority and the local community before the project was launched. As a result of these conflicts, some proposed facilities were not implemented, with their use changed to satisfy the desires of the local community. This was due to the lack of faith in the real intentions of the local authority and government, based on the previous development practices.
Q: Should not the local community obtain building permits in order to build extensions? As a tourist facility, they are supposed to take licenses. Still, the Ministry of Tourism and Antiquities tends to give licenses even if they violate and humiliate, considering their interest and acquaintances.
Q: Were there contracts obligating the residents to use their properties after the restoration, according to the agreement? Yes, but it was not very binding to some extent.
Q: What are the conditions of constructing new buildings? The allowed building footprint of the new building in empty land is about 50% of the land area. In the case of an existing old building with less than 50% of the land area, the allowed building footprint of the new building is about 50% of the empty land area. Meanwhile, additions are not allowed if the existing old building area is more than 50% of the land area.

A.2: Interview with Malik Naanaa, head of the RSCN (Dana branch).

Q: Can you tell me why the rehabilitation project of Dana was divided into three stages and how it was implemented?

The funding was insufficient for the restoration of the whole village, which consisted of 350 houses. Therefore, the village was divided into three zones. The rehabilitation project was planned into three stages; the first stage prioritises the area around the main street of Dana that connects its entrance and the edge of Dana valley. Recording, documenting, and managing the project were undertaken at all the stages of the rehabilitation project.

When the renovation work started, there were some problems with the two main bodies as each one of them wanted the work of the restoration to be restricted to the buildings belonging to them. At the same time, the dana tower hotel refused to remove the two additional floors as a part of the restoration process. In summary, this problem is a conflict of interest for some of the business owners or stakeholders. As a result, the project was delayed for a year and a half, and the RSCN was forced to draw up plan B. Based on this, the RSCN posted a declaration in the municipality of Al-Qadisiyah to all the house owners in the village. This contained the objectives of the project, how the houses could be restored, and the options of the new functions of the houses, including hotel rooms, shops, cafes, mini-markets and personal use.

It also included the financial commitment of the house owners, who were expected to pay 50% of the cost of restoring their houses in instalments within ten years. The minimum cost of restoring each house was 35,000 dinars. Those who were interested in restoring their houses were required to submit an application to the RSCN. A total of 200 applications were submitted. The RSCN approved only 54 applications after dividing the project into three stages and defined the priority area to be restored at stage one. Consequently, 120 houses were selected for restoration at stage one, which was within the zone of the first development area. The project gave priority to reducing the cost of the restoration process in order to be able to restore more houses.

The restoration of the vernacular buildings was divided into two main types, total and partial restoration, according to their physical situation. Some of the houses were demolished entirely, showing empty land. Therefore, they were reconstructed. Other houses, whose walls were in good condition, were also reconstructed because the adopted approach was to demolish the existing houses and rebuild them as they had no or small windows. Also, all roofs were removed, and new ones were created in line with the fixed standards of renovation, including the construction of new roofs and the addition of windows, bathrooms, and lighting shafts.

Q: Were the same construction materials and methods used?

Some building materials were changed due to the limited availability of original ones and the lack of locals' experience in implementing the original techniques and methods of construction. For instance, the timber beams were replaced by reinforced concrete beams, and reinforced concrete roofs replaced the cane and clay roofs. The concrete structures replaced the timber ones following the construction trend in Jordan that was widely used after the 1980s, becoming cheaper and more affordable. Inside, they were plastered with roughcast or smooth plaster and painted with white 'sheed' paint, that is lead-free, anti-insect, and affordable.

This transformation was necessary due to the limited availability of juniper wood used in constructing the original roofs. During the Ottoman period (100-150 years ago), juniper was available due to the proliferation of large trees with large branches. However, the quantities required for the restoration process were unavailable when the rehabilitation project was launched. Besides, even if another type of wood had been chosen to replace the juniper wood, it would be light wood and might be damaged over time.

Similarly, there were no available quantities of the cane required for the restoration process. Moreover, as the original roofs needed frequent maintenance, the mixture of clay and straw was replaced with concrete, intended as a durable solution for roof construction. The original mixture needs frequent maintenance due to the different seasons in Dana. The original roofs are often wet or dry, turning them into a fragile layer that incapacitates the covering and protection of the internal spaces. Therefore, the original roofs were rebuilt every year when the village was occupied by locals.

The roof construction method adopted replaced the timber beams with reinforced concrete ones in both the partial and total restoration processes, achieving wider spans. Therefore, the internal stone arch walls were no longer required to support the wide roof spans. However, these stone arch walls were rebuilt after the roofs, with no functional purpose other than to preserve the visual appearance and elements of the vernacular houses.

The construction materials and methods of Dana's walls were also changed. Most of the original walls, composed of stone, clay and straw, were transformed into new walls constructed of stone, hollow cement blocks, and concrete. This transformation is used in the case of total restoration, rebuilding a new type of wall that is frequently used in Jordan. The rebuilt walls were composed of stone masonry for the external face (10cm) and hollow cement blocks for the internal face (10 cm), with concrete filling in-between. In the case of partial restoration, the walls were restored using the original vernacular method of construction. The same original materials were employed; stone on both sides (external and internal faces), with clay filling in between, mixed with a small amount of cement (1:10) instead of straw in order to strengthen it.

The stone masonry was either left without being repointed or repointed with cement mortar to avoid insects and reptiles. The suitable proportions of cement mortar were 1 unit of white cement to 2 units of fine powder to 2 units of Dana village soil.
Q: Were the original opening sizes maintained? In the case of partial restoration, the structural openings were restored closely following the proportions of the original openings. On the other hand, in the case of total restoration, the structural openings were enlarged to provide more lighting and better ventilation while keeping the original proportions to avoid any extraneous details inconsistent with the short stone lintels of the original openings. However, this solution was not always possible because enlarging the window size while maintaining the original proportions depended on the original size and proportion of the windows and buildings. In each case of buildings, windows were proportionally enlarged up to a certain limit due to the different parameters of each building. However, enlarging the openings were not sufficient to lighten and ventilate the buildings. Therefore, new lighting shafts were created to provide more lighting and better ventilation. These introverted lighting shafts bring air and light from outside to the indoor area. To achieve suitable natural lighting in each room, the glass area which brings the sunlight into the indoor spaces should be no less than 2 m^2 per room, and the opening area in the roof should be no less than 1.5 m^2 for each room.
Q: Was there any problem with draining the rainwater in the new shafts? The rainwater drainage was treated in some shafts by rainwater soakaways and in others by planting floors to prevent flooding and waterlogging. Within the last few years, there have been no problems with the rainwater because the area of the roof openings is not large, and the average rainfall does not exceed 300 ml/year.
Q: Was the original form of houses maintained? It is significant to conserve the buildings' original form as much as possible when restoring the original buildings and constructing new buildings or additions. For instance, most of the original buildings were introverted with small external openings, responding to local's privacy need. Moreover, houses with courtyards were built to respond to the privacy needs in particular and other socio-cultural and environmental needs in general. However, interventions and additions were limited to the minimum needed to run the buildings according to their new use within the development process.

A.3: Sulieman Al-Khawaldeh, the president of Dana and Al-Qadisiyyah local community cooperative.

Q: How did you first respond to the rehabilitation project? I was against the transformation of the village. The distribution of the new uses was not designed according to the choices and preferences of the local community, who felt detached from the whole process. Therefore, I was afraid of losing our village without adequate economic benefits, as happened in Umm Qais and Taybet Zaman villages.
Q: Now, what do you think? Did the village benefit from the rehabilitation project? Yes, for sure. For instance, the hotel used to rent the rooms for 15-25 dinars, but after the rehabilitation project, they are rented for 60-70 dinars. In addition, the RSCN employed locals to operate its branch and hotel and implement the rehabilitation project. They were chosen to undertake the project after being trained in the basics of the restoration process. Job opportunities were also created related to ecotourism, such as tourist guides, drivers, chefs, and those related to making and selling gifts and souvenirs. Furthermore, job opportunities for local Dana women were created at the fruit and herb drying workshop after its production was improved due to installing the water supply system in the village.
Q: Did the tourism development change the lifestyle of Dana's community? Providing job opportunities related to tourism has changed the rural lifestyle of the local community of Dana village. The people are willing to work in various jobs related to tourist activities and deal with tourists from all over the world. Men became able to speak different languages (English, French, Italian, and Russian) and wear contemporary clothes (such as jeans and shirts instead of the traditional Bedouin clothes).
Q: what do you think of the old and new construction materials? The original vernacular materials are local, natural, not imported from outside the country, and were not manufactured or processed. They are also more durable but need frequent maintenance. On the contrary, the new synthetic construction materials are not local, durable, or sustainable as they are hard to reuse or recycle in Jordan. For instance, the original clay roofs need frequent maintenance to avoid water leakage into indoor spaces. To overcome this issue, local families used to remove the roof layer (the mixture of clay and straw) every year when winter ended and replaced it with a new one. However, this strategy was time-consuming as now we are looking for permanent solutions to avoid the annual replacement of the roof. Therefore, we covered the original roof with a concrete layer to protect it from climatic conditions.

Appendix B: Excel sheet sample of calculating the mean values of the indoor and outdoor air temperatures

The data loggers were adjusted to record the internal and external air temperature and humidity every 15 minutes. Therefore, the hourly mean values of these measurements were calculated.

Room #1									
Summer					Winter				
Date/Time	Temperature	Humidity	Hourly Temp.	Hourly %RH	Date/Time	Temperature	Humidity	Hourly Temp.	Hourly %RH
07/28/2019 00:00:00	26.129 °C	41.4 %RH			01/19/2020 00:00:00	8.646 °C	82.6 %RH		
07/28/2019 00:15:00	26.026 °C	41.4 %RH			01/19/2020 00:15:00	8.673 °C	82.9 %RH		
07/28/2019 00:30:00	25.920 °C	41.1 %RH			01/19/2020 00:30:00	8.658 °C	82.6 %RH		
07/28/2019 00:45:00	25.904 °C	41.9 %RH	25.995	41.4	01/19/2020 00:45:00	8.650 °C	82.6 %RH	8.657	82.7
07/28/2019 01:00:00	25.945 °C	42.8 %RH			01/19/2020 01:00:00	8.656 °C	82.6 %RH		
07/28/2019 01:15:00	25.985 °C	43.5 %RH			01/19/2020 01:15:00	8.649 °C	82.1 %RH		
07/28/2019 01:30:00	25.985 °C	43.5 %RH			01/19/2020 01:30:00	8.661 °C	82.4 %RH		
07/28/2019 01:45:00	25.960 °C	43.3 %RH	25.969	43.3	01/19/2020 01:45:00	8.706 °C	82.1 %RH	8.668	82.3
07/28/2019 02:00:00	25.920 °C	44.0 %RH			01/19/2020 02:00:00	8.715 °C	82.1 %RH		
07/28/2019 02:15:00	25.891 °C	43.8 %RH			01/19/2020 02:15:00	8.733 °C	81.8 %RH		
07/28/2019 02:30:00	25.858 °C	44.0 %RH			01/19/2020 02:30:00	8.731 °C	81.8 %RH		
07/28/2019 02:45:00	25.810 °C	42.8 %RH	25.870	43.7	01/19/2020 02:45:00	8.742 °C	81.6 %RH	8.730	81.8
07/28/2019 03:00:00	25.736 °C	41.6 %RH			01/19/2020 03:00:00	8.755 °C	81.3 %RH		
07/28/2019 03:15:00	25.679 °C	41.4 %RH			01/19/2020 03:15:00	8.737 °C	81.0 %RH		
07/28/2019 03:30:00	25.626 °C	41.6 %RH			01/19/2020 03:30:00	8.751 °C	81.3 %RH		
07/28/2019 03:45:00	25.580 °C	41.6 %RH	25.655	41.6	01/19/2020 03:45:00	8.716 °C	81.3 %RH	8.740	81.2
07/28/2019 04:00:00	25.533 °C	42.1 %RH			01/19/2020 04:00:00	8.670 °C	81.0 %RH		

07/28/2019 04:15:00	25.484 °C	42.6 %RH			01/19/2020 04:15:00	8.629 °C	81.3 %RH		
07/28/2019 04:30:00	25.437 °C	41.9 %RH			01/19/2020 04:30:00	8.610 °C	81.0 %RH		
07/28/2019 04:45:00	25.382 °C	41.6 %RH	25.459	42.0	01/19/2020 04:45:00	8.571 °C	81.0 %RH	8.620	81.1
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
08/26/2019 06:00:00	25.284 °C	36.5 %RH			02/17/2020 06:00:00	9.691 °C	67.7 %RH		
08/26/2019 06:15:00	25.247 °C	36.5 %RH			02/17/2020 06:15:00	9.658 °C	67.1 %RH		
08/26/2019 06:30:00	25.219 °C	36.8 %RH			02/17/2020 06:30:00	9.621 °C	67.1 %RH		
08/26/2019 06:45:00	25.200 °C	37.5 %RH	25.238	36.8	02/17/2020 06:45:00	9.594 °C	67.1 %RH	9.641	67.3
08/26/2019 07:00:00	25.189 °C	38.0 %RH			02/17/2020 07:00:00	9.569 °C	67.1 %RH		
08/26/2019 07:15:00	25.168 °C	38.2 %RH			02/17/2020 07:15:00	9.545 °C	66.9 %RH		
08/26/2019 07:30:00	25.158 °C	39.7 %RH			02/17/2020 07:30:00	9.520 °C	66.9 %RH		
08/26/2019 07:45:00	25.155 °C	40.6 %RH	25.167	39.1	02/17/2020 07:45:00	9.493 °C	66.6 %RH	9.532	66.9
08/26/2019 08:00:00	25.161 °C	41.4 %RH			02/17/2020 08:00:00	9.471 °C	66.3 %RH		
08/26/2019 08:15:00	25.167 °C	42.1 %RH			02/17/2020 08:15:00	9.450 °C	67.1 %RH		
08/26/2019 08:30:00	25.164 °C	43.1 %RH			02/17/2020 08:30:00	9.442 °C	67.4 %RH		
08/26/2019 08:45:00	25.174 °C	44.0 %RH	25.166	42.6	02/17/2020 08:45:00	9.420 °C	67.9 %RH	9.446	67.2
08/26/2019 09:00:00	25.212 °C	44.8 %RH			02/17/2020 09:00:00	9.418 °C	68.4 %RH		
08/26/2019 09:15:00	25.256 °C	44.8 %RH			02/17/2020 09:15:00	9.418 °C	69.0 %RH		
08/26/2019 09:30:00	25.303 °C	45.2 %RH			02/17/2020 09:30:00	9.420 °C	69.0 %RH		
08/26/2019 09:45:00	25.351 °C	46.5 %RH	25.280	45.3	02/17/2020 09:45:00	9.460 °C	68.4 %RH	9.429	68.7
08/26/2019 10:00:00	25.401 °C	47.0 %RH			02/17/2020 10:00:00	9.605 °C	68.7 %RH		
08/26/2019 10:15:00	25.461 °C	47.5 %RH			02/17/2020 10:15:00	9.726 °C	68.4 %RH		
08/26/2019 10:30:00	25.515 °C	48.2 %RH			02/17/2020 10:30:00	9.832 °C	68.4 %RH		
08/26/2019 10:45:00	25.584 °C	49.0 %RH	25.490	47.9	02/17/2020 10:45:00	9.894 °C	69.2 %RH	9.764	68.7

08/26/2019 11:00:00	25.650 °C	48.7 %RH			02/17/2020 11:00:00	9.940 °C	70.5 %RH		
08/26/2019 11:15:00	25.717 °C	49.0 %RH			02/17/2020 11:15:00	10.020 °C	71.6 %RH		
08/26/2019 11:30:00	25.804 °C	49.7 %RH			02/17/2020 11:30:00	10.093 °C	72.6 %RH		
08/26/2019 11:45:00	25.874 °C	50.5 %RH	25.761	49.5	02/17/2020 11:45:00	10.131 °C	72.6 %RH	10.046	71.8

Appendix C: Excel sheet sample of calculating the diurnal swings

The diurnal swings were calculated to indicate the daily variations using the following equation:

$$Diurnal\ swing = (\mathrm{Ti.max}) - (\mathrm{Ti.min})$$

(Ti.max) is the maximum indoor temperature (C°), (Ti.min) is the minimum indoor temperature (C°).

Date	Minimum Temperature	Maximum Temperature	Diurnal swing	Date	Minimum Temperature	Maximum Temperature	Diurnal swing
28-Jul	24.99	26.751	1.8 °C	19-Jan	8.071	8.74	0.7 °C
29-Jul	24.652	26.637	2.0 °C	20-Jan	7.668	8.196	0.5 °C
30-Jul	24.719	28.233	3.5 °C	21-Jan	5.724	7.618	1.9 °C
31-Jul	26.226	29.217	3.0 °C	22-Jan	5.058	5.747	0.7 °C
01-Aug	26.512	28.993	2.5 °C	23-Jan	5.237	5.707	0.5 °C
02-Aug	25.118	27.455	2.3 °C	24-Jan	4.744	5.55	0.8 °C
03-Aug	24.945	26.59	1.6 °C	25-Jan	4.062	5.477	1.4 °C
04-Aug	24.924	27.21	2.3 °C	26-Jan	4.978	6.914	1.9 °C
05-Aug	25.108	27.478	2.4 °C	27-Jan	5.846	7.458	1.6 °C
06-Aug	25.314	26.909	1.6 °C	28-Jan	6.883	7.716	0.8 °C
07-Aug	24.838	26.403	1.6 °C	29-Jan	7.147	7.605	0.5 °C
08-Aug	24.196	26.395	2.2 °C	30-Jan	6.71	8.281	1.6 °C
09-Aug	24.241	26.011	1.8 °C	31-Jan	6.873	8.028	1.2 °C
10-Aug	23.479	25.817	2.3 °C	01-Feb	6.466	7.104	0.6 °C
11-Aug	23.701	26.456	2.8 °C	02-Feb	6.841	8.425	1.6 °C
12-Aug	24.482	26.773	2.3 °C	03-Feb	7.524	9.317	1.8 °C
13-Aug	24.746	27.683	2.9 °C	04-Feb	8.031	9.062	1.0 °C
14-Aug	25.342	27.467	2.1 °C	05-Feb	8.117	10.011	1.9 °C
15-Aug	24.932	27.225	2.3 °C	06-Feb	8.953	10.607	1.7 °C
16-Aug	25.633	28.881	3.2 °C	07-Feb	7.96	10.074	2.1 °C
17-Aug	26.112	27.738	1.6 °C	08-Feb	6.539	8.024	1.5 °C
18-Aug	25.404	26.899	1.5 °C	09-Feb	5.8	8.755	3.0 °C
19-Aug	24.581	26.431	1.9 °C	10-Feb	5.393	8.236	2.8 °C
20-Aug	24.484	26.132	1.6 °C	11-Feb	6.368	8.898	2.5 °C
21-Aug	24.138	26.251	2.1 °C	12-Feb	7.998	10.282	2.3 °C

22-Aug	24.496	26.73	2.2 °C	13-Feb	7.582	9.403	1.8 °C
23-Aug	25.049	26.949	1.9 °C	14-Feb	8.332	10.493	2.2 °C
24-Aug	25.384	27.028	1.6 °C	15-Feb	9.63	11.593	2.0 °C
25-Aug	25.297	27.2	1.9 °C	16-Feb	10.139	11.019	0.9 °C
26-Aug	25.166	26.293	1.1 °C	17-Feb	9.429	10.387	1.0 °C

Appendix D: Excel sheet sample of calculating the decrement factor (f) and time lag (ŧ)

The decrement factor and time lag are calculated at each space to practically analyse the efficiency of the building envelope in resisting heat transfer. They are calculated using the following equations:

$$f = \frac{\text{Ti.max} - \text{Ti.mean}}{\text{To.max} - \text{To.mean}}$$

(Ti.max) is the maximum indoor temperature (C°), (Ti.mean) is the mean indoor temperature (C°), (To.max) is the maximum outdoor temperature (C°), and (To.mean) is the mean outdoor temperature (C°).

$$ŧ = t(\text{Ti.max}) - t(\text{To.max})$$

t(Ti.max) is the time when the indoor temperature reaches the maximum (hours), and t(To.max) is the time when the outdoor temperature is the maximum (hours).

Hourly Indoor Temperature °C (Room #1)																	
	28-Jul		29-Jul		30-Jul		31-Jul		……..	22-Aug		23-Aug		24-Aug		25-Aug	
Time	Indoor	outdoor	Indoor	outdoor	Indoor	outdoor	Indoor	outdoor	……..	Indoor	outdoor	Indoor	outdoor	Indoor	outdoor	Indoor	outdoor
00:00	25.995	20.435	26.163	18.398	26.085	20.331	26.947	26.76	……..	25.712	19.037	26.174	19.83	26.496	21.271	26.458	22.444
01:00	25.969	19.177	25.941	18.292	25.948	20.31	26.75	26.117	……..	25.508	18.685	26.033	19.319	26.351	21.074	26.281	22.061
02:00	25.87	18.308	25.728	17.703	25.754	20.111	26.566	25.861	……..	25.291	18.109	25.858	19.467	26.219	20.541	26.097	21.605
03:00	25.655	17.7	25.528	17.168	25.451	20.875	26.458	25.637	……..	25.063	18.162	25.689	19.439	26.072	19.804	25.9	20.942
04:00	25.459	17.123	25.317	16.802	24.986	21.479	26.341	25.607	……..	24.869	18.378	25.481	19.641	25.821	19.8	25.712	20.624
05:00	25.262	17.271	25.072	17.862	24.874	21.521	26.247	25.896	……..	24.637	19.309	25.303	19.829	25.554	20.158	25.528	20.69
06:00	25.09	18.715	24.947	19.013	24.719	21.923	26.226	26.545	……..	24.521	20.792	25.176	20.66	25.485	21.014	25.371	21.656
07:00	25.004	22.544	24.822	22.588	24.86	27.453	26.263	29.23	……..	24.496	25.497	25.08	24.236	25.402	25.076	25.297	26.156
08:00	24.99	24.197	24.712	25.727	25.207	29.74	26.32	31.247	……..	24.545	28.807	25.049	25.993	25.384	26.558	25.334	27.553

09:00	25.019	26.206	24.652	28.288	25.695	30.943	26.46	32.22	……..	24.649	29.224	25.076	27.649	25.437	28.243	25.448	29.01
10:00	25.109	28.342	24.697	30.024	26.201	32.176	26.761	33.568	……..	24.838	30.526	25.242	29.865	25.574	29.913	25.6	31.176
11:00	25.271	29.908	24.896	31.224	26.599	33.811	27.058	34.977	……..	25.137	31.973	25.477	31.474	25.748	31.642	25.804	32.115
12:00	25.597	29.909	25.265	31.779	26.995	35.073	27.792	36.284	……..	25.51	32.001	25.796	32.988	25.968	32.517	26.091	32.356
13:00	25.976	30.381	25.678	32.168	27.454	35.277	28.573	36.535	……..	25.865	32.625	26.161	34.306	26.227	33.115	26.331	33.662
14:00	26.301	29.889	26.021	31.993	27.838	35.377	28.902	35.744	……..	26.202	32.781	26.421	34.316	26.498	33.352	26.626	33.684
15:00	26.536	29.103	26.337	30.346	28.103	34.115	29.106	34.182	……..	26.588	31.731	26.65	32.255	26.671	31.837	26.982	31.964
16:00	26.668	27.797	26.528	29.152	28.233	32.374	29.217	32.336	……..	26.73	29.917	26.866	29.907	26.854	30.004	27.2	29.814
17:00	26.711	26.004	26.613	27.48	28.192	30.113	29.206	29.899	……..	26.653	27.301	26.949	27.332	26.984	27.46	27.186	27.493
18:00	26.665	24.152	26.637	24.893	28.015	27.848	28.92	27.56	……..	26.648	25.441	26.947	25.485	27.022	25.553	27.055	25.736
19:00	26.669	22.732	26.59	23.587	27.554	27.046	28.787	25.983	……..	26.567	24.768	26.939	24.155	27.028	24.256	26.91	24.636
20:00	26.751	21.591	26.527	22.877	27.459	26.487	28.722	24.531	……..	26.559	23.587	26.912	22.65	26.974	23.297	26.784	24.248
21:00	26.69	20.244	26.362	22.481	27.417	25.429	28.616	24.183	……..	26.492	22.757	26.834	21.791	26.878	22.526	26.747	22.802
22:00	26.564	19.15	26.257	21.041	27.394	24.843	28.469	24.252	……..	26.416	21.476	26.684	22.528	26.776	21.586	26.64	21.712
23:00	26.407	18.482	26.175	20.239	27.115	26.503	28.216	22.793	……..	26.309	20.532	26.614	21.579	26.613	22.149	26.493	21.145
Max Temp	26.751	30.381	26.637	32.168	28.233	35.377	29.217	36.535	……..	26.73	32.781	26.949	34.316	27.028	33.352	27.2	33.684
mean	25.926	23.307	25.728	24.214	26.590	27.548	27.622	29.081	……..	25.659	25.142	26.059	25.279	26.252	25.531	26.245	26.054
Min Temp	24.99		24.652		24.719		26.226		……..	24.496		25.049		25.384		25.297	
Max - Mean	0.825	7.074	0.909	7.954	1.644	7.829	1.595	7.454	……..	1.071	7.639	0.890	9.037	0.776	7.821	0.955	7.631
Decrement Factor	0.12		0.11		0.21		0.21		……..	0.14		0.10		0.10		0.13	
Time lag	07:00		05:00		02:00		03:00		……..	02:00		03:00		05:00		02:00	

Appendix E: Excel sheet sample of calculating the comfort temperature

This study adopts the BSEN15251 approach and uses the outdoor running mean temperature to calculate the comfort temperature using the following equations:

$T_{rm} = \alpha T_{rm-1} + (1 - \alpha) T_{od-1}$ (Trm) is the outdoor running mean temperature (C°), Trm−1 is the outdoor running mean temperature of the previous day (C°), Tod−1 is the mean outdoor temperature of the previous day, α is a constant between 0 and 1 that express how quickly the running mean responds to the mean outdoor temperature, α is assumed to be 0.8 for this study.

$T_{comf} = 0.33 T_{rm} + 18.8$ (Tcomf) is the comfort temperature

$T_{comf} = 0.33 T_{rm} + 18.8 \pm 2$ The comfort range of category I

$T_{comf} = 0.33 T_{rm} + 18.8 \pm 3$ The comfort range of category II

$T_{comf} = 0.33 T_{rm} + 18.8 \pm 4$ The comfort range of category III

Room #1 (Summer)						EN15251 Cat I (±2 K)		EN15251 Cat II (±3 K)		EN15251 Cat III (±4 K)	
Date	Indoor temp.	Outdoor temp.	Mean Daily Tout	Daily T_{rm}	Tcomf	T_{comf} lower Margin	T_{comf} upper Margin	T_{comf} lower Margin	T_{comf} upper Margin	T_{comf} lower Margin	T_{comf} upper Margin
21/07/2019			23.44								
22/07/2019			22.56								
23/07/2019			21.63								
24/07/2019			18.29								
25/07/2019			20.43								
26/07/2019			20.78								
27/07/2019			22.16								
07/28/2019 00:00:00	25.995	20.435	23.307	21.1	25.8	23.8	27.8	22.8	28.8	21.8	29.8
07/28/2019 01:00:00	25.969	19.177									
07/28/2019 02:00:00	25.870	18.308									
07/28/2019 03:00:00	25.655	17.700									
07/28/2019 04:00:00	25.459	17.123									
07/28/2019 05:00:00	25.262	17.271									
07/28/2019 06:00:00	25.090	18.715									
07/28/2019 07:00:00	25.004	22.544									
07/28/2019 08:00:00	24.990	24.197									
07/28/2019 09:00:00	25.019	26.206									
07/28/2019 10:00:00	25.109	28.342									
07/28/2019 11:00:00	25.271	29.908									
07/28/2019 12:00:00	25.597	29.909									
07/28/2019 13:00:00	25.976	30.381									

07/28/2019 14:00:00	26.301	29.889									
07/28/2019 15:00:00	26.536	29.103									
07/28/2019 16:00:00	26.668	27.797									
07/28/2019 17:00:00	26.711	26.004									
07/28/2019 18:00:00	26.665	24.152									
07/28/2019 19:00:00	26.669	22.732									
07/28/2019 20:00:00	26.751	21.591									
07/28/2019 21:00:00	26.690	20.244									
07/28/2019 22:00:00	26.564	19.150									
07/28/2019 23:00:00	26.407	18.482									
07/29/2019 00:00:00	26.163	18.398									
07/29/2019 01:00:00	25.941	18.292									
07/29/2019 02:00:00	25.728	17.703									
07/29/2019 03:00:00	25.528	17.168									
07/29/2019 04:00:00	25.317	16.802									
07/29/2019 05:00:00	25.072	17.862									
07/29/2019 06:00:00	24.947	19.013									
07/29/2019 07:00:00	24.822	22.588	24.214	21.0	25.7	23.7	27.7	22.7	28.7	21.7	29.7
07/29/2019 08:00:00	24.712	25.727									
07/29/2019 09:00:00	24.652	28.288									
07/29/2019 10:00:00	24.697	30.024									
07/29/2019 11:00:00	24.896	31.224									
07/29/2019 12:00:00	25.265	31.779									
07/29/2019 13:00:00	25.678	32.168									
07/29/2019 14:00:00	26.021	31.993									

07/29/2019 15:00:00	26.337	30.346									
07/29/2019 16:00:00	26.528	29.152									
07/29/2019 17:00:00	26.613	27.480									
07/29/2019 18:00:00	26.637	24.893									
07/29/2019 19:00:00	26.590	23.587									
07/29/2019 20:00:00	26.527	22.877									
07/29/2019 21:00:00	26.362	22.481									
07/29/2019 22:00:00	26.257	21.041									
07/29/2019 23:00:00	26.175	20.239									
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
08/24/2019 00:00:00	26.496	21.271	25.531	23.8	26.7	24.7	28.7	23.7	29.7	22.7	30.7
08/24/2019 01:00:00	26.351	21.074									
08/24/2019 02:00:00	26.219	20.541									
08/24/2019 03:00:00	26.072	19.804									
08/24/2019 04:00:00	25.821	19.800									
08/24/2019 05:00:00	25.554	20.158									
08/24/2019 06:00:00	25.485	21.014									
08/24/2019 07:00:00	25.402	25.076									
08/24/2019 08:00:00	25.384	26.558									
08/24/2019 09:00:00	25.437	28.243									
08/24/2019 10:00:00	25.574	29.913									
08/24/2019 11:00:00	25.748	31.642									
08/24/2019 12:00:00	25.968	32.517									

08/24/2019 13:00:00	26.227	33.115									
08/24/2019 14:00:00	26.498	33.352									
08/24/2019 15:00:00	26.671	31.837									
08/24/2019 16:00:00	26.854	30.004									
08/24/2019 17:00:00	26.984	27.460									
08/24/2019 18:00:00	27.022	25.553									
08/24/2019 19:00:00	27.028	24.256									
08/24/2019 20:00:00	26.974	23.297									
08/24/2019 21:00:00	26.878	22.526									
08/24/2019 22:00:00	26.776	21.586									
08/24/2019 23:00:00	26.613	22.149									
08/25/2019 00:00:00	26.458	22.444	26.054	24.1	26.7	24.7	28.7	23.7	29.7	22.7	30.7
08/25/2019 01:00:00	26.281	22.061									
08/25/2019 02:00:00	26.097	21.605									
08/25/2019 03:00:00	25.900	20.942									
08/25/2019 04:00:00	25.712	20.624									
08/25/2019 05:00:00	25.528	20.690									
08/25/2019 06:00:00	25.371	21.656									
08/25/2019 07:00:00	25.297	26.156									
08/25/2019 08:00:00	25.334	27.553									
08/25/2019 09:00:00	25.448	29.010									
08/25/2019 10:00:00	25.600	31.176									
08/25/2019 11:00:00	25.804	32.115									
08/25/2019 12:00:00	26.091	32.356									
08/25/2019 13:00:00	26.331	33.662									

08/25/2019 14:00:00	26.626	33.684									
08/25/2019 15:00:00	26.982	31.964									
08/25/2019 16:00:00	27.200	29.814									
08/25/2019 17:00:00	27.186	27.493									
08/25/2019 18:00:00	27.055	25.736									
08/25/2019 19:00:00	26.910	24.636									
08/25/2019 20:00:00	26.784	24.248									
08/25/2019 21:00:00	26.747	22.802									
08/25/2019 22:00:00	26.640	21.712									
08/25/2019 23:00:00	26.493	21.145									

Appendix F: Post occupancy evaluation questionnaire

F.1: Semi-structured interview with tourists for post occupancy evaluation of the vernacular dwellings in Dana village (English version)

A. General Information

Building Code: ___________________

Date: ____________________________

Time: ___________________________

1. Age Category: (i) 18-25 ☐ (ii) 26-35_☐ (iii) 36-45 ☐ (iii) 46-55 ☐ (iv) 65+ ☐

2. Gender: (i) Male☐ (ii) Female ☐

B. Building Attribute

3. How long have you been staying in this building?

___

4. Why did you choose to stay in this building?

___

5. How many hours per day do you spend in the building?

___

6. Does the building serve your needs? Please explain?

___

7. Do you think that this building needs changes? If yes, what are these changes?

___

8. What do you think the best attribute of this building is?

___

9. What do you think the worst attribute of this building is?

___

10. Are you satisfied with the indoor facilities of this building?

(i) Very Dissatisfied ☐ (ii) Dissatisfied ☐ (iv) Neutral ☐ (vi) Satisfied ☐ (vii) Very Satisfied ☐

11. Are you satisfied with the indoor physical conditions of this building?

(i) Very Dissatisfied ☐ (ii) Dissatisfied ☐ (iv) Neutral ☐ (vi) Satisfied ☐ (vii) Very Satisfied ☐

12. Are you satisfied with the opening sizes of this building?

(i) Very Dissatisfied ☐ (ii) Dissatisfied ☐ (iv) Neutral_☐ (vi) Satisfied ☐ (vii) Very Satisfied ☐

13. Are you satisfied with the overall physical environment of this building?

(i) Very Dissatisfied ☐ (ii) Dissatisfied ☐ (iv) Neutral ☐ (vi) Satisfied ☐ (vii) Very Satisfied ☐

C. Indoor Thermal Condition

14. How do you find the thermal conditions in this building in the daytime?

(i)Cold ☐ (ii)Cool ☐ (iii)Slightly Cool ☐ (iv) Neither Warm Nor Cool ☐ (v)Slightly Warm ☐ (vi)Warm ☐ (vii)Hot ☐

15. How do you prefer the thermal conditions to be in this building in the daytime?

(i) Much Cooler ☐ (ii) Cooler ☐ (iii) No Change ☐ (iv) Warmer ☐ (v) Much Warmer ☐

16. How do you find the thermal conditions in this building at night-time?

(i)Cold ☐ (ii)Cool ☐ (iii)Slightly Cool ☐ (iv) Neither Warm Nor Cool_☐ (v)Slightly Warm ☐ (vi)Warm ☐ (vii)Hot ☐

17. How do you prefer the thermal conditions to be in this building at night?

(i) Much Cooler ☐ (ii) Cooler ☐ (iii) No Change ☐ (iv) Warmer ☐ (v) Much Warmer ☐

18. How do you find the humidity in this building?

(i)Very Dry ☐ (ii)Dry ☐ (iii)Slightly Dry ☐ (iv) Neither Dry Nor Humid ☐ (v)Slightly Humid ☐ (vi)Humid ☐ (vii)Very Humid ☐

19. How do you prefer the humidity to be in this building?

(i) Much Dryer ☐ (ii) Dryer ☐ (iii) No Change ☐ (iv) More Humid ☐ (v) Much More Humid ☐

20. How do you find the air quality in this building?

(i) Very Good ☐ (ii) Good ☐ (iii) Neither Good Nor Bad ☐ (iv) Bad ☐ (v) Very Bad ☐

21. How do you feel about the air movement in this building?

(i) Very Little ☐ (ii) Little ☐ (iv) Neutral ☐ (vi) Much ☐ (vii) Very Much ☐

22. How would you prefer the air movement to be in this building?

(i) Much less ☐ (ii) less ☐ (iii) No Change ☐ (iv) More ☐ (v) Much More ☐

23. How do you feel about the daylighting levels in this building?

(i) Very Dim ☐ (ii) Dim ☐ (iv) Neutral ☐ (vi) Bright ☐ (vii) Very Bright ☐

24. How would you prefer the daylighting levels to be in this building?

(i) Much Dimmer ☐ (ii) Dimmer ☐ (iii) No Change ☐ (iv) Brighter ☐ (v) Much Brighter ☐

25. How would you rate the thermal comfort in this building?

(i) Very Uncomfortable ☐ (ii) Uncomfortable ☐ (iii) Slightly Uncomfortable ☐ (iv) Neutral ☐ (v) Slightly Comfortable ☐ (vi) Comfortable ☐ (vii) Very Comfortable ☐

D. Control

26. How do you behave to achieve your comfort if you find the thermal condition is uncomfortable?

---

27. Do you have any kind of heating system in this building? If yes, for how long do you use them to achieve your comfort during the winter? And at what time during the day?

---

28. Do you have any kind of cooling system in this building? If yes, for how long do you use them to achieve your comfort during the summer? And at what time during the day?

---

29. How would you rate the level of control in this building?

(i)Too little control ☐ (ii)Little control ☐ (iv)Neither little nor much control ☐ (vi)Much control ☐ (vii)Too much control ☐

30. Are you satisfied with the level of control in this building?

(i) Very Dissatisfied☐ (ii) Dissatisfied☐ (iv) Neutral☐ (vi) Satisfied ☐ (vii) Very Satisfied ☐

31. Would you like to add anything?

F.2: Semi-structured interview with tourists for post occupancy evaluation of the vernacular dwellings in Dana village (Arabic version)

أ) معلومات عامة

رمز البناء: ____________________

التاريخ: ______________________

الوقت: ________________________

1) الفئة العمرية: 18-25☐ 26-35☐ 36-45☐ 46-55☐ +65☐

2) الجنس: ذكر☐ انثى☐

ب) سمات البناء

3) منذ متى وانت تقيم في هذا المبنى؟

____

4) لماذا اخترت البقاء في هذا المبنى؟

____

5) كم ساعة تقضي في المبنى يوميًا؟

____

6) هل يلبي هذا المبنى احتياجاتك؟ يرجى التوضيح

____

7) هل تعتقد ان هذا المبنى يحتاج لاي تغييرات؟ إذا كانت الإجابة نعم، ما هي هذه التغييرات؟

____

8) ما هي أفضل سمة لهذا المبنى برأيك؟

____

9) ما هي أسوأ صفة لهذا المبنى برأيك؟

____

10) هل أنت راضٍ عن المرافق الداخلية لهذا المبنى؟

غير راضي ابدا☐ غير راضي☐ حيادي☐ راض☐ راض جدا☐

11) هل انت راض عن الوضع الداخلي لهذا المبنى؟

غير راضي ابدا☐ غير راضي☐ حيادي☐ راض☐ راض جدا☐

12) هل انت راض عن مساحات النوافذ لهذا المبنى؟

غير راضي ابدا☐ غير راضي☐ حيادي☐ راض☐ راض جدا☐

13) هل انت راض عن البيئة المبنية العامة لهذا المبنى؟

غير راضي ابدا☐ غير راضي☐ حيادي☐ راض☐ راض جدا☐

ج) الظروف الحرارية الداخلية

14) كيف تجد الظروف الحرارية في هذا المبنى في النهار؟

باردة جدا☐ باردة☐ بارد قليلا☐ معتدل☐ حار قليلا☐ حار☐ حار جدا☐

15) كيف تفضل ان تكون الظروف الحرارية في هذا المبنى في النهار؟

أكثر برودة☐ أبرد☐ لا تغيير☐ أدفأ☐ أكثر دفئا☐

16) كيف تجد الظروف الحرارية في هذا المبنى في الليل؟

باردة جدا☐ باردة☐ بارد قليلا☐ معتدل☐ حار قليلا☐ حار☐ حار جدا☐

17) كيف تفضل ان تكون الظروف الحرارية في هذا المبنى في الليل؟

أكثر برودة☐ أبرد☐ لا تغيير☐ أدفأ☐ أكثر دفئا☐

18) كيف تجد الرطوبة في هذا المبنى؟

جاف جدا☐ جاف☐ جاف قليلا☐ لا جاف ولا رطب☐ رطب قليلا☐ رطب☐ رطب جدا☐

19) كيف تفضل ان تكون الرطوبة في هذا المبنى؟

أكثر جفافا☐ أجف☐ لا تغيير☐ أرطب☐ أكثر رطوبة☐

20) كيف تجد جودة الهواء في هذا المبنى؟

جيدة جدا☐ جيدة☐ لا جيدة ولا سيئة☐ سيئة☐ سيئة جدا☐

21) كيف تجد حركة الهواء في هذا المبنى؟

كثيرة جدا☐ كثيرة☐ معتدلة☐ قليلة☐ قليلة جدا☐

22) كيف تفضل ان تكون حركة الهواء في هذا المبنى؟

أقل بكثير☐ أقل☐ لا تغيير☐ أكثر☐ أكثر بكثير☐

23) كيف تجد مستوى الإضاءة النهارية في هذا المبنى؟

معتم جدا☐ معتم☐ وسط☐ ساطع☐ ساطع جدا☐

24) كيف تفضل ان يكون مستوى الإضاءة النهارية في هذا المبنى؟

أكثر عتمة☐ أعتم☐ لا تغيير☐ أسطع☐ أكثر سطوعا☐

25) كيف تقيم الراحة الحرارية في هذا المبنى؟

غير مريحة جدا☐ غير مريحة☐ غير مريحة قليلا☐ معتدلة☐ مريحة قليلا☐ مريحة☐ مريحة جدا☐

<u>د) التحكم الحراري</u>

26) كيف تتصرف لتحقيق راحتك إذا وجدت أن الظروف الحرارية غير مريحة؟

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27) هل لديك أي نوع من اجهزة التدفئة في هذا المبنى؟ إذا كانت الإجابة بنعم، ما هي المدة التي تستخدمها لتحقيق راحتك أثناء الشتاء؟ وفي أي وقت خلال اليوم؟

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28) هل لديك أي نوع من اجهزة التبريد في هذا المبنى؟ إذا كانت الإجابة بنعم، ما هي المدة التي تستخدمها لتحقيق راحتك أثناء الصيف؟ وفي أي وقت خلال اليوم؟

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29) كيف تقيم مستوى التحكم الحراري في هذا المبنى؟

تحكم قليل جدا☐ تحكم قليل☐ لا قليل ولا كثير☐ تحكم كثير☐ تحكم كثير جدا☐

30) هل أنت راض عن مستوى التحكم الحراري في هذا المبنى؟

غير راضي ابدا☐ غير راضي☐ حيادي☐ راض☐ راض جدا☐

31) هل ترغب بإضافة أي شيء؟
