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Heritage adaptation beyond the technical: conflicts and compromise between social, environmental and economic sustainability

Heritage buildings are physical artefacts that embody the memory of the past in order to guide and inform future generations. Given the strategic role of heritage buildings in shaping national identities, there has been growing research and practical interest in the adaptation of such buildings, particularly in terms of how the adaptation of heritage buildings can contribute to the sustainability agenda (see, e.g. Bullen and Love, 2011; Conejos et al., 2013). Indeed, increasing awareness of climate change and the need to renew cities means that the conservation of heritage buildings has to be considered. Yet, unique traditional designs, coupled with the use of localised materials of the past can create challenges for the adaptation of such buildings.

Early research has therefore focussed on the technical challenges and problems of adapting and refurbishing heritage buildings. For example, Bullen and Love (2011) found that the lack of traditional materials and components, coupled with the challenge of finding skilled labour to handle such materials, means that the adaptation of such buildings is often economically unviable. Dyson et al. (2016) identified a number of critical success factors of adaptation, including the need for the design to match the function of the building, commercial risks, and legislation and building codes. In the context of adapting City Hall buildings in Queensland Australia, Mehr and Wilkinson (2018) also found that installing energy-efficient equipment in what are traditional structures are not only technically challenging but also one that can face resistance from local communities. Indeed, more recently, Rispoli and Organ (2019) found that the main challenges of heritage building adaption lie in the ability to communicate and collaborate between stakeholders, and for professionals to be sufficiently skilled to balance the finding of appropriate energy-efficient solutions while maintaining the preservation of heritage values.

Strategies have thus been formulated to holistically manage the economic, environmental and (to a lesser extent) social aspects of sustainability in relation to the adaptation of heritage buildings. Conejos et al. (2013), for instance, developed a holistic AdaptSTAR strategy that takes into account physical, economic, functional, technological, legal, political and social concerns. This framework was later applied in a comparative analysis of two iconic nineteenth century heritage buildings in Australia and Hong Kong to examine how the functional, technological and legal attributes that require improvement so as to achieve future adaptivity and environmental sustainability (Conejos et al., 2017). What is common in many of these frameworks and strategies is the desire to create tools to support those involved in adapting heritage buildings to make more informed decisions.

Nevertheless, what marks the adaptation of heritage buildings from other kinds of buildings is the level of uncertainty and imperfection. Littlefield (2017), for instance, reflected on how information about heritage buildings is distinct from other types of buildings, and concluded that heritage buildings embody much of the unknown, often competing and evolving ideas. Whereas information models, especially of new buildings, tend to emphasise exactness, predictability and perfection, information about heritage buildings require the art of negotiation, interpretation and to capture the narratives and stories that matter to the communities that use such buildings. The social aspects are therefore integral to the adaptation of heritage buildings, elements that must be incorporated rather than eradicated from the designs. Indeed, the critical element of the social has also recently been identified in the renovation of buildings more generally.
Buser and Carlsson (2017) and Tjørring and Gausset (2019) have found that energy retrofits of existing residential buildings is not just (or not even) a technical challenge, but one that is socially constructed as the occupants live in the buildings. Yet, while studies on the adaptation of heritage buildings have recognised the issue of the social, these are often downplayed in favour of addressing economic, environmental and technological ones. In this special issue, we present a collection of papers that, individually and collectively, examine the conflicts and compromises made to adapt heritage buildings with social, environmental and economic concerns in mind.

The papers in this special issue

In the first paper of this special issue, Februandari’s ethnographic study of what constitutes authenticity in the design of Chinese Indonesians’ houses highlights how identity especially of post-diaspora communities is always in flux, and that this struggle to become authentic is inscribed in architectural quality. Through life story interviews, participant observations, house tours and documentary analysis, Februandari analysed and compared two Indonesian Chinatowns in Lasem and Semarang to show how Chinese Indonesians design their homes to find a balance between traditional, modern and Indische (colonial Dutch) styles as they confront seclusion and discrimination as an inauthentic foreigner and assimilate in society. Thus, the design of houses is not simply a technical issue of using local designs and materials to suit the local climate and environment, but also a process of social acculturation as minority and migrant communities find their place in their adopted societies.

While Februandari’s analysis shows how heritage buildings can leave traces of identity-in-flux, the second paper by Sharma and Lee emphasises how heritage buildings can also help stabilise one’s sense of identity. As dementia becomes a growing problem in aging populations across the world, Sharma and Lee undertook a review study to examine what research has been done to develop dementia-friendly heritage settings. From a sample of 185 studies, and focussing particularly on 19 studies published over the last decade, Sharma and Lee reported how studies have shown that programmes to visit heritage sites can have positive effects for dementia patients by giving them a sense of identity, stability and opportunities to make sense of their condition. Studies have also found the need for heritage objects to stimulate the senses of sight, touch and sound and how designers of heritage programmes for dementia patients should not only emphasise the deficiencies of patients but also take a strengths-based approach to account for the abilities of these individuals. Where the built environment is concerned, there is a need for more longitudinal research to evaluate how the design and adaptation of spaces can lead to improved wellbeing of dementia patients, beyond the narrow concerns of wayfinding.

The third paper in this special issue also focusses on disability in the context of heritage building adaptation. Zahari et al. undertook an audit of four heritage buildings in Malaysia, which comprised semi-structured interviews with heritage building operators and “go along” walking interviews undertaken by three wheelchair users. Although there was acknowledgement of the need to improve accessibility of heritage buildings for people with physical disabilities, Zahari et al. found that such improvements were not done in practice in part due to financial physical constraints that act as a key barrier to the adaptation of heritage buildings. Moreover, heritage buildings, especially those constructed centuries ago, were never designed with accessibility of disabled persons in mind. Thus, the physical layout of such buildings can lock in logics that make adaptation more challenging.

This challenge of dealing with an existing structure is described in the fourth paper, which describes and analyses the opportunities and challenges associated with the refurbishment of a Grade II listed chapel on the site of Hidcote Manor Gardens in the Cotswold in England. Through a single case study, Organ traced the process of this
refurbishment and how the often-conflicting values of preserving cultural heritage and meeting the modern needs of energy conservation and sustainability are addressed, element by element. While the choice of materials and techniques for refurbishment matter, Organ found that resolving the tensions between economic, environmental and social concerns requires an interdisciplinary project team with strong leadership that can steer the team with clear objectives amidst the unfamiliarity and uncertainties associated with the bringing an historical building up to date.

Finding a balance between competing requirements is also a central theme in the fifth paper by Eriksson et al. that, through a case study of the World Heritage Town of Visby in Sweden, examined how conflicts between heritage preservation objectives and the goal of reducing energy use can be resolved. Moving beyond the single building as a unit of analysis, Eriksson et al. developed a method that categorised building stock in Visby to find techno-optimal lifecycle solutions based on energy reduction measures while capturing, maintaining and improving heritage value. Through this method, decision-makers at a district, neighbourhood of city scale would be able to formulate differentiated energy renovation strategies to meet the needs of preservation of heritage value and conservation of energy use.

While Eriksson’s et al. method can facilitate decisions about strategies for renovating heritage building stock, the long-term effects of such decisions will need to be examined as well. In the sixth paper of this special issue, Tunefalk et al. undertook a long-term evaluation of retrofitting 1940s buildings constructed in the Årstra area of Stockholm in Sweden. By taking the addition of façade insulation as an example, they noted that policy drivers for retrofitting changed over time; the energy conservation agenda shifted from one that responded to the energy crisis in the 1970s to today’s concern over climate change adaptation. Nevertheless, by analysing the energy performance alongside heritage values of these buildings, Tunefalk et al. found that while additional insulation did result in better energy performance, it is also the case that heritage values suffered as a result.

This tension in balancing between improving energy performance of heritage buildings and the preservation of heritage values continues in the final paper of this special issue. Whitman et al. undertook quantitative and qualitative comparative analysis of three timber-framed buildings in the UK, including a fifteenth century Cruck Hall in the Wye Valley restored between 2000 and 2012 to become holiday accommodation today; a private residence on the Brockhampton Estate in North East Herefordshire let by the National Trust, and; a Grade II listed former farmhouse converted into a private residence. Through simulations of various retrofit strategies and analysis of occupants’ perceptions of thermal comfort, Whitman et al. found that it is possible technically to improve the thermal performance of infill panels by incorporating well-detailed and well-installed insulation coupled with consideration of airtightness. Yet, what is technically possible also means that the defining heritage feature of the exposed timber frame can also be lost. It would seem, therefore, that a compromise is often the case in retrofitting heritage buildings for better energy performance.

Closing reflections
As already mentioned, heritage buildings play a vital role in linking the past to experiences of the present and projections of the future. Throughout the papers in this special issue, this temporal connection between history and the future features heavily in the papers, from examining what authenticity means to Indonesian Chinese householders in Februandari’s ethnographic study, to the evaluation of historic buildings in Organ’s and Whitman’s et al. analyses, to Tunefalk’s et al. review of 1940s housing in Sweden. What these studies add to existing studies of heritage building adaptation is to take into account a more longitudinal analysis of the impacts of adaptation strategies. Unlike most research that tended to focus on developing decision-support frameworks and tools to initiate adaptation projects, the studies featured in this special issue examine the impacts, often over a long period of time, of adaptation choices.
While environmental and economic concerns are still critical, these analyses also foreground the important element of the social, capturing, for instance, the experiences of patients living with dementia (Sharma and Lee) or visitors with disabilities (Zahari et al.). It is worth noting, nevertheless, that whereas the community is not always problematized as a plural, heterogeneous and often-conflicting entity in previous studies, Februandari’s study reminds us of the dynamic and ever-changing character of the communities for which these heritage buildings serve. Thus, as Churchill famously remarked, we make buildings as much as buildings make us. It is therefore vital that future research considers how social groups change over time, with inevitable consequences for changes in designing and executing adaptations. Furthermore, this opens up questions not only of how heritage buildings help societies remember, but also how such buildings re-member societies and associated cultural identities (see Suddaby et al., 2016).

A corollary of taking a more dynamic approach to managing stakeholders lies also in moving the analysis towards methodologies that help visualise the effects of decisions. It is through walking about in Zahari’s et al. study, or visualising the tensions between finding techno-optimal energy-efficient solutions and heritage values in Organ’s or Eriksson’s et al. studies that these more dynamic methodologies can open up conversations between stakeholders in order to identify where the conflicts lie and what compromises can be made. These methodologies go beyond early explorations of critical success factors often based on the perceptions of practitioners, to incorporate the experiences and views of end-users.

Finally, it is worth mentioning that the papers selected for this special issue have tended to focus on residential and cultural heritage buildings. What seems to be missing is analyses of heritage buildings of work and industrial importance. Whitman’s et al. analysis of timber-framed buildings, which highlighted an historical overview of how such architectural style was in part a response against industrialisation, points to the significance of industrial heritage. Elsewhere, Mulholland et al. (2018, 2019) also show how the adaptation of industrial heritage can generate social value and contribute to the sustainable development (or decline) of local communities. There is therefore scope for future research to examine the role adaptation of industrial heritage buildings in defining the ways societies live, work and play.

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References


Further reading

Authenticity in cultural built heritage: learning from Chinese Indonesians’ houses

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Purpose – The purpose of this paper is to explore authenticity conception of cultural built heritage. As a core of heritage management, authenticity is often seen as a validation of certain identity. In the cultural built heritage context, authenticity is vital for the community, particularly the ethnic minority community, because it can be viewed as a tool to tackle discrimination and misrecognition issues.

Design/methodology/approach – This research was conducted in two Indonesian Chinatowns, namely, Lasem and Semarang Chinatowns. An ethnography method was employed to address the research aim. Four techniques to carry out data collection were used in this research; they were life story interview, participant observation, documentary research and physical observation through house tour. Two theories were used to analyse the data, and they were Technologies of the Self from Foucault and Habitus from Bourdieu.

Findings – Result shows that authenticity conception in cultural built heritage is not fixed because it lies on the immaterial aspect (the community’s cultural values) that is continuously reinvented. This research also reveals that the immaterial aspect of cultural built heritage, the community’s cultural values, becomes the core of the conception of authenticity. These cultural values become the foundation for the community to create their cultural built environment.

Social implications – This research brings an important perspective on authenticity to be applied in heritage management. Interestingly, by adopting this perspective, heritage management could become a tool to create an inclusive society.

Originality/value – This research offers a unique perspective on heritage authenticity, which was constructed through sociological and materiality approach.

Keywords Authenticity, Cultural built heritage, Ethnography method, Indonesia Chinatown

Paper type Research paper

Introduction

Authenticity is a complex concept, which is critical in heritage management. The term authenticity usually refers to “original” or “genuine” (Jokilehto, 2009; Labadi, 2010; Zhu, 2015). In the preamble of the Venice Charter issued in 1964, authenticity is often related to materiality such as design, material, workmanship and setting. Later in the Nara Document, the concept of authenticity extended not only relates to materiality but also to non-material aspects. However, these approaches still neglect the relationship between people and the heritage sites, and how people perceive and negotiate the authenticity of heritage sites. For cultural built heritage, this point is significant because it is closely related to the creation of sense of place and identity (Jones, 2009).

In the case of ethnic minorities, the concept of authenticity of their cultural built heritage is essential to tackle the notion of identity misrecognition and, therefore, discrimination (Macdonald in Urry and Rojek, 1997). At the same time, the authorities view authenticity as a tool to create national identity (Laurence in Harrison, 2010; Smith, 2006; Corsane, 2004). Interpretation is needed to determine authenticity in heritage designation process, and it is
usually involving a selection process. Knowledge underlies that the selection process is usually adjusted to the political needs (Corsane, 2004). Given this, the notion of authenticity plays a significant role to legitimise and define identity as well as delegitimise particular identity and social culture (Golubović, 2011; Smith, 2006).

In Indonesia, as a post-diaspora (the subsequent generation of a diaspora), Chinese Indonesians are always presumed as a foreigner because of their ancestor originality and cultural difference. They have been excluded from the mainstream Indonesian society over the course of many generations. Chinese Indonesians’ ancestors were from Fujian in Southern China and in Java most of Chinese Indonesian are descendants of the Hokkien tribe of dialect. One thing to be noted regarding contemporary Chinese Indonesians is that they do not experience the migration process because they were born and live in Indonesia. As a result, Chinese Indonesians are more familiar with local culture although they may retain some of their ancestors’ culture, which is Chinese culture. This distinctiveness has resulted in Chinese Indonesians becoming a subject of discrimination practices. As a result, Chinese Indonesians produce a “passable” identity in order to be accepted as Indonesian.

**Background**

**Chinese Indonesians**

The ancestors of contemporary Chinese Indonesians came from different tribes in Southern China. Particularly from Java, Chinese Indonesians’ ancestors are mostly the Hokkien, a tribe based on dialect from Fujian province. Contemporary Chinese Indonesians can be considered as *peranakan* whose culture is closer to local culture than Chinese culture. This occurs because they are the subsequent generation of a diaspora, the post-diaspora, who were born and live in Indonesia. Interestingly, contemporary Chinese Indonesians still retain some of their ancestor’s culture. Because of this, their culture may be considered to be a hybrid culture.

The creation of this culture is directly linked to the historical background of seclusion and racial passing. Political agenda in each regime has forced Chinese Indonesians to recreate their culture. For instance, in the Colonial era, particularly in the nineteenth century, some of Chinese Indonesians tend to adopt the western culture because it was seen to upgrade their position in the social hierarchy. Whilst during the New Order regime (1966–1998), Chinese Indonesians constructed “Indonesianise” culture in order to be accepted as Indonesian.

**Indonesian Chinatowns**

Chinatowns in Southeast Asia are the result of racial segregation that took place during colonisation in order to support the political interest of the authorities (Santos, 2015). In Indonesia, the establishment of Chinatown is also political. However, history shows that Chinese settlements in Indonesia were established before Indonesia fell under colonial regime. The strategic location of Indonesia, which is at the cross-roads of the world trading route, resulted in the arrival of Chinese merchants. At that moment, two cities, Lasem and Semarang, were two most important trading posts (Widodo, 2004).

Lasem is a sub-district town situated in Rembang regency 110 km east of Semarang (the capital of Central Java province) in the north coast of Java island. This town is famous for its Chinatown and even is designated as “Little China” because of its strong Chinese nuance. This town has four Chinatown areas, namely, the Dasun, Karangturi, Babagan and Gedung Mulyo area. Interestingly, the two oldest Chinatowns, Dasun and Karangturi, were naturally established as a result of trading activity in Lasem. The two others, Babagan and Gedung Mulyo, were created by the Dutch during the era of Dutch administration (1602–1942) as a response to the political situation. Unlike other Southeast Asia’s Chinatowns, which serve as commercial area, Chinatowns in Lasem purely serve as the settlement area.
Semarang, on the contrary, is a capital city of Central Java province. Chinatown in Semarang was initially built in natural setting. However, the political situation during Dutch regime forced Chinese in Semarang to move to the new Chinese settlement created by the Dutch. Today, Semarang Chinatown is one of the busy areas in Semarang as it has become a commercial area. As a result, many traditional buildings in Semarang Chinatown were demolished or turned to serve modern commercial needs (Figure 1).

**Chinese Indonesian house**

Although the ancestors of contemporary Chinese Indonesians were from Southern China, their houses are different from those in Southern China. This is because of the differences in climate and socio-cultural situation between Indonesia and China. Generally, the Chinese Indonesian house has an eclectic style, created from the collaboration of three types of architectures: Chinese architecture from Southern China, Dutch architecture and local architecture (Lee and Chen, 1998; Pratiwo in Nas, 2007). This particular architectural style was created not only to respond to the climate difference but also as a response to their position as post-diaspora. As a post-diaspora, Chinese Indonesians have been forced to integrate with locals to ensure the stability of their identity (Buciek and Juul in Graham and Howard, 2008). Thus, Chinese Indonesians always become the “in-betweeners” because they are standing between, at least, two cultures: their ancestor’s culture and the local culture that they find themselves in.

However, Knapp (2010) stated that although the Chinese house in Indonesia is different from its roots and it varies across the region, yet they still employ the same principles that are also used in Chinese architecture, such as harmony and hierarchy that is particularly presented through its spatial arrangement. For Chinese people, hierarchy principle relates to one’s position. Every people have their own position and responsibility (Huang and Gove, 2015). According to Knapp (1999), the form and the spatial structure of Chinese houses could portray the social and family hierarchies. This means that the relationship within family members, which includes the deceased ancestors and the relationship between the house’s inhabitants and the world outside, is depicted through the spatial arrangement of the house. This principle is manifested particularly through the zoning division of the house. The value of harmony in Chinese house is based on their belief that human cannot be detached from their environment. To some extent, this value also relates to prosperity (Ruitenbeek, 1999; Xu, 1998). Thus, the balance between the house, the environment and the inhabitants is considered as important.

In addition, Knapp (1999) also argued that the Chinese house also could be considered as a social template because it represents particular arrangement of communal life.
The statements above argue that Chinese Indonesian house has been identified as a dynamic institution and the legacy of its development its architectural style may be seen as potentially highly political. In this context, regarding the issue of authenticity, one question that may emerge but is difficult to answer is which Chinese Indonesian house style can be considered authentic: the traditional, modern or the Indische style?

Literature review

Cultural built heritage, identity and community

Cultural built heritage can be understood as an essential element to understand a community: their life, their identity and what they want to become in the future (Amar, 2017). It can be manifested in forms of physical or tangible aspects such as domestic architecture or religious building as well as in the form of non-physical aspects (intangible) such as community’s daily activities. The degree to which these built environments manifest heritage is naturally drawn from the behaviour of the community who owns the heritage (Munjeri, 2004). As a result, the cultural built heritage that belongs to community can be seen as a symbol of its identity. Its creation depends on community’s cultural values. Therefore, the site of cultural built heritage of a community can be considered as a place to understand the community’s resilience, particularly relating to social, cultural and political aspect.

Framed by the theory of Foucault’s “The technologies of self” (Foucault, 1988) and that of “Habitus” from Bourdieu (Bourdieu, 2013) cultural built heritage can be considered as an instrument to instill the cultural values or social norms within a community, in which these values play a significant role in the construction of their identity. Both of them agree that identity is socially constructed and, therefore, regulated. Adopting Foucault’s conception, the process of identity formation through cultural built heritage is conceptualised by two “technologies”. The first technology relates to power and domination, whereas the second relates to self-creation constructed within the community’s historical and cultural context. The first technology is articulated through heritage materiality, whereas the second one is represented through non-material aspects. One thing that should be considered regarding the concept of self-technology from Foucault is the distinction between “subject” and “individual. The individual is transformed into the subject because of outside events as well as actions that are undertaken by him/her (Campbell-Thomson, 2011). Foucault views subject as a form of which identities are continuously modified and structured by history and culture. In this sense, as a representation of one’s identity, the characteristic of cultural built heritage cannot be considered as static because it is continuously developed as a response to particular circumstances.

Moving to Bourdieu’s conception of “habitus”, his theory views society as an area governed by its own rules (Benson, 1999). He also stated that practices conducted by society are actually governed by its own “rules of the game”, social norms or cultural values, which are affected by the constructed habitual action and knowledge that have been accumulated within a body as well as influenced by its position within society. This habitual action or the habitus is developed by a subject through a series of learning and socialising process since their early childhood. Therefore, the habitus can be considered as a less-unconscious action. Based on this understanding, it can be presumed that identity is formed and sustained by this dispositional practice. Therefore, cultural built heritage also rather can be considered as a process than a finished product. The ability of cultural built heritage to represent a certain identity has caused heritage to be associated with the idea of governmentality. Various power structures have been built up and determined to protect and manage it. Heritage management, therefore, could contribute not only on physical and economic regeneration but also can be a tool to create an inclusive society (Pendlebury et al., 2004; Shore, 2007; Tweed and Sutherland, 2007). Along with these benefits, the relationship between cultural built heritage and community should not be overlooked because the process of valuing is derived from the thought of the community on their heritage and their wish to use the past (Lowenthal in Mason, 2002).
Authenticity of cultural built heritage

Authenticity is defined as a multi-faceted conception, usually associated with notions of “original” or “genuine” and, therefore, becomes the opposite of “false” or “fake (Jokilehto, 2009; Niskasaari, 2008). The term authenticity was initially mentioned in the Venice Charter issued in 1964. In this document, authenticity is used as a tool to value and, thus, to manage monuments, based on “respect for original material and authentic documents” (ICOMOS 1965, Article 9). In this charter, the spirit of authenticity and a clear distinction between “the original, the addition and the replica in restoration work of monuments and sites” were mentioned. Above pieces of evidence show that authenticity in the Venice Charter is perceived to have a close relation to materiality. However, this perspective on authenticity becomes a problem, particularly in the Asian context. As it has been argued by Khosla (in Weiler and Gutschow, 2016, p. xxi), “building and craft of large parts of Asia […] are age-old, continuously developing, authentic, and capable of endless adaptation”, so it is “not easy to distinguish between conservation, preservation, restoration, reconstruction, and contemporary work”.

As a response, the Nara Document was issued in 1994 and followed by the issuance of Burra Charter in 1999. The issue of cultural significance was discussed in more detail in the latter charter. However, the guideline still emphasises on the physical aspects; thus, it is not applicable for, for instance, vernacular heritage. Philokyprou (2014) argued that vernacular heritage continuously grows, transforms and responds to social, economic and political situations. There is a close relationship between the values of the inhabitant and the shape of the house (Duncan in Senan, 1993). In this way, it can be seen that authenticity in cultural built heritage is socially constructed. Therefore, it also relates to the immaterial aspect such as a community’s values.

The relationship between authenticity and identity has resulted in authenticity being seen as a form of validation to determine the nature of certain image or identity. Thus, it is potentially highly political. Identity that is embodied in a heritage site is a result of reinterpretation (Munasinghe, 2005); therefore, it is not fixed. Knowledge underlies the interpretation process is critical. It brings a significant influence in determining identity. Different knowledge may have resulted in the differences of the determination of identity. This nature of authenticity may be utilised by government to manage national identity, in which, this particular identity could delegitimise particular identity and social culture. On the contrary, particularly for the ethnic minority community as a subject which does not have power, authenticity of their cultural built heritage may tackle discrimination and misrecognition issues, conducted by the mainstream society.

Unfortunately, community-defined values are often ignored in determining the “authenticity” of cultural built heritage site (Deacon and Smeets, 2013). The case of Hongcun village in China shows that the conception of authenticity that is created based on government’s perspective is creating tension between the community and its management. The management plan of this village tends to freeze this site and neglect its continuity (Xu et al., 2014). In order to retain its authenticity, a rigid regulation was issued, and as a result, the community who owns the heritage moved from that area. They feel uncomfortable because their daily activities are rigidly controlled. In this sense, the heritage management plan using the traditional perspective on authenticity to large extent does not fit with the community identity. This situation may lead into the disruption of protection work, which can threaten the sustainability of the heritage site.

House as a cultural built heritage

In a Western context, there are different meanings and ideas that distinguish house and home. The notion of house relates to physical functions, such as to provide shelter for domestic activities and to protect its inhabitants, whereas the conception of home relates to the connection
between the house’s inhabitants and the place (Mallett, 2004; Marcus, 2006; Moore, 2000; Rapoport, 1969). However, Coolen et al. (2002) argued that the meaning of built environment such as “home” and “house” is difficult to distinguish. Malpass (in Gibson and Pendlebury, 2009) argued that the conception of house cannot be separated from the notion of home. Therefore, it is continuously changing to adjust with the inhabitant’s needs and preferences. As a result, the social-cultural background of its inhabitants influences house form and its organisation. Regarding this, Max Sorre (in Rapoport, 1969) argued that houses represent the genre de vie (cultural, spiritual, material and social aspect) of the inhabitants. Drawn from these perspectives, a house can be viewed as a social construction, and thus, flexibility becomes its characteristic. In the context of heritage management, the main source to determine the authenticity of such built heritage is from the community that owns the heritage (Harrison, 2010).

Although public-owned built heritage has a different nature, public heritage space such as monument, museum or other historical buildings is basically not a dwelling place. This means, it is not inhabited and, thus, its designation as heritage artefact is often influenced by certain values of elite because there is no particular individual who own such heritage building (Harrison, 2012; Smith, 2006). In the context of heritage management, the sustainability of material and the transformation of the function of the built heritage are considered as important (Giove et al., 2010). The equilibrium between heritage management and the sustainability of economic re-use is significant. Therefore, heritage experts and agencies usually become the source to examine the authenticity of this built heritage.

Drawn from these, arguably the relationship between house and heritage is slightly different from others because they have to work as home as well as to become something that is exhibited (Malpass in Gibson and Pendlebury, 2009). Every house is intended to be inhabited for a long period of time. Hence, flexibility and utility become a priority. However, the designation of domestic architecture as a heritage asset, which belongs to the many as opposed to its occupants, has resulted in a tension drawn between what is house and what is heritage. Therefore, in many cases, heritage designation can be seen to limit the occupant’s freedom to alter or renovate their house.

Research methodology
In order to get a comprehensive understanding on the concept of authenticity in cultural built heritage, the ethnography method was employed. Two areas were investigated for this research; they are Lasem and Semarang Chinatown. In total, 33 participants were interviewed using a life story interview approach. This approach is believed could encourage the participant to recall and reflect their past life used (Bornat, 1999). Participant observation is the second technique conducted in this research because it allows the researcher to observe daily activities of Chinese Indonesians. The third strategy is investigating text-based documents, such as regulations regarding Chinese Indonesians from each Indonesian regime, newspaper, also blog posts on social media. Lastly, the researcher conducted physical survey on nine Chinese Indonesians’ houses in both Chinatowns by documenting physical aspects of the houses. Two theories were employed to analyse data, and they were Technologies of the Self from Foucault and Habitus from Bourdieu.

Findings and discussion
Cultural values of Chinese Indonesians
The notion of home is critical yet problematic for post-diaspora. A long history of seclusion and discrimination has forced Chinese Indonesians to continuously verify their identity and, thus, to defend their image of home. This is conducted in order to be accepted as Indonesians.
There are basic principles underlying the Chinese Indonesian home-making process. These cultural values are implemented in their daily practices and shape the house form. These cultural values are harmony, hierarchy and memory. Two of these values, harmony and hierarchy, are derived from Classic Confucianism that have been exported. Harmony could be defined as the main goal in Chinese Indonesian home-making process, whereas hierarchy and memory are needed to support harmony.

For Chinese Indonesians, harmony refers to diversity. Harmony can be achieved if people can accept and respect the differences between them. Therefore, according to Chinese Indonesians, being in harmony does not mean that they have to fully assimilate into local culture. In contrast, this means that Chinese Indonesians could express their own identity. In this way, harmony according to Chinese Indonesians’ perspective can be seen as related to visibility:

I used to work as a seller in Johor market. There was Sidiq, whom his stall is right beside my stall. He's from Kauman. He sold sarongs. We never had any problem. We were a friend. I also join to an organisation where the member of this organisation mostly is Javanese. Still, have no problem […] (Participant No. 1, age 70s, October 2016)

In Semarang Chinatown, participant No. 1 is considered as totok (Chinese Indonesians whose culture is closer to Chinese culture than local/Indonesian culture). Before running his own business, he used to work as a seller in Johor market. During that time, he had a friend who was a Javanese Muslim. In Indonesia, people form Javanese society are considered as locals. Although participant No. 1 and his friend come from different ethnic communities, his quotes note that they never had any conflict. They respect each other.

In contrast, the result shows that the mainstream society and Indonesian government perceives harmony as sameness. Everything that is different will be viewed as an abnormal, which becomes a threat that can danger the stabilisation of the nation. During New Order regime (1966–1998), Chinese Indonesians were categorised as an ethnic, who were “inauthentic” inhabitants of Indonesia. They are viewed as a subject that must be “Indonesianised”. Discriminatory regulation toward Chinese Indonesians was issued, such as name-changing regulation, to limit their China-rooted cultural activities only in their domestic sphere. They were prohibited to publicly display their Chine-rooted tradition (Setiono, 2008; Suryadinata, 1997):

We used to have a Chinese name, but now we have [an] Indonesian name. At that time, to enter school, we had to have [an] Indonesian name. (Participant No. 6, age 50s, February 2017)

I still remember during New Order era, for instance, during Chinese New Year somebody was sitting outside Chinese Temples. If you come to the temple to pray, he will take notes. […] We're afraid and no longer visiting the temple. The temples also were not allowed to be repaired. (Participant No. 7, age 70s, February 2017)

Although today discriminatory regulations have been revoked, many Chinese Indonesians still feel worried to show their Chinese-rooted cultures as the “other-self” conception is still deep-rooted within the mainstream society:

[…] I do. But I have to see the political conditions before I restore the way it used to be. (Participant No. 2, age 30s, October 2016)

This difference on the perception of harmony often causes friction between Chinese Indonesians and the locals. Chinese Indonesians create strategies to achieve their “ideal” harmony. For Chinese Indonesians, this is essential because harmony becomes their main goal to be achieved in their lives. To achieve a harmonious situation, Chinese Indonesians employ a system of hierarchy, particularly social and family hierarchies, and principles of memory.
Hierarchy for Chinese Indonesians relates to their position in society. Every people have its own position. Each position has ascribed specific duties and responsibilities. This means that if Chinese Indonesians have the same position as locals in a social hierarchy, their duties and responsibilities are the same as those of locals. Consequently, they will not be discriminated by the mainstream society because they will be considered to be the same as the locals. Moreover, family hierarchy is also important for Chinese Indonesians as they perceive family as a prototype of social organisation. Family is a great self. Considering this, sustaining a principle of hierarchy in their domestic space is vital.

The third principle in the home-making process of Chinese Indonesians is that of memories. For Chinese Indonesians, memories are not only about nostalgia but also a need to create an attachment with the place they are living in today. Regarding their ancestor’s homeland, Chinese Indonesians’ memories of their ancestor’s homeland are based on their parents or grandparents’ stories. The stories that have been passed down over generations are not about the physical aspects of the homeland, yet they are more about the intangible aspects, their cultural significance.

Interestingly, memories for Chinese Indonesians can also be viewed as a counter-memories and counter-history (Medina, 2011). Their memories become the tool with which they can reveal the marginalised knowledge in Chinese Indonesian discourse. The interview quotations below illustrate how Chinese Indonesians subjugate the stereotypes addressed to Chinese Indonesians. From a local perspective, the Chinese Indonesian community is seen as an exclusive community and less homosocial than, for instance, the mainstream society. They tend to be more concerned with their personal interests than creating a close relationship with the mainstream society:

In the past, we used to sit outside, having an intimate conversation with neighbours. […] the children were playing (coughing) games […] (Participant No. 1, age 70s, November 2016)

The quotation above also illustrates that memories and identity are inter-related. Chinese Indonesians recall and express their memories to create a positive image that is important to the construction of identity. Post-diaspora usually expresses their memories to secure their position in social hierarchy and to produce the “positive image of the self” (Agnew, 2005). To achieve this, there is a selection process undertaken by Chinese Indonesians in recalling their memories:

I hope the Chinatown’s atmosphere could be the same as I was a kid. It is so comfortable. […] It reflects…. reflects us. I am Chinese [Indonesian]. (Participant No. 2, age 30s, October 2016)

Reconstructing home through habit
As a post-diaspora, home for Chinese Indonesians relates to the notion of identity (Laguerre, 2017). In the home-making process, cultural values, which have been instilled within Chinese Indonesians’ body since their early years, have become the foundation of this process. Thus, each practice conducted by Chinese Indonesians is controlled by these cultural values. These practices construct habitus, a habitual action (Bourdieu, 2013). At the same time, through a series of habitual actions, Chinese Indonesians’ cultural values can also be sustained. Chinese Indonesians’ habits become a mediator between social relation and their practices (Rimmer, 2007). This self-governing-sustaining process becomes a mechanism in constructing a home. Several self-techniques, a method and procedure to govern subjects’ behaviour conducted by themselves, are needed in the home construction process (Foucault, 1988). Some of these self-techniques are derived from localised Classic Confucianism, whereas the others are conducted in order to respond to a culture of racism.

Cultural hybridity is one of the significant self-techniques in the Chinese Indonesians home-making process. This conception is derived from postcolonial discourse, where the colonial governs the colonised to create the identity of the colonised. This process fails to create the same identity. In turns, the colonised produces something new
The production of the new identity is closely influenced by “negotiation” process to respond political situation (Bhabha, 1994; Meredith, 1998). In this sense, hybrid identity in post-diaspora context can be presumed as a tool to be accepted as part of the mainstream society. This self-technique is applied in their daily practices. As a result, there are always Chinese and Javanese nuances in their daily practices and the use of domestic space. Regulation from government or heritage organisations, for instance, brought rules to the Chinese Indonesian community who internalised them within it. Chinese events, such as a Chinese parade, become one of the strategies conducted by Chinese Indonesians relating to hybridity. This strategy is viewed as a relatively effective one because such events can represent the real Chinese Indonesian image. Another event such as a weekend food market in Semarang Chinatown can be viewed as an event that is used to sustain the idea of hybridity. This event becomes a space for Chinese Indonesians and the locals to meet and interact.

Adopting mainstream society’s culture is another self-technique in the Chinese Indonesian home-making process. Chinese Indonesian reluctance to retain their traditional house façade is, perhaps, caused by this. Chinese Indonesians, particularly the younger generation, tend to have similar house styles:

[...] same with others. Western style, minimalist style. We don’t want to be viewed to be too Chinese. It can endanger us. (Participant No. 3, age 30s January 2017)

*Kenduri*, a traditional local feast, is also an event that is often conducted by Chinese Indonesians. The aim of *kenduri* is to celebrate special events such as birthdays, Chinese New Year, weddings and even Javanese/Islamic New Year and to ask for blessings. This ritual is often led by a *modin*, an Islamic chaplain who will recite Islamic prayers:

Before I married, my mother organised kenduri at our home. She ordered foods and everything from a catering company. Even the company provided us with the modin. (Participant No. 4, age 40, January 2017)

Another strategy to retain the idea of hybridity, which actually has been conducted since the early arrival of Chinese in Indonesia, is inter-marriage. By marrying local women or men, the local culture will bring many influences into Chinese Indonesian daily practices. This could occur because the inter-ethnic relationship between Chinese Indonesians and the locals is good. Moreover, as the situation in Indonesia Chinatown today is not exclusively inhabited by Chinese Indonesians, naturally, both ethnicities could interact and at the end, they adopt each other cultures.

Narration above shows that the self-technique of hybridity is closely related to another self-technique, that is, creating inter-ethnic relationship. This self-technique emerges as a response to the majority/minority dichotomy:

I went to Dorkas primary school; a Christian school. But there are non-Christian students there. Some were Muslims; others were Buddhist [...]. We got along well. When I was in high school, I went to public high school [...] there was no gap [between my Javanese friends and me] but I did receive some racial actions [...] even from the teachers. (Participant No. 2, age 30s, October 2016)

The consequence of being a minority has been depicted through the interview quotation above. As a minority, discrimination is often conducted towards Chinese Indonesians. In order to tackle this unpleasant situation, Chinese Indonesians have to create a good relationship with the locals. Good inter-ethnic relationships can bring many benefits, one of them relates to the issue of safety.

Interestingly, although Chinese Indonesians use the idea of hybridity as their self-technique to construct their homes and, therefore, their identity, retaining Chinese-rooted culture also becomes a significant self-technique in the Chinese Indonesian home-making process. As a Chinese descendant, Chinese Indonesians have a sort of obligation to retain Chinese-rooted culture. Also, two of Chinese Indonesians’ cultural values are derived from
Confucianism. Therefore, the conception of “filial piety” and “face” become the foundation of this self-technique. Filial piety is a conception to regulate one’s behaviour based on age. Although the concept of saving face relates to position, prestige and moral standards that are conducted to maintain a better image.

Ancestral ritual is one of the filial piety practices undertaken by Chinese Indonesians to retain their Chinese-rooted culture, albeit in the simplified version:

[…] Even the ancestor worship, we actually don’t know what those mean. So, we modify the details of the rituals. There used to be 8 kinds of food offered, but now, we only cook 4 kinds. Recently, I only make pork fried rice for that. So, we break the rule a lot. But we still do the general rituals. (Participant No. 1, age 70s, January 2017)

However, particularly for Protestant and Muslim Chinese Indonesians, ancestral ritual is something they cannot conduct. Their religion prohibits them to conduct this practice. They, thus, negotiate this by conducting other strategies to preserve their Chinese-rooted culture:

However, they still celebrate Chinese New Year which, for them, is just a harmless tradition. I don’t do worshipping ritual anymore, either at home or the temple. If I go to the temple, it is just for looking around […] whilst Imlek is just a tradition. We’re visiting our relatives […] Wishing them happy New Year. (Participant No. 2, age 30s, October 2016)

[…] if my grandfather asked me to accompany him to the temple, I will do it. I am just serving him and not conducting ritual […]. (Participant No. 5, age 20s, August 2017)

**Chinese Indonesian house: the architectural element**

Departing from Rapoport’s theory, which views house as a cultural production, it is necessary to look at the link between the physical aspect of Chinese Indonesian house and Chinese Indonesians’ cultural values. To begin with, it is important to understand who Chinese Indonesians are in the first place. Contemporary Chinese Indonesians are not a homogeneous community. They are a product of hybridity whose culture is hybrid. Their positions as post-diaspora have caused them to continuously produce their identities to secure their positions amongst the mainstream society. As a result, their domestic space, for instance, varies in style. Three types of Chinese Indonesian houses – traditional style, *Indische* style and modern style – from each case study area were investigated in order to understand the application of these values into domestic building practices.

Chinese Indonesian houses in both case studies, Semarang and Lasem Chinatown, can be categorised into three types: traditional style, the *Indische* style and the modern style. From interviews and archive documents, it can be assumed that the traditional style houses might be built before 1900s CE or even before the Dutch arrival, whereas the *Indische* style might be built after 1900s, particularly after Indonesia was under its Colonial regime (1602–1942). Modern style might have emerged during the New Order era, probably around 1970s. From this information, it can be presumed that the typical Chinese Indonesian house might be seen as a response to the political situation of that moment (Plates 1 and 2).

As a visual element, the house façade of Chinese Indonesian houses reveal the identity of Chinese Indonesians. Therefore, it is often linked to the notion of cultural hybridity and, therefore, to a harmony value. As a result, Chinese Indonesians do not entirely agree with the idea of restoring their house façade into a Chinese style. This relates to their conception of home that emphasises hybridity. They will find home if they are accepted as Indonesians. If their house façade is restored to a Chinese style, they fear they will be seen as others. As a result, the gap between Chinese Indonesians and the mainstream society will be perceived as being wider and this situation could endanger them. In this sense, the house façade becomes a tool for Chinese Indonesians to always remember the importance of living in the
harmonious situation. In other words, two of Chinese Indonesians’ cultural values are embodied and sustained in a house façade. Illustration below demonstrates this.

One of the Indische houses, which was situated in Lasem Chinatown, was built by the father of participant No. 1 who adored Dutch culture. This house was built around the time of the Dutch regime. He decided to build an Indische house because he wanted to be seen to have an equal position with the Dutch:

My father liked to go to Dutch stores. He was called “Meneer” (sir, in English) over there. He was proud of it. (Participant No. 1, age 70s, January 2017)

In Semarang Chinatown, some houses were renovated in order to provide space for business. Chinese Indonesian decisions to change their house’s façade into modern styles were often for business reasons. Yet, this change also can be seen as Chinese Indonesians’ effort to be viewed as a hybrid subject and more importantly, not too mainland China-oriented.

Here, three Chinese Indonesians’ cultural values are shown to be embodied and sustained through house façades. The house façade becomes a tool for Chinese Indonesians to continuously remember past events and the importance of creating a harmonious situation.

To support this, Chinese Indonesians use their house façade to show their true image of hybrid subject. Not only the house façade but also other visual elements such as the openings (doors and windows), house fence and house room also carry values of harmony, hierarchy and memory. Doors, windows, roof and house fence style are usually adjusted to the façade style. Thus, they will vary depending on the house style. Interestingly, some modern shophouses in Semarang Chinatown still have Ngang Shan roof, which is adopted from Chinese architecture.

Notes: (a) Indische house; (b) Modern house; (c) Two-stories traditional house; (d) Traditional house
Moving to Chinese Indonesian houses’ spatial arrangement and organisation, it can be viewed that Chinese Indonesians employ Chinese architecture principles in this area. Generally, the floor plan of Chinese Indonesian houses in both Chinatowns is a symmetrical rectangular shape with courtyard. In some cases, particularly in the modern style, the floor plan is sometimes asymmetrical and does not have a courtyard. The presence of courtyard in Chinese Indonesian houses is usually associated with the climate and environmental condition. In Semarang Chinatown, as the houses are situated on narrow house plots, the aim of the small courtyard is to provide adequate natural light and good air circulation.

Two features of a house plan and site layout that are significant in Chinese Indonesian houses are the presence of axial rules and spatial arrangement. The notion of openness/closeness, front/back and below/above become central in spatial arrangement and organisation of Chinese Indonesian house. Together with these notions, axis rule, which is adopted from Chinese architecture, is employed in order to organise spaces in Chinese Indonesians’ houses. There are two axes crossing Chinese house plot: the horizontal and the vertical axes. The vertical axis is started from the middle point of the gate and symmetrically “split” house plot into two parts: the left and the right. The vertical axis is considered as a path of Qi, an energy, which can bring a good luck. The other axis is the horizontal axis, which is horizontally crossing three central points. The horizontal axis is used to determine house’s zone (Knapp, 2003; Pratiwo, 1990).

In Lasem, the main building lies along the north-south axis, whereas the service buildings are situated on the left and right of the north-south axis. This means that the farther the building from the axial lines, its function is less complex. This situation also
occurs in Semarang. Clearly, orderliness becomes the main foundation of Chinese Indonesian house spatial arrangement and organisation. This conception relates to hierarchy and harmony values (Figure 2).

**Chinese Indonesian house as a battle arena and the problem of its authenticity**

As a site of Chinese Indonesians’ domestic activity, Chinese Indonesian houses play an important role in the formation of Chinese Indonesian passable identity, an identity, which can be accepted by mainstream society. Through its visual elements, Chinese Indonesian houses become the image of the Chinese Indonesian community. The struggle of Chinese Indonesians to be accepted as Indonesian can be seen to be clearly depicted through it. Therefore, Chinese Indonesian house may also be seen as a battle arena for Chinese Indonesian identity discourse.

Regarding this, Chinese Indonesian houses can be considered as an institution to govern Chinese Indonesian behaviour in their home-making processes (Foucault, 1988). Therefore, arguably, house can be viewed as a mechanism of discipline to maintain the exercise of power within society (Fontana-Giusti, 2013). From Bourdieu’s perspective, house is perceived as a control mechanism through the process of internalisation and the creation of habitus. In this sense, Chinese Indonesian houses serve as a form of cultural capital to internalise certain values carried by all elements of the house. Research finding shows that although Chinese Indonesian house varies in style, each of them still employs similar rules for their home. For instance, although the floor plan of Chinese Indonesian house differs, its zoning organisation still follows the same rules. This means that there are specific values that become the guidelines used by Chinese Indonesians to build their houses. The harmony, hierarchy and memory principles are applied to their houses. Although Chinese Indonesians, for instance, changed their traditional houses into modern styles, they still consider these values as significant factors to be applied to their houses. Such a case can be found in Lasem Chinatown. Some Chinese Indonesians decide to change their house style into modern styles. Interestingly, some of them retain the traditional style of fence for their modern houses. They consider such fences to represent “Chineseness”, yet they might not realise that their decision to retain that fence is based on cultural values that are continuously instilled within them. Similar to Lasem, the presence of high iron fences in Chinese Indonesian houses in Semarang Chinatown is also similar to the high wall fences in

![Figure 2. Map of case study area](image)

**Notes:** (Left) Lasem Chinatown; (Right) Semarang Chinatown
Lasem. The emergence of these fences was triggered by an anti-China riot incident in 1998. Therefore, Chinese Indonesians always argue that the existence of such fences relates to a notion of safety. Interestingly, the fences still exist today although the situation is more stable. If we analyse it further, the presence of the iron fence actually can be substituted with other equipment, such as CCTV; thus, the iron fence could be removed. The Chinese Indonesian decision to sustain the fences is probably not only based on their values, particularly the hierarchy value, but also based on their habitus. A long and continuously process of internalisation has caused them to unconsciously implement their values in their houses (Plate 3).

Regarding authenticity, drawn from two case studies, it can be seen that the authenticity of Chinese Indonesian houses lies on its intangible aspects, the cultural values of its inhabitants. Therefore, it is not fixed. Both cases demonstrate that the variation of house styles occurs because of the implantation of their values that are continuously reinterpreted by its inhabitants in order to looking for the sense of place (Harrison, 2010). He argued that the sense of place is something that communities have to create because different generation may have different circumstances. The sense of place is created with a help from, one of them, their built heritage.

Conclusion
This study shows that the authenticity of cultural built heritage is not fixed because it lies on the community cultural values that own that cultural built heritage which are continuously reinvented. This occurs because the community needs to maintain their connection to the place as well as to others. In the context of post-diaspora, this sense of place is created with the help from their domestic space. Post-diaspora community utilises their houses to express their “passable identity”, an identity that can be accepted by mainstream society. In other words, house of post-diaspora can be considered as an apparatus to combat discrimination towards them. Therefore, as illustrated in previous sections, the transformation of cultural built heritage is inevitable. Drawn from this, it would inappropriate to determine that the later transformation of cultural built heritage is inauthentic. Although they may transform into

Plate 3. Iron fence in Chinese Indonesians’ houses
something that is visually far from the traditional style, it is still constructed based on similar foundation relating to the former style.

These circumstances show that using cultural built heritage’s material alone, with no regard to its immaterial aspects, is not an appropriate tool for assessing authenticity. The primary source to assess the cultural built heritage’s authenticity is from the community itself. In the context of heritage designation, the implementation of a perspective acknowledging transition in definition of authenticity in heritage designation may create not only a more sustainable path of heritage assessment but also create a more inclusive society.

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Authenticity in cultural built heritage


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Abstract

Purpose – Preserving our built heritage from the onslaught of weather, pollution, development and the effects of tourism is a complex endeavour. Appended to this is the need to ensure that heritage buildings are inclusive to all users. Thus, built heritage is plagued with contradictions and conflict between conservation goals and those to support inclusivity given the limited resources often available. Dementia has been purposely selected for this study as numbers of diagnosed sufferers are increasing at an alarming rate, and engagement with heritage has been proven to support well-being. The paper aims to discuss this issue.

Design/methodology/approach – This research review draws on systematic principles and presents an analysis of the available literature on well-being programmes designed for people living with dementia and their care supporters, with particular reference to programmes in heritage settings, and the resulting impact for users.

Findings – This review critically evaluates the available evidence from published literature on the role of the heritage setting, on how it impacts on the experience of dementia participants. In doing so, it draws on findings from the experiences and well-being of people living with dementia and their care supporters; assesses the current state of knowledge, identifies support implications and makes recommendations for future research. In doing so, it highlights a dearth in the literature on research related to the physical environment setting, particular addressing any cognitive impairments that may arise that can alter psychosocial processes, such as lighting, temperature, acoustics and materiality, so that they can be understood and suitably adapted to support the well-being of those living with dementia.

Originality/value – The scant lack of financial resources to support inclusivity in built heritage, and the argument that some heritage cannot be adapted, often leads to only limited opportune for people with dementia. Thus, there is an inherent need for an understanding of current research and well-being programmes so that it can be focalled in the future to support built heritage tourism in a way that it is inclusive to all.

Keywords Well-being, Dementia, Built environment, Heritage

Paper type Literature review

1. Introduction

With increased numbers of people living with dementia, it is becoming a colossal challenge that can no longer be overlooked in the UK. According to the Alzheimer’s Society (2017) report, there were an estimated 850,000 people living with dementia in the UK in 2015. This number is expected to increase to over 1m by 2025 and over 2m by 2051. Notably, more than 40,000 people under the age of 65 in the UK are currently living with early-onset dementia (Prince et al., 2014).

Dementia is characterised by a progressive decline in a person’s physical, cognitive, social and emotional capabilities. The deterioration can lead to impaired memory, learning and reasoning, stress, visuo-perceptual problems and difficulty in adjusting to the sensory/mobility impairment that can accompany ageing. As a result, people living with dementia need more support in activities of daily life and have an increased need for care, which can be stressful for both the person with dementia and their care supporter (van der Linde et al., 2013). Thus, the support should be designed to alleviate stress, and to maintain and enhance the well-being of people living with dementia and those caring for them. This is particularly important to ensure social inclusion, which World Bank (2019) defines as improving the terms on which individuals and groups take part in society – improving the ability, opportunity and dignity of those disadvantaged on the basis of their identity – which in turn improves well-being and self-esteem.
Built heritage refers to the preservation of monuments and historic buildings, often coveting structures with statutory protection by legislation such as the Ancient Monument Acts, Archaeological Areas Acts, Monument Ordonantie and National Heritage Acts (Herbert 1989; Prentice, 1993). Such recognition is granted if the built structure(s) is deemed to foster historic significance or architectural merit (Herbert, 1989), and as a result, the legislation leads to an increase in the awareness, protection, preservation, restoration and the display of its heritage properties (Poria et al., 2011). For the purposes of this review, “heritage” is defined as an “aspect of the worth or importance attached by people to qualities of places, categorised as aesthetic, evidential, communal or historical value” (Historic England, n.d.). A report by Fujiwara et al. (2014) evidences that there is an association between heritage site visits and visitor well-being. The report emphasises that visiting heritage sites has a substantial positive connection with the life satisfaction of its visitors, and concludes that this connection is more significant in terms of impact than from participation in sports and the arts. Work by English Heritage suggests that heritage assets have the ability to create “pride”, “a sense of place” and “a sense of community” by linking the present with the past (Wineinger, 2011; English Heritage, 2000, 2006, 2014). Further, research undertaken by Age UK has recognised that engagement with creative and cultural activities including heritage, makes a significant contribution to one’s overall well-being compared to other factors (Age UK, 2017; Maeer, Robinson and Hobson, 2016). The value of heritage has been described as a source of identity, and a source of character and distinctiveness (Historic England, 2016). Thus, the provision of appropriate opportunities for people with dementia and their care supporters to engage in visits to heritage sites can provide valuable well-being and health benefits. However, the relationship between built heritage and tourism is plagued with contradictions and conflict between conservation goals and those for financial profit (Nuryanti, 1996). Some researchers have argued that heritage and tourism are incompatible (Berry, 1994) and a conflict relationship is inevitable (Daniel, 1996). The scant lack of financial resources to support inclusivity in built heritage, and the argument that some heritage cannot be adapted, often leads to only limited opportunity for people with dementia. Thus, there is a need to understand existing research and well-being programmes so that it can be focused in the future to support built heritage tourism in a way that it is inclusive to all by directing policy, research funding, academic research and built heritage decision makers. This research review presents an analysis of the available literature on well-being programmes designed for people living with dementia and their care supporters, with particular reference to programmes in heritage settings and the resulting impact for users.

2. Method
This research review draws upon the principles of a systematic review in its approach to searching for peer-reviewed material relating to well-being programmes for people with dementia and their care supporters that are delivered in museum, historic or heritage settings. The selection criteria of the literature were primarily based on the direct relevance to the subject, and also a number of studies which focused on related subjects due to their substantial importance. Research reviews have been more popular in recent years to understand the current status of existing research and identify gaps/new research opportunities (e.g. see Delzendeh et al., 2017; Weiss et al., 2017).

Review papers usually follow a process of “search” for relevant publications, utilising citation indexes against pre-determined criteria for eligibility and relevance to form an inclusion set relating to the research area. To reduce bias in this process, an objective and transparent approach for research synthesis was adopted, including both quantitative analysis and qualitative reviews. Searches were conducted using Science Direct, Web of Science and Ovid Abstracts, and four databases accessed via EBSCO Host (Academic Search Premier, CINAHL, Hospitality and Tourism and MEDLINE) from 2010 to date, using the
search terms listed in Table I. Only a limited number of studies specific to well-being programmes for people with dementia delivered within heritage settings were identified. There are examples in the UK and elsewhere of well-being programmes provided by arts and heritage organisations targeting different service user groups, which feature the viewing and/or handling of art works, artefacts and objects, sometimes with associated arts and crafts activities. These are sometimes delivered onsite (within the museum, historic or heritage setting) and sometimes in residential, health or care facilities. Therefore, the terms for the database searches were developed to include such programmes for older people and people with cognitive impairment, and similar programmes delivered by specialised museum/heritage/gallery staff in any care settings.

3. Search results
On the basis of the inclusion criteria detailed in Table I, the titles and abstracts of the journal papers were screened for relevance. A total of 185 journal papers were recovered from various sources (see Table II). If there was clear relevance, the full paper was retrieved for detailed analysis. After screening of titles, abstracts and removal of duplications, 14 papers were found to meet the inclusion criteria, with a further five studies identified through “snowballing” (i.e. via reference lists in the retrieved papers), making a total of nineteen papers for review; these are summarised in Table III.

4. Overview of the research review
Table III details the 19 papers in chronological publication date order, commencing with the most recent first; each paper was subsequently assigned with a number to ease identification.

<table>
<thead>
<tr>
<th>Database</th>
<th>No. of journal papers identified</th>
<th>No. of journal papers after screening of titles, abstracts and removal of duplications</th>
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<tbody>
<tr>
<td>EBSCOhost (included Academic Search Premier, CINAHL, Hospitality and Tourism, MEDLINE)</td>
<td>154</td>
<td>9</td>
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<tr>
<td>Web of Science</td>
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<td>Ovid</td>
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<td>4</td>
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<tr>
<td>Science Direct</td>
<td>23</td>
<td>0</td>
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<tr>
<td>TOTAL</td>
<td>185</td>
<td>14</td>
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Table I. Research review search terms

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<td>TOTAL</td>
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plus an additional 5 papers identified through “snowballing”, totalling 19

Table II. Research review results
<table>
<thead>
<tr>
<th>No.</th>
<th>Reference and country (where the study was conducted)</th>
<th>Programme design</th>
<th>Study objective and method</th>
<th>Findings from the study organised into categories such as</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Roe et al. (2016), &quot;Coffee, cake and culture: evaluation of an arts for health programme for older people in the COMMUNITY with Dementia&quot;, Whitworth art gallery and Manchester Museum in 2012, UK</td>
<td>June 2012–December 2012 Total 6 sessions Interactive museum objects handling session Sample size: n=39 Ages: 75–92</td>
<td>Identify benefits and impacts of the arts for health programme and its feasibility for older people, with or without diagnosed memory loss – dementia, living in a care home or supported living facility and their care staff Evaluation research using non-participant observation and field notes and semi-structured group interview (digitally recorded)</td>
<td>Effective programme design  Sessions were beneficial and well structured  Staff support and flexibility to address the needs of the participants  Environment or settings  Planned route – easy navigation through the building spaces  Quite spaces  Well-being impact  Getting out and about  Part of the normal society  Shared experience and learning new things, participating in creative activities  Tactile, sensory elements of the session  Others  Benefits to the gallery and museum – designing such programmes in future. Benefits for working with older people  Transport is important feature-funding for taxi service</td>
</tr>
<tr>
<td>2.</td>
<td>Camic et al. (2015), &quot;Theorising how Art Gallery Interventions impact People with Dementia and their Caregivers&quot;, The Gerontologist, pp. 1-10</td>
<td>1 h of art viewing and discussion followed by 1 h of art-making facilitated by a professional artist 8 weeks, 2 h group sessions Two different gallery setting Sample size: n=28, 12 PLWD (mild-to-moderate) Age: 58–94 years</td>
<td>Develop a theoretical understanding of how the process of viewing and making art in the social and physical context of an art gallery environment impacts people with dementia and accompanying caregivers Data collected through detailed observational field notes. Semi-structured post session</td>
<td>Effective programme design  Environment or settings  Well-being impact  Others</td>
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<th>Findings from the study organised into categories such as</th>
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</thead>
<tbody>
<tr>
<td>Flatt J.D. et al. (2015), &quot;Subjective experiences of an art museum engagement activity for persons with early Alzheimer's disease and their family caregivers&quot;, <em>American Journal of Alzheimer's Disease and other Dementias</em> 30A: 380–389</td>
<td>The Andy Warhol Museum in Pittsburgh, Pennsylvania, USA</td>
<td>1 time engagement with art viewing and making activity (3 h session)</td>
<td><strong>Effective programme design</strong>&lt;br&gt;Small groups&lt;br&gt;Staff support&lt;br&gt;Better communication about the activities&lt;br&gt;Organisation of the programme-timing and length of programme, transportation and parking, and access to refreshments&lt;br&gt;<strong>Environment or settings</strong>&lt;br&gt;Transportation and time for parking&lt;br&gt;Well-being impact&lt;br&gt;Sense of self&lt;br&gt;Social connection&lt;br&gt;Mental stimulation by the art activity- novel experience&lt;br&gt;Learning new skills&lt;br&gt;Opportunity to reminisce&lt;br&gt;Feel more comfortable and allowed participants to interact more closely&lt;br&gt;<strong>Well-being impact</strong>&lt;br&gt;<strong>Others</strong>&lt;br&gt;Enhance staff support by proving appropriate staff training&lt;br&gt;Effective programme design&lt;br&gt;Break sessions need careful planning and time allocation&lt;br&gt;Well-being impact&lt;br&gt;Enhances subjective well-being for both the PLWD and their care supporters when handling the object that art viewing&lt;br&gt;Well-being score did not increase from social activity</td>
</tr>
<tr>
<td>Johnson et al. (2015), “Museum activities in dementia care: using visual analog scales to measure subjective well-being”, <em>Dementia</em>, 6(6), pp. 591-610</td>
<td>Museum objects handling and art viewing in small groups 11 sessions Museum setting Sample size: n=66 (36 PLWD +30 care partners) (Early to</td>
<td>The study aim was to quantitatively compared the impact of two museum-based activities and a social activity on the subjective well-being of PLWD and their care supporters</td>
<td><strong>Effective programme design</strong>&lt;br&gt;Break sessions need careful planning and time allocation&lt;br&gt;Well-being impact&lt;br&gt;Enhances subjective well-being for both the PLWD and their care supporters when handling the object that art viewing&lt;br&gt;Well-being score did not increase from social activity</td>
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<tr>
<td>Museum in the southeast of England</td>
<td>middle stage dementia, Age: 48 to 85</td>
<td>Quasi-experimental crossover design was used. Visual analog scales (VAS) were selected to measure subjective well-being. Evaluation questionnaire at the end of the intervention.</td>
<td>Effective programme design</td>
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<td></td>
<td>Interactive object handling session and an instant photography activity, Sample size: n=114 (73% women), Aged: 42–105, Conducted in one metro area and only in independently-living communities</td>
<td>Investigation of the qualities of the participant experience in a reminiscence museum outreach programme using historical artefacts (Artifacts were brought to each community including stereoscopes, stereographs, a ViewMaster, and 11 historic cameras). Mixed methods i.e. post-programme interviews with participants and staff interviews, brief group interview after the programme, audio recordings of conversations during the programme, and focused observations.</td>
<td>Sight, touch and sound important aspects of the session</td>
</tr>
<tr>
<td>Smiraglia (2015), “Qualities of the participant experience in an object-based museum outreach programme to retirement communities”, <em>Educational Gerontology</em>, 41(3), pp. 238-248</td>
<td>Implemented at 12 retirement communities around the Boston area, USA</td>
<td>Well-being impact</td>
<td>Important aspect of the programme because of the prevalence of conversation</td>
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<td>Reduction in the unwanted/background noise levels</td>
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<td>Appropriate staff support to handle the objects</td>
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<td>Considering users' needs when designing sessions</td>
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<td>Well-being impact</td>
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<td>Sensory and Cognitive benefits from the session</td>
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<td>Engaged showing keen interest in interacting with the objects and learning more about them</td>
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<td>Enhanced evaluation skills</td>
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<td>Social benefits-sharing information, and sharing memories, helping each other</td>
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<td>Emotional benefits-enjoyment or delight, but also negative, emotions expressed frustration at not being able to get a camera open, object handling was challenging due to heavy weight, some participants with visual impairments could not handle the object very well as they were scared that they might break the camera</td>
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<td>Others</td>
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<td>Disappointed that the session did not brought the model of</td>
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<td>6. Solway et al. (2015), “Museum object handling in older adult mental health”, <em>International Journal of Mental Health Promotion</em>, 17(4), pp. 201–214</td>
<td>Museum object handling sessions, Nine group sessions were held with 5 – 12 participants per group, Hospital settings, Facilitated by museum professional, Sample size: Older adults (n=42 (29 women))</td>
<td>To further, understand psychological and social aspects of object handling in mental health inpatients, Audio recordings for each session, The protocol was based on Ander et al. (2011) for one-to-one sessions but adapted for group sessions; audio recordings of nine sessions were collected for subsequent analysis</td>
<td>Effective programme design, Staff support – to learn about the object, conversation/active participation among the participants, Well-being impact, Learning about the object and learning from each other, Learning new things, Social and emotional benefits, Shared exploration and discovery, Individual’s personality, Enjoyment, enrichment through touch and sense of privilege, Memories, personal associations and identity, camera that they had owned, Background noise was making it difficult for few participants to hear, Effective programme design, Well-being impact, Others</td>
<td></td>
</tr>
<tr>
<td>7. Camic et al. (2014), “Viewing and making Art together: a multi-Session art gallery-based intervention for people with dementia and their carers”, <em>Aging &amp; Mental Health</em>, 18:2, 161-168</td>
<td>Eight-week interactive art viewing and art-making intervention, Two distinctly different galleries, Sample size: 24 (12 PLWD (mild-to-moderate), Age 55 years and more</td>
<td>Impact on social inclusion, carer burden, and quality of life and daily living activities for a PLWD, Mixed methods, Pre-post design using standardised questionnaires and interviews, Art making sessions were audio-recorded for later analysis, Qualitative data was analysed using thematic analysis</td>
<td>Well-being impact, Enhance the relationship between the care supporter and the person with the dementia- “uplifting to do something together”, Enhances social relationship-caring relationship, Increased and enhanced level of cognitive engagement for the PWD, Emotional enhancement, Capable of learning new skills and knowledge for people with dementia, Included and valued as individuals- treated as equal contributors to the society, Environment or settings, Access public setting-empowering and special, Others</td>
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Table III.

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<tr>
<td>8. Zeilig et al. (2014), “The participative arts for people with a dementia: a critical review”, International Journal of Ageing and Later Life 9: 7–34</td>
<td>Critical review, which involved the careful pulling out of academic and grey literature, those non-pharmacological interventions are important for people living with a dementia AR viewing and Making; Numerous projects that use art with PWD, research into art-making activities for PWD is sparse (Eekelaar et al. 2012). However, despite small samples there is evidence that those with a dementia who engage in arts activities experience improvements in social and psychological well-being Role of museums and art galleries: Despite the increase in understanding about the possible cognitive and psychological benefits of arts and health interventions in museums, research is still at an early stage (Camic and Chatterjee 2013).</td>
<td>Well-being impact Enacted communication skills, cognitive ability New leaning ability Enhance confidence and self-esteem of the people with Dementia Social inclusion and participation Others New insights into Dementia-acceptance</td>
<td>environment-feeling of active members of society Social inclusion</td>
</tr>
<tr>
<td>Reference and country (where the study was conducted)</td>
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<td>PWD were able to undertake new learning. Zeisel (2009) makes numerous observations about the possibilities that PWD have for aesthetic appreciation of art that are based on his experience of museum tours with his “Artists for Alzheimer’s” programme.</td>
<td>Interactive museum object handling sessions</td>
<td>Qualitative approach based on objectivist and constructionist methods</td>
<td>Effective programme design (continued) Designed according to participant interest - personalised elements in the sessions</td>
</tr>
<tr>
<td>Zeisel (2009) makes numerous observations about the possibilities that PWD have for aesthetic appreciation of art that are based on his experience of museum tours with his “Artists for Alzheimer’s” programme.</td>
<td>Group sessions and occasional rehabilitation one-to-one sessions</td>
<td>Semi-structured interview with the clients, health care and museum staff and filed notes</td>
<td>Facilitator and staff support Well-being impact Learning about objects and “expressions of well-being” such as eliciting memories leading to a renewed sense of identity (p. 234).</td>
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<tr>
<td>In 3 National Health Service health care settings: inpatient neurological rehabilitation, London; outpatient neurological rehabilitation, Oxford; and inpatient mental health care, Reading</td>
<td>66 sessions with clients ($n=85$) across the three sites were carried out over 18 months by 4 facilitators</td>
<td>Pre and post session (well-being measures)</td>
<td></td>
</tr>
<tr>
<td>Ander et al. (2013), “Using museum objects to improve well-being in mental health service users and neurological rehabilitation clients”, <em>British Journal of Occupational Therapy</em>, 76(5), 208-216</td>
<td>Qualitative approach based on objectivist and constructionist methods</td>
<td>Effective programme design</td>
<td></td>
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<tr>
<td>Camic and Chatterjee (2013), “Museums and art galleries as Dementia-friendly heritage settings”</td>
<td>Effective programme design</td>
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<td>This research paper offers the rational for the use of</td>
<td>Staff supported environment-</td>
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<td>Use of physical objects-tactile stimulation</td>
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Findings from the study organised into categories such as:
- Effective programme design
- Environment or settings
- Well-being impact
- Others
<table>
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<tr>
<td>museums and art galleries as setting for non-pharmacological intervention to enhance health and well-being of the community that it serves</td>
<td>relaxing</td>
<td>Environment or settings</td>
<td></td>
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<tr>
<td>Numerous practice-based examples and research demonstrates how museum interventions contribute to emotional well-being; these outcomes are drawn together by (Wood, 2007) but have also been cited by others (Shaer D et al., 2008; Davenport and Corner, 2012); sense of connection, and belonging; human capital: using and improving skills; optimism and hope; moral values, beliefs; identity capital, self-esteem; emotional capital, resilience; opportunity for success; recognition of achievement; support; quiet, rest, sanctuary; Social capital, relationships; meaningful pursuits; safe, rich</td>
<td>Enhance the sense of connection</td>
<td>Safe and prestigious setting</td>
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<td>Well-being impact</td>
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<td>Social interaction/network</td>
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<td>Self-esteem, Identity leading to hope, sense of being still part of the society</td>
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<td>Learning new skills</td>
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<td>Access to art</td>
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<td>Others</td>
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<td></td>
<td></td>
<td>Collaboration between cultural heritage, health care and university sectors to further advance research, policy development and evidence-based practice</td>
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<td></td>
<td>Gallery-based intervention at London’s Dulwich Picture Gallery, the oldest public art gallery in Europe</td>
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<td>Museum environment; access to arts and culture</td>
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<td>Interactive art viewing and art-making visual response</td>
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<td>Three 90 min sessions over 3 weeks</td>
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<td>Gallery setting</td>
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<td>Sample size: $n=6$ (3 male and 3 female)</td>
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<td>Aged 50 or over (early to mid-stages of dementia)</td>
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<td>The study took place over 7 weeks without a control group</td>
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<td>Audio recordings and content analysis, utilising a mixed methods pre-post design with 4-week follow-up</td>
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<td>The study aim was explored a novel way to gather PWD’s episodic memory and verbal fluency, through audio recordings, during a gallery-based intervention in a gallery setting</td>
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<td>Mixed methods: participants were audio-recorded in a pre-post and follow-up interviews. The data from gallery sessions, pre-, and post interviews were transcribed and systematically analysed using quantitative content analysis (Krippendorff, 2004)</td>
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<td>Four weeks post intervention, participants were interviewed again, shown reproductions of the art they had viewed, and asked for feedback about the group</td>
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<td>Well-being impact</td>
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<td>Episodic memory increased</td>
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<td>Verbal Fluency enhanced during the session</td>
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<td>Emotional repose-while viewing the painting</td>
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<td>Improved mood, confidence, and reduced isolation</td>
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<td>Valuable mode of interaction and understanding among the person with Dementia and the care supporter</td>
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<td>Social networking-shared experience</td>
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<td>Reduces isolation</td>
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<td>Mood boost</td>
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<td>More chatty</td>
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<td>Doing stuff together- learning new skills</td>
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<td>Reminiscence</td>
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| 12. | Thomson, Ander, Lanceley, Menon, Noble and Chatterjee (2012), "Enhancing cancer patient well-being with a non-Interactive heritage based intervention-object handling or looking at the object photograph and discussing |
|     | The effectiveness of a novel, non-pharmacological, heritage-focused intervention with adult female inpatients |
|     | Well-being impact |
|     | Enhanced level of positive emotion, well-being and happiness |

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| pharmacological, heritage-focused intervention*; *Journal of Pain and Symptom Management; 44, pp. 731-740  
Cancer patients, London hospital | with a facilitator  
Sessions on a one-to-one basis at patients’ bedsides and lasted about half an hour  
Sample size: \( n = 100 \) females (tactile = 79 and visual = 21) | Initiated with completing the pre-session measures, selected their first object/photograph, responded to interview questions prompting discussion about physical and emotional properties of objects/photographs in turn, completed post session measures without reference to earlier scores  
Mixed methods pre-post design using standardised questionnaires and interviews |
Participants identified from 4 wards of a large inner London hospital (oncology, acute and elderly care) and 3 other health care settings in London and Oxford (neurological  
Interactive heritage based intervention- object handling or looking at the object photograph and discussing with a facilitator  
One-to-one, facilitated sessions for 40 min  
For 18-month period  
Hospital setting  
Sample size: \( n = 158 \) participants (42 male, 116 female)  
Aged 25-85 years | | Effective programme design  
Enhanced interaction between the patient and the facilitator- direct communication (handling the object) then viewing the photographs  
Well-being impact  
Happiness  
Enhance shared experience between participant and facilitator in actual handling of the objects  
Stimulate thought and improve communication |
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<td>14.</td>
<td>National Museums Liverpool (2012), “House of Memories; National Museums Liverpool Evaluation Report”</td>
<td>1200 participants attended House of Memories (12.8% males and 87.2% females) Museum setting Focus groups: n=34 and five people were interviewed</td>
<td>Aim was to provide the sub-regional social and health care work force with a unique training experience House of Memories is a training and delivery programme built around the objects, archives and stories held within the Museum of Liverpool. Multi method ethnographic based study. Quantitative and qualitative data- questionnaires (pre and post session), focus groups, interviews- semi- structured interview schedule was designed and the same questions were asked of everyone Participant observation, field notes, interviews and documentary methods</td>
<td>Effective programme design Practical and interactive- empowering including drama, tours of the museum and memory box workshops Necessary knowledge to deliver memory activities in my care setting Well-being impact Reduce feelings of distress, humiliation or fear for people living with dementia Increase self-esteem and confidence for people with dementia Build more effective relationships with people living with dementia Understanding the family’s perspective and increased confidence to engage with family members Others Awareness and understanding of dementia such various stages, types, etc. Increased understanding that listening and communicating effectively Equip the staff with new skills and resources to share with people living with dementia Feeling confident to help people with dementia Sense of the concerns of those working with dementia about medication and a desire to explore and learn more about (continued)</td>
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## Table III.

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<td>15. Ander <em>et al.</em> (2012), “Heritage, health and well-being: assessing the impact of a heritage-focused intervention on health and well-being”, <em>International Journal of Heritage Studies</em> London, UK</td>
<td>Interactive museum object handling sessions One-to-one and group sessions Hospital setting The sessions lasted from 15 to 75 min Sample Size n = 185 (52 male, 133 female)</td>
<td>To assess the impact on well-being of taking museum objects into hospitals and health care contexts Audio recordings were made of the handling sessions, field notes by facilitators to understand the contexts and the participant behaviours, and semi-structured interviews were conducted with patients, health care staff and museum professionals Total Number of handling session recorded and transcribed=51</td>
<td>medication and alternative strategies for helping people appropriate resources to deliver memory activities in my care setting Well-being outcomes New perspectives, engaging with the object Positive feeling; excitement enjoyment, wonder, luck and surprise Learning including skills and confidence Energy including alertness Positive mood Sense of identity Something different, inspiring Calming, relieves anxiety Social experience Tactile experience Others “Stimulation and distraction”, both highly important for well-being</td>
<td>Effective programme design Environment or settings Well-being impact Others</td>
</tr>
<tr>
<td>16. Lanceley <em>et al.</em> (2012), “Investigating the therapeutic potential of a heritage-object focused intervention: a qualitative study”, <em>Journal of Health Psychology</em></td>
<td>One-to-one object handling session at the patients’ bedside London hospital cancer centre, UK Cancer Patients Sample size: n =10 women (Age between 40 and 65 years)</td>
<td>This study explores the therapeutic potential of heritage-object handling in nurse-patient encounters with women facing cancer Qualitative research methods-Sessions were audio-recorded. Debriefing interview with the researcher, during which they</td>
<td>Well-being Impact Sense of identity, continuity, and stability Sensory impact Emotional impact-positive and negative; fear, powerlessness Expression to convey their experience</td>
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<td>17</td>
<td>Roberts et al. (2011), &quot;New roles for art galleries: art viewing as a community intervention for family carers of people with mental health problems&quot;, <em>Arts &amp; Health: an International Journal for Research, Policy and Practice</em>, 3, pp. 146–159</td>
<td>Group interactive art viewing art-making session. Hour-long Gallery setting. Facilitated by a trained member Sample size: n=10 (8 females carer-participants and 2 males facilitator) Age 30–60. Severe and enduring mental health problems</td>
<td>This study aimed to understand the psychological and social aspects of how art viewing, in a public art gallery, could be used as an activity to support family carers of people with mental health problems Qualitative study, audio recording of the gallery session, semi-structured research interviews</td>
<td>Effective programme design Planning of the session-starting with art viewing and that art making Trained staff Considered needs Environment or settings Safe and quite space Valued/special/privileged Architecture quality Well-being impact Enhanced experience Change the perspective of looking at art Value/recognising the role (including the care supporter) New leaning/education/understanding Emotional impact-memories/reminiscence Connection among the person and the careers</td>
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<tr>
<td>18</td>
<td>MacPherson et al. (2009), &quot;An Art gallery access programme for people with Dementia: you do it for the moment&quot;, <em>Aging &amp; Mental Health</em>, 13, pp. 744-752 National Gallery of Australia (NGA)</td>
<td>Gallery setting Involving dissimilar types of art viewed in different art gallery environments Attended the gallery once a week for 6 weeks – to discuss artwork with a trained</td>
<td>This project was to determine whether participants could significantly engage in an activity which, while normal for unimpaired populations, is at a higher intellectual and sensory level than</td>
<td>Well-being impact Participants reported that they were treated with dignity, reminisce, felt sense of achievement, normal, part of the community and chance for social interaction Remained engaged from the beginning to end-laughing; smiling; gesturing; active listening Social impact</td>
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<tr>
<td>19. Mittelman Epstein (2009), “Meet me at MoMA programme. Research”</td>
<td>Meet Me at MoMA programme, implemented in 2006 at the Museum of Modern Art (MoMA) in New York City. A monthly programme offered to people with early- to middle-stage Alzheimer’s disease and their family members and caregivers. Creating, developing, and implementing Small tour groups (no more than eight.</td>
<td>Facilitator at the gallery. Sample size: n= 23. Programmes often provided to people with dementia. The session was filmed. Pre-programme questionnaire. Behavioural analysis (sessions were filmed) and Focus groups (informal discussions with staff). Mixed-subject design was used to examine levels of engagement of the participants. Mixed design analyses of variance (ANOVA) were conducted on the proportion of very engaged, engaged, neutral and negative observations.</td>
<td>This ground breaking study provides the first formal evaluation that demonstrates, with both quantitative and qualitative evidence, the many benefits of making art accessible to people with Alzheimer’s disease and their caregivers. MoMA’s Alzheimer’s programme (Rosenberg, 2009) was evaluated by Mittelman.</td>
<td>Effective programme design. Participate in a programme, prompting required. Sometimes care supporters enthusiastic, discouraged some of the PLWD from responding. Need-based activity. Positive experience. Engagement. Overall satisfied. Enjoyed. The Importance of the Educator: the style and approach of the educators. Rather warm and interactive and the interaction.</td>
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<tr>
<td>Reference and country (where the study was conducted)</td>
<td>Programme design</td>
<td>Study objective and method</td>
<td>Findings from the study organised into categories such as</td>
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<td>Effective programme design</td>
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<td>people with dementia plus their family members and caregivers, for a total of sixteen people</td>
<td>and Epstein (2008) using self-rating and observer-rated tools, and the intervention was found to be intellectually, emotionally and socially satisfying</td>
<td>Exceptional importance to them. The way involve the participants with dementia</td>
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<td>lead through gallery</td>
<td>Quantitative consisting of Self-Rating Scales Questionnaire packet: Change from baseline (immediately before) to one week after Museum visit</td>
<td>Environment or settings</td>
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<tr>
<td>A trained educator leads each group through a tour of four or five artworks related to a theme and presented in a predetermined sequence</td>
<td>Observer-Rated Scales</td>
<td>Chance for a special outing</td>
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<td>Each tour lasts for one and a half hours, with about 15–20 min spent at each artwork</td>
<td>Individual reactions during Museum visit</td>
<td>Opportunity to go to a museum, stimulating experience</td>
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<tr>
<td>Once a month on Tuesday</td>
<td>Group interaction during Museum visit</td>
<td>Enjoy experience</td>
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<td>In museum setting</td>
<td>Take-Home Evaluation</td>
<td>Feelings of being welcome and important</td>
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<td>Responses by caregivers</td>
<td>Safe environment</td>
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<td></td>
<td>capture both qualitative and quantitative feedback</td>
<td>Well-being impact</td>
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<td>Family relationships</td>
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<td>Self-esteem of the person with dementia and the caregiver</td>
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<td>Quality of life improved significant amount of time looking at the educator and at the art</td>
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<td>A small reduction of attention during the discussion of artwork.</td>
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<td>Prompting required, people with dementia respond to the educator</td>
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<td>Sometimes care supporters enthusiastic nature- discouraged some of the people with dementia from responding</td>
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<td>Enhanced group interaction – conversations between the person with dementia and the caretaker humour, smiled, or laughed. interaction among the pair</td>
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<td>Felt comfortable (meet each other at other occasions)</td>
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<td>The number of responses of people with dementia to their caregiver, the number of unprompted or spontaneous comments by people with dementia</td>
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<td>Privacy</td>
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<td>Self-esteem</td>
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Table III. Dementia-friendly heritage settings (continued)
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<thead>
<tr>
<th>Reference and country (where the study was conducted)</th>
<th>Programme design</th>
<th>Study objective and method</th>
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Findings from the study organised into categories such as Effective programme design
Environment or settings
Well-being impact
Others

A sense of the uplift that people with dementia
Caregivers are looking for activities that will be emotionally and intellectually stimulating
Enhanced self-esteem
Pleasure of enjoying a stimulating experience
Resulting enhanced feelings of self-worth
Learning
For the caregivers, the pleasure of the art experience
Enhanced by sharing it with their spouses and with other couples
The relief of knowing that their spouses will be treated with dignity
Acceptance
elicit their comments
Genuine interest and appreciation, rekindles feelings of self-worth
Intellectual Stimulation
Shared Experiences
Opportunity to participate in an activity that is of interest to both partners
Identity as a couple
Pleasure in taking part in an activity Relaxed and engaged
Social Interaction
Social interactions become events fraught with strain and shame socializing activity
Extended to include more social interaction after the gallery tour
Accepting Environment
value placed
Temporarily removes the

(continued)
<table>
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<tr>
<th>Reference and country (where the study was conducted)</th>
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<th>Study objective and method</th>
<th>Findings from the study organised into categories such as</th>
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<td>Well-being impact</td>
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<td>Others</td>
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</tbody>
</table>

- Emotional Carryover
  - Positive changes to mood
  - Caregivers reported fewer emotional problems
  - All but one person with dementia reported elevated mood

- Importance of the facilitator approach
- Past experience with art
- Primary care responsibility, enjoyed the experience
- Surprised by the degree of engagement of the person with dementia during the programme
- Program Extension-future programs, which is a testament to their positive experiences
Of the 19 studies, 10 relate to people with dementia and their care givers (i.e. Camic et al., 2015; Flatt et al., 2015; Johnson et al., 2015; Camic et al., 2014; Zeilig et al., 2014; Camic and Chatterjee, 2013; Eekelaar et al., 2012; National Museums Liverpool (2012; MacPherson et al., 2009; Mittelman and Epstein, 2009). Of the other nine papers, three concern patients with mental health problems and their care supporters; three relate to older people with cancer; and three to older people in general.

In total, 16 of the papers report evaluation studies concerning well-being programmes based upon art viewing, including discussion of the selected art object (i.e. Camic et al., 2015; Flatt et al., 2015; Camic et al., 2014; Eekelaar et al., 2012; Roberts et al., 2011; MacPherson et al., 2009; Mittelman and Epstein, 2009) or object handling (i.e. Roe et al., 2016; Smiraglia, 2015; Solway et al., 2015; Thomson, Ander, Lanceley, Menon, Noble and Chatterjee, 2012; Thomson, Ander, Menon, Lanceley and Chatterjee, 2012; Ander et al., 2012; Lanceley et al., 2012). Two of these are internal evaluation reports, one by the National Museum Liverpool (2012) and one by the Museum of Modern Arts (MoMA) in New York (Mittelman and Epstein, 2009). The Liverpool Project (National Museums Liverpool, 2012) evaluates a training programme designed to equip museum staff and carers at the National Museum to deliver sensory and arts sessions to people with dementia. Six of the projects involve a related art or craftmaking activity completed during the session (i.e. Roe et al., 2016; Camic et al., 2014, 2015; Flatt et al., 2015; Eekelaar et al., 2012; Roberts et al., 2011). Of the other three papers, one is a literature review (i.e. Zeilig et al., 2014), another is a comparative study of two museum-based activities (i.e. Johnson et al., 2015) and the third is a discussion paper (i.e. Camic and Chatterjee, 2013) considering the benefits of museum and art based activities as a non-pharmacological intervention to promote health and well-being.

Ten of the programmes are delivered in museum or art galleries (i.e. Roe et al., 2016; Camic et al., 2014, 2015, 2014; Flatt et al., 2015; Johnson et al., 2015; Eekelaar et al., 2012; National Museums Liverpool, 2012; Roberts et al., 2011; MacPherson et al., 2009; Mittelman and Epstein, 2009), six take place in hospital or care settings (i.e. Solway et al., 2015; Zeilig et al., 2014; Thomson, Ander, Lanceley, Menon, Noble and Chatterjee, 2012; Thomson, Ander, Menon, Lanceley and Chatterjee, 2012; Ander et al., 2012; Lanceley et al., 2012), and one in an independent living community facility (i.e. Smiraglia, 2015). None of the projects is delivered in a heritage setting. Three projects are based in USA (i.e. Flatt et al., 2015; Smiraglia, 2015; Mittelman and Epstein, 2009), one in Australia (i.e. MacPherson et al., 2009) and the rest in the UK.

Of the 16 evaluation studies, eight studies employ qualitative methods (i.e. Roe et al., 2016; Camic et al., 2015; Solway et al., 2015; Ander et al., 2012, 2013; National Museums Liverpool, 2012; Lanceley et al., 2012; Roberts et al., 2011), and an equal number of studies states that they deploy mixed methods in their evaluation (i.e. Flatt et al., 2015; Smiraglia, 2015; Camic et al., 2014; Eekelaar et al., 2012; Thomson, Ander, Lanceley, Menon, Noble and Chatterjee, 2012; Thomson, Ander, Menon, Lanceley and Chatterjee, 2012; MacPherson et al., 2009; Mittelman and Epstein, 2009).

Data were extracted from the identified papers relating to the country where the study was conducted, the programme design, study objectives, methods used and the findings from each study, with particular reference to the concerns of the Sensory Palaces programme evaluation, i.e.:

- programme design (e.g. activities, participants, number, staff support, staff number, staff training and disciplines facilitator expertise);
- issues related to setting or environment (e.g. the nature of setting, atmosphere value, safety, access, wayfinding, etc.); and
- the impact on the well-being of the participants (e.g. including and social enhancement, intellectual enhancement, reminiscence, positive feeling, engagement and enjoyment, tactile stimulation, etc.).
Findings not related to the above categories were also noted, and are presented in this research review below.

5. Review of the literature

The 19 identified papers relevant to this research review were analysed thematically to identify key messages in the literature. Table IV provides a summary of the analysis relating to each of the categories.

The majority of the studies included in this research review emphasised the well-being benefits of attending programme sessions for the participants, and explicitly for those people living with dementia and their care supporters (i.e. Roe et al., 2016; Camic et al., 2014, 2015; Flatt et al., 2015; Johnson et al., 2015; Smiraglia, 2015; Solway et al., 2015; Zeilig et al., 2014; Ander et al., 2013; Camic and Chatterjee, 2013; Eekelaar et al., 2012; Thomson, Ander, Lanceley, Menon, Noble and Chatterjee, 2012; Thomson, Ander, Menon, Lancele and Chatterjee, 2012; Ander et al., 2012; Lanceley et al., 2012; Roberts et al., 2011; MacPherson et al., 2009; Mittelman and Epstein, 2009). Participants reported that they were treated with dignity, felt a sense of achievement by learning new skills and welcomed the opportunities for social interaction (MacPherson et al., 2009). Lanceley et al. (2012) emphasised the psychological benefits to the participants. In total, 14 studies discussed the importance of carefully structuring/design of such programmes, not only providing social, sensory, tactile stimulation but also intellectually stimulating, enjoyable, engaging via activities designed to accommodate the needs of participants (i.e. Roe et al., 2016; Camic et al., 2014, 2015; Flatt et al., 2015; Smiraglia, 2015; Solway et al., 2015; Ander et al., 2013; Camic and Chatterjee, 2013; Eekelaar et al., 2012; Thomson, Ander, Menon, Lancele and Chatterjee, 2012; Ander et al., 2012; Roberts et al., 2011; MacPherson et al., 2009; Mittelman and Epstein, 2009).

5.1 Programme design

Session design/structure. In total, 14 papers highlighted the well-being benefits of including physical objects in the sessions (i.e. Roe et al., 2016; Camic et al., 2014, 2015; Flatt et al., 2015; Smiraglia, 2015; Solway et al., 2015; Ander et al., 2013; Camic and Chatterjee, 2013; Eekelaar et al., 2012; Thomson, Ander, Menon, Lancele and Chatterjee, 2012; Lanceley et al., 2012; Roberts et al., 2011; MacPherson et al., 2009; Mittelman and Epstein, 2009). Most demonstrated the importance of touchable, physical objects as major beneficial components of the programmes (i.e. Flatt et al., 2015; Smiraglia, 2015; Solway et al., 2015; Camic et al., 2014; Ander et al., 2012, 2013; Lanceley et al., 2012; Roberts et al., 2011). The Heritage in Hospitals research project, reported by Ander et al. (2013), reported on the therapeutic role of museum objects in a hospital setting. It stated that the objects should be easy to handle, taking into consideration the physical capabilities of the participants. The significance of physical interaction with objects i.e. through touch, sight and sound, offers a richer experience to the participants (i.e. Smiraglia, 2015; Solway et al., 2015; Ander et al., 2012; Lanceley et al., 2012; Roberts et al., 2011), and this literature suggests that the use of heritage objects provides a sense of identity, continuity, and stability (i.e. Camic et al., 2015; Flatt et al., 2015; Solway et al., 2015; Ander et al., 2013). Taking a physical object and engaging with that object through various senses can be a powerful experience, according to Ander et al. (2012). This study also stressed that the museum object handling sessions provided both “stimulation and distraction,” for participants, both of which are extremely significant for well-being. It has been observed that during heritage-object handling sessions, people with impairments, with staff support, were able to engage with the object at various levels, including in a creative manner and to consider what their disease meant to them (i.e. Solway et al., 2015; National Museums Liverpool, 2012). The skills of people with dementia should not be underestimated while designing these sessions. There is often an
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<th>Categories</th>
<th>Commonalities and differences</th>
<th>No. of studies identified</th>
<th>Reference</th>
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<tbody>
<tr>
<td>Programme design</td>
<td>Session design: session structure, making art work and taking them home, sharing information about the session e.g., the routes to follow in advance, something different Enjoyable experience, richer experience, small group size, sight, touch and sound, touchable/physical objects, discussion, sharing information, engagement, shared, story, prompts for disclosure, role play, special, access to art, responding to painting, shared experience, social aspect, intellectual stimulation, need-based activity, opportunity for participation for both Staffing: sufficient staff, flexibility in staff support, feeling special, relaxing</td>
<td>14</td>
<td>Roe et al. (2016), Camic et al. (2015), Flatt et al. (2015), Smiraglia (2015), Solway et al. (2015), Camic et al. (2014), Ander et al. (2013), Camic and Chatterjee (2013), Eekelaar et al. (2012), Thomson, Ander, Menon, Lanceley and Chatterjee (2012), Lanceley et al. (2012), Roberts et al. (2011), MacPherson et al. (2009), Mittelman and Epstein (2009)</td>
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<tr>
<td>Staffing</td>
<td>Staff training: trained facilitator/staff, relationship with the facilitator, communication</td>
<td>5</td>
<td>Roe et al. (2016), Camic et al. (2015), Flatt et al. (2015), Camic and Chatterjee (2013), MacPherson et al. (2009)</td>
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Table IV.
Research review findings by category

(continued)
over emphasis on their difficulties and problems rather than focussing on their actual abilities. If the sessions are not designed appropriately, they could lead to disengagement of the participant (Solway et al., 2015). Two studies suggested that in order to provide better opportunities for participants, the number of participants attending a particular session

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<tr>
<td>Others</td>
<td>Sustainability and development: future feasibility of the programmes, new perspectives, alternative approaches for support, collaboration between the health sector, heritage sector and university to deliver such programmes</td>
<td>6</td>
<td>Roe et al. (2016), Camic and Chatterjee (2013), National Museums Liverpool (2012), Ander et al. (2012), MacPherson et al. (2009), Mittelman and Epstein (2009)</td>
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<tr>
<td>Others</td>
<td>Inclusion: part of society, structure to people’s lives, relationship between the facilitator and the PWD, stability, see art differently, open doors to other different experience, normal learning, chance for special outing, more social network after the session</td>
<td>7</td>
<td>Camic et al. (2015), Zeilig et al. (2014), Camic and Chatterjee (2013), Eekelaar et al. (2012), Thomson, Ander, Menon, Lancele and Chatterjee (2012), Roberts et al. (2011), Mittelman and Epstein (2009)</td>
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<tr>
<td>Others</td>
<td>Relief that the PWD will be treated with dignity</td>
<td>5</td>
<td>Camic et al. (2015), Flatt et al. (2015), Smiraglia (2015), MacPherson et al. (2009), Mittelman and Epstein (2009)</td>
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Table IV.
should be purposely small (i.e. Flatt et al., 2015; Mittelman and Epstein, 2009). This is not only beneficial for the people with dementia but also helps the staff to provide appropriate care and support during the session (Johnson et al., 2015).

Staffing. Five studies included in the review suggested that sessions should be designed with an appropriate number of staff, i.e. providing sufficient support to people with dementia and their care supporters (i.e. Roe et al., 2016; Camic et al., 2015; Flatt et al., 2015; Camic and Chatterjee, 2013; MacPherson et al., 2009). The studies also highlighted the importance of staff flexibility, for example, by varying or interrupting planned sessions to provide emotional support to the participants if needed (i.e. Roe et al., 2016; Camic et al., 2015; Flatt et al., 2015). This not only helps participants feel more relaxed, but provides them with a psychological benefit such as feeling special (i.e. Flatt et al., 2015; Camic and Chatterjee, 2013). Sessions designed with sufficient numbers of staff to support the participants can additionally provide a sense of psychological security (Ander et al., 2013).

Staff training. Staff must have an understanding of the impact the condition has on people with dementia. This includes consideration of how the individual person with dementia might think and feel. It will be helpful if the staff can offer support according to participants’ needs as far as possible. Therefore, trained facilitator and staff support is necessary as it will provide a sense of safety and security to the participants (i.e. Roe et al., 2016; Thomson, Ander, Menon, Lanceley and Chatterjee, 2012; National Museums Liverpool, 2012; Roberts et al., 2011; Mittelman and Epstein, 2009) during programme sessions.

5.2 Impact on well-being

Social enhancement. In total, 12 studies supported the social benefits of attending such programmes from the perspective of people with dementia, care supporters and from the perspective of the staff involved (i.e. Roe et al., 2016; Camic et al., 2014, 2015; Flatt et al., 2015; Smiraglia, 2015; Zeilig et al., 2014; Ander et al., 2013; Camic and Chatterjee, 2013; Eekelaar et al., 2012; Ander et al., 2012; MacPherson et al., 2009; Mittelman and Epstein, 2009). The studies highlighted the perspective of care supporters, which suggested that participating in such sessions/groups helped in reducing their sense of isolation. Care supporters felt that attendance together with their partner enhanced their identity as a couple and not just as a care supporter for a person with dementia, which could be a lonely experience. Several studies reported that care supporters appreciated that the sessions helped both carers and people with dementia to feel less alone, through meeting other people in similar situations and feeling supported by other carers (i.e. Camic et al., 2015; Flatt et al., 2015; Solway et al., 2015; Ander et al., 2013; Thomson, Ander, Lanceley, Menon, Noble and Chatterjee, 2012). Participation not only provided a shared experience but also a strong sense of returning to “normality”, and enjoying activities as they did prior to the onset of the dementia. Inclusion is also aided by taking the service out into various community settings, particularly for groups who may feel stigma in public spaces, related to social views about the illness.

Learning. Communication, storytelling, discussion, group participation and improved verbal fluency, allowed for meaningful communication and understanding to occur, be it through making art, discussing paintings in the gallery or having the opportunity to socialise during the sessions (i.e. Ander et al., 2013; Eekelaar et al., 2012; Roberts et al., 2011). Six studies identified shared learning, and engagement between people with dementia and their care supporters have a stimulating impact on the participants (i.e. Smiraglia, 2015; Solway et al., 2015; Zeilig et al., 2014; Ander et al., 2013; Thomson, Ander, Menon, Lanceley and Chatterjee, 2012; Mittelman and Epstein, 2009). For some, art-making encouraged a valued manner of interaction and understanding/collaboration for participants.

Psychological benefits. In total, 18 studies highlighted some psychological benefit of participating in such sessions, for example, positive feelings, personhood, sense of self,
autonomy, control, comfort and a sense of continuity (i.e. Roe et al., 2016; Camic et al., 2014, 2015; Flatt et al., 2015; Johnson et al., 2015; Smiraglia, 2015; Solway et al., 2015; Zeilig et al., 2014; Ander et al., 2013; Camic and Chatterjee, 2013; Eekelaar et al., 2012; Thomson, Ander, Lanceley, Menon, Noble and Chatterjee, 2012; Thomson, Ander, Menon, Lanceley and Chatterjee, 2012; Ander et al., 2012; Lanceley et al., 2012; Roberts et al., 2011; MacPherson et al., 2009; Mittelman and Epstein, 2009). The people who participated in the programmes reported that these sessions elicit enjoyment and improvements in mood, and help them to participate in activities in an enjoyable manner (i.e. Camic et al., 2015; Johnson et al., 2015; Thomson, Ander, Menon, Lanceley and Chatterjee, 2012; Ander et al., 2012). For some, memories were stimulated by the object handling activities, including memories of time spent with family or friends (i.e. Eekelaar et al., 2012; Roberts et al., 2011; MacPherson et al., 2009). Smiraglia (2015) reports on how participants talked about their experiences of doing photography with their families. Further benefits of sessions could include a general sense of achievement, enhanced learning abilities, confidence and connections with past memories, gaining a sense of identity, a feeling of being valued and other emotional benefits (i.e. Smiraglia, 2015; Solway et al., 2015; Ander et al., 2013; Camic and Chatterjee, 2013; Ander et al., 2012; Lanceley et al., 2012; Mittelman and Epstein, 2009). There was evidence of significant improvements in positive emotions, well-being and happiness and in patients’ perceptions of their own health, and positive impacts on relationships among staff, patients and their care supporters (i.e. Solway et al., 2015; Ander et al., 2013).

5.3 Programme settings

Significance of the programme setting. Within the literature reviewed, there was some limited consideration of the significance of the settings in which the sessions took place, and little specifically about historic or heritage settings and their impact on participants. Where the setting was considered, the studies referred to two main aspects of the built environment, although these are not developed in detail in this body of literature. One relates to the ways in which attending programmes in galleries or museums settings made participants feel part of a luxurious, prestigious setting. Attendance not only gave them opportunity to visit these spaces, but also to feel accepted back into society, to feel valued and to regain a sense of identity, often lost on the journey into the illness. The second element concerns the physical aspects of the built environment such as anxieties about wayfinding and navigating through various spaces (i.e. Roe et al., 2016; Mittelman and Epstein, 2009).

“Gallery/Museum” settings. Eight studies found that using gallery or museum settings as venues for delivering such sessions help to make the overall experience much richer for the participants (i.e. Camic et al., 2014, 2015; Flatt et al., 2015; Ander et al., 2013; Camic and Chatterjee, 2013; Ander et al., 2012; Roberts et al., 2011; Mittelman and Epstein, 2009). These studies stressed participants’ experience of museums and art galleries as special settings for programme delivery, described, for example, as privileged, quiet, special, welcome, important and as having architectural grandeur. Participants in some studies emphasised the significance of such settings as a “valued place” which takes them away from everyday activity and worries about the illness (i.e. Camic et al., 2014, 2015). The literature included in this review suggests that art viewing or object handling sessions delivered in a prestigious setting can make participants feel privileged, welcome and important and provided them with chance to visit such famous settings, which they might not otherwise do (i.e. Camic et al., 2014, 2015; Camic and Chatterjee 2013; Mittelman and Epstein, 2009). The art gallery/museum setting was used as an enabling and distinctive environment supported participants to feel like active members of society, who are socially included and valuable as people (Camic et al., 2014).

Physical aspects of environment. It is documented in four studies that the physical characteristics of the environment are also important when considering certain sites as
venues in which to deliver such programmes (i.e. Roe et al., 2016; Camic and Chatterjee, 2013; Roberts et al., 2011; Mittelman and Epstein, 2009). Two studies highlighted that concerns about wayfinding/navigation through various spaces concerns have been mentioned by participants (i.e. Roe et al., 2016; Mittelman and Epstein, 2009). It is also recognised that if information is shared in advance and appropriate staff support is provided on the day, this can help improve safety and provide a much more relaxed environment for the participants (i.e. Camic and Chatterjee, 2013; Roberts et al., 2011; Mittelman and Epstein, 2009).

5.4 Other issues in the literature

Programme sustainability and development. Six studies raised the challenges of maintaining and developing programmes beyond pilot phases, and highlighted the future feasibility of the programmes, considering new perspectives, alternative approaches for support and collaborations between the health sector, heritage sector and universities to deliver such programmes (i.e. Roe et al., 2016; Camic and Chatterjee, 2013; National Museums Liverpool, 2012; Ander et al., 2012; MacPherson et al., 2009; Mittelman and Epstein, 2009). Evaluation evidence of programmes in collaboration with universities could help to justify their well-being impact, which could further help in substantiating the need and the necessary resources for funders to deliver more of these sessions for people with dementia.

Public awareness of dementia. Five studies discussed benefits relating to the development of new insights, acceptance and awareness about dementia in general and people with dementia in particular (i.e. Camic et al., 2015; Zeilig et al., 2014; National Museums Liverpool, 2012; Roberts et al., 2011; Mittelman and Epstein, 2009). Staff participation in the studies have highlighted that running programmes of this kind for groups of people with specific needs, such as people living with dementia, has enhanced their understanding of dementia and increased general awareness about the disease. It further aided them to understand the perspectives of the people with dementia and their care supporters. With better understanding and training, the facilitators are enabled to deliver the sessions in a better way, incorporating sensory approaches, enhanced communication, i.e. more listening, slowing down and responding to participants’ need and moving at their pace (National Museums Liverpool, 2012).

Inclusion. Seven studies emphasised the significance of people with dementia and their care supporters to feel “normal”, i.e. feeling part of society, and the value of activities such as these programmes provide structure and stability to their lives (i.e. Camic et al., 2015; Zeilig et al., 2014; Camic and Chatterjee, 2013; Eekelaar et al., 2012; Thomson, Ander, Menon, Lancele and Chatterjee, 2012; Roberts et al., 2011; Mittelman and Epstein, 2009). Further this could be through enriched relationships between the facilitator and the person with dementia. The studies have also highlighted that participants felt that these sessions opened doors to different experiences, giving them more confidence to access other opportunities, and for carers also so that they were assured that the person with dementia would be treated with dignity.

Barriers and concerns. Five studies acknowledged various concerns about specific programmes, such as insufficient information sharing in advance with the participants, for example, about the breaks/time allocation to each session, the routes they will follow, entrances to buildings and concerns about background noises. One study reflected on whether the visual stimulation of art enabled the person with dementia to remain engaged in the process (i.e. Mittelman and Epstein (2009)). Some studies also highlighted worries expressed by participants about whether they would be capable of completing the activities included in the sessions (i.e. Camic et al., 2015; Flatt et al., 2015; Smiraglia, 2015; MacPherson et al., 2009; Mittelman and Epstein, 2009). One study stressed that sometimes the enthusiasm of the carer to participate may discourage the person with dementia to respond (i.e. Mittelman and Epstein, 2009).
6. Discussion
The analysis of the literature in this research review demonstrates that participative arts and object handling programmes are able to contribute positively to the lives of those living with dementia in various ways, and are being increasingly suggested as a valuable activity as a means to reduce the negative impacts of the illness. This review supports conclusions drawn elsewhere; that is, that such programmes appear to be able to support communication, encourage creative capabilities, stimulate new learning particularly “in the moment”, improve cognitive function, increase confidence and self-esteem, social participation (MLA Council, 2010) and generate a sense of autonomy amongst other acknowledged benefits such as social, tactile, intellectual, sensory stimulation (UK Department of Health, 2009). Chatterjee et al. (2009) confirmed that museum objects handling sessions enhanced self-reported patient life contentment and health status of in patients in hospital settings. Rosenberg (2009) reported on a study at New York’s MoMA, in which people in the early stages of Alzheimer’s disease and their care supporters participated in art viewing sessions in the museum, facilitated by trained museum staff. Research has also reported increased sustained attention, engagement and communication during arts-based activities (Kinney and Rentz, 2005; Musella et al., 2009; Rosenberg, 2009). The physical spaces and social contexts in which art and museum objects are viewed or handled can influence learning and social interactions (Falk and Dierking 2000). For example, the therapeutic significance of the art gallery setting for care supporters was justified in a study that involved people caring for a relative with a severe and longstanding mental health problem (Roberts et al., 2011). “House of Memories” is a museum-led dementia awareness programme run by the National Museums Liverpool, which offers training, access to resources and museum-based activities to allow care supporters to deliver person-centred care for people with dementia (House of Memories, 2017). Silverman (2010) emphasises the importance of museums as places of stimulation, and suggests that museum settings can contribute to participants’ health in many ways, such as support relaxation; physiological benefits, emotions support and encourage identity. Several major international galleries have used their venues for interventions, with the aim to include promotion of health and well-being. Examples include programmes run by the National Gallery of Australia, Sydney, the MoMA, New York, Whitworth Gallery in Manchester and Tate Britain, London (Roe et al., 2016; Camic, Roberts and Colbert, 2009). More recently, Historic Royal Palaces have published a guide to making heritage sites more dementia-friendly, based on case studies from a number of heritage sites in the UK (Historic Royal Palaces, 2017).

Within the papers reviewed in this research review, there is evidence of broad agreement about aspects of participatory arts and cultural programmes for people with dementia and their carers, including design principles and areas of benefit for participants. This literature suggests that setting such programmes in publicly accessible cultural, architecturally important or historical settings adds something to the experiences of the participants; however, this is not explored in depth or detail, and is not a specific research question for any of the studies reviewed.

The review has suggested a wide research landscape to address the impact of multidimensional enhancement experience of senses, i.e. via use of spaces/setting/arts-based activities/handling objects have on well-being and health of people living with dementia. For people with dementia, it is vital to explore into all the senses to generate memories. It may possibly be a photograph to look at, an object to touch, music to listen to or something to smell or taste can take anyone back in time, a lot to a very specific memory. Such multisensory programs can have psychological benefits, but very few have been studied empirically (Olarazán et al., 2010; National Collaborating Centre for Mental Health, 2007). The evidence base could be strengthened. In particular, studies that take place over
longer time periods with more diverse groups of people with dementia and that use a variety of evaluative methods (several studies have confirmed the effectiveness of combining qualitative with quantitative measures) are necessary (Cox et al., 2004).

Despite the apparent potential of these programmes, there is a major research gap; on the whole, though the scientific base is increasing, there is largely a lack of rigorous methodology to validate the benefits, and research findings are mixed. Complex interventions such as these are often implemented in a varied style by different investors (with different expertise), to varied populations and in dissimilar settings, all of which can affect the results derived (Pawson et al., 2004). This inconsistency increases challenges in terms of recognising an appropriate programme model.

In addition, and more apparent for the built environment setting, there was scant research available to support guidance on the physical aspects of the environment. Wayfinding and navigation were identified and raised as particular concerns to those living with dementia, and there is research available in the general built environment domain that can be applied to built heritage settings (e.g. see Arthur and Passini, 1992). However, no research was notably identified that addressed cognitive impairments over and above physical impairments that regulations governing disability usually address. An accessible or inclusive building design should not disable any user; it should enable the independent and equal use of a facility by all (Wu et al., 2004, 2007). With the introduction of the Disability Discrimination Act 1995 in the UK, the consideration of issues such as access and inclusive design has become more important, but has failed to address aspects related directly to dementia. The physical environment has been proven to alter psychosocial processes (Evans, 2003). Therefore, longitudinal studies are needed to examine the potential role of the physical environment heritage setting on dementia; and must include aspects such as lighting, temperature, acoustics and materiality, so that they can be understood and suitably adapted to support the well-being of those living with dementia.

Further research is also necessary to examine how the heritage built environment setting can facilitate and encourage and improve other aspects of general health and well-being, for example, through encouragement of walking and self-exploration.

Finally, it was perhaps surprisingly that there was little discourse in the reviewed literature that addressed the argument that some heritage cannot be adapted, generally leading to only limited opportune for people with dementia, particularly within limited financial resources in heritage management overall.

It is acknowledged that the key words in this research review (Table I) were carefully and purposely selected to ensure that the outputs identified addressed the research aim and scope of this paper. The resultant 185 papers (see Table II) were subsequently manually narrowed to 19 papers, representing a 10 percent inclusion rate based on detailed manual investigation within the project scope. Thus, 19 papers is recognised in itself as limited in number, and is based on the number of researches that have been undertaken in this area since 2010, which highlights the scant attention paid to dementia-friendly heritage settings generally.

7. Conclusion
This research review demonstrates that there is a growing body of evidence to suggest that the arts, cultural and heritage sectors can make a significant contribution to improve the health and well-being of people in general, including for people living with dementia and their carers. This review supports conclusions drawn elsewhere, that is, that such programmes appear to be able to support communication, encourage creative capabilities, stimulate new learning particularly “in the moment”, improve cognitive function, increase confidence and self-esteem, social participation (MLA Council, 2010) and generate a sense of autonomy amongst other
acknowledged benefits such as social, tactile, intellectual, sensory stimulation (UK Department of Health, 2009). This is particularly important to enable social inclusion for all, and improved well-being and self-esteem of those suffering with dementia. However, there is limited robust empirical and qualitative evidence about the impact and contribution of the settings, in particular heritage settings, such as historical sites and buildings in which such programmes or activities take place. The little work that has been conducted suggests that heritage settings could be used as integral components of an intervention, i.e. forming a link with the past memories of the participants, but on the whole the research lacks rigorous methodology to substantiate the benefits. In addition, as funding for heritage built environment settings is largely limited, and plagued with conflict between conservation goals and those to support inclusivity, it should also be focalled in the future to support:

- wayfinding and navigation in heritage settings against the benefits of self-exploration for those living with dementia; and
- cognitive impairments in heritage settings, including aspects of lighting, temperature, acoustics and materiality, so that they can be understood and suitably adapted to support the well-being of those living with dementia.

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Further reading


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Factors contribute in development of the assessment framework for wheelchair accessibility in National Heritage Buildings in Malaysia

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Abstract
Purpose – The purpose of this paper is to reveal the significant factors that contribute to the development of the assessment framework for wheelchair accessibility to National Heritage Buildings.
Design/methodology/approach – A qualitative approach was conducted via semi-structured interviews and go-along interview (Accessible Audit) through selected multiple case studies to reveal the main factors that contribute to the development of the assessment framework for wheelchair users in National Heritage Buildings in Malaysia. There are four National Heritage Buildings (gazetted under National Heritage Act, 2005) selected for this research.
Findings – The findings revealed a few significant factors comprising the physical built environment, organizational behavior and structure, financial resources, and existing legislation.
Research limitations/implications – This research is limited to wheelchair users and National Heritage Buildings, which was conducted through semi-structured interviews and go-along interview (Accessible Audit).

The researchers want to thank the Ministry of Higher Education, The National University of Malaysia, Universiti Teknologi Mara, Malaysia and Malaysia Museums Department for their professional contribution to this journal paper.
Practical implications – This research investigates the standpoints of both the National Heritage Building operators and the wheelchair users pertaining to accessibility in National Heritage Buildings with regard to their respective roles as management and users.

Social implications – The research demonstrates the importance of social participation effects on the accessibility in National Heritage Buildings based on empirical evidence in highlighting operators' and wheelchair users' challenges toward enhancing their accessibility.

Originality/value – This research will be a great contribution to the development of the assessment framework for wheelchair accessibility in National Heritage Buildings in Malaysia, including accessibility for pushchair, elderly, and pregnant women.

Keywords Accessibility, Assessment framework, National Heritage Building, Wheelchair user

Paper type Research paper

Introduction
National Heritage Buildings have become popular among international and local tourists. The buildings reveal their historical background and unique architectural style that were left behind by our past generations. Apart from our country’s vast development, such as its technology that is becoming more vital and expanded, and the skyscrapers built in many places, our national heritage and history have also drawn global attention (Zolkafli et al., 2019). Recently in 2017, Malaysia received 25.9m tourist arrivals bringing in a total receipt of RM 82.1bn (www.tourism.gov.my/statistics, accessed on January 10, 2019). This shows that tourism is an industry that contributes to Malaysia’s income. Thus, the industry is obligated to provide quality services and facilities to welcome and attract more tourists to come to Malaysia.

Tourism has become a social construct of life for an individual (Michopoulou et al., 2015). Part of the facilities and services to be provided is accessibility which is a crucial factor in attracting tourists (Md Ali et al., 2019). How easily places of interest can be accessed makes visiting them an enjoyable experience for the tourists. However, it is always forgotten that there are also people with disabilities among these tourists. Wheelchair users have as equal interest in tourism as able people have (Yau et al., 2004). Accessibility issues have hindered people with disabilities, especially wheelchair users, the chance to take part in various social events including tourism (Pagán, 2015). Of all disabled people, wheelchair users are the ones facing the most barriers in their day-to-day lives, which prevent them from enjoying the ease of mobility and access (Kassim, 2017; Page and Thorsteinsson, 2018). They move around with their wheels to participate in social activities around them. However, they feel discriminated against due to the inaccessibility of many places, including places of tourist attraction (Souca Maria Luiza, 2008; Darcy et al., 2011; Kose, 2015). Therefore, the objectives and questions of this research are as follows.

Research objectives
(1) To identify problems or obstacles that the National Heritage Building operators encounter in providing accessibility for wheelchair users to the National Heritage Buildings.

(2) To identify problems or obstacles that wheelchair users face in the National Heritage Building.

Literature review
Built environment
In built environment, building specification and design contribute to the ease of ingress and egress of a building (Bullen, 2007; Nwachukwu et al., 2017). How a person may reach, explore and appreciate the matters inside the building itself depends on the design. Inclusion has often been taken to define “disability inclusion,” which is synonymous with accessibility and barrier-free (Lau et al., 2016). With the United Nations’ advocacy of the rights of persons with disabilities (PWDs), the Convention on the Rights of PWDs was adopted in 2006 to establish
the Person with Disabled rights in society and development. The convention specifies that joined states must recognize and abolish hurdles and obstacles of accessibility to buildings and other physical environments (United Nations, 2006). Since its introduction, access for a disabled person to buildings has become a legal right in many developing countries including Malaysia. It has also become a major concern and a difficult challenge confronting facilities and building managers (Ismail et al., 2014). For buildings and built environments to be more socially sustainable, there should be equity and accessibility for people with different levels of abilities. Accessibility for wheelchair users is the most difficult to provide, especially in the National Heritage Buildings (Poria et al., 2009). The World Health Organization (2002) recognizes involvement in social activities as a fundamental right. Involvement is defined in the International Classification of Functioning, Disability, and Health as an individual’s participation in life situations (World Health Organization, 2007). Individuals with mobility impairment have a limited chance of participating in social and community events (Riggins et al., 2011; Williams and Willmott, 2012). In many cases, individuals with mobility impairments are equipped with wheelchairs to aid movement and participation. There is an indication that obtaining a wheelchair has encouraged participation among individuals with mobility impairments (Salminen et al., 2009). Wheelchair users have many disadvantages due to the difficulty in entering buildings and problems in maneuvering around the space within the buildings (Imrie and Kumar, 1998). Obstacles such as high kerbs, steep ramps, uneven surfaces, and staircases are the most challenging for wheelchair users (Beale et al., 2006). Buildings of hundred years old had a lot of constraints in terms of structural stability, heritage authentication, legislation issues, and a rigid building design (Zahari et al., 2016; Zolkafli et al., 2019). Without considering the constraints, installing or providing an access for wheelchair users in such buildings is a challenge (Silva and Perera, 2017) due to various reasons.

Among the irrefutable reasons, conserving and adapting a heritage building and reusing it for other purposes such as functioning as museums or galleries are complicated and costly (Yung and Chan, 2012). Poor design adaptations can jeopardize the integrity of heritage buildings. Thus, the new function should be compatible (Australia ICOMOS Burra Charter, 2013) and reduce intrusion with the fabric. To meet all sustainability characters, a heritage building needs to be equipped with current facilities, especially ramps, lifts, and good lighting (Bullen and Love, 2011; Silva and Perera, 2017). A consultation with the local communities should be carried out regarding any tourism planning or development and operation of the heritage site. Part of the significant challenges in managing cultural heritage assets in Malaysia is the financial resource. Managing built heritage assets such as heritage buildings is regarded as expensive and costly by most people (Ismail et al., 2014); hence, it is commonly funded by the government or private institutions if the building is rented out although the funding mainly depends on the owner of the building.

Based on the provision for wheelchair users in National Heritage Buildings, the management plays a significant role (Hasbollah, 2015) in providing accessibility. The management’s determination to provide accessibilities in their National Heritage Building leads them to put in numerous efforts to ensure that it is successful in terms of money or building design. Along with their efforts, the expertise and knowledge of the management in handling the National Heritage Building is also important (Poria et al., 2003). Understanding the nature of the building and the related regulation, makes the project successful without jeopardizing the authentication of the building.

Disability and right of independent living
The phrase “independent living” first attracted attention in the 1970s following its adoption by disability activists in the USA, which introduced self-help programs to enable students with “severe” physical impairments to enroll in mainstream programs. However,
the extension of university-based schemes to all wheelchair users proved difficult (Barnes and Mercer, 2005). Wheelchair users have argued for recognition of the wider barriers that are present in work relations as social inclusion (Rahim et al., 2014; Kassim, 2017; Siti Zaharah et al., 2017).

Related policies
In Malaysia, the building regulation was only put into force in 1974, which is the Road, Sewerage, and Building Act 1974 (Act 133). Then in 1984, came into force the Uniform Building By Laws (Legal Research Board, 1984) which was enacted through Act 133 and that emphasizes a building’s specification and requirement to ensure public safety. However, Act 133 does not clearly state any clauses to provide accessibilities for wheelchair users. Meanwhile in UBBL 1984, the By Laws 34A was included in 1990, which mentioned disabled provision in all buildings. In addition to Act 133 and UBBL 1984, another act is National Heritage Act, 2005 (Act 645). This act protects and gazettes all Heritage and National Heritage assets that are significant to the country’s history. According to clause 46 of Act 645, a Heritage Commissioner needs to carefully prepare the conservation management plan to ensure quality environment life in terms of the physical, socioeconomical, traffic, and the local community. In that regard, a conservation management plan guideline was drafted by the National Heritage Department of Malaysia to guide the parties involved in a conservation project. In the guideline, it is clearly stated that every conservation plan must also provide access for wheelchair users to the heritage building. It shows that the access for wheelchair users is important to the current needs (Bahagian Konservasi, 2015).

In 2006, Malaysia has signed the Convention of Rights of Person with Disabilities and takes the oath to promote, protect, and ensure the full and equal enjoyment of all human rights and fundamental freedoms by all PWDs (Canadian Human Rights Commission, 2015). As a result, the Person with Disabilities Act was put into force in 2008 to cater to the registration, protection, rehabilitation, development and well-being of PWDs (Siti Zaharah et al., 2017). In enabling PWDs to fully participate in society, this act recognized the importance of accessibility to the physical, social, economic, and cultural environment; to health and education; and to information and communication. This act implies that a person with a disability should not be excluded from participating in social activities such as tourism. Thus, it is important for National Heritage Buildings that are open to the public to provide facilities and services to the disabled so that they can take a tour and appreciate their visit.

Methodology
In achieving the objectives of this research, two types of methodology are used: Structured Interviews and Access Audit (go-along interviews with the wheelchair users).

Existing research methodologies
In 2016, Lau, Ho, and Yau in their research entitled “Assessing the disability inclusiveness of university buildings in Hong Kong” used the structured interview to examine the policies used in the research.

A good example of accessibility research is Accessible Built Environment, which was carried out between 2010 and 2014 (Rahim et al., 2010, 2014). Their research aimed to gather information in achieving accessibility for the disabled in Built Environment. The researcher used Access Audit as a method in achieving their objectives. In 2018, a research was carried out using the Go-Along Interview (Accessible Audit) to gain challenges for wheelchair travelers in visiting the National Heritage Building (Zahari et al., 2018).
Methodology used

There are two methods used to achieve the research objectives, which are the Structured Interview and the Go-along Interview (Access Audit). Structured interview is used to identify the problem confronting the National Heritage Building operators in providing accessibility to wheelchair users. Meanwhile, the go-along interview (Access Audit) is used to look into the problems faced by wheelchair users while visiting the National Heritage Buildings.

Research setting. The present research selects the National Heritage Buildings (gazetted under National Heritage Act, 2005 (Act 645)) as the setting to discover accessibility in National Heritage Buildings in Heritage Tourism. They were selected because as a nation of racial and cultural diversity, Malaysia emerges as one of the world’s most optimistic market for tourism (Ismail et al., 2014). UNESCO has listed five places in Malaysia as world heritage sites. Such indication reveals that Malaysia is a growing attraction to local and international tourists regardless of their background. Thus, Heritage Tourism in Malaysia serves as an appropriate research setting in providing new insight into the accessibility to National Heritage Buildings for the disabled in a slightly different context.

Case studies and structured interview. Selection of case studies was based on the List of National Heritage Buildings under the National Heritage Act, 2005. There are 46 National Heritage Buildings throughout Malaysia. From 46 case studies only 8 can be accessed freely by the public. Four of these buildings are located in Kuala Lumpur. According to the Ministry of Tourism and Culture (2014), Kuala Lumpur has the highest percentage of tourist destinations compared with other states in Malaysia.

The four National Heritage Buildings selected for this research were Building A, Building B, Building C and Building D. These National Heritage Buildings were selected due to their functions, where the public can visit them (refer to Table I).

The ethics and practices

The interviews were conducted with four selected National Heritage Building operators. The interview questions were separated into two sections. Section 1 comprised demographic profile questions. The demographic questions help the researcher to warm up the interview session by asking for the participants’ professional background and trying to get acquainted with them. Section 2 consisted of technical and management questions such as the physical built environment, existing accessibility to the National Heritage Building, legislative matters, and financial resources. These questions were answered by the National Heritage Building operators and were analyzed using Atlas Ti version 8 as the thematic analysis.

The go-along walking interview method (access audit). The go-along interview is a long way of discovering one’s experience and it is a noble way to obtain participants’ insights into their experience as well as their connections to the place and social environments within their neighborhood (Carpiano, 2009; Garcia et al., 2012; Kinney, 2017). Go-along interviews have been used to explore social activism (Anderson, 2004), neighborhood public health

<table>
<thead>
<tr>
<th>Building</th>
<th>Years built</th>
<th>Years gazetted</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1963</td>
<td>2015</td>
<td>The main museum building houses four exhibition galleries featuring Malaysia’s history and rich cultural diversity.</td>
</tr>
<tr>
<td>B</td>
<td>1896</td>
<td>2007</td>
<td>This building was made as administration office back in 1905 and again used as state government office in 1917. In 1986, after a few usages, this building had been rented out to an organization to display the art and craft.</td>
</tr>
<tr>
<td>C</td>
<td>1928</td>
<td>2011</td>
<td>Museum</td>
</tr>
<tr>
<td>D</td>
<td>1898</td>
<td>2012</td>
<td>Gallery</td>
</tr>
</tbody>
</table>

Table I.
National Heritage Buildings background information
resources, urban social work outreach, transition from adolescence toward adulthood, and health disparities. In this study, the participants were brought to the selected National Heritage Buildings and the researcher walked alongside them while proceeding with the interview. The interviews were recorded and transcribed.

The ethics and practices
The walking interview has a number of practical and ethical considerations that must be addressed to ensure the safety of both the participant and the researcher, but these are manageable and should be addressed to ensure that the voices of the vulnerable and marginalized populations are included in the research (Kinney, 2017). Safety is one of several issues highlighted by Carpiano (2009) using “go-along” to explore the relationship between space and person. The weather factor such as rain or strong wind can be unsafe for the interview to be executed. It is important for the researcher to be ready with an alternative plan such as changing the date of the interview. Besides that, the mode of transportation should be selected carefully. The area and time of executing the walking interview should also be considered. The area must be secluded and safe for the researcher and participants to conduct the interview. The route for the Go-along Walking Interview should be safe. The tools used to record the interview must be suitable and sufficient for a quality interview. All equipment ranging from a small recorder to a large microphone and from a digital camera to a digital video recorder must be suitable with how the interview will be executed.

In this research, the participants and researchers had decided to use the real-time approach. The disabled will arrive at the National Heritage Building separately from the researcher. This research takes place during daylight hours and in the National Heritage Building where many other tourists and staff of the building were on duty. In ensuring the quality of the interview, the researcher used a video recorder and an audio recorder, as well as employed two assistants to help record the video and assist the wheelchair users to go through the interview.

The age requirements to be the participants for this study are that the individual must be 18 years old and above so that the information given is reliable and mature. The individual must have passion in traveling and touring to other places so that they can give rich information on the accessibility of a building they have entered. Thus, the participants should be wheelchair users who love to travel.

Three disabled participants agreed to join this study. These three participants were physically disabled and used a wheelchair to commute from their houses to the place where the go-along interview was held. The same three wheelchair users went through the go-along interview in four different national heritage buildings to provide their experiences on the accessibilities of those buildings. Therefore, there were 12 results gained from these interviews which will be discussed later.

Results and discussion
The interview. In this study, two types of interviews were executed. First, the interviews with the National Heritage Building operators were semi-structured interviews which were held in their own offices. The results from the interviews were analyzed and managed by using Atlas Ti version 8 and are depicted in Table II. These interviews revealed the challenges that need to be addressed by the building operators in providing accessibility for the wheelchair users.

From the above table, the National Heritage Building operators have a few challenges that they must overcome to provide accessibility to the building. The National Heritage Buildings were gazetted due to their significant National History, Architectural Styles, and their contribution to the country from previous usage. These buildings were then gazetted and carefully conserved and further adapted for other functions to prolong the life span of the buildings. However, when these buildings were adapted to new functions as museums or
galleries, providing accessibilities for wheelchair users (disabled) was difficult due to certain challenges. The greatest challenge is financial resources. Conserving an old historical building is already costly, and providing new accessibilities for the wheelchair users, such as ramps, lifts, or wheelchair platforms will add to the existing cost. Thus, the building operators need to seek alternative financial resources. The second challenge faced by the National Heritage Building operators is physical built environment. Most existing building designs are ill-suited to be altered in order to provide accessibility for wheelchair users. Wheelchair users need a bigger and spacious space for them to maneuver the wheels. Not only that, the ramps provided must be at an appropriate gradient for them to access the building, but which may disturb the protected façade of the building. In addition to the physical built environment, legislation should also be considered. These National Heritage Buildings were gazetted under the National Heritage Act, 2005 (Act 645), and to conserve these buildings, they need to follow the Conservation Guideline that was produced by the National Heritage Department. The interview with all building operators revealed that they were concerned about the difficulty in providing accessibilities due to legislative constraints.

The go-along interview. Semi-structured interviews were conducted with the go-along participants in relation to the accessibility of National Heritage Buildings. The interview
revealed a few main contributing factors in developing the assessment framework for wheelchair users to have an access to the national heritage buildings. The interview questions were divided into two sections. Section 1 consisted of demographic questions such as age, cause of disability, years of being disabled, work, traveling experience, and experience visiting National Heritage Buildings (refer to Table III). Section 1 was executed before the go-along interview was to commence. The demographic questions help the researcher to warm up the go-along interview session by asking the participants about their personal background.

Section 2 consisted of accessibility questions which were constructed based on accessibility specification for wheelchair users based on the Malaysian Standard 1184:2014 Universal Design and Accessibility in the Built Environment– Code of Practice (refer to Table IV).

Accessible Audit by the wheelchair users was performed based on the above questions. The researcher briefed the participants on how the interview would be conducted and how the data would be recorded. The results are depicted in Tables V–VIII.

Accessible audit for Building A. Based on the above table, Building A did not provide facilities such as lifts, ramps to all exhibition galleries and disabled toilets for wheelchair users. Thus, to reach the lift at the main gallery inside the National Heritage Building, the wheelchair users need to go through the museum which requires assistance from the staff. Without the staff, it is difficult for them to access the building. Ramps were provided at all galleries, but not the handrail (see Plate 1). The absence of handrail or grab rail made it difficult for the wheelchair users to climb the ramp, especially if they used an ordinary wheelchair (not an electric wheelchair).

Accessible audit for Building B. As depicted in the above table, no car parking is provided for the disabled, causing difficulty for the wheelchair user to park their cars. Besides that, the main entrance has a 50-mm small drain, making it inaccessible to the wheelchair user if there is no help from the staff or other people. Next to the entrance, the provided ramp is very narrow and steep which makes it dangerous to use without any help. Although there is a lift provided in this National Heritage Building, the indicator button is beyond the reach of the wheelchair user (Plate 2).

Accessible audit for Building C. Based on the above table, the steps at the main entrance of the National Heritage Buildings make this building immediately inaccessible. Furthermore, this National Heritage Building consists of two storeys and there is no lift or ramp to access the second floor.

Accessible audit for Building D. Based on the above table, there are steps at the main entrance of this National Heritage Building, making it immediately inaccessible to wheelchair users. Moreover, the building consists of two storeys with no lift or ramp for the user to access the second floor.

<table>
<thead>
<tr>
<th>Participant</th>
<th>P1</th>
<th>P2</th>
<th>P3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>44</td>
<td>39</td>
<td>55</td>
</tr>
<tr>
<td>Designation</td>
<td>Art Crafter</td>
<td>Crafter</td>
<td>Business</td>
</tr>
<tr>
<td>Causes of Disability</td>
<td>Spinal Injury</td>
<td>Amputated</td>
<td>Born with no legs</td>
</tr>
<tr>
<td>Years of Disabled</td>
<td>20 years</td>
<td>39 years</td>
<td>55 years</td>
</tr>
<tr>
<td>Do you have assistant?</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Which country have you traveled before?</td>
<td>China, Singapore, Thailand, and Taiwan</td>
<td>Taiwan, China, and Thailand</td>
<td>Taiwan, China, and Hong Kong</td>
</tr>
<tr>
<td>Have you ever visited national heritage building in Malaysia? (if no why?)</td>
<td>“I don't know how is the facilities provided in the building due to the age of the building”</td>
<td>“I am afraid that I cannot go inside the building because I travel alone.”</td>
<td>“I visited National Heritage Building before. Unfortunately, not all exhibition places I can access”</td>
</tr>
</tbody>
</table>

Table III.
Demographic profile of selected participants with a wheelchair
1. Approach to building
   a. Car Parking
      - Location
      - Numbers of designated parking
      - Signage
      - Surface
      - Vehicle parking with auxiliary moveable ramps
      - Curb Ramp from parking space to an adjacent higher pedestrian
   b. Routes/Path to the Building
      - Way Finding with other physical Support
      - Width of the path
      - Passing space for wheelchair users
      - Turning Space for wheelchair users on landing
   c. External ramps
      - Slope and length
      - Width of ramps
      - Landing of ramps
      - Guided with handrails
      - Drainage of ramps
      - Surface material of ramps
   d. External steps
   e. Handrails

2. Access within building
   a. Entrances
      - Identification
      - Floor level at the entrance
      - Main entrance doorways
      - Doorways width
      - Clear height of doorways
      - Circulation Space
   c. Entrance foyers/lobbies
      - Unobstructed manoeuvring space
      - Visibility through an entrance door
   d. Horizontal Circulation
      - Internal passages
      - Turning space for 90° turn of a wheelchair in corridors
      - Circulation space for 180° wheelchair turn
      - Floor in corridors
   e. Vertical Circulation
      - Ramps
         - Ramps in the corridor
         - Handrails
         - Continuity of Handrail
         - Height of handrail
         - Horizontal extension of a handrail
         - Visual and tactile information
      - Passenger lifts
         - Inner dimension of cars
         - Door opening
         - Equipment in the car
         - Handrail
         - Allergic button
         - Lighting
         - Emergency warnings

Table IV. Malaysia standard 1184:2014 universal design and accessibility in the built environment – code of practice
National Heritage Buildings are old buildings and were built before there were any building regulations and regulated specifications of wheelchair accessibility (Harun, 2017; Welage and Liu, 2011; Olivadese et al., 2017). In this research, there were four vital factors considered in developing the assessment framework for wheelchair user in National Heritage Building: physical built environment; financial resources, organizational behavior and structure, and legislative matters. This study was executed using two methods to achieve its objective: a semi-structured interview with the National Heritage Building operators and Accessible Audit through the Go-along interview with the wheelchair participants. First, it is concluded from the perspectives of the National Heritage Building operators that they are more concerned on the financial resources and legislative matters since they were bound by both. Without sufficient financial resources their hands are tied. Besides that, the National Heritage Building operators must know and understand the rules and regulations in the act and the guideline regarding the maintenance of these National Heritage Buildings. Good understanding will then lead them to a better decision. Thus, accessibility for wheelchair users can be provided without jeopardizing the authentication of these National Heritage Buildings. Accessible audit and go-along interviews revealed that the physical built environment of these National Heritage Buildings was inaccessible. The participants concluded that the accessibility of the national heritage building is the most inconvenient causing them to feel unwelcomed. They suggested that the building should be installed with facilities and accessibility for the disabled and wheelchair users like them so that they will not feel left out by the society and the environment. They also have the same desires and other life goals like any other abled and normal people. They want to visit, experience, and enjoy our National Heritage Building and what is within the building (right of independent living). Thus, in this regard accessibility plays an important role (see Figure 1).

Table IV.

<table>
<thead>
<tr>
<th>Design guidance based on MS 1184:2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. Toilet</td>
</tr>
<tr>
<td>Reception Counters, desks, ticket offices location</td>
</tr>
<tr>
<td>Space to manoeuvre</td>
</tr>
<tr>
<td>Height</td>
</tr>
<tr>
<td>lighting</td>
</tr>
<tr>
<td>ticketing system</td>
</tr>
<tr>
<td>WCs</td>
</tr>
<tr>
<td>Door opening</td>
</tr>
<tr>
<td>Grab handrail</td>
</tr>
<tr>
<td>Lighting</td>
</tr>
<tr>
<td>Emergency button</td>
</tr>
<tr>
<td>Height of WCs</td>
</tr>
<tr>
<td>Wash basins</td>
</tr>
<tr>
<td>Height of washbasin with knee and toe clearance</td>
</tr>
<tr>
<td>Water supply</td>
</tr>
<tr>
<td>Tap and Bidet</td>
</tr>
<tr>
<td>Urinal</td>
</tr>
<tr>
<td>j. Equipment such as wheelchair</td>
</tr>
<tr>
<td>Fire Emergency warning systems, signals, and information</td>
</tr>
</tbody>
</table>
### Design guidance based on MS 1184:2014

<table>
<thead>
<tr>
<th>1. Approach to building</th>
<th>P1</th>
<th>P2</th>
<th>P3</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Car Parking</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>b. Routes/Path to the Building</td>
<td>O</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>c. External ramps</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>d. External steps</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>e. Handrails</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Access within building</th>
<th>P1</th>
<th>P2</th>
<th>P3</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Entrances</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Identification</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Floor level at the entrance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Main entrance doorways</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doorways width</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clear height of doorways</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Circulation Space</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Entrance foyers/lobbies</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Unobstructed manoeuvring space</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visibility through an entrance door</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. Horizontal Circulation</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Internal passages</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turning space for 90° turn of a wheelchair in corridors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Circulation space for 180° wheelchair turn</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Floor in corridors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e. Vertical circulation</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Ramps</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ramps in the corridor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Handrails</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuity of Handrail</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Height of handrail</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horizontal extension of a handrail</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visual and tactile information</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f. Passenger lifts</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Inner dimension of cars</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Door opening</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment in the car</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Handrail</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Allergic button</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lighting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency warnings</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stopping and levelling accuracy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control device and signals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of lifts for fire evacuation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>h. Wheelchair platform stair lifts</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Reception Counters, desks, and ticket offices</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Location</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Space to maneuver</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Height</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lighting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ticketing system</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i. Toilet</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>WC s</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>j. Equipment such as wheelchair</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>k. Fire Emergency warning systems, signals, and information</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

**Table V.** Accessible audit through the go-along interview of Building A
1. **Approach to building**
   - a. Car parking
   - b. Routes/path to the building
   - c. External ramps
   - d. External steps
   - e. Handrails

2. **Access within building**
   - a. Entrances
     - Identification
     - Floor level at the entrance
     - Main entrance doorways
     - Doorways width
     - Clear height of doorways
     - Circulation space
     - (50 mm drain at the entrance and no handrail)
   - c. Entrance foyers/lobbies
     - Unobstructed maneuvering space
     - Visibility through an entrance door
   - d. Horizontal circulation
     - Internal passages
     - Turning space for 90° turn of a wheelchair in corridors
     - Circulation space for 180° wheelchair turn
     - Floor in corridors
   - e. Vertical circulation
     - Ramps
     - Ramps in the corridor
     - Handrails
     - Continuity of Handrail
     - Height of handrail
     - Horizontal extension of a handrail
     - Visual and tactile information
     - (ramp provided very narrow and steep)
   - f. Passenger lifts
     - Inner dimension of cars
     - Door opening
     - Equipment in the car
     - Handrail
     - Allergic button
     - Lighting
     - Emergency warnings
     - Stopping and levelling accuracy
     - Control device and signals
     - Use of lifts for fire evacuation
     - (the indicator button beyond the reach of wheelchair users)
   - h. Wheelchair platform stair lifts
     - Reception Counters, desks, ticket offices
     - Location
     - Space to maneuver
     - Height
     - Lighting
     - Ticketing system
     - O
     - O
     - O
     - O
     - X
     - X
     - X

<table>
<thead>
<tr>
<th></th>
<th>P1</th>
<th>P2</th>
<th>P3</th>
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</thead>
<tbody>
<tr>
<td><strong>Table VI.</strong> Accessible audit through the go-along interview of Building B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design guidance based on MS 1184:2014</td>
<td>B (A)</td>
<td>B (B)</td>
<td>B (C)</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>1. Approach to building</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Car parking</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>b. Routes/path to the Building</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>c. External ramps</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>d. External steps</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>e. Handrails</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>2. Access within the building</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Entrances</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Identification</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Floor level at the entrance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Main entrance doorways</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doorways width</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clear height of doorways</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Circulation space</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Entrance foyers/lobbies</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Unobstructed maneuvering space</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visibility through an entrance door</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. Horizontal circulation</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>e. Vertical circulation</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Ramps</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ramps in the corridor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(the second floor is inaccessible)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Handrails</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>f. Passenger lifts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>h. Wheelchair platform stair lifts</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Reception Counters, desks, and ticket offices</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>i. Toilet</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>j. Equipment such as wheelchair</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>k. Fire Emergency warning systems, signals, and information</td>
<td>X</td>
<td>X</td>
<td>X</td>
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</table>

Table VII. Accessible audit through the go-along interview of Building C
<table>
<thead>
<tr>
<th>Table VIII. Accessible audit through the go-along interview of Building D</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Design guidance based on MS 1184:2014</td>
<td>P1</td>
</tr>
<tr>
<td>1. <strong>Approach to building</strong></td>
<td></td>
</tr>
<tr>
<td>a. Car parking</td>
<td>X</td>
</tr>
<tr>
<td>b. Routes/path to the building</td>
<td>X</td>
</tr>
<tr>
<td>c. External ramps</td>
<td>O</td>
</tr>
<tr>
<td>d. External steps</td>
<td>O</td>
</tr>
<tr>
<td>e. Handrails</td>
<td>O</td>
</tr>
<tr>
<td>2. <strong>Access within building</strong></td>
<td></td>
</tr>
<tr>
<td>a. Entrances</td>
<td>O</td>
</tr>
<tr>
<td>Identification</td>
<td>(there is a 50-mm drop at the door)</td>
</tr>
<tr>
<td>Floor level at the entrance</td>
<td></td>
</tr>
<tr>
<td>Main entrance doorways</td>
<td></td>
</tr>
<tr>
<td>Doorways width</td>
<td></td>
</tr>
<tr>
<td>Clear height of doorways</td>
<td></td>
</tr>
<tr>
<td>Circulation space</td>
<td></td>
</tr>
<tr>
<td>c. Entrance foyers/lobbies</td>
<td>X</td>
</tr>
<tr>
<td>Unobstructed maneuvering space</td>
<td></td>
</tr>
<tr>
<td>Visibility through an entrance door</td>
<td></td>
</tr>
<tr>
<td>d. Horizontal circulation</td>
<td>X</td>
</tr>
<tr>
<td>e. Vertical circulation</td>
<td>O</td>
</tr>
<tr>
<td>Ramps</td>
<td>(there is no lift or ramp to access the second floor)</td>
</tr>
<tr>
<td>Handrails</td>
<td></td>
</tr>
<tr>
<td>Continuity of Handrail</td>
<td></td>
</tr>
<tr>
<td>Height of handrail</td>
<td></td>
</tr>
<tr>
<td>Horizontal extension of a handrail</td>
<td></td>
</tr>
<tr>
<td>Visual and tactile information</td>
<td></td>
</tr>
<tr>
<td>f. Passenger lifts</td>
<td>O</td>
</tr>
<tr>
<td>h. Wheelchair platform stair lifts</td>
<td>O</td>
</tr>
<tr>
<td>Reception Counters, desks, and ticket offices</td>
<td>X</td>
</tr>
<tr>
<td>Location</td>
<td></td>
</tr>
<tr>
<td>Space to maneuver</td>
<td></td>
</tr>
<tr>
<td>Height</td>
<td></td>
</tr>
<tr>
<td>Lighting</td>
<td></td>
</tr>
<tr>
<td>Ticketing system</td>
<td></td>
</tr>
<tr>
<td>i. Toilet</td>
<td>O</td>
</tr>
<tr>
<td>WC</td>
<td></td>
</tr>
<tr>
<td>j. Equipment such as wheelchair</td>
<td>O</td>
</tr>
<tr>
<td>k. Fire Emergency warning systems, signals, and information</td>
<td>X</td>
</tr>
</tbody>
</table>
The accessibility into and inside a building encourages wheelchair users to visit again. With easier access, they feel invited to visit the National Heritage Building. Therefore, it is important for National Heritage Buildings as a place of tourist attraction to upgrade and enhance their accessibility for the disabled and wheelchair users so that these users can
participate in social activities like how abled people do. This research is not only beneficial to the wheelchair users but also to others with mobility impairment, such as the elderly, pregnant women, and mothers with an infant (stroller).

References


Michopoulos, E., Darcy, S., Ambrose, I., Buhaldis, D., Michopoulos, E., Darcy, S., Ambrose, I. and Buhaldis, D. (2015), “Guest editorial accessible tourism futures: the world we dream to live in and the opportunities we hope to have”.

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Wheelchair accessibility


Further reading


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The opportunities and challenges of improving the condition and sustainability of a historic building at an international tourist attraction in the UK

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Abstract

Purpose – Heritage tourism has become increasingly popular, and improving the sustainability of such sites is essential both nationally and internationally. The purpose of this paper is to explore the opportunities and challenges of improving the condition and sustainability of a chapel at a busy international heritage tourist attraction.

Design/methodology/approach – A case study approach was adopted. This utilised interviews with four of the primary building professionals involved with the refurbishment project. Documentary analysis and observations were also used.

Findings – The present case study presents the opportunities and challenges faced by a tourist heritage attraction. Improvements to the condition and sustainability of such assets are essential to ensure their sustained and enhanced use, and the protection of heritage buildings. Such projects create opportunities to increase knowledge and understanding about these assets as well as enhancing opportunities for meaning making for visitors. The paper highlights the importance of a strong leader and a balanced team working towards common objectives. Further, whilst synergies between conservation and sustainability exist, there are also tensions and compromises.

Research limitations/implications – This case study highlights the opportunities and challenges of improving the condition and sustainability of built cultural heritage at a tourist attraction. Opportunities included increased knowledge and understanding about the heritage asset; enhancement of values for present and future generations; improved condition, increased usability; and increased sustainability. Challenges were: team turnover; delays resulting from archaeological findings; previous work resulting in building defects; the existing building condition; and unfamiliarity and the uncertainty regarding particular measures.

Practical implications – The practical implications of this case study include ensuring clear project objectives and a balanced project team are in place. These should be enhanced by a good system of information recording throughout the project to limit the impact of staff absence. Good communication within the team and with external members such as manufacturers will reduce the impact of unfamiliar products and aid in decision making. Future research should explore whether these findings are applicable to other heritage tourist attractions, and whether visitors’ narrative encounters with the asset change following a sustainability improvement project.

Originality/value – Limited research has been previously performed on improving the sustainability of built cultural heritage at tourist attractions. This research investigates the opportunities and challenges facing building professionals in improving such heritage assets. The improvement of heritage tourist attractions requires careful consideration. Whilst they need to be conserved for future generations, increasing the sustainability of such assets is essential to ensure their continued usability.

Keywords Refurbishment, Heritage, Energy efficiency, Heritage tourism, Hidcote, Lawrence Waterbury Johnston

Paper type Case study

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Introduction
Heritage tourism has become increasingly popular, and demand for this type of tourism is estimated to increase by 15 per cent annually (Durak et al., 2016). It is described as “one of the most significant types of tourism” (Timothy and Boyd, 2006, p. 2). Cultural heritage is often inherently linked with physical spaces (Adger et al., 2012), with historic buildings forming part of heritage tourism (Gholitabar et al., 2018).

Cultural heritage has been shown to facilitate “sense-making and identity-building through phenomenological encounters of the self in the destination space” (Jamal and Hill, 2004, p. 359). The integration of the historic built environment with the “productive living environment” to create meaning is important (Newman, 2016, p. 402).

Energy efficiency and sustainability are key issues for the building stock. Indeed, it has been recognised that historic buildings are a key component in reducing carbon emissions (Pigliautile et al., 2018). Climate change poses a threat to the long-term survival and usability of built cultural heritage (Hall et al., 2016). To ensure the continued use of cultural heritage, such assets must be sustainable. However, improving the energy efficiency and sustainability of historic buildings is complex, requiring “cooperation between experts” (Dvornik Perhavec et al., 2015, p. 81) and “a multidisciplinary approach” (Roberti et al., 2015, p. 189).

Built cultural heritage is a non-renewable resource and can be vulnerable to change (Phillips, 2015). Such buildings have “endured climate changes over the centuries” with adjustments made to adapt these structures to their local climate (Silva and Henriques, 2014, p. 381). However, the type and speed of change are important.

For built cultural heritage open to visitors, there are additional challenges, including the consideration of visitor impact (Landorf, 2009). As visitors to built cultural heritage increase, questions relating to sustainability and conservation are raised. This includes how such assets are sustained from a conservation perspective whilst continuing to welcome increasing visitor numbers. Garrod and Fyall (2000) emphasise that by increasing the number of visitors there is a danger of negatively impacting on the property and surrounding area. This is echoed by Timothy and Boyd (2006) who identify wear-and-tear as a principal challenge. Additionally, consideration is needed about how the energy consumption of assets can be attenuated whilst increasing visitor numbers and enhancing the visitor experience.

Whilst extensive literature exists on heritage tourism (e.g. Timothy and Boyd, 2006) and improving the sustainability of heritage buildings (e.g. Yazdani Mehr and Wilkinson, 2018; Norrström, 2013), there is currently limited research on improving the sustainability of built cultural heritage at tourist attractions.

This paper aims to investigate the opportunities and challenges of improving the sustainability of a listed building at a heritage tourist attraction from the perspective of building professionals. The research questions are:

RQ1. What aspects of sustainability of a heritage building can be improved?

RQ2. What are the key opportunities and challenges of improving the condition and sustainability of a heritage building?

Background
Improving the energy efficiency of historic assets can contribute to their preservation for future generations, aligned with conservation and sustainability principles, and facilitate their continued use. However, energy and carbon savings in historic properties “are considered difficult to achieve due to limited retrofitting capability” (Forster et al., 2011, p. 654). Tensions exist between the preservation of historic properties and
thermal comfort. The literature describes balancing thermal comfort with building preservation as one of the greatest challenges for retrofitting heritage properties (Sunikka-Blank and Galvin, 2016). Changes to the building fabric must be carefully considered to avoid irreparably damaging the significance of heritage assets (Godwin, 2011). Therefore, improvements must be done on a case-by-case basis (Gonçalves de Almeida, 2014).

Current conservation philosophy and the statutory protection of built heritage are based on the principles developed by John Ruskin (1849) and William Morris (1877). Conservation policies have been strengthened further through the principles developed by global heritage bodies (Mansfield, 2008). Emphasis is placed on the importance of heritage conservation as an on-going process in a similar way to “the pursuit of sustainability” (McKercher and Du Cros, 2002, p. 54).

National and international conservation principles are based on minimal intervention, reversibility of measures, authenticity (Pendlebury et al., 2014) and compatibility (Webb, 2017). “Authenticity” is recognised as “not an easy concept” (Forster, 2010a, b, p. 94) and is described in tourism research as “complex” (Jamal and Hill, 2004). In building conservation, it can relate to the original fabric and the development of an asset over time (Forster, 2010a, b).

In relation to built cultural heritage, Wesener (2017) argues that authenticity can be grounded in one of two paradigms – the realist and the constructivist. The former perceives authenticity “in relation to inherent qualities or intrinsic values” of a place (Wesener, 2017, p. 142). The latter considers authenticity to be “socially constructed, mutable and time-bound” (Wesener, 2017, p. 142), complementing Forster’s (2010a, b) definition. The concept includes “personal authenticity”, extending to the local community and their “lived existence” with a place, and tourists and how they experience a place (Jamal and Hill, 2004, p. 359). Authenticity, therefore, must not only include the original fabric of a heritage asset, but also incorporate consideration of the asset’s evolution along its timeline, people’s interpretation and meaning of the structure, and consequently its close association people’s process of meaning making. Norrström (2013, p. 2624) argues that the preservation of different “time layers” “generates diversity and also means preserving memory, the intangible value giving meaning to a place”.

The concept of “value” for heritage assets was introduced by Morris (1877). Where an asset is considered to embody values, it is deemed to have “significance” and can be protected through legislation. For UK structures this can result in a listing of Grade I, II or II* being applied under the Planning (Listed Buildings and Conservation Areas) Act 1990. This protection aims to manage alterations, thus avoiding damage to an asset’s irreplaceable values. Therefore, the application of measures, including energy efficiency improvements, must be carefully considered (Crockford, 2014; Mazzarella, 2015) and be, as far as possible, reversible.

**Built cultural heritage, conservation and sustainability**

Existing research calls for a new definition of sustainable development to incorporate the role of cultural heritage (Pereira Roders and van Oers, 2011), recognising the role such properties have in reducing environmental impact and improving the comfort of users (Pigliautile et al., 2018). The concepts of heritage and sustainability are inextricably linked. Heritage “buildings are inherently sustainable” (Todorović et al., 2015, p. 131). Whilst the social and environmental dimensions of sustainability relating to such structures include reductions in waste and the preservation of the character of a place (Todorović et al., 2015), there are further aspects of sustainability embedded in built cultural heritage. “Inheritance” is a principal concept underlying built cultural heritage, its associated tourism and sustainability (Garrod and Fyall, 2000).

The social dimension of sustainability is presented by Tweed and Sutherland (2007) as having the greatest pertinence to built cultural heritage. The notion of inter-generational
equity (Bourdieu, 1984) not only resonates with the Brundtland definition of “sustainable development” (World Commission on Environment and Development, 1987) but also with conservation. Historic England (2008, p. 71) defines “conservation” as “The process of managing change to a significant place in its setting in ways that will best sustain its heritage values, while recognising opportunities to reveal or reinforce those values for present and future generations”.

The inter-generational factor appears in the literature to be the principal element of social sustainability underpinning the argument for sustainable improvements to built heritage tourist attractions. More than this, the social sustainability dimension of cultural built heritage contributes to “people’s sense of belonging” (Tweed and Sutherland, 2007, p. 63), identity (Gholitabar et al., 2018), and to authenticity.

The conservation of built cultural heritage includes maintaining the building fabric (Tweed and Sutherland, 2007). Therefore, this not only contributes to the environmental dimension of sustainability through the retention of embodied energy, but it also has an economic dimension by retaining or enhancing the value of a property. Although Tweed and Sutherland (2007) highlight that tourists can boost the local and national economy, the economic dimension of sustainability also has implications for heritage organisations with paying visitors by generating income to invest in the conservation of its assets.

**The National Trust**

Founded in 1885, The National Trust (“NT”) is a charity that works to preserve national natural and built heritage forever, for present and future generations (Cullen and Hooper, 2004). It forms part of The International National Trusts Organisation, a group of similar organisations aiming to represent international conservation and share best practice.

As an independent national organisation, NT has stewardship of 300 historic properties open to the public, over 300-holiday cottages and thousands of tenanted properties (NT, 2010). NT and other organisations such as Historic England recognise that the conservation of these assets should not be about “stopping the clock”, rather it should be about carefully managing change (Lithgow, 2011). In addition to this, NT has the objective of reducing its energy use (NT, 2016) to contribute to greater resilience across its portfolio (NT, 2010).

Similar to other heritage organisations, NT perceives “conservation” as “the careful management of change”, aiming to reveal and share the significance and special qualities of places (Cullen and Meier, 2016, p. 3). Not only is this to protect, enhance and contribute to the understanding about and enjoyment of such places by present and future generations but also to reveal and share the significance of such places (Lithgow, 2011). This aligns with the UK’s Revised National Planning Policy Framework (Ministry of Housing, Communities and Local Government, 2018a). The framework outlines the UK Government’s “planning policies for England and how these are expected to be applied” (Ministry of Housing, Communities and Local Government, 2018b).

Indeed, as highlighted by the internationally adopted 1964 Venice Charter, we have a duty to transfer such assets to future generations in “the full richness of their authenticity” (Cullen and Meier, 2016, p. 5). The preservation of built cultural heritage is action to “prevent deterioration and prolong the lifespan of a building of cultural value” (Munarim and Ghisi (2016, p. 244).

**Measuring performance**

Increasing knowledge of a heritage asset is important. It can result in discovering new evidence and changes to current understanding about a structure. Increasing knowledge and understanding about an asset’s values and evolution” can facilitate “informed management” of changes and sensitive conservation (ICOMOS, 1996, p. 49). It can lead to
“a reappraisal of existing interpretations” of what is deemed to be significant about a structure (Historic England, 2006, p. 9), inform strategic planning and heritage management, and support the identification of risks associated with future alterations. It can also assist in developing a strategy to support visitors’ “meaning-making”. Indeed, it is the meanings embedded in places that “reveal who we are, how we have changed, and into what we are changing”, helping us to understand ourselves (Newman, 2016, p. 399).

NT measures its performance of implementing conservation into practice through its conservation performance indicator (CPI) (NT, 2017). This includes increasing both the condition of and the knowledge about assets in the care of NT. The CPI provides measurable objectives against which to annually compare changes. Refurbishment projects not only enable condition improvements of such structures but also provide an opportunity to increase the knowledge and understanding we have about their historic and physical fabric.

### Methodology

The paper aims to identify the challenges and opportunities during the improvement of a heritage building at a tourist attraction from the perspective of the building professionals working directly on the project. Therefore, an interpretivist philosophical perspective was adopted for this research, enabling the identification of research participants’ perspectives and meanings. Interpretivism acknowledges that reality is socially constructed through individuals’ interpretations (Silverman, 2011) and shared meanings (Geels, 2010). Actors are “creative and continuously engaged in sense-making” (Geels, 2010, p. 499). Further, this approach enables the context in which the building is situated to be considered (Bullen and Love, 2011).

### Data collection

The research comprised of qualitative data, complementary to the interpretivist approach. A case study approach was adopted to investigate the phenomenon “within its real-world context” (Yin, 2013, p. 16). As one of the largest charity organisations in the UK with over 5 million members, focusing on the conservation and preservation of national heritage, the NT was selected for this research (NT, 2019). There were three primary reasons for selecting Hidcote Manor Garden’s chapel as a case study:

- the extent of the refurbishment works to a Grade II listed building;
- the existing poor condition and known historic complexity of the building; and
- the large number of visitors to the estate.

The research was collected through a combination of semi-structured interviews and informal conversations, documentary analysis and observations. Interviews and informal conversations were conducted with members of the project team on-site or at the interviewees’ office. Interviewees (Table I) were selected based on their level of involvement with the project – all interviewees needed to have directly worked in excess of ten working days on the project.

<table>
<thead>
<tr>
<th>Interviewee Code Role and key decisions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building curator Cu Guided decisions on conservation-related aspects during the latter phases of the project</td>
</tr>
<tr>
<td>Main contractor C1 Undertook both main refurbishment works (Phase 2), and previous phase of repairs (Phase 1)</td>
</tr>
<tr>
<td>Senior surveyor SS Occasional inspection and overview of the project and support to the lead surveyor</td>
</tr>
<tr>
<td>Business support B Provided support to the project team and an overview of the project, with guidance from the senior surveyor undertook project management in the absence of a surveyor during the project</td>
</tr>
</tbody>
</table>

Table I: Interviewees and project role
days on the project in a professional capacity and to have been involved with key decisions regarding the project.

Interviews were facilitated using a topic guide (Bryman, 2008), exploring the decisions and challenges faced during the project. Topics within this guide are outlined in Table II. Using an inductive approach, thematic analysis of the qualitative data was then undertaken to identify key themes (Bryman, 2008) and rival explanations sought to improve the validity of the findings (Yin, 2013). Additional strategies employed to increase the validity included having long-term involvement with the project and using different sources of information such as documentation where possible (Yin, 2015).

The documents used as part of this research were diverse, including schedules of works, photographs and digital scans, work tenders, product descriptions and guarantees and archaeological reports.

Case study: Hidcote manor gardens
Situated in the Cotswolds in England, within an Area of Outstanding Natural Beauty (Cotswolds Conservation Board, n.d.), Hidcote Manor Gardens (“Hidcote”) is an Arts and Crafts-inspired garden created by Lawrence Waterbury Johnston (1871–1958), an American who assumed British citizenship in 1900 (Brown, 2004). Whilst the garden is of international significance, there are multiple structures across this site that have a Grade I or II listed designation (Historic England, n.d.).

Johnston served in the Imperial Yeomanry, beginning his military career as a private, eventually becoming a major, serving in both the Second Boer War and the First World War. During the First World War he was severely wounded and left for dead (Brown, 2004).

Hidcote was bought by Johnston on behalf of his mother, Gertrude Winthrop in 1907. He created two substantial gardens: Hidcote and later the Serre de la Madone at Menton on the French Riviera. Hidcote is now considered to be one of the most influential gardens of the twentieth century (Brown, 2004; Elliot, 2000). Despite this claim, no peer-reviewed research was identified on Johnston’s Hidcote during this study.

Johnston created sheltered garden “rooms” and wide vistas (Brown, 2004), each “room” presenting “its own style of ornament or planting” (Elliot, 2000, p. 25). Johnston was involved with plant hunting expeditions, (Pearson and Pavord, 2007; Brown, 2004; Desmond, 1994). NT acquired Hidcote in 1948 (Elliot, 2000), the first asset to be obtained based on the importance of its garden alone. The site now receives around 175,000 national and international visitors annually (NT, n.d.).

Findings and discussion
A successful project should “transform the building into an asset for the wider property” (Interviewee SS), but also sustain and enhance the significance of the property

<table>
<thead>
<tr>
<th>Topic</th>
<th>Interview sub-topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Background and history</td>
<td>Background of the building and wider site, including historical meaning and usage.</td>
</tr>
<tr>
<td></td>
<td>Project information</td>
</tr>
<tr>
<td></td>
<td>Role within the project team</td>
</tr>
<tr>
<td>Project team</td>
<td>The key team members in making decisions</td>
</tr>
<tr>
<td>Physical properties of the building and the project works</td>
<td>Physical properties and condition of the building</td>
</tr>
<tr>
<td></td>
<td>Works performed to components of the building including the windows, walls, roof, floor, door</td>
</tr>
<tr>
<td></td>
<td>Factors influencing the adoption of the selected measures and approaches</td>
</tr>
<tr>
<td>Challenges</td>
<td>Identification of challenges pertaining to the project</td>
</tr>
</tbody>
</table>

Table II.
Outline of interview topics
For this to translate in practice, a clear brief, objectives (Interviewee SS) and specification (Interviewee CI) are necessary to ensure the team can work towards common goals.

Every heritage project is “unique and bespoke” (Interviewee SS) and when managing heritage building improvements there is always an element of the unexpected (Interviewee B). Whilst there will be differences between projects (Interviewee SS), the process and principles adopted, and the lessons learnt from the challenges faced can be applied more broadly.

Knowledge and understanding – the site

Prior to the Dissolution of the Monasteries in the sixteenth century, the site was owned by the priory of Bradenstoke (Interviewee Cu). The original manor house was constructed as a farmhouse in the seventeenth century, passing into the Freeman family of Batsford, Gloucestershire by the end of the eighteenth century, before passing to John Tucker who put the property up for auction (Interviewee Cu). Once Winthrop had purchased the property in 1907, she and Johnston made numerous changes, including “re-siting the main entrance to the north, within a large courtyard” and extending the existing house (Interviewee Cu).

Un-consecrated chapel

Hidcote includes a Grade II listed un-consecrated chapel. The objective of the chapel refurbishment was to provide “a more flexible part of the property’s indoor space, including improving the heating, lighting, insulation, minor structural repairs and interior decoration” (Interviewee B). A further project objective was to improve the building condition, create a usable, sustainable exhibition and events space and to increase the knowledge about the building.

The listing by Historic England (n.d.) describes the original building as the eighteenth-century barn. The sale particulars at the time of Winthrop’s purchase in 1907 list a “nag stable for 4 horses with a good room over and saddle room adjoining” (Interviewee Cu). One possibility is that the chapel is the stable identified in the sales particulars, although this is not certain (Interviewee Cu). It is possible that building improvements were undertaken following the return of Lawrence Johnston from the First World War in 1919 for his warhorses although there is currently no empirical evidence to support this (Interviewee Cu). Based on photographic evidence the building is thought to have been converted into a chapel after 1930, the conversion completed by 1939 (Interviewee Cu; Cotswold Archaeology, 2017). Further, research has been undertaken by the archivists, Building Curator and archaeologist, identifying three main phases of the chapel between 1907 and 1939 (Table III).

Existing condition and sustainability improvements

The chapel is constructed of porous materials. It has solid brick walls. Stone is used externally on three elevations: there is ashlar to the northeast, squared Cotswold stone to the northwest (Plate 1) and the southeast elevation is finished in brick with stone quoins. The arch brace truss roof is covered with stone slates.

The existing roof trusses and windows are thought to have been salvaged from ecclesiastical buildings and installed as part of the 1930s conversion (Interviewee Cu). The building incorporates three windows of diamond leaded lights installed by Johnston during the 1930s conversion. The door to the chapel is an unpainted studded door with

<table>
<thead>
<tr>
<th>Phase</th>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1907</td>
<td>Four box stable with room over and adjoining room</td>
</tr>
<tr>
<td>2</td>
<td>By 1930</td>
<td>Two box stable with blue brick floor</td>
</tr>
<tr>
<td>3</td>
<td>By 1939</td>
<td>Chapel</td>
</tr>
</tbody>
</table>

Table III. Main phases of the chapel since 1907.
decorative strap hinges, converted from a plank door which is visible on the rear side of
the door (Plates 2 and 3). The retention of this door contributed to realist and constructivist
definitions of authenticity, as well as providing an opportunity terms “narrative encounters
and interactions” (Jamal and Hill, 2004).

Condition
In recent years the chapel had limited usability due to cold and damp (Interviewee SS) and
therefore was being utilised as storage space (Interviewees SS, B and C1). It was
experiencing significant damp penetration from its southeast brick elevation. The original
condition was summarised by Interviewee B:

The building was cold and damp, even in the summer, and whilst not unusable, it would have been
difficult to expand the uses of the building or improve its internal condition without improving the
pointing, roofing and heating.

The project extended beyond simply repairing the building – it was also about improving
the “thermal performance for its potential increased use, and in doing so [we] learnt more
about the history of the building” (Interviewee SS). This contributed to the objective of
increasing the knowledge about and condition of the building.

The building was exposed to wind-driven rain and condensation. The poor condition of
the bricks was thought to have been exacerbated by “puddles from the old adjacent lane
being splashed up the face of the wall over a number of years” and “rising damp from
the soil contact of the grass verge” (Interviewee C1). As the moisture within the pores of
the masonry increases, in colder weather this can increase the likelihood of freeze-thaw
action. At the chapel it was not possible to reduce wind-driven rain or change the
brickwork on the southeast elevation for a less porous alternative due to conservation
principles. However, work could be undertaken to reduce the level of condensation to
avoid the condition of the chapel diminishing at an accelerated rate.
The chapel previously included an optional plug-in heating device (Interviewee SS) but had no permanent heating. The mains gas network does not currently extend to the estate and therefore heating is provided by oil and electricity. The decision to install underfloor heating following the raising of the brick floor was to provide adequate thermal comfort without detracting from the chapel’s aesthetics and authenticity.

Whilst Silva and Henriques (2014) suggest that a tension exists between building users’ thermal comfort needs and conservation requirements, the building professionals interviewed did not identify this as an issue at the chapel. Instead, it was recognised that there was a tension between user needs and environmental sustainability – the increased use of the building will result in increased heating and lighting and therefore increasing the carbon and environmental footprint of the building and wider estate (environmental sustainability). However, by improving the building condition and increasing the use of the chapel, the intention was to improve building sustainability holistically. The aim was to mitigate future repair costs (economic sustainability), and preserve a historic asset for future generations whilst contributing to visitors’ meaning making (social sustainability).

**Improvement project**
The project comprised of two phases, with Phase 1 enabling Phase 2.
Phase 1
As a consequence of extensive moisture ingress and frost attack, Phase 1 in 2016 saw the replacement of 350 bricks in the southwest elevation. These replacements were sourced from a reclamation centre to match the existing bricks by a specialist contractor (Interviewee C1) (Plate 4). A 3.5 natural hydraulic lime mortar was used as this was considered to be best suited to “the weather conditions” rather than putty lime (Interviewee C1). During Phase 1 some of the stone slates were replaced to ensure the roof remained watertight (Interviewees B, C1 and SS). Flaunching was replaced and lime mortar pointing was completed on the north elevation (Interviewee C1). During this phase, improvement works were also required to the adjoining boiler house.

Phase 2
External insulation on the chapel was not considered an appropriate solution due to the aesthetic qualities of the external fabric. Although internal insulation was installed, it is recognised that this has the potential to isolate the external walls from the internal heat source. This would enable the moisture content of the bricks to remain higher following wet weather for longer periods, and increase the risk of frost attack.
(King and Weeks, 2016; Zagorskas et al., 2014). Further, internal insulation could result in building behavioural changes in relation to moisture and heat (Zagorskas et al., 2014). The condition of the walls will, therefore, be monitored as part of an on-going process.

**Specification of improvements**

The original specification was developed for interventions to be reversible, breathable and compatible with the existing fabric whilst causing the least loss of the existing fabric. This is in line with conservation principles, also reducing the loss potential of embodied energy and contributing to environmental sustainability. Table IV provides the key materials provided in this original specification.

Breathability was increased by removing materials such as concrete. Original finishes were selected with the intention of reflecting Johnston’s chapel concept, which was considered to take precedence over the older agricultural building. Whilst this took precedence, the existing fabric would be retained, thus avoiding the “physical erosion” of the building through visual interferences resulting in “the essential character of the building becomes thoroughly obscured” (Royal Institution of Chartered Surveyors, 2009, p. 5).

Amendments to the original specification were required with changes primarily including A1, B6 and B7 (Table IV). With regards to A1, only the southeast wall required a new initial plaster coat beneath the cork insulation. This was due to this wall suffering from the greatest...
levels of damp penetration (Interviewee C1) and consequently the existing plaster was in an inadequate condition to retain. For B7, the cork insulation to the walls was extended to 300 mm below the floor level rather than the 40 mm specified in the original specification to ensure an adequate overlap was maintained due to the deeper archaeological excavations.

### Improvements, challenges and opportunities

Clear objectives and an overarching vision are essential for the delivery of a successful project. This can be provided by a strong leader, capable of drawing together the project team, property staff, and interest groups (Interviewee B). Professionals within the interdisciplinary team should have “appropriate skills and respect for everyone else’s skills” (Interviewee SS). This supports the findings of Rehman Toor and Ogynlana (2009) and Chua et al. (1999), who highlight the importance of project team competence, and Dvornik Perhavc et al. (2015) who highlight the importance of an interdisciplinary approach.

A “healthy working relationship between the property manager and building surveyor so that any issues that arise do not linger and cause later issues in the project” is essential (Interviewee C1). This working relationship extended to the wider team, supporting Rehman Toor and Ogynlana (2009). The contractor was able to approach both the Building Surveyor and the Senior Surveyor for guidance on unfamiliar materials. Whilst this supported the existing literature finding that good working relationships are crucial (Chua et al., 1999), it contests the importance of experience (Rehman Toor and Ogynlana, 2009). Where necessary, surveyors drew on expertise external to the project team by approaching product manufacturers for clarification. This highlights the importance of drawing on the knowledge of experts outside the project team to attain the project objectives.

<table>
<thead>
<tr>
<th>Element</th>
<th>Original specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Walls</td>
<td>Ty Mawr internal insulation system to achieve a minimum of 0.3 W/m²K consisting of</td>
</tr>
<tr>
<td></td>
<td>(1) lime plaster to even the internal surface</td>
</tr>
<tr>
<td></td>
<td>(2) 10 mm adhesive mortar – a combination of natural hydraulic lime and cork aggregates (Ty-Mawr, n.d.)</td>
</tr>
<tr>
<td></td>
<td>(3) 40 mm cork insulation applied to the walls fixed with insulated fixings</td>
</tr>
<tr>
<td></td>
<td>(4) Lime plaster – 6 mm basecoat of putty lime with hemp, mesh and a 3-4 mm putty lime with silver sand topcoat and</td>
</tr>
<tr>
<td></td>
<td>(5) Decoration with clay paint</td>
</tr>
<tr>
<td>B. Floor</td>
<td>Ty Mawr insulating lime floor with underfloor heating system was specified, including</td>
</tr>
<tr>
<td></td>
<td>(1) Geotextile layer 1</td>
</tr>
<tr>
<td></td>
<td>(2) Insulating recycled foam glass hardcore to a minimum depth of 120 mm, compacted to a ratio of 1.3:1</td>
</tr>
<tr>
<td></td>
<td>(3) Geotextile layer 2 and geogrid</td>
</tr>
<tr>
<td></td>
<td>(4) Clip rails and underfloor heating system</td>
</tr>
<tr>
<td></td>
<td>(5) 60 mm hydraulic lime screed</td>
</tr>
<tr>
<td></td>
<td>(6) A glazed tile finish based on internal curatorial and local authority conservation officer approval</td>
</tr>
<tr>
<td></td>
<td>(7) A 40 mm cork downstand on the wall to lap the insulating hardcore was also specified as recommended by Ty Mawr</td>
</tr>
<tr>
<td>C. Roof</td>
<td>(1) 50 mm thick rigid thermostet phenolic insulation was used between rafters below a 25-50 mm air gap to maintain adequate ventilation, using timber battens. The insulation boards were taped, including at the perimeter with an aluminium foil tape</td>
</tr>
<tr>
<td></td>
<td>(2) Rigid thermostet phenolic insulating plasterboard was specified to finish the ceiling, fitted tight to the wall and rafters, and taped and jointed. A multi-finish plaster skim was provided</td>
</tr>
<tr>
<td>D. Windows</td>
<td>The specification required the window reveals to be insulated with 20 mm cork as specified for the main walls</td>
</tr>
</tbody>
</table>
During the works there was a change in the surveyor overseeing the project. This resulted in a period with no surveyor or project manager assigned to the works. Despite thorough project notes from the previous surveyor to guide project team decisions (Interviewee B), project progress slowed following unexpected discoveries requiring technical knowledge to better inform decisions. Once appointed, the new surveyor needed to closely liaise with the client, contractor, building curator and wider consultancy team to understand the project history and the previous decisions made. Towards the end of Phase 2 there was a change in building curator, which resulted in the need to work as a team to provide this member with a complete history of the project. Although the project timescale was impacted, the chapel refurbishment works were delivered against the project objectives. Previous research suggests that project success can be influenced by project team turnover, but Chua et al. (1999, p. 149) highlight that importance of team turnover is “outweighed by the capability of key personnel”.

**Boiler house**
To provide heat to the underfloor heating system a 4 kW electric boiler was installed in the adjoining building known as the “boiler house”. During Phase 1, the boiler house roof was found to be enabling water ingress. This had resulted from historic works to the boiler house roof leading to the decay of the wall plate and battens, subsequent tile slippage and water ingress. The outward thrust of the rafters had resulted in the walls becoming pushed out of vertical alignment. The wall plate, battens and, where necessary, slates were replaced prior to the installation of the new electric boiler.

**The floor and archaeology**
Unexpected findings were uncovered during the excavation of the floor, halting works to the floor. An archaeological watching brief was performed which highlighted:

“[…] a history which was previously unknown revealing at least a number of development stages […] prior to conversion into a chapel. There is some evidence for even earlier use” of the building.
(Interviewee Cu)

This discovery, in addition to further research by the Building Curator and volunteer archivists, has meant that the “understanding of the building will continue to evolve as further research is undertaken”, “helping to shed light on the history of the courtyard development during Lawrence Johnston’s time” at Hidcote (Interviewee Cu). Therefore, whilst the findings resulted in delays, and required amendments to the original specification, it also presented an opportunity to expand knowledge and understanding about the building.

The initial 190 mm concrete slab was lifted to reveal a “black concrete” layer up to 40 mm thick (Cotswold Archaeology, 2017) over Staffordshire blue bricks (Plate 5). This surface was undulating, sloping to an open gulley at the front of the internal area, and then sloping downwards to the bottom left-hand corner. The floor incorporated a number of vertically protruding timbers (Plate 6). Due to their size, the timber posts were identified as likely to have previously been structural and likely to have formed the front of horse boxes (Cotswold Archaeology, 2017) within stables. This provided the opportunity to develop an understanding of the evolution of the building.

Through discussion with the local authority conservation officer it was agreed to lift and relay bricks flat instead of the original intention to use a tiled finish. This was to showcase the bricks and indicate the history of the chapel and present this brick floor as an opportunity for time-bound (Wesener, 2017) narrative encounters (Jamal and Hill, 2004). A full digital scan of the floor’s original brickwork was undertaken by the archaeologist to provide an exact archaeological record and a guide for relaying the floor.
Upon lifting the brick flooring, the mortar transpired to be cement-based rather than lime-based as anticipated. The strength of the mortar resulted in a number of the bricks breaking when lifted, and it was not possible to successfully remove this mortar from any bricks lifted intact.

Due to the difficulty in retaining the existing bricks, the contractor sourced bricks matching the period and type of the original Staffordshire blue bricks from local reclamation centres. Using a digital scan of the original floor produced by the archaeologist prior to lifting the original bricks, the contractor was able to lay the reclaimed brick floor to follow the same pattern. With agreement from the conservation officer, the new floor was laid flat rather than reinstating undulations. The primary reason for this was three-fold:

1. To avoid a highly uneven surface which could result in trip hazards for visitors, giving consideration to the legal case Taylor v English Heritage [2016] EWCA Civ 448 (BAILI, 2016).

2. Conform to conservation principles by avoiding falsification and promoting honesty of the works, whilst integrating with the building as a whole, and without detracting from Johnston’s original concept. It also aimed to reveal the aesthetic and historic value of the floor and wider building under Article 9 (ICOMOS, 1965).

3. To provide a space suitable and sufficiently flexible for events which may require tables, chairs or freestanding stands.
The extent of the excavation works meant that 5 tonnes of hardcore was needed to raise the ground level (Interviewee C1) before the Ty Mawr insulating lime floor could be laid. This insulating lime floor was an unfamiliar product to both the surveyors and contractors. The insulating lime floor consisted of 7 tonnes of insulating hardcore (Interviewee C1) – recycled foam glass, was unusual in that, unlike traditional hardcore, individual pieces had a diameter of between 20 and 40 mm (Interviewee C1) (Plate 7). To reach the manufacturer’s designated compaction ratio of 1.3:1 the contractor spent two hours with a vibrating-plate compactor across the floor. However, there was concern that the insulating hardcore had slight movement when the project team walked across the surface. Where hardcore is insufficiently compacted, it will settle over time (Holland, 2012) and can result in cracking occurring in the screed (Pye and Harrison, 2003). On liaising with the manufacturer’s technical team, a technical video with the wider project team, and the insulating hardcore was compacted for a further two hours with the geotextile placed between the hardcore and vibrating-plate compactor. This sufficiently stabilised the hardcore in preparation for the underfloor heating pipes in clips to be laid. The video also highlighted that the lime screed (Plate 8) specified was thicker than traditional screeds. This additional time required in inspecting the insulating hardcore and liaising with the contractor and manufacturer is the risk identified.
Plate 7.
Chapel floor insulating hardcore

Plate 8.
Chapel floor lime screed
by Pulaski *et al.* (2006) that unfamiliar products can lead to inefficiencies in the construction process.

Concern was expressed by the heating engineer about the insulating lime floor build up. This related to the length of time the internal environment would take to heat due to the floor build up. The heating engineer suggested alterations to the floor design to reflect the heat back into the room for a quicker thermal response. The decision was made by the surveyor not to amend the original floor design for three primary reasons:

1. The intention was to increase the thermal mass in the building to facilitate a slower thermal response. This would enable heating to be run at lower temperatures over long periods of time with the aim of contributing to the long-term health of the building.

2. To avoid the building suffering from large changes in temperature which could impact on the condition of the building and avoid “peaks and troughs” in energy use.

3. To avoid voiding the floor manufacturer guarantee.

The underfloor heating pipes included no joints within the floor. This was to avoid potential leaks beneath the brickwork as the likely place for a leak is proposed to be at a connection between pipes (Bleicher and Vatal, 2016). Instead, these pipes only included joints once they had penetrated the wall into the boiler house. If a leak were to occur, due to the way the heating pipework joints have been installed it is likely that this will be more easily accessible.

The building is not rectangular and this became a challenge when laying the reclaimed Staffordshire blue brick floor. With one end of the chapel 20 mm shorter than the other, there were tapered bricks included in the original floor, likely to have been obscured by the horse stable partitions. Although the floor was relaid in accordance with the archaeological digital scan, one amendment was made to the original pattern to avoid detracting from the aesthetic – the tapered bricks were placed at the edge of the wall perpendicular to the door. A “neat 3.5 hydraulic lime grouting” was used between the brick joints to facilitate slight flexibility, breathability and heat transfer from the underfloor heating (Interviewee C1).

Timber inserts were positioned above the original timber posts which were found during floor excavation (Plate 9). These timber inserts reflect the history of the building with its changing uses, providing visitors with opportunities for narrative encounters and “place-making”, through the representation of a timeframe (Newman, 2016) both spatially and temporally (Jamal and Hill, 2004). This representation of time and space as part of the narrative is important. It is an attempt to avoid a reductionist approach by prioritising space over time, which thus represents a place with a series of discontinuous events, provide visitors with objective, constructive and personal authenticity (Jamal and Hill, 2004), and enable the creation of a functional, adaptable space. It was considered particularly important to feature the brick floor with timber inserts to represent the changes the chapel underwent under Johnston.

**Walls**

To avoid significant time delays, when the initial works to the floor halted due to archaeological findings, works to the roof and walls continued. A number of through-timbers (Plate 10) and changes in brickwork type – indicating historic changes to the building height, were discovered. Changes to the building height are thought to have occurred during the conversion into a chapel (Cotswold Archaeology, 2017). The through-timbers were identified as most likely used to attach boarding to the walls (Cotswold Archaeology, 2017) to protect Johnston’s horses against injury.

During an inspection following the installation of the insulating lime floor, horizontal cracking was identified through the bed joints in the wall at low level. Located in the southeast elevation which previously had repointing and 350 bricks replaced, the cause of the crack was likely to be from two probable causes: the settlement of the ground beneath
the wall or the settlement of the lime mortar. Both possibilities were a result of the length of
time a vibrating-plate compactor had been used to compact the insulating hardcore. The
decision was made to repoint and monitor the cracking to identify whether these reopened.
The reopening did not occur after 12 months although monitoring will continue.

Door and windows
The chapel door (Plates 2 and 3) presents a narrative, outwardly appearing to be a chapel
door, and inwardly presenting an agricultural appearance. This door required a new locking
mechanism, having previously been padlocked from the outside. A carpenter specialising in
heritage work was consulted and developed a solution to be sensitive to the aesthetics of the
chapel, enabling the building to be suitably secured without the loss of the original door or
wall fabric, and without negatively impacting visually on the door.

When the door swung inwards it pressed into the new lime plaster. Consequently, the
main contractor tapered the lime plaster to avoid constant damage from occurring.
The alternative would have been to alter the original door and opening which was decided
to be inappropriate from a conservation perspective, as this contributed to the overall
narrative of the building.
The option of installing secondary glazing behind the existing windows was discussed. The
decision was that secondary glazing would detract from the overall aesthetics, and
potentially lead to increased condensation and the accumulation of insects between the window and secondary glazing. Due to the smaller surface area of the window relative to the surface area of the walls, improving the thermal performance of the walls was deemed to be a priority over the windows (Interviewee C1). Instead, the windows and the surrounding stonework were cleaned (Plate 11), including lightly brushing the stone (Interviewee SS).

**Roof**

In addition to ensuring the roof was watertight, roofing works included the replacement of tiles where necessary. However, many of the existing stone slates to the chapel were retained. Internally, 50 mm rigid insulation was installed between the rafters with a 25 mm continuous air gap between the insulation and tiles (Interviewee C1). The purpose of this was to ensure adequate ventilation to remove accumulated moisture, and reducing the likelihood of timber decay. The incorporation of a 25 mm air gap follows guidance from Stirling (2002) and Historic England (2016). The insulation was fitted tightly against the rafters to avoid gaps from forming which could result in cold bridging, and local formation of condensation and black spot mould (Historic England, 2016). The underside of the insulation was finished with plasterboard and a plaster skim, leaving the roof trusses exposed thereby retaining the appearance of a chapel roof. The roof trusses were cleaned
down by hand with water and a soft cloth and oiled following guidance from the building curator (Interviewee SS).

**Sustainability**

The project demonstrated the importance of flexibility and compromise to attain a holistic sense of sustainability. The original building was unheated and therefore the introduction of a heating system increased the carbon footprint and energy bills of the building and wider estate, negatively affecting the dimensions of environmental and economic sustainability. However, the heating is intended to better sustain the condition of the building thus retaining much of the embodied energy of the existing fabric in the long term, contributing to environmental sustainability. Further, the building was well insulated to reduce the demand for heating, limiting the negative impact on environmental and economic sustainability.

The building has become more functional and flexible, contributing to social and economic sustainability. Utilising traditional materials and skills also contributed to social sustainability. Facilitated by this improvement project, increasing the understanding and knowledge of the building and wider site has provided the project team, organisation and estate visitors with opportunities for further meaning making, enhancing heritage values for present and future generations, further contributing to social sustainability.
The discovery of alterations and additions made by Johnston including the use of “hard plaster and concrete” guided decisions made within the improvement project. Harder materials such as concrete and cement were deemed to be detrimental to the building’s condition aiding the retention of moisture. Decisions were therefore based on improving the longevity and health of the overall building, in line with conservation principles of reversibility and breathability, thus increasing the physical sustainability of the building. It is intended that this will subsequently contribute to the reduction in long-term maintenance costs and therefore to economic sustainability. Economic sustainability, for heritage and charitable organisations, as with other organisations, is a key consideration. Further, by also ensuring heritage assets are provided in a good and as complete a condition as possible for present and future generations, this contributes to one aspect of social sustainability.

**Project team and communication**

Effective communication, collaboration and good working relationships within an interdisciplinary team are crucial for the successful delivery of an improvement project of a cultural heritage asset at a tourist attraction. The importance of adequate communication for project success has also been identified on large-scale construction projects (Rehman Toor and Ogynlana, 2009). This is particularly important when less familiar measures are being installed.

Clear communication is critically important when team members leave the project prior to completion. Project notes can, however, guide the project team and enable new team members to gain a good knowledge of the project history to provide appropriate professional advice. Further, there is a need to go beyond collaboration to foster understanding and the respect of the different perspectives and priorities within that team, facilitating the selection of the most appropriate solution where changes are required.

**Existing condition**

Improving building condition was essential in addition to increasing sustainability. Improving the condition was a key objective of the project and needed to be completed in two phases. The first phase enabled the second phase.

Conservation principles favour the retention of as much of the original fabric as practical. This has a sustainability dimension by retaining as much of the embodied energy within the materials of the existing building, thus limiting the need for new materials, which has an environmental dimension. The challenge was to make the roof watertight by performing repairs to specific tiles rather than wholesale replacement of the roof covering. This highlights the importance of employing suitably skilled contractors with an understanding of conservation principles to form part of the project team, but who are also willing to potentially engage with unfamiliar materials.

**Unintended consequences**

As part of the works, there were two unintended consequences identified. The first related to compaction of the insulating hardcore, resulting in the formation of horizontal cracking in the bed joints of the wall. The cracks were repointed and following 12 months of monitoring, no cracks have reformed.

The second unintended consequence was that, whilst a flexible space has been created, sound reverberation appears to be an issue. Mitigation measures that are visually obvious will detract from the visual aesthetic that the project has achieved and are therefore not appropriate. However, future intervention will include investigations into how this reverberation can be attenuated without impacting on the internal aesthetic of the building.

On-going monitoring is taking place at the chapel to understand its performance following the works. The project appears to have achieved the requirements of the brief – to create a usable, comfortable space whilst improving the condition of the building.
Conclusion
The paper has sought to investigate the opportunities and challenges of improving the sustainability of a listed building at a cultural heritage tourist attraction from the perspective of building professionals. The chapel improvement project aimed to convert a building being used for storage into a flexible, usable space. This incorporated improving the condition of the building and improving the overall sustainability. Enhancing and revealing the significance of heritage is a key aim of policy and modern conservation philosophy. However, in the context of climate change heritage assets must also adapt to ensure their continued sustainability.

Whilst each heritage asset is unique, the findings of the present research can be applied to other sites to identify whether they apply to other built cultural heritage tourist sites. By investigating the renovation of the chapel at NT’s Hidcote Manor Gardens, four primary opportunities and five challenges have been identified when improving the sustainability of a heritage asset. Opportunities were increased knowledge and understanding about the heritage asset; enhancement of values for present and future generations; improved condition, increased usability; and increased sustainability. The challenges of improving the sustainability of a heritage asset included project team turnover; delays resulting from archaeological findings and subsequent amendment of the specification; previous work resulting in building defects; the existing building condition; and unfamiliarity and the uncertainty of the team regarding particular measures.

To successfully overcome the challenges presented during such projects, there is a need for a strong, balanced team with respect for each team member’s skills. There is a need for strong leadership and common objectives for the team to work towards. Of greater importance than experience, the team must be capable of communicating clearly to ensure that, where challenges arise, these can be effectively and expeditiously resolved. This complements findings of previous research on project management of non-heritage projects.

The opportunities for performing an improvement project on buildings with heritage values and significance include increasing the knowledge and understanding of the building in the context of the wider site. This can enhance or shift the meaning, significance or the values represented by the asset. At a tourist site this provides an opportunity to enhance visitors’ narrative encounters with the property.

Successful projects should enhance and reveal the embodied values and significance of built cultural assets for present and future generations. This inter-generational concept provides a common thread between conservation principles and sustainability. In the context of the wider debate focused on reorientating the definition of sustainable development, this shared concept should not be overlooked. Enhancing values at heritage tourism sites should facilitate greater meaningful encounters between visitors and the cultural asset.

The project improved the condition of the listed building, facilitating its usefulness as a flexible space for events and exhibitions, whilst improving its sustainability. Works were performed in two phases, using breathable materials that are compatible with the building in line with conservation principles. This included increasing the watertightness of the chapel and adjacent boiler house, reducing dampness in the buildings before improvements to the sustainability of the building could be undertaken.

Sustainability in historic buildings at tourist sites requires careful balance in relation to economic, environmental and social sustainability, but also with conservation principles. Heritage buildings have inherent sustainability through their embodied energy (environmental sustainability) and their embodied meanings and values (social sustainability). Sustainability and conservation were considered to be complementary, both broadly considering the use of resources from an inter-generational perspective. However, tensions between these concepts also exist. Sustainability must not result in the loss of significance in the building and therefore improving the sustainability of the building was approached holistically. Further conservation
compromises regarding heritage features may be needed if a usable space is to be created. In this sense, the original undulating floor was laid flat to ensure the space was not only flexible and usable but also that visitors’ well-being was maintained.

The sustainability of built cultural heritage can be improved through different dimensions of sustainability. From an environmental sustainability perspective, retaining much of the original fabric, and the use of some materials from reclamation centres mitigates the potential impact of the works and building in relation to its environmental footprint and embodied energy. However, by installing and running an electric heating system in the chapel and increasing the use of the space, the energy consumed within the building has a negative impact on environmental sustainability. Through the introduction of heating, the expectation is that the condition of the building will diminish less rapidly. This has positive implications for environmental sustainability in the avoidance of losing building fabric where it becomes defective and economic sustainability in avoiding potentially more costly and invasive repairs in the future.

There are also challenges relating to sustainability. The negative implication in relation to economic sustainability in installing heating is that the running costs of the space have increased. However, the space can now be used for events and exhibitions. This supports planning policy in the aim to find a compatible and useful function of historic buildings and also provides the opportunity to generate revenue to invest back into the building and wider site.

Increased running costs resulting from energy consumption have been mitigated through the improvement in energy efficiency within the building. This has environmental and economic sustainability implications, but also implications for social sustainability. The creation of a usable, flexible space that is thermally comfortable is considered here as a branch of social sustainability. However, social sustainability also extends to increased meaning-making opportunities for visitors to the chapel.

The loss of team members during the project presented a key challenge. However, through clear communication, a competent, interdisciplinary team and strong leader with clear objectives the effects of project team turnover can be alleviated.

Although archaeological discoveries resulted in delays to the project timetable, these discoveries during the project resulted in identifying a historically significant period in the evolution of the site during the early twentieth century. It has also further catalysed archival research to develop this knowledge further. The significance of the findings particularly relates to the use of the building as a horse stable prior to its conversion into an unconsecrated chapel, marking a significant change during the life of Johnston.

Previous works and the existing building condition can result in the need to undertake additional or enabling works to ensure the building is weather tight. This can, however, increase uncertainty about the extent of the improvement works required.

Where the project team is unfamiliar with particular products or measures, this can increase the time the project team spends on ensuring the correct installation. This supports previous research which has found unfamiliarity with products increases time inefficiencies. However, it also emphasises the importance of clear communication and good working relationships, supporting the findings of previous research on factors influencing the success of construction projects. This is particularly pertinent for improving the sustainability of built cultural heritage where there is likely to be a higher level of uncertainty and some unfamiliar products. This can also result in the potential for unintended consequences.

The present research has implications for policy relating to sustainability in building conservation and building professionals working with built cultural heritage at tourist attractions. It highlights the potential challenges and opportunities facing professionals and the importance of a strong leader and project team to ensure the success of the project.
The project findings are limited to the case study presented, however this provides analytical generalisability. Further research opportunities include the applicability of these findings to other built cultural heritage tourist attractions, and whether such projects enhance the meaningful encounters tourists have with the building and wider site.

References


Further reading


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Balancing preservation and energy efficiency in building stocks

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Abstract

Purpose – Energy use in buildings needs to be reduced to meet political goals; however, reducing energy use can conflict with heritage preservation objectives. The purpose of this paper is to demonstrate a method that combines quantitative and qualitative analyses of the potential of energy savings in an historic building stock. Specifically, this study examines how requirements of historic building preservation affect the energy saving potential on a building stock level.

Design/methodology/approach – Using the World Heritage Town of Visby, Sweden as a case study, this paper illustrates a step-by-step method as a basis for implementing energy savings techniques in an historic building stock. The method contains the following steps: categorisation of a building stock, definition of restriction levels for energy renovation scenarios and life cycle costs optimisation of energy measures in archetype buildings representing the building stock. Finally, this study analyses how different energy renovation strategies will impact heritage values and energy saving potentials for different categories of buildings.

Findings – The outcome of the study is twofold: first, the method has been tested and proven useful and second, the results from the application of the method have been used to formulate differentiated energy renovation strategies for the case study.

Originality/value – The study shows that it is possible to integrate techno-economic analysis with assessment of heritage values in a given building stock in order to facilitate a strategic discussion balancing policies and targets for energy savings with policies for the preservation of heritage values. The findings will contribute to sounder policy development and planning for historic building stocks.

Keywords Energy efficiency, Archetype building, Building stock, Character-defining elements, Differentiated energy renovation strategies, Heritage significance

1. Introduction

1.1 Background

In Europe, a renovation revolution is fast approaching due to the energy transition of the building stock (Saheb, 2016). The European Commission has requested that all member states develop national renovation strategies for their existing building stock (Swedish Energy Agency ET2016:15, 2016). In addition, national renovation strategies related to the Energy Efficiency Directive are evaluated regularly and require member states to establish long-term strategies to reach higher energy efficiency in their building stock (Castellazzi et al., 2016). Since historic buildings are generally not exempt from the energy saving requirements, a challenge arises when it comes to how interests connected to historic building stocks can be balanced to achieve the greatest possible benefit to society.

The European guidelines on improving energy performance in historic buildings (CEN/TC346/WG8) define historic buildings as buildings with heritage significance.
Heritage significance is the combination of all the heritage values: technical, historical, aesthetic and cultural values ascribed to a building or a built environment. In Sweden, 60 per cent of all residential buildings were built before 1970 and 26 per cent before 1945 (European Commission/Energy, n.d.). National building regulations state that all buildings constructed before 1920 have important cultural and historical values (BBR, n.d.). Consequently, the preservation needs of historic buildings need to be carefully balanced with national goals to improve energy efficiency by 50 per cent by 2030 according to the Swedish energy policy (Swedish Government, 2017). Strategies for balancing demands on preserving heritage values and improving energy efficiency need to be developed and implemented. In addition, the focus also needs to change from single buildings to the entire building stock to ensure the impact of energy savings on heritage buildings reaches the district level.

The interdisciplinary field of energy efficiency in historic buildings focuses mainly on relations between decreasing energy use, improving indoor thermal comfort and maintaining the heritage significance of buildings. Energy efficiency in historic buildings has become an established field of research, a trend reflected in the increased number of published review papers. To date, research has mainly focussed on case studies based on surveys of individual buildings (Webb, 2017; Martínez-Molina et al., 2016; Cabeza et al., 2018). These studies focus either on integrating new technologies, retrofitting and energy improving measures or on improving indoor climate. Future study needs to turn towards more in-depth descriptions and analyses of assessments of heritage significance and risks related to heritage significance (Lidelöw et al., 2019). However, there is also a need to discuss conservation theory and conservation principles when assessing heritage values and energy efficiency measures (EEMs) (Orn, 2018). Recently, studies have focussed on how energy retrofitting in historic buildings compromises heritage values by identifying the potential of continuous use of buildings with respect for heritage values (Webb, 2017). For example, Roberti et al. (2017) performed a systematic analysis to examine how retrofits influence character-defining elements of a building based on input from a group of professionals, mainly architects. In addition, recent research has examined the problems associated with balancing assessments of heritage values and economic or technical assessments of energy efficiency (Leijonhufvud, 2016). A method to systemise this kind of decision making was developed and used in the European EFFESUS project where estimations of applicability of interventions were made by expert groups and implemented in a decision-making methodology (Egusquiza and Izkara, 2016).

When assessing built environments and districts, researchers have turned to an approach that recognises that single character-defining elements are only interesting in relation to their context (Guzmán et al., 2017). Buildings stocks require approaches and methods that are different than what individual buildings require in order to contribute to the reaching of climate goals through reducing energy used in buildings. One example of doing this is the systematic facility-energy-efficiency model (Junghans, 2013) which is based on identifying the buildings that have the greatest energy saving potential in a building stock by using key indicators such as heat source, building type, etc.

The joint European projects Tabula and Episcope approached the building stock from another angle where building stock data for each participating country where used as inputs to model different energy performance scenarios and for developing strategies for local as well as national building stocks (Loga et al., 2016). The Swedish building stock was divided into single-family houses and multi-family houses according to their age and climate zones. Buildings built before 1960 form one large group, which is not always useful if the target is the historic building stock.

This paper presents a stepwise structured method for managing energy efficiency and heritage values on the building stock level where the relationship between energy savings,
life cycle costs (LCC) and the heritage values of the building stock can be shown from different scenarios. This paper specifically emphasises the heritage-oriented aspects and builds upon previous research on how to deal with energy efficiency in building stocks (Liu et al., 2018) (Plate 1).

1.2 Case study

The historic city of Visby is used as a building stock case study. Visby was designated a UNESCO World Heritage Site in 1995. This designation means that society has taken on the responsibility of caring and managing the values associated with the site for future generations. To maintain these values and to regulate building activities within the World Heritage Site, a detailed development plan for Visby has been established, including a complementary building scheme of the city. The detailed development plan and the building scheme represent the common societal interests as well as the expert voice in every building project the city council/municipality approves. In addition, the building scheme has an educational objective as it is distributed to all house owners and tenants who live in or own buildings in the historic city. In this study, the building scheme is used to define restrictions with respect to the preservation of heritage values.

The following are main expressions that constitute the main features of the cultural significance of the built heritage of Visby and that are also emphasised in the building scheme:

- the urban pattern with its medieval characteristics with long parallel streets following the coastline and narrow alleys connecting these streets;
- historic typical characters of the city based on how different periods have affected the built environment in different ways – e.g., the medieval city and the bourgeois city; and
- main construction techniques and materials in the building stock and their connection to traditional building techniques as well as other influences at different times in history.

Visby’s building stock includes a wide range of historic building periods from the medieval through the contemporary, with eighteenth and nineteenth centuries’ architecture dominating the city. The technical standard of the buildings is relatively high. From an energy perspective, it is important to note that about 25 per cent of the buildings are connected to a district heating (DH) system and that it is technically possible to connect more buildings.

Plate 1.
The World Heritage Town of Visby is characterised by its medieval street pattern and buildings with a wide range of ages and construction types.
1.3 Aim of research
This paper describes a method that allows for a combined quantitative and qualitative analysis of potential energy savings in relation to its impact on heritage values and character-defining elements of buildings within an historic building stock. More specifically, this paper aims at exploring the balance between preservation of historic buildings and energy savings potential. The objective is to contribute to sounder planning and policy development for districts with historic buildings.

To reach this aim, the following research questions have been identified:

RQ1. How can restrictions for preservation of heritage values be used strategically to design energy renovation scenarios?

RQ2. What would be the impact on heritage values if techno-optimal energy solutions were to be applied and how would restrictions with respect to preservation of heritage values affect the energy savings potential and LCC?

RQ3. How can the proposed method be used to facilitate differentiated energy renovation strategies to contribute to sounder policy development on a building stock level?

1.4 Overall method
The overall method shows how it is possible to address the issue of energy efficiency at the building stock level by combining a techno-economic analysis with assessment of consideration for heritage values in a given building stock. It also includes an LCC optimisation tool for selecting cost-efficient energy renovation measures. This method is applied to Visby’s building stock by using categorised archetype buildings.

The step-by-step method contains the following parts (Figure 1):

- categorisation of the building stock;
- definition of restriction levels for energy renovation scenarios; and
- LCC optimisation of energy measures in archetype buildings.

The analysis that follows is a validation of the above methodological steps and contains the following parts:

- heritage and energy impact analysis on building stock level; and
- development of differentiated energy renovation strategies.

The following chapters present the method used and the results from applying the method on the case study.

Figure 1.
The proposed step-by-step methodology from inventory of building stock to the up scaling of potential energy savings and LCC to finding adapted and differentiated renovation strategies for a specific building stock.
2. Categorisation of building stock

A building stock consists of individual buildings with unique physical appearances influenced by various conditions such as geography, climate, activities, traditions, history, culture and politics (Thuvander, 2008). The research field of energy efficiency in historic buildings needs to expand its scope from individual buildings to building stocks to understand the energy savings potential in relation to different and competing societal objectives at the overall district level.

In this study, we use a categorisation method that follows a stepwise procedure where background data about the building stock are collected from surveys, documents and energy information and physical characters of buildings such as number of stories, boundaries (adjoining walls), floor areas and volumes are used to first identify building categories represented by archetype buildings and then arranged in groups (Broström et al., 2017).

2.1 Building categories

The categorisation of Visby’s building stock resulted in 12 building categories (Table I). These categories represent about 88 per cent of the buildings and 70 per cent of the heated area in Visby.

Categories 1, 2 and 3 are one storey to one-and-a-half storey buildings mostly used for single dwellings, and Categories 2 and 3 have one or two adjacent walls, respectively. Categories 4, 5 and 6 are multi-storey buildings used for apartments or commercial purposes and Categories 5 and 6 have one or two adjacent walls, respectively. Single-dwelling buildings are mostly constructed of wood and apartment buildings are mostly constructed of stone.

2.2 Building archetypes

For each building category an archetype building has been defined. The archetypes are based on each building category’s average heated area, window-to-wall ratio and U-values of floor, walls and windows (Liu et al., 2018). Because the building archetypes do not

<table>
<thead>
<tr>
<th>Building category</th>
<th>Main character</th>
<th>No. of buildings</th>
<th>Average heated area</th>
<th>Total heated area</th>
</tr>
</thead>
<tbody>
<tr>
<td>1w</td>
<td>1–1½ stories freestanding</td>
<td>309</td>
<td>89</td>
<td>30,282</td>
</tr>
<tr>
<td>1s</td>
<td>1–1½ stories freestanding</td>
<td>55</td>
<td>87</td>
<td>4,785</td>
</tr>
<tr>
<td>2w</td>
<td>1–1½ stories one adjacent wall</td>
<td>166</td>
<td>100</td>
<td>16,600</td>
</tr>
<tr>
<td>2s</td>
<td>1–1½ stories one adjacent wall</td>
<td>46</td>
<td>88</td>
<td>4,048</td>
</tr>
<tr>
<td>3w</td>
<td>1–1½ stories two adjacent walls</td>
<td>25</td>
<td>116</td>
<td>2,900</td>
</tr>
<tr>
<td>3s</td>
<td>1–1½ stories two adjacent walls</td>
<td>16</td>
<td>104</td>
<td>1,664</td>
</tr>
<tr>
<td>4w</td>
<td>2 or more stories freestanding</td>
<td>33</td>
<td>398</td>
<td>13,134</td>
</tr>
<tr>
<td>4s</td>
<td>2 or more stories freestanding</td>
<td>75</td>
<td>370</td>
<td>27,750</td>
</tr>
<tr>
<td>5w</td>
<td>2 or more stories one adjacent wall</td>
<td>30</td>
<td>372</td>
<td>11,160</td>
</tr>
<tr>
<td>5s</td>
<td>2 or more stories one adjacent wall</td>
<td>83</td>
<td>345</td>
<td>28,635</td>
</tr>
<tr>
<td>6w</td>
<td>2 or more stories two adjacent walls</td>
<td>18</td>
<td>387</td>
<td>6,966</td>
</tr>
<tr>
<td>6s</td>
<td>2 or more stories two adjacent walls</td>
<td>64</td>
<td>360</td>
<td>23,040</td>
</tr>
</tbody>
</table>

Table I. Number of buildings and heated area for all building categories.
represent a specific building, they should not be assumed to be of a certain age or have a certain heritage value. The use of building archetypes allows us to experiment with the buildings based on different aspects. They can represent buildings with high heritage values as well as buildings with lesser value. This will allow for designing future scenarios useful for creating a knowledge base for decisions about the building stock. Two examples of archetypes are shown in Figure 2.

2.3 Building category groups

In the case of Visby, there are no significant differences in the archetype buildings’ energy performance if they have adjacent walls or not. On the basis of this similarity and energy performance, buildings are categorised into four main groups:

(1) Groups 1-3w consist of 500 relatively small wood buildings primarily constructed using post and plank and often covered with a render. This group represents 26 per cent of the heated area of the building stock. These will be referred to as single-dwelling wood buildings.

(2) Groups 1-3s consist of the same building size as 1-3w, but these are buildings constructed with stone as the main material. This group represents a small part (6 per cent) of the heated area of the building stock. These will be referred to as single-dwelling stone buildings.

(3) Groups 4-6w consist of 81 wood buildings with two or more stories. They represent 18 per cent of the heated area of the building stock. These will be referred to as wood apartment buildings.

(4) Groups 4-6s consist of 222 stone buildings and represent the largest part (46 per cent) of the heated area of the building stock. These will be referred to as stone apartment buildings.

3. Restriction levels

The second step in the method defines the restriction levels used as starting conditions for different energy renovation scenarios. Restriction levels are based on an interpretation of the building scheme by identifying the character-defining elements that are designated to be preserved.

Damages to buildings and the built environment can be defined as light, medium or heavy (Romão et al., 2016). Light damage is non-structural damage, medium is moderate structural damage and heavy is where the entire structure is in danger. Similar graded scales are used in research projects that assess the risks different EEM have on heritage significance, indoor climate and biological growth (Troi and Bastian, 2015; Eriksson et al., 2014). In this study, acceptable or not acceptable damage to heritage values based on the building scheme is used when designing restriction levels for renovation scenarios for the LCC optimisation.
3.1 Character-defining elements

Heritage values considered in the Visby case study rely on the building scheme mentioned above. A parallel study asked house owners to identify which characters define the heritage values in Visby’s buildings. The results show that the building scheme and the citizens’ voices agree (Eriksson, 2018). According to the building scheme, roofs with various covering materials and windows, doors and façades are all elements that constitute the architectural, material, technical and aesthetic character of the buildings, elements also important for the heritage significance of the entire city (Hallberg, 2010). Table II lists the characteristics of buildings sorted according to building periods.

The focus of the building scheme lies on exteriors of the buildings and building constructions. Roof changes that interfere with original construction and expression should be avoided. Façades have the longest list of restrictions as they are the most important elements that reflect the character of the city as a whole. Two types of façades are among the most common in Visby: buildings with render and buildings without render. Preservation and maintenance are prioritised for existing renders as well as the use of traditional materials if anything needs to be restored or replaced. Specifically, lime mortar on wood is important.

The building scheme states that technical equipment, such as heat pumps, installed to improve the energy performance of the buildings is generally not allowed on the façades. There can be exceptions, however, if they are not visible from the street. Exterior insulation is not allowed if it changes the character of the façade. Panelled façades should be kept and if replacement is needed, builders are required to use similar materials, dimensions, profiles, etc. Windows should be preserved as far as possible and if replacement is needed, the original appearance must be kept by using similar materials, construction and detailing (Hallberg, 2010).

In order to balance the preservation of heritage values and energy savings, a strict interpretation has been applied to expressions in the building scheme such as “exceptionally”, “inappropriate” and “as far as possible” when it comes to which changes can be accepted in buildings. That is, we interpret “exceptionally”, “inappropriate” and “as far as possible” as “not allowed”.

3.2 Restriction levels for energy renovation scenarios

This study uses four energy renovation scenarios with different starting conditions for the archetype buildings. The reference scenario and the optimal scenario are without restrictions, whereas the balanced and restricted scenarios are designed in line with the interpretation of the local building scheme:

- Reference LCC scenario – status quo.
- Optimal LCC scenario – cost-optimal energy renovation scenario with no restrictions on the selection of EEM.
- Balanced scenario – lowest LCC is obtained with restrictions set to thickness of insulation and window replacement.
- Restricted scenario – lowest LCC is obtained with restriction to thickness of insulation, wall insulation and window replacement.

The restriction levels are designed so that the most restrictive scenario corresponds to what would cause light change (light damage) to the buildings, while the balanced scenario could affect the buildings to a certain extent and thus cause medium change (medium damage). While the optimal scenario has no restrictions set to any EEM which could cause a high degree of change (heavy damage). In older segments of buildings, there are EEM that are
<table>
<thead>
<tr>
<th>Character-defining elements of the built environment of Visby, presented in the order of historical building periods used in the building scheme.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Table II.</strong></td>
</tr>
<tr>
<td><strong>Foundation</strong></td>
</tr>
<tr>
<td><strong>Building frame</strong></td>
</tr>
<tr>
<td><strong>Roof construction</strong></td>
</tr>
<tr>
<td><strong>Roof covering</strong></td>
</tr>
<tr>
<td><strong>Facade and facade material</strong></td>
</tr>
<tr>
<td><strong>Doors and windows</strong></td>
</tr>
<tr>
<td><strong>Stairs</strong></td>
</tr>
<tr>
<td><strong>Decorative architectural elements</strong></td>
</tr>
<tr>
<td><strong>Chimneys and other features</strong></td>
</tr>
<tr>
<td><strong>Interiors</strong></td>
</tr>
</tbody>
</table>
more challenging than others. External wall insulation and replacement of windows are problematic in more general terms due to negative impact on building character (Rispoli and Organ, 2018).

4. LCC optimisation

The lowest LCC of the various category buildings is obtained using LCC optimisation software – Optimal Energy Retrofit Advisory – Mixed Integer Linear Program (OPERA–MILP). The objective is to obtain the cost-optimal energy renovation strategy corresponding to the lowest building LCC (Gustafsson and Karlsson, 1989; Liu et al., 2015). A more thorough description of OPERA–MILP together with a validation of the software is presented in a parallel study (Milić et al., 2018).

The optimisation in OPERA–MILP software is based on a pre-set period (50 years) and considers costs of building maintenance, investment cost for heating system, EEMs on the building envelope and energy supply. Future costs are discounted to the base year using the net present value method. Any residual value at the end of the life cycle from building maintenance and investments is subtracted from the total LCC. To obtain the cost-optimal energy renovation solution, several EEMs targeting the building envelope and heating systems are incorporated in OPERA–MILP: roof insulation, floor insulation, inside and outside insulation of the external wall, replacement of windows and weather stripping. The heating systems are DH, groundwater heat pump (GHP), electric radiator (ER) and wood boiler (WB).

The energy balance of the building is calculated using 12-time steps per year. Heat losses from ventilation, infiltration, transmission and domestic hot water use are included. Free energy in the form of heat from internal sources (e.g. heat from occupants and passive solar gains) is also included. The maximum building power demand is calculated based on the total heat losses of the building multiplied by the temperature difference between the indoor and the outdoor design temperature. In addition, the energy balance calculation accounts for domestic hot water use. Moreover, the LCC of the archetype buildings in their original condition has been calculated to investigate the effects of cost-optimal energy renovation.

4.1 Input data: OPERA–MILP

The input data used in OPERA–MILP software are collected from established sources used by the building industry for cost calculations. The indoor temperature is set to 21°C in all buildings, common advice about indoor temperature in Sweden (Folkhälsomyndighetens allmänna råd om temperatur inomhus, 2014). Internal heat generation and domestic hot water use are estimated with data from Sveby (Sveby) which is a Swedish industry standard for energy in buildings. Solar gains are calculated using a window model implemented in building energy simulation software in IDA ICE software. The costs for the various measures in OPERA–MILP are estimated market costs from a branch standard database (Wikells, n.d.).

4.2 LCC optimisation of energy renovation scenarios

4.2.1 Reference scenario. The reference scenario represents the situation if no measures are made to improve energy performance of the buildings. DH is selected as default in all of the archetype buildings (Table III).

The specific energy use (kWh/m²) and the LCC are higher in stone buildings, mainly because of higher transmission losses through the external walls compared to wood buildings. The highest specific energy use and LCC occur in the single-dwelling stone archetype building 1s, while the wood apartment archetype building 6w have the lowest specific energy use and the lowest LCC.
4.2.2 Optimal scenario. The objective of the optimal scenario is to find the cost-optimal renovation solution for each archetype building without any restrictions with respect to heritage values. For practical reasons, however, the insulation thickness of exterior walls is limited to 42 cm (Table IV).

The optimal scenario results in the following measures:

1. windows should be replaced in all buildings;
2. roof insulation in all buildings;
3. floor insulation in the single-dwelling wood and stone buildings (1-3 w/s);
4. internal wall insulation (of external walls) for all stone buildings;
5. air tightening in all buildings; and
6. replacement of heating system in some buildings (see below).

Floor insulation is selected in one storey single-dwelling buildings with a thickness between 24 and 26 cm because of poor thermal properties of the floor. The opposite is true for two storey apartment buildings, where the thermal properties of the floors are better.

Balancing preservation and energy efficiency

<table>
<thead>
<tr>
<th>Archetype building</th>
<th>Heating system – Building power demand (kW)</th>
<th>Energy use (kWh/m² and year)</th>
<th>LCC (kSEK)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1w</td>
<td>DH – 6.9</td>
<td>200.1</td>
<td>551</td>
</tr>
<tr>
<td>1s</td>
<td>DH – 9.1</td>
<td>324.0</td>
<td>709</td>
</tr>
<tr>
<td>2w</td>
<td>DH – 6.4</td>
<td>178.6</td>
<td>499</td>
</tr>
<tr>
<td>2s</td>
<td>DH – 7.8</td>
<td>266.2</td>
<td>603</td>
</tr>
<tr>
<td>3w</td>
<td>DH – 6.7</td>
<td>161.2</td>
<td>507</td>
</tr>
<tr>
<td>3s</td>
<td>DH – 7.6</td>
<td>218.0</td>
<td>578</td>
</tr>
<tr>
<td>4w</td>
<td>DH – 19.0</td>
<td>128.1</td>
<td>1,486</td>
</tr>
<tr>
<td>4s</td>
<td>DH – 27.3</td>
<td>219.8</td>
<td>2,044</td>
</tr>
<tr>
<td>5w</td>
<td>DH – 16.3</td>
<td>115.4</td>
<td>1,244</td>
</tr>
<tr>
<td>5s</td>
<td>DH – 22.2</td>
<td>187.3</td>
<td>1,644</td>
</tr>
<tr>
<td>6w</td>
<td>DH – 14.4</td>
<td>99.1</td>
<td>1,064</td>
</tr>
<tr>
<td>6s</td>
<td>DH – 17.9</td>
<td>143.2</td>
<td>1,307</td>
</tr>
</tbody>
</table>

Table III. Power demand, energy performance and LCC for the archetype buildings in the reference scenario

<table>
<thead>
<tr>
<th>Archetype building</th>
<th>Heating system – Power demand (kW)</th>
<th>Roof insulation (cm)</th>
<th>Floor insulation (cm)</th>
<th>External wall inside insulation (cm)</th>
<th>Window replacement</th>
<th>Air tightening</th>
<th>Energy use (kWh/m²/year)</th>
<th>LCC (kSEK)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1w</td>
<td>DH – 4.51</td>
<td>12</td>
<td>26</td>
<td>0</td>
<td>2-panes</td>
<td>Yes</td>
<td>109.1</td>
<td>412</td>
</tr>
<tr>
<td>1s</td>
<td>DH – 2.88</td>
<td>10</td>
<td>24</td>
<td>20</td>
<td>2-panes</td>
<td>Yes</td>
<td>70.8</td>
<td>447</td>
</tr>
<tr>
<td>2w</td>
<td>DH – 4.02</td>
<td>12</td>
<td>26</td>
<td>0</td>
<td>2-panes</td>
<td>Yes</td>
<td>91.7</td>
<td>366</td>
</tr>
<tr>
<td>2s</td>
<td>DH – 2.77</td>
<td>10</td>
<td>24</td>
<td>20</td>
<td>2-panes</td>
<td>Yes</td>
<td>66.4</td>
<td>388</td>
</tr>
<tr>
<td>3w</td>
<td>DH – 4.01</td>
<td>12</td>
<td>26</td>
<td>0</td>
<td>2-panes</td>
<td>Yes</td>
<td>78.8</td>
<td>362</td>
</tr>
<tr>
<td>3s</td>
<td>DH – 3.02</td>
<td>10</td>
<td>24</td>
<td>20</td>
<td>2-panes</td>
<td>Yes</td>
<td>63.8</td>
<td>376</td>
</tr>
<tr>
<td>4w</td>
<td>WB – 18.05</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>2-panes</td>
<td>Yes</td>
<td>97.3</td>
<td>1,117</td>
</tr>
<tr>
<td>4s</td>
<td>WB – 12.92</td>
<td>10</td>
<td>0</td>
<td>16</td>
<td>2-panes</td>
<td>Yes</td>
<td>71.3</td>
<td>1,317</td>
</tr>
<tr>
<td>5w</td>
<td>WB – 15.46</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>2-panes</td>
<td>Yes</td>
<td>87.6</td>
<td>948</td>
</tr>
<tr>
<td>5s</td>
<td>WB – 11.47</td>
<td>10</td>
<td>0</td>
<td>16</td>
<td>2-panes</td>
<td>Yes</td>
<td>67.5</td>
<td>1,092</td>
</tr>
<tr>
<td>6w</td>
<td>WB – 13.74</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>2-panes</td>
<td>Yes</td>
<td>76.4</td>
<td>815</td>
</tr>
<tr>
<td>6s</td>
<td>WB – 10.91</td>
<td>10</td>
<td>0</td>
<td>16</td>
<td>2-panes</td>
<td>Yes</td>
<td>64.1</td>
<td>902</td>
</tr>
</tbody>
</table>

Table IV. Selected energy efficiency measures, power demand, energy performance and LCC for the optimal scenario
Interior insulation of exterior walls is selected in stone buildings, both single-dwelling buildings (1-3s) and apartment buildings (4-6s), because stone walls have poor thermal properties compared to wood walls. Internal insulation is selected due to the high costs of adding external wall insulation to buildings.

DH is suggested for single-dwelling buildings in wood and stone (1-3w and 1-3s), while WB are selected for apartment buildings. The reason for this is that DH is benefitted by a low energy use due to low investment cost and high running cost. The opposite applies for the WB because of higher investment cost but lower running cost.

As a consequence of the proposed measures, LCC and energy use are significantly lower in the optimal scenario in comparison to the reference scenario.

4.2.3 Balanced scenario. The balanced scenario has restrictions on changing windows as well as restrictions on the thickness of floor insulation and external wall insulation (Table V).

The balanced scenario results in the following measures:

1. roof insulation in all buildings;
2. floor insulation in the single-dwelling buildings in both wood and stone (1-3w and 1-3s);
3. internal wall insulation for all stone buildings (1-3s and 4-6s);
4. air tightening in all buildings; and
5. replacement of heating system in the apartment buildings in both wood and stone (4-6w and 4-6s).

In comparison to the optimal scenario, both floor insulation and wall insulation are limited to 16 cm due to given restrictions. Roof insulation is more or less the same as in the optimal scenario. Energy use increased compared to the optimal scenario but more so for the stone buildings than for the wood buildings. The LCC in this scenario are higher compared to the optimal scenario, yet lower than the reference scenario.

4.2.4 Restricted scenario. The restricted scenario does not allow EEM that could have a negative impact on the visible character-defining elements. Therefore, window replacement, external wall insulation and interior insulation are excluded. As in the balanced scenario, insulation thickness for the floor and roof is restricted (Table VI).

The restricted scenario results in the following measures:

1. roof insulation in all buildings;
(2) floor insulation for all the single-dwelling buildings, in both wood and stone (1-3w and 1-3s);

(3) air tightening in all buildings; and

(4) replacement of heating system in all buildings except for the single-dwelling wood buildings (1-3w).

DH is selected for single-dwelling wood buildings (1-3w). Ground source heat pumps are selected for the stone apartment buildings (4-6s) and WB are selected for the single-dwelling stone buildings (1-3s) and wood apartment buildings (4-6w). LCC and energy use are the same as in the balanced scenario for all the wood buildings, whereas both LCC and energy use are increased for all the stone buildings.

5. Building stock analysis

To analyse the consequences of the different scenarios on a building stock level, the results for each archetype are scaled up to show the effects of each scenario for the building stock as a whole as well as for the building categories and the building category groups presented earlier.

5.1 Energy use

Figure 3 shows that there are considerable differences between the four scenarios in terms of energy use for the building stock as a whole. The cost-optimal scenario would reduce the energy use by 16.9 GWh/year (55 per cent) compared with the reference scenario. The energy savings potential for the balanced scenario compared with the reference case is 45 per cent, and the potential energy savings in the most restricted scenario is 18 per cent.

There are considerable differences between the balanced and the restricted scenario in relation to the optimal scenario. The balanced scenario would use 3.1 GWh/year more energy, whereas the restricted scenario would use 11.2 GWh/year more energy than the optimal scenario.

In the next step, we analyse the energy use in the building stock of the four building category groups (Figure 4).

Single-dwelling wood buildings (1-3w) constitute 29 per cent of the total heated area of the building stock. The reference case gives the highest energy use in all building category groups. The optimal renovation scenario will reduce energy use by 48 per cent (4.5 GWh/year),

<table>
<thead>
<tr>
<th>Archetype</th>
<th>Heating system – Building power demand (kW)</th>
<th>Roof insulation (cm)</th>
<th>Floor insulation (cm)</th>
<th>Air tightening</th>
<th>Energy use (kWh/m² and year)</th>
<th>LCC (kSEK)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1w</td>
<td>DH – 4.9</td>
<td>12</td>
<td>16</td>
<td>Yes</td>
<td>131.2</td>
<td>459</td>
</tr>
<tr>
<td>1s</td>
<td>WB – 7.4</td>
<td>6</td>
<td>16</td>
<td>Yes</td>
<td>252.3</td>
<td>570</td>
</tr>
<tr>
<td>2w</td>
<td>DH – 4.4</td>
<td>12</td>
<td>16</td>
<td>Yes</td>
<td>111.9</td>
<td>409</td>
</tr>
<tr>
<td>2s</td>
<td>WB – 6.2</td>
<td>6</td>
<td>16</td>
<td>Yes</td>
<td>197.5</td>
<td>496</td>
</tr>
<tr>
<td>3w</td>
<td>DH – 4.5</td>
<td>12</td>
<td>16</td>
<td>Yes</td>
<td>96.1</td>
<td>404</td>
</tr>
<tr>
<td>3s-</td>
<td>WB – 5.7</td>
<td>6</td>
<td>16</td>
<td>Yes</td>
<td>152.1</td>
<td>471</td>
</tr>
<tr>
<td>4w</td>
<td>WB – 17.2</td>
<td>12</td>
<td>0</td>
<td>Yes</td>
<td>113.0</td>
<td>1,230</td>
</tr>
<tr>
<td>4s</td>
<td>GHP – 25.7</td>
<td>10</td>
<td>0</td>
<td>Yes</td>
<td>204.5</td>
<td>1,560</td>
</tr>
<tr>
<td>5w</td>
<td>WB – 14.7</td>
<td>12</td>
<td>0</td>
<td>Yes</td>
<td>101.2</td>
<td>1,042</td>
</tr>
<tr>
<td>5s</td>
<td>GHP – 20.8</td>
<td>10</td>
<td>0</td>
<td>Yes</td>
<td>172.9</td>
<td>1,287</td>
</tr>
<tr>
<td>6w</td>
<td>WB – 13.0</td>
<td>12</td>
<td>0</td>
<td>Yes</td>
<td>86.7</td>
<td>889</td>
</tr>
<tr>
<td>6s</td>
<td>GHP – 16.6</td>
<td>10</td>
<td>0</td>
<td>Yes</td>
<td>131.3</td>
<td>1,043</td>
</tr>
</tbody>
</table>

Table VI. Selected energy efficiency measures, power demand, energy performance and LCC for the restricted scenario

Balancing preservation and energy efficiency
while the balanced scenario and the restricted scenario reduce the energy use by 36 per cent (3.4 GWh/year).

Single-dwelling stone buildings (1-3s) constitute the smallest part of building stock (6 per cent of the total heated area). The energy savings potential is relatively high in this group. The difference between the reference case and the optimal scenario results in an energy savings potential of 77 per cent (2.3 GWh/year), the balanced scenario results in an energy savings of 67 per cent (2 GWh/year) and the restricted scenario results in an energy savings of 25 per cent (0.7 GWh/year).

Wood apartment buildings (4-6w) constitute 18 per cent of the total heated area and the energy savings potential is relatively low. The energy savings potential given of the optimal scenario compared with the reference scenario is 24 per cent (0.9 GWh/year) and for the
balanced and optimal scenario the energy savings potential is even lower 14 per cent (0.5 GWh/year).

Stone apartment buildings (4-6s) are the largest building category group in terms of heated area by 48 per cent. Naturally, this group has the largest energy savings potential and the largest variations between the three renovation scenarios. The optimal renovation scenario gives an energy savings potential of 74 per cent or 9.4 GWh/year. The energy savings potential for the balanced renovation scenario is 54 per cent or 8.1 GWh/year compared with the reference case. The restricted renovation scenario gives an energy savings potential of 8 per cent or 1.2 GWh/year.

5.2 Life cycle cost
Figure 5 presents the LCC over 50 years for the whole building stock for each of the scenarios. Differences between the energy renovation scenarios are less than the differences in energy use. The reference scenario is by far the most costly, and the optimal scenario is the most profitable.

The difference between the most cost-optimal scenario and the most restricted scenario is 89 MSEK or 13 per cent higher than LCC, while the difference between the balanced scenario and the optimal scenario is 57 MSEK or 9 per cent higher than LCC. In the next step, we analyse the differences in LCC for each category (Figure 6).

The largest monetary savings on building stock level are predicted for the single-dwelling wood buildings (1-3w) and stone apartment buildings (4-6s). The LCC for all wood buildings are the same in both the balanced and restricted scenarios. For the single-dwelling wood buildings (1-3w), the balanced and restricted scenarios give a savings of 49 MSEK or a savings of 17 per cent in relation to the reference scenario.

The wood apartment buildings (4-6w) have a relatively low LCC savings potential of 18 MSEK, as this group constitutes a smaller part of the building stock when it comes to heated area. The single-dwelling stone buildings (1-3s) lower the LCC by 30 per cent in the balanced renovation scenario and by 19 per cent in the restricted renovation scenario compared with the reference scenario. The stone apartment buildings (4-6s) lower the LCC in the balanced renovation scenario by 28 per cent and in the restricted renovation scenario by 22 per cent compared with the reference scenario.

Balancing preservation and energy efficiency

**Figure 5.**
LCC MSEK for the whole building stock for the reference, the optimal, the balanced and the restricted scenarios
LCC has an impact on building stock level depending on which strategy is used. Based on how the ownership is distributed within the building stock, the importance of the LCC outcome differs. In a building stock with a large proportion of privately owned properties, LCC will be of less interest to overall building stock strategies but of greater interest to individual property owners.

6. Discussion
As shown in the analysis, there is a need to work with differentiated renovation strategies that are based on the heterogeneous nature of the building stock in order to succeed with this. Previous research in the area of historical buildings and energy efficiency has mainly focussed on energy refurbishment for individual buildings (as described in the introduction). The present paper provides a method that takes into account the specific site’s character in terms of heritage values. This is a new way to explore the relationship between the building conservation principles, changing as much as necessary but as little as possible, in order to find the balance between saving energy and preserving heritage values.

In a heterogeneous historic building stock, general guideline, targets and strategies are imprecise and sometimes destructive tools both in terms of energy efficiency and preservation of heritage values. The main reason for developing differentiated energy renovation strategies for selected parts of a building stock is to manage differences in buildings regarding size, construction, building materials, age, design, etc. Different parts of a building stock have different technical conditions and energy savings potential. Buildings tolerate varying degrees of change if their heritage values are to be taken into account in processes of change. General guidelines and strategies therefore work poorly in heterogeneous historic building stocks. In the case of Visby, we found a higher potential of energy savings in the stone buildings than in the wood buildings. Therefore, different energy renovation strategies should be designed for the specific conditions for buildings constructed in stone and buildings constructed in wood. The apartment buildings are the ones that constitute the largest part of the total heated area and therefore it would be most beneficial to start energy improving this part of the building stock.
The proposed method can be used to facilitate a strategic discussion balancing policies and targets for energy savings with policies for the preservation of heritage values to answer questions like:

- What is the cost, in terms of energy and money, of imposing restrictions on energy measures?
- What is the cost, in terms of lost heritage values, to achieve different targets for energy efficiency?

We argue that the method will promote more informed and balanced policymaking based on both a quantitative and qualitative analysis.

The proposed method, from categorising buildings to defining differentiated energy renovation strategies, can advantageously be used on other well-defined building stocks. But the use requires investment in terms of time and resources, prerequisites are that there is available data about the physical and technical characteristics of the buildings stock as well as a systematic assessment of the building stock’s heritage values and character-defining elements. The limitation lies in the amount of available data and the quality of data used for the LCC optimisation such as costs, types of measures. Despite the method’s limitations, this study shows a step towards a more comprehensive way of balancing the energy savings and heritage values of building stocks rather than single buildings.

This is a top-down method for planning and policymaking. When it comes to individual buildings the proposed measures for the different categories should not be taken for granted but rather serve as input to a more detailed analysis.

Further research is needed to refine the presented method and to develop methods that are useful for building stocks that are not as well-documented as our presented case study. This future research should contribute to sounder policies for energy efficiency in existing buildings with heritage values.

7. Conclusion
The results and experiences from this study can be divided into two parts: the results from the specific case study and the results and experiences from the step-by-step method. The following is a summary of the results from the Visby case study:

- the categorisation method that resulted in six main archetype buildings each divided into two sub groups based on the main construction material has been sufficient for the well-defined building stock in Visby;
- the predicted energy savings potential is found to be higher in the stone buildings than in the wood buildings; and
- the results (energy use and LCC) from the optimisation of the energy renovation scenarios can be used as a starting point for developing differentiated energy savings strategies for Visby.

The general conclusions from the application of the method are:

- by using archetypal models of the buildings in the building stock, it is possible to predict different scenarios and scale this up to the building stock level;
- preservation objectives can be transformed into restriction levels for renovation scenarios of the optimisation of LCC and energy use for archetype buildings;
- the results from the energy renovation scenarios (optimal, restricted and balanced) can be used to show how different decisions regarding restriction levels affect LCC and energy use for all or part of a building stock; and
differentiated energy renovation strategies can be developed on the basis of the building stock comparative analyses of energy use and LCC.

This study identifies ways to balance energy and preservation in a historic building stock by systematic analyses. By using different energy renovation scenarios for an LCC optimisation, we show how different levels of restrictions affect the energy savings potential as well as the LCC of a building stock. The main outcome shows the potential of how the balance between interests can be integrated in an optimisation process by setting restrictions in accordance with preservation objectives. We have demonstrated the benefits of developing differentiated energy renovation strategies to find the optimal energy savings potential for the buildings within the World Heritage Site of Visby.

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Long-term effects of additional insulation of building façades in Sweden
Towards a holistic approach

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Abstract
Purpose – The purpose of this paper is to evaluate long-term effects of previous policies for energy efficiency on energy performance and heritage values. A further ambition is to better understand the relationship between energy and preservation by exploring a quantitative method of combining energy performance data with official heritage designation.

Design/methodology/approach – The study is based on a quantitative analysis of energy performance, completed additional insulations, and official heritage classification for individual buildings. Data have been collected and analysed for a sample consisting of 289 multi-family buildings heated with district heating and constructed 1940–1949 in an urban area in Stockholm, Sweden.

Findings – The data exhibit a significant correlation between the studied features. The study further shows that additional insulation has been installed in roughly half of the buildings. The large majority of them were carried out in the national programme for home improvement called ROT.

Research limitations/implications – The findings indicate that previous policies for energy efficiency had an important effect on energy performance and heritage values in the studied area. They continue to affect urban planning and building permit administration today. Research of the physics of individual buildings would be needed in order to determine the reason for differences in the sample.

Originality/value – By presenting a novel method, the study provides a useful tool for policy makers to bridge the gap between issues of energy and preservation and adopt a more holistic approach towards a sustainable built environment.

Keywords Energy efficiency, Policy evaluation, Built heritage, Additional insulation, Swedish urban planning

Paper type Research paper

Introduction
Purpose and question
The addition of thermal insulation to façades has been a measure to save energy in the Swedish building stock for a long time. It was first supported by national policies in the 1970s. Introduced in the wake of the global oil crisis in 1973, loans and subsidies for installing additional façade insulation were provided in large scale to property owners until the early 1990s. First included in the national programme “Energy savings plan for existing buildings” (Energisparplan för befintlig bebyggelse, hence abbreviated EBB), instruments encouraging additional façade insulations were then transferred to the home improvement programme ROT (an acronym for the Swedish words for renovation, refurbishment and extension) (Legnér and Leijonhufvud, 2019; Tunefalk and Legnér, 2019). Most likely, these two long-lasting programmes had an important role in reducing the energy use in the Swedish building stock, while at the same time making a large impact on heritage values in urban areas. ROT in particular had an explicit target of refurbishing older buildings (Tunefalk and Legnér, 2019).

The purpose of the study is to evaluate long-term effects of previous policies for energy efficiency on energy performance and heritage values. A further ambition is to contribute to a...
better understanding of the relationship between energy retrofits, energy performance (kWh/m²/year), and heritage values by exploring a quantitative method of combining energy performance data with official heritage classification. The study answers the question:

**RQ1.** What effects have previous policies for energy efficiency had on energy performance and heritage values in the building stock?

The method presented in this study is a step towards a more holistic approach to current challenges in the building stock. Different values attributed to the built environment are entangled and will inevitably affect each other. Including heritage values in a study of energy-saving policies can therefore be useful for future policy-making. A difficulty in evaluating energy savings and effects on heritage values is the fact that building elements generally have a long lifespan, and retrofits thus keep having effects on both heritage values and energy use long after they have been carried out. It therefore takes time to establish the full effects of policy measures. Studying energy-saving policies from several decades ago provides an opportunity to analyse long-term effects on both heritage and energy. This can hopefully contribute to better informed policy making that can help achieve ambitious targets for energy savings, without affecting other important values in the built environment.

**Previous research**

The National Board of Housing, Building and Planning (Boverket) has conducted a survey of the technical status, indoor environment and energy efficiency of the Swedish building stock (Boverket, 2010). It concludes that the knowledge of the relationship between energy and heritage is inadequate and calls for further research on the subject. On the one hand, the survey recommends further additional insulation of existing buildings, especially on façades, with an estimated potential energy saving of 20–40 per cent. On the other hand, it acknowledges the potential risk of façade insulation for existing heritage values, and concludes that additional façade insulation should be limited to a small number of buildings. This ambivalence points to the difficulties of balancing the different values of the built environment, a difficulty that the method presented in this paper may contribute to mitigate.

Johansson and Wahlgren (2017) examine effects of energy-related renovation of buildings erected before 1945, based on inventories assessing historical values and technical status of the thermal envelope. A total of 47 per cent of the buildings in their sample from Gothenburg, Sweden, had visible additional insulation on façades. They conclude that there is a lack of knowledge of the renovation history of buildings. The benefits of long-term historical evaluations of policy measures have been demonstrated by Mallaburn and Eyre (2014), arguing that lessons from 40 years of UK experience with energy efficiency policies were largely ignored in the formulation of the UK Green Deal. Furthermore, Swan et al. (2017) surveyed attitudes towards increased energy efficiency in UK social housing in recent years, concluding that there seems to have been a decrease in interest in reducing carbon dioxide emissions while there has been a growing interest in addressing fuel poverty with policies.

Looking at Sweden, Gohardani et al. (2015) examine how the decision-making process leading to energy-saving opportunities in tenant owners’ cooperatives may be improved. Some research, such as Yarrow (2016), poses a much more sceptical view on the potential of policies, concluding that considerations of historic values intersect with those of energy efficiency in context specific ways that cannot be accounted for in general policies. Instead, informal negotiation characterises decision-making processes.

Sandberg et al. provided an historical analysis of energy use and policy-making in Norway. Sunikka-Blank and Galvin (2015), Judson et al. (2014) and Rispoli and Organ (2018) studied the relation between heritage values and energy from the perspective of homeowners, in UK and Australia, respectively. Based on interviews, they all conclude that
homeowners have broader motivations for renovation decisions than is found in policy statements. In order for policies to be implemented, they need to consider multiple aspects of the building stock and the rationale of homeowners.

Our own previous studies of Swedish energy efficiency policies have concluded that EBB and ROT had a significant impact on heritage values in the built environment, while at the same time resulting in empirically based knowledge of the built environment in Sweden that previously had been missing (Legnér and Leijonhufvud, 2019; Tunefalk and Legnér, 2019). These studies have also demonstrated how the rationale for large energy-saving programmes changed over time from a reduced import of oil, via less dependency on nuclear power, to financial stimulations of the building sector, and in later years a mitigation of climate change. However, the resulting energy savings and their bearings on heritage values have previously not been investigated.

Some evaluations of energy savings were made while policies were still in effect. E.g. a report made by Byggforskningsrådet (The Council for Building Research) at the end of the first wave of energy subsidies concluded that additional insulation to exterior walls was the most common measure, but also the least cost-efficient, considering investment cost and life-time (Bostadsstyrelsen 1984). However, the evaluation was based on calculated effects and did not consider factors such as different methods for installation, etc. This study presents the first statistical analysis of energy savings provided by the extensive façade insulations carried out in the 1970s and 1980s.

**Subsidies for additional façade insulations**

Subsidies for additional insulation of exterior walls and other measures for increased energy efficiency were available for property owners from the mid-1970s. There were strong incentives for homeowners and housing companies to add insulation to walls and replace windows. Starting in 1975, up to 35 per cent of the cost for energy retrofits could be subsidised, with an additional possibility of lending 65 per cent of the total cost of improvements. This made it possible for property owners to fund the whole investment using governmental grants and loans (Legnér and Leijonhufvud, 2019). These early subsidies were part of the national programme EBB and included measures such as new windows, conversion to electric heating and additional insulation.

From 1984 subsidies for energy efficiency were included in the ROT programme. Although the regulations took a somewhat new form, the governmental objectives for energy savings were still ambitious and subsidies remained extensive. The target for the ten-year programme was to modernise 275,000 apartments and 150,000 detached houses older than 30 years, including cutting the energy use in buildings with 30 per cent. Included in the programme were energy efficiency subsidies of 10–15 per cent of the cost of investments for, e.g. additional insulation and new energy efficient windows. The programme also included interest subsidies amounting to roughly half the interest cost for loans for energy efficiency measures, including additional façade insulation. Also, an advantageous housing loan was provided for home improvement and energy efficiency. The financial instruments could in some, but not all, cases be combined (Tunefalk and Legnér, 2019).

Throughout the era of the two big energy-saving programmes loans and subsidies were administered by regional housing committees subordinate to the Board of Housing. Applications of property owners were evaluated based on potential energy savings, cost of investment and the age and state of the building (Bostadsstyrelsen, 1984). Measures that affected the character of the building, e.g. additional façade insulation, also demanded building permits administered by the local municipalities.

After 1993 many national policies on energy efficiency in the building stock were both introduced and quickly cancelled. None, however, has had such a profound effect on the built environment as the programmes of the 1970s and 1980s. Additional insulation has not been a targeted measure for later policies.
Policies for built heritage

The study relates energy retrofits to the designation of heritage values made by the city of Stockholm. The designation is made by the city museum and is based on a definition of heritage value as “the possibility to detect and convey information about, and understanding of, different time-periods and contexts” (Riksantikvarieämbetet, 2014, p. 12). It also includes experience values, such as aesthetic or symbolic value. This designation is used in the day-to-day administration of building permits, and therefore has a direct impact on the development of individual buildings and urban areas.

The Planning and Building Regulation of Sweden stipulates that all changes to a building must be made in consideration of its specific character regarding building technique and historic, heritage and aesthetic values (Plan och bygglagen). Buildings with particular or extraordinary heritage values may not be altered. The definition of values is, however, not articulated in the legislation, but is instead left to the individual municipalities. For this reason, the designation made by the city is of direct importance to the urban environment of Stockholm; it determines which buildings are subject to which paragraph. This study sets out to establish to what degree the designation is affected by additional façade insulations, i.e. if previous policies for energy efficiency affects today’s administration of buildings permits and planning. It is also possible that the designation of heritage buildings obstructs energy retrofits, and thus hampers the pace of energy efficiency improvements.

Material and methods

The study is based on a quantitative analysis of data collected from three databases: The National Energy Performance Certificate Database (EPCD), The National Database of Built Heritage (Bebyggelseregistret, abbreviated BeBR), and The Stockholm Heritage Designation Map (Stadsmuseets kulturhistoriska klassificeringskarta). The importance of each for the study is described in brief below:

(1) The EPCD is provided by The National Board of Housing, Building and Planning (Boverket). It is a result of EU directive 2002/91/EC, demanding that all buildings constructed, sold or rented have an approved energy performance certificate. The certificate is used both as information to potential buyers or tenants, and as a verification that new buildings meets current EP demands. Data included in the EPCD is building-specific EP, defined as kWh/m²/year, energy use corrected to a normal year, heat source, year of construction, A temp, location, adjacent walls, etc. c. 90 per cent of all multi-family buildings are represented in the database, and c. 15 per cent of the single-family buildings. In this study, the EPCD was used to determine the EP of individual buildings, as well as to draw a sample of buildings. Unlike most EU countries, the energy certificates in Sweden are based on measured data for energy use and issued by certified energy experts, making it a reliable data source (Mangold et al., 2018). However, certain ambiguities remain. For some properties with more than one building EP has been reported for the whole property and divided between included buildings. In theory, this reduces the benefits of a study of correlations between additional façade insulation, heritage protection and EP on a building level. In the studied area, this proved to be of no significance for the results since all properties contained buildings with the same heritage code, and either all or none of the buildings on a single property had additionally insulated façades.

(2) The BeBR is provided by The Swedish National Heritage Board. It includes descriptions, photographs and retrofit history (e.g. major changes, including additional insulation) for buildings in Sweden, including almost all individual buildings.
in Stockholm. The studied area is based on a survey from 2005. In this study, BeBR is used to mine data on additional insulation of buildings.

Based on historical documents and building inspection, the BeBR is a secondary source. The reliability of this study is partially dependent on the work of The Swedish National Heritage Board. However, the many photographs in the database have allowed us to verify the data. There is no reason to doubt the reliability of the BeBR.

(3) The Stockholm Heritage Designation Map is a legal document used in urban planning and building permit assessment in Stockholm. It provides a classification to each building based on its heritage values. The city conservation director is responsible for the heritage designation. Buildings are graded into three categories: blue, green and yellow. Blue represents the highest degree of protection and is applied to buildings with extraordinary heritage values; green represents particularly valuable buildings; yellow means that the building has a positive influence on the area and/or has some heritage values. Buildings that are not referred to any of these categories are classified as grey (Stockholms stadsmuseum, 2018).

Combining these sets of data enables a quantitative analysis of relations between the parameters EP, completed additional insulation, and heritage protection level, fulfilling the purpose of this study.

Sample selection
A sample of buildings based on location, building type, year of construction and heat source was made using the EPCD. Data have been collected and analysed for a single-stage cluster sample, consisting of all multi-family buildings heated with district heating and constructed 1940–1949 in the urban area of Årsta in Stockholm, Sweden. By identifying a homogenous sample of buildings, the number of factors that can interfere with the results are limited. These buildings are not of a very high age but they have been designated historically valuable.

The location was chosen because it is a cohesive area of multi-family buildings from the 1940s. The study is located to Stockholm, the capital and largest city, due to the advantages of studying a densely populated area, with larger possibilities to retrieve a feasible sample. In a country with large variations in climate as is the case in Sweden, it is appropriate to make a sample from the same location.

The sample is limited to multi-family buildings because: EP data are available for most of them (as opposed to single-family dwellings), providing a good basis for statistical analysis; they have a homogenous and measurable heat source (district heating), allowing reliable comparisons; they have a homogenous building fabric, also allowing comparisons; and they consume a large portion of the provided energy in the housing stock. Buildings used as residence to at least 50 per cent and have more than two apartments are classified as multi-family buildings.

For the sake of comparability, the sample is limited to buildings constructed in the years 1940–1949. Compared to previous decades many buildings were constructed in Sweden during these years, of which many also remain today (Nylander, 2013). It is also likely that they have been subject to additional insulation. According to the policy statement of ROT, buildings from 1930 to 1945 had the biggest need for additional insulation.

The heat source is a crucial factor for the EP of a building. Buildings with heat pump consume c. half of the delivered energy compared to those with district heating, which is the dominant heat source in the area. Mangold et al. (2015) recommend using one heating type when using EPC data to create an overview of the building stock. In order to correctly analyse the effects of additional façade insulations on the EP, buildings that are not heated to at least 90 per cent with district heating have been excluded from the sample.
Delimitations

Even though loans and subsidies were provided for a variety of measures, such as installation of new windows or boiler, this study is limited to analysing additional façade insulations. Unlike, e.g. new windows, it is a measure with the sole purpose of improving the energy efficiency. On the contrary to a new boiler, it is a measure that affects the character of a building, allowing a study of relations between energy savings and heritage values.

The analysis does not account for the degree of additional insulation in buildings. All entities have been given a value of either “insulated” or “not insulated”. A thick insulation has the same value as a thin. Buildings that have only partially been additionally insulated, e.g. one of the façades, have been given the value “insulated”. Admittedly, this reduction does not account for the many variations displayed in the building stock. However, it allows for an overall evaluation of the measure.

Finally, it should be noted that the empirical part of this paper is a case study of a specific area and building type. The purpose of the study is largely exploratory, and it is uncertain if extrapolations of the results to a larger building stock can be made. Further studies are needed to determine the effects of energy savings subsidies on the built environment as a whole. The results are nevertheless of interest since they demonstrate the practical applicability of a novel and robust method for evaluating effects of previous policies for energy efficiency on EP and heritage protection.

The case of Årsta

The area Årsta in Stockholm, Sweden, was first planned in 1939 and mostly constructed between 1943 and 1947, with additions made in the early 1950s. The area was extended to the south in the first half of the 1960s (Stockholms stadsmuseum, 2009). It is predominantly a residential area, consisting of 316 properties. Almost all residential buildings are multi-family buildings. Characteristic for the environment in Årsta – and other close suburbs in Stockholm – are slim, typically three-story lamellar buildings, with a majority of one- and two-room apartments (see Plate 1). The original façades are plain, without decorations, typically in lightly coloured plaster (Stockholms byggnadsnämnd, 1983). When constructed, the area was located outside of the city. After massive expansions of suburbs in the 1960s and 1970s, it is now considered to be located relatively close to the city centre.

Source: Bebyggelseregistret

Plate 1.
Typical three-storey lamellar buildings in Årsta
Results

There are 289 multi-family buildings constructed 1940–1949 in Årsta. 141, or 49 per cent, of these have additional façade insulation. 140, or 48 per cent, have not been additionally insulated. In eight buildings the study has not been able to determine whether additional façade insulation has been installed or not. BeBr has not provided clear information on these buildings.

The EP of the buildings in the study varies widely, from 106 to 266 kWh/m²/year. The average EP is 165 kWh/m²/year. Buildings with additional façade insulation have an EP of 147 kWh/m²/year, which is 20 per cent less than buildings with original insulation, which have an EP of 183 kWh/m²/year (see Table I).

The correlation between additional façade insulation and EP is statistically significant (T = −8.4, R_s = 0.65). A total of 12 per cent of the buildings with additional façade insulation and 73 per cent of those without have an EP that is higher than mean. Grading the buildings by EP, 92 per cent of the first quartile (the lowest EP) have additional façade insulation, and 15 per cent of the fourth quartile. However, a few of the buildings with additional façade insulation have a conspicuously high EP. In fact, the building with highest EP by far, 266 kWh/m²/year, had additional façade insulation installed in the 1980s. As Figure 1 demonstrates, the spread in EP is even among the buildings with original insulation; all four quartiles are approximately the same size. The EP of buildings with additional façade insulation has a positive skew. There is a longer span between the highest and lowest EP, and the first and second quartiles are significantly narrower than the third and fourth.

The time from the first introduction of energy-saving subsidies can be divided into three periods of c. one decade each. The first period consists of EBB and its precursory policies, stretching from 1973 to 1982. The second period is the ROT programme, 1983–1993, which took up many of the policies included in EBB. The third period is 1994–2005, when no major energy-saving programme was active. The study ends with the year 2005, when the inventory of the retrofit history was performed. During the first two periods, major subsidies were available for additional insulation.

As demonstrated in Figure 2, this division shows that the majority of the additional façade insulations in the sample was made during the ROT programme. A total of 19 (13 per cent) of the additional façade insulations were made during EBB; 96 (68 per cent) were made during ROT; 17 (12 per cent) were made later. Nine insulations (6 per cent) have not been dated. The study shows only small differences in EP between insulations made in the different periods. Buildings that had additional façade insulation installed during EBB have an EP of 150; those that were insulated during ROT have an EP of 147; buildings with later additional façade insulation have an EP of 141.

The Stockholm Heritage Designation Map classifies the majority of the buildings in the area, 250 buildings or 87 per cent, in yellow category, “having a positive influence on the area and/or has some heritage values” (Stockholms stadsmuseum, 2018) (see Plate 1). A total of 26 buildings or 9 per cent are categorised as green, “particularly valuable buildings”. Only two buildings are categorised as blue, “buildings with extraordinary heritage values”. A total of 11 buildings or 4 per cent are categorised as grey, the lowest assessment of heritage values.

<table>
<thead>
<tr>
<th>Table I. Energy performance of buildings with additional insulation, with original insulation and those there is some uncertainty about</th>
<th>Number</th>
<th>Share (%)</th>
<th>kWh/m²/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional insulation</td>
<td>141</td>
<td>49</td>
<td>147</td>
</tr>
<tr>
<td>Original insulation</td>
<td>140</td>
<td>48</td>
<td>183</td>
</tr>
<tr>
<td>Uncertain</td>
<td>8</td>
<td>3</td>
<td>162</td>
</tr>
<tr>
<td>Total</td>
<td>289</td>
<td>100</td>
<td>165</td>
</tr>
</tbody>
</table>
Notes: Blue objects have a particularly high historical value. Green objects have a high value, while yellow ones have some value.

Source: Stockholms stadsmuseum (2018)
Of the 141 buildings with additional façade insulation 130, or 92 per cent, are categorised as yellow and 11, or 8 per cent, as grey. None of the buildings with additional façade insulation have been designated as being “particularly valuable” or having “extraordinary heritage values”. Of the 250 buildings in the yellow category, 52 per cent have additional façade insulation. The 11 buildings in the grey category all have additional façade insulation.

As expected, considering the rate of additional façade insulation in each category, there is a significant difference in EP in relation to heritage classification. Buildings in the yellow category have an overall EP of 160; the green category has an EP of 190; and the blue, i.e. the most valuable buildings, 221.

Discussion
The case study displays a strong correlation between completed additional façade insulations and lower EP. Based on the sample for this study the difference is 36 kWh/m²/year, or 20 per cent between buildings with additional façade insulation and those without. The rate of additionally insulated façades is high – c. half of the buildings – considering that installation of additional insulation is a costly retrofit with a large impact on the buildings’ character. Generally, the measure was successful in saving energy: the savings per m² were substantial and a large share of the buildings was affected (Figure 3).

It comes as no surprise that additional insulation has effect on the EP of buildings. However, the study also shows that the EP varies widely, even among the buildings with additional façade insulation. In fact, the building with the highest EP has had additional façade insulation installed. This might be a coincidence. Although the benefit of additional façade insulation for the EP was significant, the range is wide between the most and least

![Figure 2.](image)

Energy performance of buildings according to the period in which they were given added insulation

![Figure 3.](image)

Energy performance in all buildings (yellow), in ones with additional insulation (blue), and in ones with original insulation (brown)
efficient additional insulations. Regardless of insulation or no insulation, it is worth noting the big difference in EP among a group of very similar buildings. Although the material qualities of the buildings show great similarities the difference between the best and worst EP is c. 250 per cent. Further research, including detailed studies of the physics and use of individual buildings, is needed to determine the reason for this gap. Still, the results from this study indicates potential problems in policy-making based on grouping of the building stock by year of construction or building type.

Most of the additional insulation of buildings covered by the study was carried out during the ROT programme in the 1980s and early 1990s. This is likely connected to the age of the buildings in the sample. Previous studies have shown that the pace of energy retrofits in buildings from the 1930s was highest in the 1970s, during EBB (Leijonhufvud et al., 2018). It is likely that areas from the 1940s were considered “good enough” during EBB, just to be targeted in the succeeding programme. When ROT was launched, these buildings were more than 30 years old, a requirement in order to receive funding at the beginning of the programme (Tunefalk and Legnér, 2019). Only a few buildings had additional façade insulation installed after ROT, either because there were fewer financial incitements for property owners after the beneficial subsidies during EBB and ROT were cancelled, or because there was less need since the most urgent measures had already been taken.

There seems to be a small improvement taking place in the way additional insulation was carried out. Buildings insulated in the period 1994–2005 have slightly lower EP than those insulated 1983–1993, which in turn are slightly more energy efficient than those insulated 1973–1982. The differences are however small, and it is questionable whether methods for lowering the EP by additional insulation of façades were improving during the period, or if the difference is a coincidence. It is however possible that the same EP was achieved with a thinner insulation in later times, increasing the energy efficiency with less effect on the character of buildings. Qualitative studies are needed to determine the effects in individual cases.

The study demonstrates a strong relationship between completed additional façade insulation and official heritage designation. All buildings that are categorised as lacking heritage values have had additional façade insulation installed, and none of the buildings categorised as “particularly valuable” or having “extraordinary heritage values”. It is possible that the most valuable or vulnerable buildings were exempt from façade alterations, but it is nonetheless likely that additional insulation has affected the valuation of buildings. Since the city’s heritage designation of buildings is used in the day-to-day administration of building permits and planning, and determines what legal statute is invoked, additional façade insulations made in the past – and by extension the policy measures included in EBB and ROT – continue to have effects on the character of the built environment.

The study has implications for both future policy-making and further research. The results indicate that policy measures were decisive in order for additional façade insulations to be carried out. In order to further improve the EP of the existing building stock, policy measures are most likely needed. The results further indicate that very few property owners will redo completed additional insulations. The study shows no evidence for this being done, even though 40 years have passed since the first ones. This implies that the emphasis in policy design and implementation should be on qualitative measures. It is however important that future policy-making acknowledges the small number of buildings that are classified as particularly valuable or having extraordinary heritage values. Although the results from this study indicate that these buildings have a significantly higher EP than other buildings, they constitute only a small part of the building stock. As demands for energy efficiency increases, it is important to ensure a satisfying protection for heritage values. For further research, the study has presented a method of combining data for EP, energy retrofits, and heritage protection, as well as identified a number of additional research questions.
Conclusion

The study indicates that energy-saving policies during the 1970s and 1980s were widely implemented in the built environment. They had a profound effect on the EP of buildings as well as on the heritage values in urban areas. Most likely they continue to affect the planning and administration of building permits today. The study demonstrates how a quantitative analysis, combining energy data with official heritage designation, can contribute to a better understanding of the relationship between energy retrofits, energy performance, and heritage values. In order to achieve a sustainable development, future policy making must bridge the gap between the issues of energy and heritage and take a holistic approach to the challenges in the built environment. Such an approach is made possible using methods for combining data related to different aspects of the built environment.

References

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Further reading


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Heritage retrofit and cultural empathy; a discussion of challenges regarding the energy performance of historic UK timber-framed dwellings

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Abstract
Purpose – The energy retrofit of the existing building stock, and specifically the thermal upgrading of the buildings’ envelopes, has been identified as a key action for both the decarbonisation of the built environment and the reduction in fuel poverty. When considering the energy retrofit of heritage buildings it is, however, important to recognise both the technical issues that this entails and the potential impact on their cultural value and the emotional responses to it. The purpose of this paper is to focus on the thermal upgrading of historic timber-framed buildings in the UK.
Design/methodology/approach – The paper begins by exploring the cultural significance of this form of building construction, before examining three case studies using both quantitative and qualitative methodologies.
Findings – The results show that whilst the application of energy retrofit actions to this emblematic typology may have limited success, the emotional connection of the buildings’ occupants often results in the work resulting in higher user satisfaction than would otherwise be expected.
Research limitations/implications – Although limited in number, the three case studies provide an insight into the complex issues surrounding the low energy retrofit of historic timber-framed buildings. Further research into this area is encouraged.
Practical implications – The paper contains the monitoring of specific retrofit details, the results of which should inform future projects.
Social implications – The review of the cultural significance of historic timber-frame buildings in the UK underlines the importance of the conservation and continuing survival of these buildings.
Originality/value – Previous heritage retrofit research in the UK has focussed on solid wall construction with little investigation into the issues surrounding the retrofit of historic timber-frame buildings. This paper explores this previously under-researched area. Additionally, this paper begins to explore the possible links between occupants’ emotional connection to historic buildings and their perceived levels of comfort.
Keywords Thermal comfort, Cultural significance, Energy retrofit, Historic timber frame

Introduction
In 2018, the Intergovernmental Panel on Climate Change (IPCC, 2018) reiterated that reductions in heating and cooling demand, and specifically building envelope improvements, present the largest energy saving potential in the built environment (p. 141). The same report thanks go to the occupants and owners of all three case studies for allowing access and monitoring of their homes.
acknowledged that in developed countries, this would primarily be in the form of energy retrofits of the existing building stock (IPCC, 2018, p. 142). In 2014 the UK government committed to improving the energy efficiency of our current building stock in order to achieve carbon emission targets (DECC, 2014, p. 73). They too identified energy efficient renovation as the overarching approach for realising this, with the thermal improvement of the buildings’ envelopes as their first principle (DECC, 2014). However, when considering historic buildings it is important that these thermal improvements have limited negative impact on both their heritage value and their historic built fabric. As such it is important to understand both the cultural significance of these buildings and the technical conflicts that may arise (Historic England, 2012).

It has been estimated that approximately 22 per cent of dwellings in England and Wales were built pre-1919 (Nicol et al., 2014, pp. 4-5), as were 45 per cent of non-domestic properties (Pout et al., 1998, p. 10). Of these approximately 1.2 per cent of pre-1919 dwellings and 2 per cent of pre-1919 non-domestic properties are of traditional timber-framed construction (Whitman, 2017). Although small in number, totalling around 68,000 (Whitman, 2017), these buildings with their loadbearing timber structure, often exposed both internally and externally, hold a special place in the national, and especially English, notion of cultural identity. It has been asserted that there is something quintessentially English about these buildings (Ballantyne and Law, 2011b, p. 125), something that elevates their place in the national conscience. This paper aims to explore the communal or associative values of historic timber-framed buildings in the UK, before examining how these values impact on the energy retrofit of these buildings, through the analysis of three case studies.

Whilst it has been acknowledged that those who live in naturally ventilated buildings usually accept a wider range of comfort temperatures (Givoni, 1994, p. 39) and psychological adaptation is identified as an influencing factor in adaptive thermal comfort (Humphreys, 2015, p. 100), little research has been undertaken into the correlation between occupants’ perception of their home’s cultural value and their perceived comfort. In general it has been noted that few studies exist that examine the role of the occupant in the assessment of historic building retrofits (Fouseki and Cassar, 2014, p. 97), with those that do, focusing either on the occupants’ decision making process (Sunikka-Blank and Galvin, 2016) or the effect of their behaviour on energy use (Ben and Steemers, 2014). This paper begins to explore the links between occupants’ associative and heritage values and their perceived thermal comfort.

The cultural significance of historic timber-framed buildings in the UK

The publication of the Burra Charter (ICOMOS, 2013) was possibly one of the first times that the concept of cultural significance was clearly articulated, especially when related to the management of the historic environment (Worthing and Bond, 2008). The Charter defines cultural significance as the “aesthetic, historic, scientific, social or spiritual value for past, present or future generations” (Worthing and Bond, 2008, p. 2). These values have now been adopted by most heritage bodies both internationally and in the UK (Historic England, 2008, p. 27; Cadw, 2011, p. 16; Historic Environment Scotland, 2016, p. 48) and inform planning policy (Ministry of Housing, 2019). In England and Wales these values are expressed as Evidential Value – the fabric of the asset itself; Historic Value – events, people or lifestyles represented or associated to the asset; Aesthetic Value – the sensory or intellectual pleasure that the asset evokes; and Communal Value – the meaning the asset has for those who relate to it (Ministry of Housing, 2019). Whereas in Scotland the terms used are Intrinsic, Contextual and Associative values (Ministry of Housing, 2019). The first part of this paper aims to explore the communal and associative values of historic timber-framed construction in the UK. It begins with a summary of its ongoing influence, even once it ceased to be a common construction technique, before turning to examine the reasons behind its enduring popularity.
The endurance of a style

Timber construction in the UK can be traced back to Neolithic times (Hillam et al., 1990, p. 214), however, fully timber-framed buildings, as commonly understood in the UK today, appear to have developed around the late twelfth century (Walker, 1999, p. 21). Surviving examples of such buildings can be found at Fyfield Hall, Essex (Bettley and Pevsner, 2007, p. 375) and the Wheat and Barley Barns at Cressing Temple, also in Essex (Bettley and Pevsner, 2007, p. 313). From this time until the 1600s, timber framing became a common construction technique (Harris, 2010) but fell out of favour in the late seventeenth century, following the Great Fire of London (Reddaway, 1940) and similar conflagrations in cities across the country (Borsay, 1989). However, even after timber framing ceased to be a standard structural solution, its aesthetics continued to be replicated, from the eighteenth century cottage orné, to the Victorian Olde English Style and the mock-Tudor houses of interwar suburbia. The enduring influence of timber-framed buildings can be seen to this day, be it implicit, as seen in the applied timber screens or tile hanging of the RIBA House of the Year award winners 2016–2018 (RIBA, 2018) or explicitly reproduced on mass housing.

Age old roots, rural idylls and the handmade

It has been attested that our fascination with the timber-frame results from its links to the past, and more specifically a Tudor past (Ballantyne and Law, 2011a, b; Stamp, 2006; Simpson, 1977). There is clear evidence for their reasoning. The “Tudor” period, from the crowning of Henry VII in 1485, until the death of Elizabeth I in 1603, is revered as a golden age of England (Ballantyne and Law, 2011a, p. 16). Its monarchs are seen as the most English of monarchs (Ballantyne and Law, 2011a, p. 30), which coupled with Henry VIII’s break from Rome, and the links with Shakespeare all add to the celebration of this age as truly “Old England” (Stamp, 2006, p. 5).

Yet if the imitation of the style was specifically to create an association with the Tudor age, would it not be more precise to use architectural styles developed under Tudor rule? If so, then surely the emerging renaissance architecture of Elizabethan houses such as Hardwick Hall or the great brick palaces of Henry VIII would be better archetypes to follow. Similarly, it is not the most emblematic Tudor timber-framed buildings that are reproduced, for example, those in the ornamental style epitomised by houses such as Little Morton Hall. Instead, they look towards the vernacular architecture of the Kent and Sussex Weald, as so clearly illustrated by the work of architect George Devey, 1820–1886 (Allibone, 1991) whose work was to influence Richard Norman Shaw and William Eden Nesfield (Allibone, 1991, p. 29, 44 and 81). Could it not, therefore, be said that these buildings did not look back to a specific Tudor past, but rather to a more generic Old England? A simpler, pre-industrial “time-gone-by”? (Simpson, 1977, p. 36; Ballantyne and Law, 2011a, pp. 38-39). Girouard (1977) narrated that “Dislike of the present led them to the past, dislike of the town, the country […]” (p. 5).

The rural idyll and the picturesque

Timber framing is essentially seen as a rural architecture, as such, just as it represents the past, it is also synonymous with the countryside. The romantic movement of the eighteenth and nineteenth century moralised the dichotomy between town and country, with health, honesty and virtue being characteristics of the country and corruption, greed and vainglory the town (Tuan, 1974, p. 236). In the 1870s, as Britain was losing its industrial supremacy to Germany and the USA (Howkins, 1986, p. 63), the metaphor of “the workshop of the world” (MacLeod, 2014) fell out of favour, with industrialisation increasingly seen as something un-English (Daniels, 1991, p. 15). As pride in the industrial north faded and power moved south (Howkins, 1986, p. 65), the “workshop of the world” became replaced with a “green and pleasant land” (Bunce, 1994, p. 21) and more specifically one formed by an idealised
“South Country” (Howkins, 1986, p. 65), a notional definition of rurality, embodied in the countryside of southern England as seen by those looking out from the urban world (Howkins, 1986, p. 64).

At the same time, traditional rural life was under threat, whereas once industry had attracted people to the city, the lack of rural employment of the late nineteenth century now drove them to it (Lowe, 1989, p. 12). As the productivity of the countryside declined, its potential as an escape from the city increased, both physically through the emergent rail network (Howitt, 1844, p. 316-5) and ideologically such as through Cadbury’s Chocolate boxes’ illustration with rural scenes painted by artists such as Myles Birkett-Foster (Short, 2006, p. 141). Just as the works of Birkett-Foster, Wordsworth, Constable, Turner, et al. provided a link for the city dwellers to the rural idyll, so did timber framing become the shorthand for the vernacular architecture of the “South Country” (Jackson, 1973, p. 140).

Therefore, we can see that the significance of timber-framed architecture can be traced to the past, be it a specific Tudor past or a more generic past. At the same time, it draws on a desire for an escape from the city, a return to the country. However, if these were the only issues at play here, could you not say the same about stone cottages or other rural typologies?

The materials of timber-framed buildings, the oak for the frame, the hazel withies for the wattle and the earth for the daub, come directly from the land, thereby making it truly an architecture with roots. On the frontispiece of Laugier’s 1753 Essai sur l’architecture (Laugier, 1777) his “rustic hut” is shown constructed of tree trunks growing from the ground, underlining timber-framed buildings’ “fundamental link between soil and house, nation and village, as if the cottage had grown up out of the land on which it stood” (Sayer, 2000, p. 115) a sentiment shared by the interwar Conservative Prime Minister Stanley Baldwin, in his inaugural speech to the Royal Society of Arts, 26 January 1927 (Daily Mail, 1927, p. 59). Baldwin also highlighted it as a link to the mediaeval craftsman (Daily Mail, 1927). Though his assertion may be questioned since the craftsmanship in machine cut applied timbers of contemporary designs was limited, we find here another component of the significance of timber framing, that of the handmade. There is the sense that almost anyone could, if not build from scratch, at least add to and amend a timber-framed, or apparently timber-framed home (Ballantyne and Law, 2011a, b, p. 125, p. 140). Equally there is the acknowledgement of the skill and care of the artisan. This embodiment of the craftsman skill and ancestral knowledge are recognised internationally by ICOMOS as the key values of wooden architecture (ICOMOS, 2017).

In a world in which production becomes increasingly mechanised there is a counter-reaction to perfection, an attribute previously aimed for by the skilled artisan, and the irregularities resulting from manual labour become more highly prized (Osborne, 1977; Sennett, 2008, p. 84). A key factor in the added value of “the handmade” has been identified as the perceived love and personal care invested in the production of the product by the craftsman, as opposed to the impersonal, emotionless work of the machine (Fuchs et al., 2015). Timber framing with its axe signatures, saw marks and carpenter’s marks, clearly manifests the hand of the artisan in its production, and as a consequence, Fuchs et al. would argue, their love.

The enduring importance of timber-framed buildings in the British or more specifically English cultural identity would, therefore, appear to be a combined result of three key factors. A connection to the past, be this specifically a Tudor past or a more general times gone by; its evocation of the rural idyll, being not only present in the countryside but physically made of it; and the evidence of the hand of the craftsman, increasingly valued in an progressively mechanised world. All three are symptoms of the industrialised world, the desire to return to a time before it, to escape from the city created by it and a rejection of the perfection it has enabled. We have seen that even after timber framing ceased to be a common structural solution, its aesthetics continued to be replicated. Yet these
imitations underline the need to conserve the remaining examples of true timber-framed buildings that inspired them. If we were to be left with only reproductions, with their half-timbers only skin deep, then an integral part of our identity would be lost. It can be argued, therefore, that the continued use of historic timber-framed buildings and their conservation is of national importance. The following case studies look at the low energy retrofit of three historic timber-framed dwellings, examining their success both quantitatively and qualitatively.

Case studies
With many low carbon retrofits, the main objective is the reduction of greenhouse gas emissions. However, given the small percentage of the total domestic building stock represented by historic timber-framed dwellings, reducing their emissions will have a minimal impact. The overriding aim of retrofitting these properties should, therefore, be to ensure that these buildings provide reasonable comfort to their inhabitants and by doing so enabling their continued occupation and survival. As such, there is a focus on the thermal performance of the building’s envelope. At the same time, it essential that any retrofit actions do not put at risk the historic building fabric nor damage the previously identified buildings’ heritage value.

The three buildings chosen are a mediaeval peasant hall now let as holiday accommodation; an estate cottage built over three centuries, now let by the National Trust as a single-family residence; and a farmhouse dating from the sixteenth Century, now in private ownership. As such, the case studies represent a variety of ownership models, tenancies and uses. The first and third case studies have undergone substantial retrofits and display a variety of different panel infills, both old and new. In the case of the first, this work was designed and overseen by a local, sole practitioner architect. In contrast, the second case study has had minor retrofit interventions with no change to the existing panel infills, with the works specified by the Estate surveyor in line with the National Trust’s environmental standards. The retrofit of the third case study dates from prior to the current ownership and appears to have been undertaken without planning permission or listing building consent. Proposals to rectify the damage caused by this retrofit have recently been granted planning permission.

Location
The first two case studies (1 and 2) are both located in the county of Herefordshire, in the English West Midlands or Welsh Marches. Figure 1 illustrates that this county encompasses the southwest quadrant of a western concentration of timber-framed buildings in the UK. The predominant panel infill materials in Herefordshire are exposed brick (47 per cent), lime plaster or cement render (44 per cent) and wattle and daub (8 per cent) (Whitman, 2017, p. 218). A high proportion of buildings with modern infill can also be found locally, with 16 per cent of those listed with twentieth century infills located within the county boundaries (Whitman, 2017).

The third case study is located in Suffolk, in East Anglia, an area encompassing the highest concentration of historic timber-framed buildings in the UK (44 per cent) (Whitman, 2017, p. 153). The predominant panel infill materials in Suffolk are lime plaster or cement render (53 per cent), followed by completely rendered buildings (34 per cent) and timber clad buildings (8 per cent). The remaining 5 per cent are divided between brick, wattle and daub, tile hanging, stone and modern infill.

Climatic conditions
The majority of the UK is located in a temperate maritime climate with warm summers and cold winters, classified under the Köppen–Geiger climate classification system as Cfb
The heating season typically lasts from November until March with no requirement for mechanical cooling during the summer months. Figure 2 shows the climates for Herefordshire and Suffolk generated using the software Meteonorm™ version 6.1, compared to the UK average values as published by the Met Office (2009). Both counties share similar temperatures, higher than the UK average. Levels of relative humidity are consistent with the UK average but precipitation is lower. Suffolk receives marginally less (538 mm) than Herefordshire (546 mm) over the year, however, the pattern of precipitation differs considerably. Suffolk experiences the maximum levels of precipitation during the summer months, the inverse to the UK average, due to the summer thunderstorms that are more common in the east of the country (Manley, 1955, p. 262). It should be noted that Herefordshire has a fairly dry climate considering its western location due to the rain shadow of the Welsh Mountains (Phillips, 2013, p. 117).
Methodology

Quantitative monitoring

*In situ* hygrothermal monitoring was undertaken, including U-value measurements following BS ISO 9869-1:2014 (British Standards Institution, 2014), thermography following best practice guidance (Hart, 1991; Young, 2015), pressure testing according to BS EN ISO 9972:2015 (British Standards Institution, 2015) and measurements of internal hygrothermal comfort based on criteria defined by Givoni (1998) using TinyTag Ultra 2 TGU-4500 sensors. The measured *in situ* U-value measurements were then compared to U-values calculated according to BS EN ISO 6946:2007 (British Standards Institution, 2007) with values taken from BS EN 12524:2000 (British Standards Institution, 2000). Timber moisture content was also monitored but the detailed results are not presented in this paper. Due to personal circumstances of the tenant at Case Study 2, equipment could not be left onsite, thereby limiting monitoring to only thermography, pressure testing and timber moisture content at this case study. It was, however, possible to monitor this property both pre- and post-retrofit.

Quantitative simulation

Simulations were undertaken using the software DesignBuilder Version 4.2.0.54, a graphical interface for the dynamic simulation engine EnergyPlus DLL v8.1.0.009 (Design Builder, 2014). For the building thermal zone calculation, EnergyPlus uses a heat balance model based on the assumption that the air in each building zone is homogenous with no stratification of temperature (Crawley *et al.*, 2001, p. 323). The complicated timber frame was, therefore, simplified to block sub-surfaces, the area of which accurately represents the area of timber frame, if not its precise location and configuration (Figure 3).

Simulations were undertaken for each of the retrofit solutions undertaken at the case studies, with each of the individual retrofit actions simulated separately in order to assess their specific impact on the buildings' heating energy demand. In addition, simulations of the combined effect of multiple retrofit actions, both real and hypothetical scenarios, were undertaken to compare the current and future potential performance of these buildings.

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**Figure 2.**
Climatic data for the UK, Herefordshire and Suffolk

<table>
<thead>
<tr>
<th>Legend</th>
<th>UK Average</th>
<th>Herefordshire</th>
<th>Suffolk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precipitation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relative Humidity</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Sources:** Meteotest (2016) and Met. Office (2009)
Qualitative monitoring
At Case Studies 2 and 3, a simple semi-structured interview was devised following the guidance given by Nichol et al. (2012) using an adaptation of the Bedford (1936) comfort scale from 1 – very cold, to 7 – very hot and including observations on the occupants current and typical behaviour with relation to their thermal comfort. Direct interviews were not possible at Case Study 1, however, access to the visitors’ book of this holiday accommodation allowed a systematic review of guests’ comments.

Summary of case studies
Table I summarises the key statistics of the three case studies. It can be seen that Case Study 3 is the largest property, with Case Studies 1 and 2 being similar in size and Case Study 1 being the most compact property.

There follows more detailed descriptions of each case study and the associated results of in situ monitoring, digital simulation and the occupants perceptions of comfort.

Case Study 1
Introduction
Case Study 1 is a fifteenth century cruck hall in the Wye Valley, Herefordshire. For much of the twentieth century it lay abandoned and derelict, before being restored 2000–2012. It now provides holiday accommodation. The renovation involved three different approaches to wall infill panels, retaining surviving oak lath and lime plaster panels where possible (7 per cent of infill panels by area); new wattle-and-daub panels (18 per cent); and multi-foil insulation (46 per cent), the foil held by upright staves within a void, finished internally and externally with lime plaster on expanded metal lath. The distribution of these panels is shown in Figure 4.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Case Study 1</th>
<th>Case Study 2</th>
<th>Case Study 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>C15th</td>
<td>C16th</td>
<td>C16th</td>
</tr>
<tr>
<td>Tenancy</td>
<td>Holiday let</td>
<td>Let</td>
<td>Owner occupied</td>
</tr>
<tr>
<td>Net floor area (m²)</td>
<td>101</td>
<td>157</td>
<td>238.5</td>
</tr>
<tr>
<td>Area of external envelope (m²)</td>
<td>425</td>
<td>430</td>
<td>734</td>
</tr>
<tr>
<td>Percentage of external envelope (%)</td>
<td>14.6</td>
<td>23.1</td>
<td>19.3</td>
</tr>
<tr>
<td>Surface in contact with the ground</td>
<td>14.6</td>
<td>23.1</td>
<td>19.3</td>
</tr>
<tr>
<td>Timber-framed wall</td>
<td>33.8</td>
<td>15.6</td>
<td>41.5</td>
</tr>
<tr>
<td>Masonry wall</td>
<td>1.9</td>
<td>32</td>
<td>34</td>
</tr>
<tr>
<td>Openings</td>
<td>21.4</td>
<td>32</td>
<td>34</td>
</tr>
</tbody>
</table>

Note: *Including surfaces in contact with the ground

Figure 3.
Design builder models of (from left) Case Studies 1, 2 and 3

Table I.
Key statistics of three case studies
A new thatched roof was installed using reed from the Tay Estuary and Sedge, for the ridge, from the Norfolk Broads (Williams, 2011). From 2012 until 2015 the central bay of the hall was left with no internal finish to the underside of the thatch. Following pressure testing by the authors in 2015 it was decided to torch (lime plaster) the underside of this central section. The ground floor slab is a new construction due to the need to relocate the building by approximately 500 m during restoration. The slab construction is limecrete on expanded clay insulation, finished in sandstone flags.

In situ measurements

In situ monitoring was undertaken in 2015 (Whitman and Prizeman, 2016). A summary of the results is shown in Table II.

Those panels incorporating multi-foil insulation achieve the lowest $U$-value but do not achieve the anticipated calculated value, perhaps due to the internal staves and the exposed oak frame, both identified as thermal bridges by thermography. The pressure testing shows the airtightness of the house to be extremely poor, partly due to infiltrations.

<table>
<thead>
<tr>
<th>$U$-value</th>
<th>Material</th>
<th>Measured $U$-value (W/m$^2$ K)</th>
<th>Calculated $U$-value (W/m$^2$ K)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Repaired original lath and plaster</td>
<td>2.51</td>
<td>2.40</td>
</tr>
<tr>
<td></td>
<td>New wattle and daub</td>
<td>3.25</td>
<td>2.99</td>
</tr>
<tr>
<td></td>
<td>Lime plastered multi-foil insulation</td>
<td>0.71</td>
<td>0.41</td>
</tr>
<tr>
<td></td>
<td>UK Building Regulations Part L1B</td>
<td>–</td>
<td>0.70$^a$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Airtightness</th>
<th>Air changes per hour @50 Pa</th>
<th>Air permeability @50 Pa (m$^3$/h m$^2$)</th>
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</thead>
<tbody>
<tr>
<td>Pre-torching of thatched ceiling</td>
<td>130</td>
<td>154</td>
</tr>
<tr>
<td>Post-torching of thatched ceiling</td>
<td>68</td>
<td>80</td>
</tr>
<tr>
<td>UK Building Regulations Part L1A</td>
<td>–</td>
<td>5$^b$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hygrothermal comfort</th>
<th>Percentage of hours comfort achieved$^c$ pre-torching (%)</th>
<th>Percentage of hours comfort achieved$^c$ post-torching (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exterior</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Main hall</td>
<td>53</td>
<td>70</td>
</tr>
<tr>
<td>Bedroom (ground floor)</td>
<td>17</td>
<td>25</td>
</tr>
<tr>
<td>Bathroom</td>
<td>67</td>
<td>85</td>
</tr>
</tbody>
</table>

Notes: $^aU$-value for existing building with change of use. In this case from farm building back to house; $^b$an air permeability index is stated only for new constructions; $^c$percentage of occupied hours where hygrothermal conditions comply with criteria defined by Givoni (1998)
between the infill materials and timber frame, however, the untorched thatch roof was a major contributing factor. Following torching of this element the air permeability index is almost halved. The effect of this can be seen in the increase in the percentage of occupied hours where hygrothermal comfort is achieved, even despite the external climate being less favourable.

**Energy use simulations**

Four scenarios of infill panels were simulated using the measured $U$-values. The first imagined all lath and plaster panels had survived; the second imagined all panels had been replaced with new wattle and daub; the third that all had been replaced with the new multi-foil panels; and the fourth simulated the as-built situation with a mixture of all three panel types. These four scenarios were simulated with both the pre- and post-torching air-change-rates and a third hypothetical air-change-rate of 10 ac/h@50 Pa.

Figure 5 illustrates the high heating demand of this case study, with a building energy index of 455 kWh/m², principally due to the poor airtightness of the building envelope. It can also be seen that the performance of the infill panels has little effect on the heating energy demand with a variation of only $+4$ and $-0.01$ per cent when compared to the current situation. However, the simple act of torching the underside of the thatched roof, thereby improving the airtightness, sees a 36 per cent reduction. Further work, such as improving the joints between panel and timber frame and plugging post-holes could potentially improve the airtightness to a hypothetical 10 ac/h@50 Pa, thereby achieving a reduction of 72 per cent. Whilst for this specific property no historic fabric was lost in the upgrading of the infill panels, the results of these simulations should have significant weighting in the planning of future retrofits of historic timber-framed buildings.

**Occupants’ perceptions of comfort**

Of the 173 guests who had written in the book, between the house opening in August 2011 and July 2017, 12 per cent commented on the house being cold and draughty, whilst 9 per cent commented on it being warm or cosy. The other 79 per cent entries in the guest book made no mention of thermal comfort conditions within the house, commenting instead on their delight of staying in a fourteenth century cruck hall and the quality of the restoration work that the owner and his architect had achieved. It is interesting to note that all of the comments related to the house being cold or draughty were written prior to the torching of the thatched ceiling, confirming the impact of this action.

**Figure 5.**
Simulated heating energy demand (kWh/m²) for Case Study 1

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Heating Energy Demand (kWh/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LATH&amp;PLASTER</td>
<td>500</td>
</tr>
<tr>
<td>WATTLE&amp;DAUB</td>
<td>400</td>
</tr>
<tr>
<td>MULTIFOIL</td>
<td>300</td>
</tr>
<tr>
<td>AS-BUILT</td>
<td>200</td>
</tr>
</tbody>
</table>

Note: Hypothetical scenarios in grey
Case Study 2

Introduction

The second case study, let by the National Trust as a private residence, is located on the Brockhampton Estate in North East Herefordshire and has sections dating from the sixteenth, seventeenth and nineteenth centuries. In response to the Minimum Energy Efficiency Stands for let properties The Energy Efficiency (Private Rented Property) (England and Wales) Regulations (2015) the National Trust developed a set of environmental standards specifically for their let estate. These standards aim to achieve an Energy Performance Certificate of E or above, with the minimum intervention. The complete refurbishment of this property, following the end of a long lease, enabled the implementation of these standards, resulting in the fitting of secondary glazing and installation of roof insulation. No interventions were made to the walls or solid concrete floor. Thermography indicated that most infills were of modern concrete block, although some surviving wattle and daub were positively identified.

In situ measurements

As previously noted, due to the personal circumstances of the occupant, no monitoring equipment could be left onsite, therefore, measurements were limited to pressure testing and thermography which were undertaken in June 2015 prior to the retrofit and in November 2015 following its completion. The results are presented in Table III.

The increase in airtightness resulting from the installation of the secondary glazing is noticeable. Whilst beneficial with regards to energy efficiency, there could be some issues concerning increased internal moisture levels. This was particularly noted in the bathroom where no controlled ventilation strategy had been implemented. Thermography showed an improvement of the thermal performance of the roof.

Energy use simulations

The two retrofit actions (secondary glazing and roof insulation) were simulated separately. In addition, two hypothetical retrofit actions were modelled, the first replacing all concrete block infill panels with wood-fibre insulation and the second replacing all infill panels, including historic wattle and daub. Combinations of all retrofit actions, both real and hypothetical, were also simulated.

The results (Figure 6) demonstrate that the installation of secondary glazing is more effective (10 per cent reduction) than replacing all the infill panels (9 per cent reduction). Whilst it can be argued that secondary glazing is visually intrusive it is, however, a fully reversible retrofit action and does not result in the loss of historic fabric. The insulating of the roof is the retrofit action with the greatest individual benefit (25 per cent reduction) which when combined with the secondary glazing results in an overall reduction of 34 per cent and is the solution that was applied in reality with a building performance index of 75 kWh/m². It is questionable whether the additional 11 per cent reduction, achievable by replacing all infill panels, would ever be justifiable considering the disruption and potential loss of historic fabric.

<table>
<thead>
<tr>
<th>Airtightness</th>
<th>Air changes per hour @50 Pa</th>
<th>Air permeability @50 Pa (m³/(h m²))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-retrofit</td>
<td>16.5</td>
<td>17.8</td>
</tr>
<tr>
<td>Post-retrofit</td>
<td>10.8</td>
<td>11.7</td>
</tr>
<tr>
<td>UK Building Regulations Part L1A</td>
<td>–</td>
<td>5³</td>
</tr>
</tbody>
</table>

Note: aAn air permeability index is stated only for new constructions
Occupants’ perceptions of comfort
A semi-structured interview was conducted with the one occupant to gain an insight into their perception of the internal thermal comfort. The interview took place on the morning of 28 July 2017 in the kitchen with the sun shining outside. The occupant reported to be comfortable at the time of answering, whilst standing wearing jeans and long sleeve top, with a dry-bulb temperature of 23.7°C and a relative humidity of 52.2 per cent. They found the house cold in winter. This they counteract by wearing thick jumpers. They describe the kitchen as the coldest room of the house, with the bathroom being ok and the sitting room being warm once the log burner was lit. They commented on how the heat from the log burner did not reach the rest of the house due to the sitting room being single storey and separated from the rest of the house by the thick stone chimney. Historically this would have been continually heated from both sides by open fires in both the living room and kitchen. Currently, the flue of the log burner imparts little heat to this large thermal mass. In summer the downstairs rooms were reported to be comfortable or pleasantly cool; however, the upstairs room can overheat, especially the main bedroom, located above the kitchen.

The heating is a modern central heating system fuelled by liquefied petroleum gas (LPG). This was noted to be expensive but not a limiting factor, with heating being used as required from September to March, on a thermostat set to 21°C from 6 a.m.–10 p.m., and 15°C at night or when unoccupied. However, it was noted that the heating struggled to achieve a temperature of 19°C, this being blamed on the insufficient number of radiators. In the living room, the one radiator was felt to make little difference and the log burner is used every day in winter 1 p.m.–10 p.m.

Even though the occupant found the house cold in winter and hot upstairs in summer they were happy living there and accepted that these were part and parcel of choosing to living in an old house in the countryside. They were content with their home and would not consider moving or requesting further retrofit actions.

Case Study 3
Introduction
The third case study, now a private residence with two occupants, is located in the centre of Suffolk and is a Grade II listed former farmhouse, dating back to the sixteenth century (Historic England, 2014).

In the early to mid-twentieth century the timber-frame was overclad in cement render. The timber cill beams were encased in concrete and their interior faces painted with an
impervious resin. In around 2005 most of the lath and plaster infill panels were replaced with rigid polyisocyanurate (PIR) thermal insulation. This detail exacerbates the cold bridging of the historic timber frame by the introduction of additional timber battening to take the plasterboard. The PIR insulation is not mechanically fixed or bonded and is left free standing within the opening with large gaps around the sides in many instances.

On opening up the walls, it was observed that the expanded metal lath used to carry the cement render had in many places completely corroded away and the original oak laths were in a state of advanced decay. Areas of the external cement render are cracked allowing rain penetration into the wall and building interior.

It is likely that the cement render was applied to reduce the need for maintenance of the previous lime render and the PIR insulation installed to improve internal comfort conditions and reduce energy consumption. However, neither was undertaken with a full understanding of the performance of the historic built fabric, and has now resulted in the poor current condition of the building.

The current ground floor slab is cast concrete finished in honed sandstone flags. The roof is thatched, insulated at ceiling level with mineral wool batts.

**In situ measurements**

The measured $U$-value of the PIR insulated infill panels is well below the calculated value, even when the thermal bridging of the timber frame is considered. This shortcoming is due to the poor design detail and installation of the rigid insulation and gypsum plasterboard. Both materials are ill suited to historic timber frames with their irregular shapes and crooked angles. Internal thermography identified cold edges on most panel, highlighting the deficiencies of this detail. Its poor airtightness is further corroborated by the pressure testing results and as a consequence the low number of hours where hygrothermal comfort are achieved. Measurements of timber moisture content identified conditions at risk from biological attack from fungi and insect larvae, largely due to the use of non-moisture permeable materials and finishes (Table IV).

<table>
<thead>
<tr>
<th>Material</th>
<th>Measured $U$-value (W/m²K)</th>
<th>Calculated $U$-value (W/m²K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIR insulation with cement external render and gypsum plasterboard lining</td>
<td>1.72</td>
<td>0.921</td>
</tr>
<tr>
<td>UK building regulations Part L1B</td>
<td>–</td>
<td>0.70&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Airtightness</th>
<th>Air changes per hour @50 Pa</th>
<th>Air permeability @50 Pa (m³/(h m²))</th>
</tr>
</thead>
<tbody>
<tr>
<td>As measured 11 March 2017</td>
<td>18</td>
<td>19</td>
</tr>
<tr>
<td>UK Building Regulations Part L1A</td>
<td>–</td>
<td>5&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hygrothermal comfort</th>
<th>Percentage of hours comfort achieved&lt;sup&gt;d&lt;/sup&gt; (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exterior</td>
<td>12</td>
</tr>
<tr>
<td>Drawing room&lt;sup&gt;c&lt;/sup&gt;</td>
<td>50</td>
</tr>
<tr>
<td>Study</td>
<td>26</td>
</tr>
<tr>
<td>Guest Bedroom</td>
<td>4</td>
</tr>
<tr>
<td>Master Bedroom</td>
<td>38</td>
</tr>
</tbody>
</table>

**Table IV.** Results of *in situ* monitoring at Case Study 3, March-April 2017

**Notes:**<sup>a</sup>$U$-value for existing building with change of use. In this case from farm building back to house;<sup>b</sup>an air permeability index is stated only for new constructions;<sup>c</sup>no data recorded 5 November 2016–11 March 2017 due to failure of sensor;<sup>d</sup>percentage of total hours where hygrothermal conditions comply with criteria defined by Givoni (1998).
Energy use simulations
The current situation was simulated using the measured $U$-values and airtightness. A further two simulations were undertaken using the calculated $U$-value to simulate the outcome potentially anticipated when the retrofit was undertaken. One used the measured airtightness, whilst the second assumed an improved airtightness with an air change rate of 0.5 ac/h, a level seen to be achievable at Case Study 2.

Based on surviving infill panels in the West Gable it is assumed that the house originally had lath and plaster infill panels. Two hypothetical pre-retrofit simulations were undertaken based on this assumption, one with the measured air change rate (0.9 ac/h), and a second assuming an air change rate of 0.5 ac/h.

Finally, four hypothetical retrofit actions were simulated. The first replaced all windows with triple glazing. As all current windows are already well fitting, it was assumed that this would not result in an increase in airtightness. The second assumed an increase in airtightness could be achieved by sealing all junctions between the gypsum plasterboard and timber frame. The third replicates the current owners proposals to replace all PIR insulation with an equal thickness of sheep’s wool, replace the external cement render with lime render on oak laths, and the internal gypsum plasterboard with lime plaster on oak lath. In the first instance, the airtightness is maintained at its current level, whilst the fourth and final simulation assumes that this revised construction would achieve an improved air change rate of 0.5 ac/h. As the roof is already well insulated with 200 mm of mineral wool, this was not proposed as a retrofit action.

Figure 7 shows that potentially, prior to the retrofit by the previous owner, the heating demand for the house could have been marginally better (~1 per cent) than the current situation which has a building energy index of 92 kWh/m². If the assumption that the original lath and plaster were more airtight than the current detail, then the house may even have been 10 per cent more efficient. Obviously, this was not the intended outcome. If the thermal performance of the walls had achieved their calculated design value of 0.921 W/m² K, then a 26 or 35 per cent reduction in heating energy demand would have been accomplished depending on the airtightness achieved.

Note: Existing situation shown in red
Source: Author’s own (2017)
The replacement of all windows with triple glazing makes little difference to the heating energy demand with the simulation results showing only a 2 per cent reduction. This is to be expected, as most of the windows are already double glazed units in modern timber frames.

The simulation suggests that the new retrofit proposals of the current owner could achieve a 23 or 32 per cent reduction in heating energy demand depending on the resulting airtightness. These results assume that the sheep’s wool and lime plaster detail would achieve the calculated design $U$-value, which may not be the case, but is more probable than that of the rigid polyisocyanurate and gypsum boards due to the materials abilities to adapt to the irregularities of the timber frame fully filling the infill panel.

**Occupants’ perceptions of comfort**

Semi-structured interviews with both of the occupants took place on the 11 March 2017 with the sun shining. In summary, both occupants found the ground floor of the house to be comfortable in winter but slightly warm in summer. The converse was true with the upper floors, with both finding them comfortable in summer but in winter slightly cool in the case of the male occupant and cold in the case of the female. The difference in subjective thermal perceptions and preferences between the two occupants was evident from both reporting to feel comfortable during the interviews, despite the male occupant being outside in a t-shirt and trousers with a dry-bulb temperature of 14.8°C and the female occupant reclining inside in a fleece, t-shirt and jeans at a temperature of 18.8°C. It was also notable in the female’s study being kept slightly warmer than the rest of the house and the male’s study on the top floor being slightly cooler.

It is interesting to note their thermal perceptions of the house do not appear to corroborate the hygrothermal monitoring. This is possibly due to the fact that the hygrothermal monitoring measured only air temperature and thermal comfort may have been achieved by radiation from the underfloor heating. It may, however, also indicate that the occupants are willing to accept lower comfort criteria in order to allow them to realise their ambition to live in a historic timber-frame building in a rural location.

With regards to heating and ventilation habits, the ground source heat pump was used almost continually throughout the year, except June and July, providing underfloor heating to the ground floor only. In addition, the log burner in the first floor drawing room was used every night throughout the year. Although the use of the log burner appeared to be at least in part a custom rather than being driven by thermal requirements. Electric convection heaters provide heating for the guest rooms. The windows to the master bedroom were always open and a window in the study was often opened. The rest of the windows were regularly opened especially in summer, with their use being governed principally by the need for fresh air, rather than as a means of regulating temperature.

**Discussion**

The results from the case studies highlight that it is possible to improve the thermal performance of the infill panels themselves if the incorporation of insulation is well detailed and installed. However, this is in itself does not guarantee an improvement in the internal hygrothermal comfort conditions. The airtightness of other elements of the building must also be considered, as must the critical junction between the infill and the timber frame. Ensuring that this detail is, and remains, airtight is a challenge that is evident in all three case studies. From a technical perspective, a pragmatic solution would be to apply either external or internal wall insulation that covers the timber frame, thereby reducing the thermal bridging of the frame and improving airtightness. However this would obscure this building typologies defining feature, the exposed timber frame, which we have seen is fundamental to its cultural significance. Whilst it could be argued for a compromise, leaving one side exposed, this would either diminish the pleasure of the occupant or the public
depending on the side it was installed. Even for those buildings, such as case study three, where the timber frame is already overclad, great care would still be required to maintain the irregularities and angles of the external envelope which bear testament to the true nature of the building’s construction. In Germany where a greater degree of energy retrofit of this building typology has already been undertaken, some have spoken out in opposition claiming “Insulation is the death sentence for half-timbered houses (Dämmung ist das Todesurteil für Fachwerkhäuser)” (Stephan, 2014) due to loss of the internal character both visual and climatic resulting from the use of internal wall insulation (Stephan, 2014). Given the case studies occupants’ apparent willingness to accept the short comings of their timber-framed homes, perhaps this calls into question the need to focus on the thermal performance of their walls. The results of the simulations and associated in situ monitoring have highlighted that it is often apparently small measures, such as plastering ceilings and installing secondary glazing, which can have the most significant impact on reducing the heating demand of these historic timber-framed buildings. It is interesting to note that property with the least intervention and the highest achieved reduction in heating demand was the property owned by National Trust, The Oaks. This is perhaps not surprising that an organisation with a large property portfolio of historic buildings should achieve the best balance between intervention, outlay and payback.

Conclusions
It has been shown that timber-framed buildings occupy a special place in the cultural identity of the UK and more specifically England. They form a link to a rural, pre-industrialised past, their hand carved timbers bearing testament to the skill of the craftsman and the productivity of the land. In order to ensure their continuing survival, their ongoing use and occupation must be considered. A balance must be met between improving their energy efficiency and maintaining their historic and cultural value. However, the research presented in this paper questions the assumption that twenty-first century standards must be achieved. At the same time the differences between the three case studies highlight the need for the review of the retrofit of historic timber-framed buildings on a case-by-case basis. The significance and condition of each building element must be considered to ensure that the proposed retrofit action does not produce unintended consequences and/or the unnecessary loss of historic fabric. To assist in this work further research is needed into possible solutions for the energy retrofit of historic timber-framed buildings and their potential impacts, both positive and negative on these buildings. At the same time, the work in this paper begins to question the influencing factors of occupant comfort and satisfaction in heritage buildings, opening a potential new field of investigation. By understanding both the technical parameters and the emotional connections with our built heritage it is hoped that these buildings can continue to feature in our collective cultural identity for generations to come.

References


IPCC (2018), “Global warming of 1.5°C. The intergovernmental panel on climate change”, Intergovernmental Panel on Climate Change.


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