THE FUTURE OF HISTORIC BUILDINGS: RETROFITTING TO IMPROVE THE THERMAL PERFORMANCE OF NEW ZEALAND ARCHITECTURAL HERITAGE

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ABSTRACT
Heritage conservation and energy efficiency considerations have converged in recent years. While new construction has focused on improved thermal performance to achieve high comfort levels in an energy efficient manner, the retrofitting of existing buildings with the same principles has just started to be recognised as a strategic measure, since they form much of the building stock and often have poor performance. In this context, listed heritage buildings play an important role and have the potential to lead as best practices. In fact, given their cultural significance, they are the most likely to remain for a long lifespan, so their adaptability to the future needs is of high importance. Although thermal retrofits were seen as a threat to conservation until recent decades, now they started to be recognised as a measure to help with the protection of heritage, ensuring healthy environments for a longer lifetime. In New Zealand, however, there is a gap between heritage preservation practices and environmental sustainability considerations. Existing policies only focus on other types of upgrades, such as seismic strengthening, fire safety and accessibility. In terms of industry practice, most retrofits only include shallow improvements, without making deep modifications to energy efficiency and indoor comfort. Therefore, there is the potential to use certification schemes for the retrofit of historic buildings in New Zealand. A comparison between three existing international retrofit certification schemes is presented, analysing GBC Historic Building®, EnerPHit and BREEAM® RFO. Each scheme has shown to have benefits and limitations – GBC® and BREEAM® provide a holistic approach, while EnerPHit focuses on energy and comfort. All schemes are relevant to NZ, as certified thermal retrofitting can bring long-term benefits in regards to energy savings and the health of the occupants of historic buildings, which are intangible aspects commonly disregarded in NZ building renovations.
Keywords: thermal retrofit, heritage buildings, energy efficiency, thermal comfort.

1 Introduction

Once two separate topics, heritage conservation and environmental considerations have been converging and integrating in recent years. Recognition by the UN sustainable agenda has meant a new level of importance given to cultural heritage, as it contributes to making cities sustainable as an enabler of inclusive economic development, a promoter for social cohesion, inclusion and equity, and a driver for the sustainability and liveability of urban spaces [1]. It is now recognised that preservation of the natural basis of life and cultural heritage preservation are equally significant objectives. This approach is described and supported by 3encult, the first European research project on the union between conservation of historic buildings and climate protection, which states that "[h]eritage preservation and energy efficiency need not be mutually exclusive aims. Conservation planned by an interdisciplinary team of experts will balance the values of energy and culture" [2].

In this context, since it is widely recognised that buildings designed for the future need to be planned to consume minimum energy and to minimise GHG emissions while ensuring comfortable conditions in a changing climate [3], there is a need to think about solutions for

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WIT Transactions on Ecology and the Environment, Vol 217, © 2019 WIT Press
www.witpress.com, ISSN 1743-3541 (on-line)
doi:10.2495/SDP180021

existing buildings, especially historic heritage. In recent years it has been recognised worldwide that energy efficiency in existing buildings is the greatest opportunity for a sustainable future [4]. In this context, listed heritage buildings play an important role and have great potential to lead as examples. As historic buildings are the most likely to remain for a long lifespan, their adaptability to the future is of high priority.

Although until recently energy retrofit was seen as a threat to conservation, nowadays it is recognised as a measure to help with protection of heritage by providing healthy indoor environments that can have a longer lifespan [5]. Retrofits in places of cultural and historical significance are often described as a balancing act between optimisation and conservation of original features [6]. The concept of thermal retrofit in this paper considers upgrades to energy efficiency and thermal comfort, which shall be addressed together, especially in New Zealand, where a significant part of the building stock does not provide adequate indoor comfort conditions. Therefore, thermal retrofit focuses on both topics and can lead to great improvements to overall environmental performance and occupants' health.

In New Zealand, however, there is a gap between preservation and thermal performance improvements of existing and historic buildings, which, if successfully achieved, would lead to a better environmental outcome. Most retrofits only include shallow changes, without making any deep modifications to energy efficiency and indoor environmental quality. The following sections present the state-of-the-art in retrofitting heritage buildings in New Zealand, discussing the main issues and opportunities for this practice in the country.

2 THE HERITAGE FRAMEWORK IN NEW ZEALAND

Although New Zealand has one of the youngest heritage building stocks in the world, there are several historic buildings that have significance and should be preserved. In fact, due to the lack of old stock, it becomes even more important to conserve places of historic significance that remain from the past: in order to ensure the conservation of heritage buildings for the future, it is necessary to recognise the value of existing buildings in the present. Heritage places are fundamental to civil society because they contribute to community identity and generate significant economic benefits in the form of urban vibrancy [7]. For these reasons, a set of policies are in place to support the protection of heritage.

2.1 Overview of policies for heritage protection

While many countries manage historic heritage under a centralised government agency, New Zealand's Heritage Policy relies on centralised and decentralised actions. New Zealand's heritage system involves shared responsibility between local and central government with a range of organisations involved [8]. The main piece of legislation to promote the sustainable management of natural and physical resources is the Resource Management Act 1991 (RMA), which aims to protect historic heritage from inappropriate subdivision, use and development [9]. In 2003, the elevation of historic heritage to a matter of national importance under section 6 of the RMA raised the bar for heritage planning assessment and protection practices [7].

Local district plans have to be elaborated according to the principles contained in the RMA – these plans give effect to the provisions of the Act [7]. In addition, another important national legislation is the Heritage New Zealand Pouhere Taonga Act (2014), which was meant to bring together some efforts towards the protection of heritage [10]. It outlines the functions and powers of Heritage New Zealand and the Māori Heritage Council, which include the preparation of general policy statements related to archaeological sites, properties owned by Heritage New Zealand, administration of the New Zealand Heritage List/Rārangi

Kōrero, including the National Historic Landmarks List and Heritage NZ's advocacy role [8] Buildings scheduled under the NZ Heritage List under Categories 1 or 2 are not guaranteed protection – their protection shall be assured by local district plans, which include buildings in the NZ Heritage List as well as other buildings of local significance.

In addition to these regulations, the ICOMOS New Zealand Charter consists of the local iteration of international conservation principles and provides guidance on principles for heritage conservation [11]. Heritage policies in New Zealand involve a number of regulations and organisations, creating a complex system that is often difficult for property owners, designers, consultants and the general public to understand [7]. Gregory and Stoltz discuss the integration between the two main Acts, pointing out that "the regimes could be integrated and improved to ensure a better relationship between the RMA and the HNZ Act", since "it is evident that the identification, advocacy and management of heritage in New Zealand have the potential to be complicated" [12]. There is also an evident need for heritage provisions in district plans to be more consistent, to avoid uncertainty all parties involved in the process.

2.2 Existing building stock performance in New Zealand

While pre-European Māori houses (*whare*) were made of natural materials that had good thermal properties (such as *raupō* reeds) or kept out the wind (such as earth), early European-style timber frame construction in New Zealand was less efficient at maintaining heat [13]. New Zealand's building stock has had many problems related to indoor environmental quality, with low indoor temperatures, damp and mould being some of the major ones. A significant part of New Zealand's building stock was built before the introduction of mandatory insulation in 1978 [14], which includes the majority of listed heritage buildings. Most historic buildings in NZ were designed according to styles influenced by the Villa, Arts and Crafts, Bungalow, Art Deco and Modern movements; they are mainly (but not exclusively) timber-framed structures with painted corrugated iron roofs, timber weatherboards, timber-framed windows with single pane glazing and timber foundations [15]. The low performance of the existing building stock has strong impacts on the health of building occupants – fuel poverty and cold, damp houses remain a serious policy problem. Many studies have shown that low housing and heating standards are causing severe effects on NZ's population health [16].

2.3 Legislative framework related to the upgrade of heritage buildings in New Zealand

At present, there is no specific regulatory framework for thermal retrofits for Heritage Buildings in New Zealand. The existing policies do not mention specific ways to carry out retrofits focusing on energy efficiency or occupants' comfort through upgrades to the thermal envelope or to plant systems.

While all new building work must comply with the Building Act, which is given enforcement through the New Zealand Building Code (NZBC) [17], alterations to existing buildings are not required to comply with the updated code - except for accessibility and escape from fire which must comply as nearly as it is reasonably practicable [18]. BRANZ, the Building Research Association of New Zealand, recognises that "code compliance can be a grey area issue for partial renovations" and that the main requirement is that "by law, a partial renovation must not reduce the performance of the existing structure" [19].

To explain some of these matters, Heritage NZ published guidelines based on the Building Act for the sustainable management of historic heritage in 2007 [15]. The document provides general guidance on upgrades in regard to earthquake engineering, natural hazards (including snow, wind, landslides, tsunami, coastal erosion, volcanic eruption, wild fire and flooding corrosion), moisture and biological deterioration, fire safety, safety in use accessibility, security and energy efficiency. However, being guidelines, they are just a recommendation and they are not mandatory, providing only general guidance; in addition, many policies have changed since its publication in 2007, with some of the recommendations being outdated.

A recent piece of legislation targeted building performance issues in existing rental housing without thermal insulation, making it compulsory for landlords to install underfloor and ceiling insulation from 2019 [20]. This is an important first step in requiring thermal upgrades to existing buildings, however, there is no mention to historic buildings – it is a legislation for all existing rental housing. The policy makes an exception for buildings where, due to design or access issues, it is “not reasonably practicable to install insulation”, which might be the case for historic buildings. Another point to highlight is that the legislation includes underfloor and ceiling insulation only, excluding walls, windows, doors and other construction elements that would contribute to the improvement of the building’s performance and comfort more holistically. Therefore, buildings might still have poor performance, considering significant energy losses through these other elements.

A much more substantial focus is given to structural strengthening, especially after the tragedy of the Canterbury earthquakes in 2011. The earthquakes have affected many historic landmarks in Christchuch, including its main cathedral (Fig. 1(a)) and several other Unreinforced Masonry (URM) buildings (Fig. 1(b)). Good efforts have targeted improvements to the structural performance of heritage buildings, with new legislation demanding local councils to identify all earthquake-prone buildings and to upgrade them to a level of at least 34% of the New Building Standard (NBS). To this regard, the Heritage EQUIP program was developed by the Ministry for Culture & Heritage to provide funding and advice to earthquake strengthen heritage buildings [21].

Since heritage policies in New Zealand include central and local actions, it is also important to analyse key local regulations. Auckland, NZ’s largest city, has a number of notable heritage buildings, many of them built of timber (Fig. 2(a) and 2(b)), which often have issues related to mould and timber conservation. The Auckland Plan 2050 recognises that “cold and damp housing is the most serious issue in Auckland’s existing dwellings. They cost more to heat and have links to negative health outcomes” [24]. Therefore, one of the goals is to introduce compulsory “warrants of fitness” for all rental properties and use levers to enforce minimum standards. The details for these proposals are yet to be released in the next stages of the plan.

(a) (b)

Figure 1: (a) Christchurch Cathedral after the earthquakes in 2011 [22]; (b) URM building on Barbados St. damaged after the earthquake [23].

(a) (b)

Figure 2: (a) Old Government House in Auckland, built with local timber fashioned to look like stone [25]; (b) Typical timber houses in Renall St. Historic Area, Auckland [26].

NZ's capital Wellington has made notable efforts to ensure the protection of its heritage, recognising that it is a "precious and finite resource" [27]. It aims to give flexibility for economic activities which might help the conservation, such as the adaptive reuse of a listed building or object that enables the owners, occupiers or users of it to make reasonable and economic use of it. However, there are no mentions to upgrades to improve thermal performance; the policy recognises upgrades to structural stability, accessibility, and means of escape from fire, which shall be carried out as to minimise the effect on heritage values [27]. Fig. 3(a) shows a heritage building Cuba Street, one of the main heritage precincts, Fig. 3(b) illustrates a seismically retrofitted heritage building; both are Category 1 under Heritage NZ.

Another noteworthy example is the City of Napier, an important heritage hub with a large number of Art Deco buildings completed after the earthquake of 1931 (Fig. 3(c)). The City of Napier District Plan seeks to "encourage alterations to improve structural performance (earthquake strengthening), fire safety and physical access whilst minimising significant loss of heritage values" [30]. This is expected to enable the buildings to continue to be used in a safe and economical manner, as well as assist in retaining the heritage fabric of the city. The

(a) (b) (c)

Figure 3: (a) Wellington Workingmens Club Building [25]; (b) Public Trust Building in Wellington [28]; (c) Art Deco example, the Masonic Hotel in Napier [29].

goal is to "ensure, where possible, that regulation is not a barrier to upgrading buildings and that demolition is not the only option left for owners". The plan differentiates rules for safety-related alterations from general amenity-related alterations and repairs and maintenance. In this sense, upgrades to thermal performance would be treated within the second group [30].

3 CURRENT THERMAL RETROFIT PRACTICE IN NEW ZEALAND

As encouraged by existing policies, the retrofit of heritage buildings in New Zealand are commonly carried out only when there is an imminent threat, i.e. structural strengthening for earthquake safety or protection from fire. The other common practice is to carry out "cosmetic" improvements to increase property values and "modernise" these buildings by carrying out spatial layout improvements and upgrades to kitchens and bathrooms. Even thermal retrofit usually focuses on very simple measures, as the main aim is to "meet the performance requirements of the New Zealand Building Code (NZBC) and [there is] little concern for thermal comfort, indoor air quality and airtightness" [31]. These practices usually focus on the installation of ceiling and underfloor insulation and the addition of clean heating sources, such as what is encouraged by the Warm Up New Zealand: Healthy Homes Program [32]. However, improvements to the performance of walls and windows, for example, are not common practice, and can compromise the overall performance. There is no extensive literature on the state-of-the-art of retrofit practices in the country. Therefore, an online survey is currently being carried out as part of this research to identify current retrofit practices, identifying the main challenges and possibilities for the future according to professionals involved in this area.

Some other initiatives have been targeting existing buildings in general. For instance, Beacon Pathway, an Incorporated Society for building research, has developed the HomeSmart Renovations program, which was a large scale, New Zealand-wide renovation project which investigated consumers' reasons and interests in retrofitting their homes to improve their performances. As part of this program, 650 participating homeowners had their home's performance assessed by independent assessors [33]. Also, a previous research undertaken at the University of Auckland has investigated retrofit solutions for mid-century State Housing up to the Passive House Standard [31]. Lastly, the BRANZ Renovate Program provides advice in regard to renovations on historic buildings according to each typology common to historic periods, including Villa, Bungalow, Art Deco, 1940s–1960s, 1970s. The program contains literature that helps to assist in designing retrofits, including the installation of insulation and upgrading of windows [19].

Overall, there is a lack of knowledge and practice in NZ in regard to thermal retrofit in general, which is even more critical in regard to historic heritage, which seems to be excluded from the energy performance conversations. Very little has been done for developing a structured and robust partway towards a large-scale retrofit strategy for buildings with historical significance in the country.

4 DISCUSSION ON INTERNATIONAL STANDARDS FOR THERMAL RETROFITS IN NEW ZEALAND

Although there are no regulations or initiatives focusing specifically on thermal retrofits of heritage buildings in New Zealand, local and international certification schemes and standards for green buildings can be beneficial if applied in the country. A comparison between existing schemes that are relevant for thermal upgrades for the New Zealand context is given in Table 1. The three selected certification schemes provide an overview of best practice internationally, they were selected because they were developed specifically for existing buildings.

In addition to the international schemes compared, there is also a local certification scheme that can be applied to retrofitting existing buildings: Greenstar NZ, developed by the New Zealand Green Building Council (NZGBC) [34]. This tool is applicable to new and existing buildings (where more than 50% of the building is being refurbished) and rates a building or fitout's overall environmental impact. The rating system awards points in nine categories: Energy; Water; Materials; Indoor Environment Quality; Transport; Land Use and Ecology; Management; Emissions; Innovation. The only mention to historic buildings in the Greenstar scheme is the Innovation Challenge: Culture, Heritage and Identity, which encourages project teams to show how the project celebrates its heritage and takes steps to educate the public about the building and its history. However, this is only a small section of the scheme acknowledging historic features. Greenstar was not developed specifically for existing or historic buildings, therefore many of its credits are more aligned with new construction. NZGBC is currently developing new tools to specifically assess retrofits of existing buildings, therefore this new tool might be a better way for evaluation in the future, especially if it gives consideration about the retention of heritage fabric.

Table 1: Comparison of certification schemes including or targeting historic buildings' renovation/upgrading.

Certification Name	**EnerPHit**	**GBC Historic Building®**	**BREEAM® International Refurbishment and Fit-Out (RFO)**
Org.	Passive House Institute (PHI)	Green Building Council of Italy (GBC Italy)	Building Research Establishment (BRE)
Year of release	2010	2014	2014
Country of origin	Germany	Italy	United Kingdom
Countries where applicable	Internationally applicable	Italy only	Internationally applicable
Outcome	Certificate for Quality-Approved Energy Retrofit of existing buildings by using Passive House components.	Certification of the sustainability level of conservation, rehabilitation and adaptation of historic buildings subject to major renovations.	Certification for existing non-domestic sustainable building refurbishment and fit-out projects.
Applicability to historic and other existing buildings	Applicable to existing buildings in general (including historic buildings)	Specific for pre-industrial buildings: buildings must have been built before 1945 for at least 50% of the existing technical elements.	The international version is applicable to the refurbishment and fit-out of non-domestic buildings, including historic buildings formally listed and protected under international, national or local laws.

Table 1: Continued.

Certification Name	EnerPHit	GBC Historic Building®	BREEAM® International Refurbishment and Fit-Out (RFO)
Summary of topics evaluated	Evaluation of a building's Energy Consumption and Thermal Comfort.	The rating system is derived from LEED®. and is divided into the following categories: • Historic Value; • Sustainable Sites; • Water Efficiency; • Energy and Atmosphere; • Materials and Resources; • Indoor Environmental Quality; • Innovation; • Regional Priority.	The scheme rates the following sections: • Management; • Health and wellbeing; • Energy; • Transport; • Water; • Materials; • Waste; • Land use & ecology; • Pollution; • Innovation.
Specific sections about historic features	The scheme provides exceptions for certain restrictions related to heritage conservation. Limit U-Values of the exterior envelope building components may be exceeded, based on one or more of the following reasons: • If required by the historical building preservation authorities • If special, additional requirements exist and there are no components available that also comply with the EnerPHit criteria • If the U-value of windows is increased due to a high thermal transmittance of the window installation offset to the insulation layer in a wall that has interior insulation • If reliably damage-free construction is only possible with a smaller insulation thickness in the case of interior insulation • For other compelling reasons relating to construction	The topic area 'Historic Value' addresses preservation principles to be included within the sustainability agenda, though prerequisites (mandatory) and credits (optional). Prerequisites: • P1: Preliminary analysis. Credits: • C1.1: Advanced analysis: energy audit; • C1.2: Advanced analysis: diagnostic tests on materials and deterioration; • C1.3: Advanced analysis: diagnostic tests on structures and structural monitoring; • C2: Project reversibility; • C3.1: Compatibility of the new use and open community; • C.3.2: Chemical and physical compatibility of mortars; • C3.3: Structural compatibility; • C4: Sustainable building site; • C5: Scheduled maintenance plan; • C6: Specialist in preservation of buildings and sites.	• Ene 01 Reduction of energy use and carbon emissions: two additional credits are available for Historic buildings, where a specialist study has been undertaken by a Qualified Heritage Conservation Specialist to investigate the implications of improving building fabric and services performance while minimising negative impacts of both the historic character of the building, the condition of the building fabric and indoor air quality. • Mat 05 Designing for durability and resilience: for heritage buildings, measures to protect vulnerable parts of the building from damage and to limit material degradation should be compatible with any heritage requirement.

Table 1: Continued.

Certification Name	EnerPHit	GBC Historic Building®	BREEAM® International Refurbishment and Fit-Out (RFO
Specific requirements for energy and thermal upgrades	There are two compliance methods: 1) Component method: Maximum U-Values for opaque and transparent components according to climate zone; Requirements for the ventilation system. 2) Energy demand method: Max. heating demand from 15 to 35 kWh/(m²a) depending on climate zone; Max. cooling according to climate zone. Additional criteria applicable for both methods: Pressurization test result n50 [1/h] ≤ 1.0; Renewable Primary Energy (PER), demand according to class (Classic/Plus/ Premium); Renewable energy generation, according to class.	Topic Energy and Atmosphere Prerequisites: • Prerequisite 1: Fundamental commissioning of building energy systems • Prerequisite 2: Minimum energy performance Prerequisite 3: Fundamental refrigerant management Credits: • Credit 1: Optimize energy performance • Credit 2: Renewable energies • Credit 3: Enhanced commissioning • Credit 4: Enhanced refrigerant management • Credit 5: Measurement and verification	Energy credits: • Ene 01 Reduction of energy use and carbon emissions; • Ene 02 Energy monitoring; • Ene 03 External lighting; • Ene 04 Low carbon design; • Ene 05 Energy efficient cold storage; • Ene 06 Energy efficient transport systems; • Ene 07 Energy efficient laboratory systems; • Ene 08 Energy efficient equipment; • Ene 09 Drying space.

Each scheme presents unique benefits and challenges, given their diverse objectives and targeted buildings, whether they are applicable to any existing buildings (EnerPHit and BREEAM®) or historic buildings only (GBC Historic Building®).

The GBC Historic Building® encompasses many different aspects of historic building adaptation, providing a comprehensive retrofit approach. Currently, GBC Historic Building® is available only in Italy, but future activities will evaluate its applicability at European and international level [35]. The scheme is still in its initial stages with a few buildings tested and certified [36], but it has great potential for the future as it is applicable to a vast building stock in Italy and beyond. One of the positive aspects of this scheme is that its energy assessment is based on building performance improvement compared to a reference condition, rather than aiming to achieve pre-defined and fixed performance levels. This allows greater opportunities in terms of the level of intervention on heritage building. Considering that sometimes it is not possible to add renewable generation due to preservation requirements, the scheme allows renewable energy to be provided from certified off-site green energy production [35].

The EnerPHit standard [37] was founded on the principles of the Passive House standard, which is a reliable certification given the good correlation between expected performance and real performance. Significant energy savings of between 75 and 90% can be achieved in existing buildings according to the EnerPHit framework [38]. If the energy demand is reduced by such a degree, meeting the remaining demand with renewable energy sources will be feasible [39]. EnerPHit lists the following measures as the most effective in existing constructions: improved thermal insulation, reduction of thermal bridges, considerably improved airtightness, use of high-quality windows, ventilation with highly efficient heat recovery, efficient heat generation, use of renewable energy sources [38]. Also, EnerPHit allows a step-by-step approach that aims to make it possible to retrofit when there are financial constraints. A long-term plan is prepared, which is then broken into smaller steps. This plan can be part of an integrated retrofit plan, which encompasses all other aspects that need to be improved. Although the method is quite prescriptive in terms of performance for each construction element, many materials and solutions can be used.

BREEAM® RFO provides a holistic approach, which goes beyond GBC in terms of broader topics, such as transport and management. One of the advantages of this scheme is that it has been tailored to the requirements of fit-out projects and to reflect the split between tenant and landlord responsibilities, as it is split into four parts: fabric and structure; core services; local services and interior design [40]. Therefore, projects can assess themselves against a single category, all four or any combination. Another positive aspect is that the energy requirements have specific sections for historic buildings, acknowledging the relationship between possible alterations to the building envelope and conservation of historic features.

While all of the presented schemes could be relevant to New Zealand heritage buildings, currently only EnerPHit and BREEAM RFO can be applied internationally. These two tools could be used depending on the purpose of the retrofit, whether it aims to focus only on very high energy performance and comfort, or encompass a range of interventions to improve overall sustainability which can be balanced within the scheme, i.e. very high water efficiency but low energy efficiency. Both tools were developed by internationally renowned organisations and can provide positive guidance on best practice for heritage building retrofit in NZ.

5 CONCLUSIONS

This paper has provided an overview on issues and opportunities related to thermal retrofit of heritage buildings in New Zealand, providing the basis for subsequent stages of this research. Heritage buildings are valuable assets and their adaptation to future needs is an important aspect that contributes to their preservation. The literature review has found that the country's heritage policies form a complex system, which sometimes results in inconsistencies and weakness, as even the simple protection and basic conservation of historic buildings is not completely guaranteed. When it comes to building adaptation, the focus of current regulations is almost exclusively on seismic strengthening, fire protection and accessibility. While other upgrades are more commonly discussed and implemented in historic buildings in New Zealand, the energy issue has not been addressed thoroughly yet. In terms of industry practice, more visually concerning matters are usually addressed first, while intangible problems, such as inadequate indoor environmental quality or energy inefficiency, are usually disregarded. In the common misconception that heritage buildings cannot be efficient, the research development regarding thermal retrofit becomes strategic to increase awareness and knowledge on the topic, with positive impact on the market transformation and the conservation of the country's cultural legacy.

Integration of thermal retrofit with other required upgrades, such as structural strengthening, seems to be a promising opportunity, since many heritage buildings are going through a process of structural upgrade in the country due to new legislation. Both thermal and structural retrofits have a dichotomy in common: the less interventions, the less likely a building is to get well conserved over time in terms of structural stability and protection from decay; however, with more invasive interventions, there is also a higher loss of the original fabric. This reassures the view of heritage building retrofitting as a "balancing act": each intervention should be carefully analysed and planned by integrating the various disciplines involved in the process.

The application of certification schemes for heritage buildings is a very important step to assure the quality of these interventions. Providing a third-party certification ensures the quality and transparency of the retrofit process beyond visible components, as it is important to note that many aspects such as airtightness, thermal bridges and level of insulation, cannot be easily checked once works are completed. In addition, it can enhance value and reliability of upgrades carried out, improving the capital value of properties. In this context, BREEAM® RFO and EnerPHit are applicable to NZ and can be valuable references for the retrofit of historic buildings – their implementation can help encourage deep retrofit measures, rather than the current focus on "cosmetic" improvements to the building fabric. Ensuring that heritage buildings have a sustainable future is an important topic to be discussed in the country and this area is yet to be developed in New Zealand.

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