



Energy retrofit interventions in historic buildings: Exploring guidance and attitudes of conservation professionals to slim double glazing in the UK



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ABSTRACT

In the UK, 20% of houses were built before 1919 and are protected from energy efficiency requirements that would unacceptably alter their character. To meet carbon emission reduction targets, however, it is necessary to keep the number of buildings exempt from energy efficiency improvements to a minimum. The need to preserve the aesthetic and structural qualities of historic buildings makes energy retrofit complicated and costly but these arguments should not be used to resist change. The research presented in this paper investigates how conservation professionals in the UK approach and sanction energy retrofit measures in historic buildings. It provides an overview of the current UK legislation and guidance relating to energy efficiency in heritage buildings and presents findings from a study focused on the approach of conservation professionals to retrofit slim profile double glazing (SPDG). It finds that there is regional variation to energy retrofit in historic buildings between Scotland and the rest of the UK, and that individual conservation professionals hold different views on the use of SPDG, which leads to inconsistencies in its application. Recommendations are made for a more consistent approach to window upgrade as a means of improving the energy efficiency and comfort of historic buildings and for greater interdisciplinary cooperation to align conservation of energy with conservation of heritage.

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1. Introduction

Improving the energy efficiency of historic buildings is vitally important, not only as a means of protecting them from emptiness and dereliction, but also as an essential element of any emission reduction strategy in the built environment. Research in 2005 showed that the UK residential housing sector could deliver a 60% reduction in CO₂ emissions by 2050 if the average heat loss of all existing housing was cut by one third [1]. A large proportion of the UK housing stock (20%) are historic buildings built before 1919 [2], which often have particularly high energy consumption. A study of pre-1919 houses in Bath, showed that their average energy consumption was 195 kWh/m² per annum [3]. A report by the BRE in 2005 found that the average energy consumption of pre-1919 houses in England was 25,475 kWh/per household/per year compared to 18,634 kWh/per household/per year for houses built post 1980 [5]. EU directives dictate energy efficiency standards on build-

ings undergoing renovation or extension but these do not extend to historic buildings [6]. As a result, countries set their own rules. In the UK, the regulations are such that historic buildings are often exempt from energy efficiency requirements. However, to meet the CO₂ reduction targets, the number of buildings exempt from energy efficiency improvements has to be kept to a minimum. Exempting historic buildings from energy efficiency improvements not only relegates people to live and work in polluting, uncomfortable dwellings that are expensive to run but also forces unrealistic CO₂ reductions on other properties. This is particularly significant in cities such as London and Bath, where the concentration of historic buildings is higher than the UK average [3,4].

A growing body of academic research seeks to align energy conservation with heritage conservation in EU countries, including the evaluation of energy efficiency in historic buildings in Italy [7]; and a study on the need for interdisciplinary cooperation to overcome barriers to renewable energy in heritage buildings in Switzerland [8]. In the UK, there are a number of government-funded heritage agencies who publish guidance documents on how best to improve the energy efficiency of historic buildings. Little research has been done into comparing the guidance for different parts of the UK or investigating how it is interpreted in practice. This paper seeks to

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address this gap in knowledge and investigate how guidance is implemented in relation to window retrofit.

In the UK, windows have become a focal point for energy efficiency improvements in historic buildings for a number of reasons. Double glazing not only reduces heat loss but also condensation and noise, and therefore has a positive impact on occupant comfort levels. When traditional windows fail, property owners look for opportunities to improve both energy efficiency and comfort. The development of slim profile double glazing (SPDG) makes it possible to improve the U-value of windows without ‘unacceptably’ altering the appearance of a building. SPDG is thin enough (ranging from between 8.2 and 16 mm in depth) to be fitted into some existing single glazed window rebates or can be used in new windows that replicate a traditional profile. Depending on the type of SPDG used, the U-value (centre of pane) can range between 1 W/m² K to 2.8 W/m² K which, depending on the style of window, can result in heat loss reductions of between 63% and 73% compared to single glazing [9]. Table 1 illustrates the differences between a window fitted with single glazing and the different replacement options. As illustrated in the table, normal double glazing has an edge seal, the material that separates the two panes of glass, which is about 10 mm deep. SPDG has varying depths of edge seal depending on the manufacturer but typically they tend to range from between 5 and 7 mm. The slim line unit is designed with narrower edge seals so that it can be fitted into finer frames/glazing bars. In order to cover up the edge seal, the rebate that the glass sits in needs to be at least 2 mm deeper than the edge seal, i.e. between 7 and 9 mm in the case of SPDG and at least 12 mm in the case of normal double glazing. Please note, there are many variations in edge seal/frame rebate depending on manufacturer, so the sketches and dimensions given in Table 1 are not to scale and are included here for illustrative purposes only. Typical depths and U-values given in the table are based on current guidance.

Despite the energy efficiency benefits of SPDG, there are some concerns regarding the use of this type of glazing in historic buildings, such as accelerated loss of historic glass; need for thicker glazing bars to support the increased weight; and a flatter, more uniform reflection compared to old glass.

The research presented here specifically focuses on listed buildings – buildings that are protected because of their historic/architectural value. In the UK, any alteration or extension to a listed building requires consent from the local authority where it resides. Most local authorities employ conservation professionals to decide on the appropriateness of alterations. They play a key role in determining whether energy efficiency improvements can be made to the building envelope. Local authorities are required by law to publish online all their decisions relating to alterations to listed buildings.

This paper presents results from a study investigating the approach of UK conservation professionals to SPDG in listed buildings. Primary and secondary data sources are utilized to explore current legislation and guidance in different parts of the UK and to investigate how authorisation for improvements varies between the regions, using window retrofit as an example. Recommendations are made for improving guidance and procedures.

2. Methodology

The study comprised two main elements. Firstly, a review was undertaken of the legislative framework and guidance literature on energy efficiency in historic buildings. Differences between the guidance for England, Scotland and Wales were explored.

Secondly, a multi-method data collection was conducted to gather information on the approach of UK conservation professionals to the use of slim profile double glazing. This comprised 1) a

questionnaire survey to gather quantitative and qualitative data regarding conservation professionals’ approaches and opinions; 2) interviews to further explore specific issues and 3) online analysis of local authority decisions to install SPDG in listed buildings. The intention was to derive an understanding of the current processes and use of legislation and guidance across the UK, and particularly to find out how conservation professionals opine on changes to historic buildings and what shapes their decisions.

2.1. Survey

A web-based survey form was developed that consisted of 35 questions, designed to reveal the opinions and approach of conservation professionals to energy efficiency and SPDG and to show how legislation and guidance is interpreted in practice. The survey included questions on whether conservation professionals agree or disagree that energy efficiency in listed buildings is important; the circumstances under which they allow slim profile double glazing to be used; and their greatest concerns associated with it. A few questions were not opinion-based and required simple answers such as indicating which guidance documents they refer to. Most questions were closed-ended with ‘further comment’ fields for those wanting to qualify their responses. For questions revealing behaviour, three point Likert frequency scales (never, occasionally, frequently) were used, whilst for those revealing opinion, Likert four point agree/disagree scales were used.

The survey was initially intended to gather mainly quantitative data. However, the respondents made extensive use of the ‘further comment’ field and thus provided a wealth of qualitative data.

A link to the web-based survey was emailed to 200 conservation professionals across the UK in April 2014. There were 52 completed surveys returned, giving a response rate of 26% (see Section 3.2 for further details).

2.2. Interviews

It was intended that interviews would be carried out for qualitative data collection purposes, i.e. to help interpret the quantitative data from the survey. The need, however, for interviews was reduced by the extensive use of the ‘further comment’ field by respondents. The interviews were carried out over the telephone and were of a semi-structured nature following up on themes that emerged from the survey, such as the decision procedure on window applications in historic building; discussion over the reasons for opposing or supporting SPDG in historic buildings; and examples of SPDG being installed in notable buildings.

Interviewees were recruited through the questionnaire survey: at the end of the survey respondents were asked if they would be prepared to be interviewed. Overall, seventeen people responded ‘yes’ but only seven of those actually took part in interviews, of which four were from England, two from Scotland and one from Wales.

2.3. Local planning authority databases

All UK local authorities maintain online databases of applications to alter listed buildings [11]. These are publically available and can typically be accessed through the planning section of local authority websites. Filters can be applied in the database search feature in order to refine the selection of archived planning applications, e.g. to only display those relating to windows in historic buildings. Supporting documentation and decision notices can then be accessed. The data is potentially extremely useful because it provides evidence of how property owners are applying to improve the energy efficiency and comfort of their historic buildings and how conservation professionals are responding to these applica-

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