

# IS IT ALL ABOUT THE WINDOWS? RESIDENTS' VALUES IN RESIDENTIAL HERITAGE BUILDINGS

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**ABSTRACT.** Reducing energy and associated carbon emissions from the built environment is fundamental to meeting our climate goals. Retrofit of existing buildings is therefore a key strategy. Heritage buildings present particular challenges for retrofitting because of their traditional construction and need to retain historic values. Replacing windows is often a critical element of a low energy retrofit, but for heritage buildings this can be problematic.

This paper explores the values that residents invest in their windows, and the opportunities and challenges for retrofitting heritage fenestration. Qualitative data from 16 case studies of heritage buildings in the county of Cumbria, UK, is examined to gain a greater understanding of residents' views, which are often neglected in policy approaches. Findings show that residents, in both designated and undesignated heritage buildings, value their original windows and appreciate the thermal benefits of traditional features such as shutters or curtains. Residents generally considered complete window replacement unacceptable but were more positive about options such as secondary glazing or internal shutters. Challenges, including costs and finding skilled tradespeople to produce shutters or undertake restoration were identified. The paper concludes with the implications of these findings for retrofitting heritage fenestration for carbon reduction.

**KEYWORDS:** Heritage buildings, windows, user values, retrofit.

## 1. INTRODUCTION

It has long been accepted that the built environment is a major source of energy use and resultant carbon emissions, and that these must be urgently reduced to help mitigate climate change [1]. The average rate of building stock replacement across Europe is around 1% per year [2]: retrofitting existing buildings is therefore a key carbon reduction strategy [3]. Heritage buildings can be defined by age, planning policy designation, construction type, or specific values [4]. The UK has the oldest housing stock in Europe [5] with around 20–30% of UK buildings likely to have heritage value, although only a small percentage are officially designated as such [6]. The heritage values and traditional, often regionally specific, construction of heritage buildings can present challenges for energy retrofitting, with tension apparent between adaptations for carbon reduction and the retention of heritage [7].

Windows are often a focus of retrofit efforts to improve thermal performance and reduce undesirable infiltration in older buildings. However residents value windows for more than just their functionality [8]. The replacement and retrofit of original windows is often a particular source of tension, in both planning policies [9] and to residents [10] and the replacement of original single glazing with modern double glazing is often prohibited in designated heritage buildings [11].

Research in this area has tended to focus on planning interpretations of acceptable changes to heritage buildings, such as a study of UK conservation planning

professionals' approach to slim-line double glazing [9], which identified inconsistency both between individual planners and between different UK regions. Policy designations are often taken as the arbiter of acceptability for retrofits [12, 13], and the heritage values that residents invest in their buildings tend to be overlooked [14, 15]. This can lead to the assumption that if window replacement is acceptable in planning policy, then it can, and will, be enacted. However, because owner occupied domestic retrofit is predominantly instigated, managed, and funded by homeowners, their views will clearly determine retrofit uptake. Residents have been shown to invest heritage values in their buildings, including those that are not designated [16], and these values have significant implications for the retrofits they consider acceptable and will therefore enact [10, 17].

This paper examines the values that residents invest in their windows, the types of fenestration retrofits that they might consider acceptable, and any barriers that they identify to these improvements, through 16 case studies of residential heritage buildings.

## 2. METHODOLOGY

16 residential heritage buildings in Cumbria, north-west England, were recruited as case studies from previous respondents to a survey of pre-1940 Cumbrian buildings [10]. Cumbria is a predominantly rural, mountainous, and upland area. It includes the Lake District National Park Cultural Landscape



FIGURE 1. Original windows.

World Heritage Site which has additional planning restrictions.

The number of case studies was chosen to be sufficient to provide a diverse range of building types, ages, locations, household compositions and energy usage, following principles of maximum variation selection [18]. The buildings chosen were representative of wider Cumbrian heritage buildings but are not representative of the broader UK heritage stock. However, the case studies' rich data can still provide learning applicable to a wide range of heritage buildings across the UK and Europe.

Occupancy ranged from one to five residents. Six buildings were detached, six semi-detached and four terraced, with floor areas varying from 67–373 m<sup>2</sup> with a mean size of 144 m<sup>2</sup>. All buildings were stone built, mainly of limestone and sandstone, but with some of slate, granite, and fieldstone. Building ages ranged from pre-1700–1928; two were grade II and one grade II\* listed (the third and second highest levels of UK heritage protection respectively), six were in protected conservation areas, and seven had no planning designations. For windows, two of the buildings had double glazed UPVC windows, two had double glazed timber, one had replica single glazing and ten retained at least some original glazing.

The development of the case studies involved a site visit including semi-structured interviews, and building surveys, this paper reports part of a larger study as described in [6]. Interviews covered: the building's history; residents' attitudes to carbon reduction and heritage retention; their energy behaviours; perceptions of indoor environmental quality; and perceived barriers to carbon reduction. Participants also completed a questionnaire on the acceptability of various retrofits, including eight relating to fenestration; providing a commentary on their reasoning and key barriers. Participants then led a "tour" of their building, identifying heritage features they valued. The visits were audio recorded, transcribed and analysed, and,

with residents' permission, photographs were taken of various features. The retrofit questionnaire and interview transcripts were checked with residents. Most visits took place in early 2020, but as a result of the Covid-19 pandemic, visits to case studies (CS) 4, 10, 12 and 16 were conducted virtually in January and February 2021. For these cases, residents were still able to lead a tour of most of their buildings with portable devices, although broadband in some rooms was problematic. Ethical approval for the research was obtained.

### 3. RESULTS

#### 3.1. VALUES FOR WINDOWS

It was clear that all residents with original windows strongly valued them, identifying them as features they particularly liked about their buildings:

- CS3: "I'm unashamedly timber, sash windows and things like that ... On the front, they are leaded. I really like the leaded windows a lot from both inside and out ... That reflection of the trees in the leads, I love, I think it's just absolutely ..." (Building age: 1928, conservation area (CA))
- CS9: "There are just so many things that make it, not unique but special, you know, the windows, the beautiful window lights and the beautiful windows ... it's wonderful, wobbly glass ... I like the fact that I can look at it from different angles and see a different shape outside." (1896, CA)
- CS14: "I love those windows and I think they are absolutely gorgeous." (Mid-1700s, undesignated (UD)).

It was noticeable that the windows that participants valued were all quite different in style and form, and that buildings varied in age and designation, and yet all were appreciated by residents (Figure 1).

Residents with traditional window additions such as original internal shutters and thick, heavy curtains,



FIGURE 2. Internal shutters and secondary glazing in different cases.

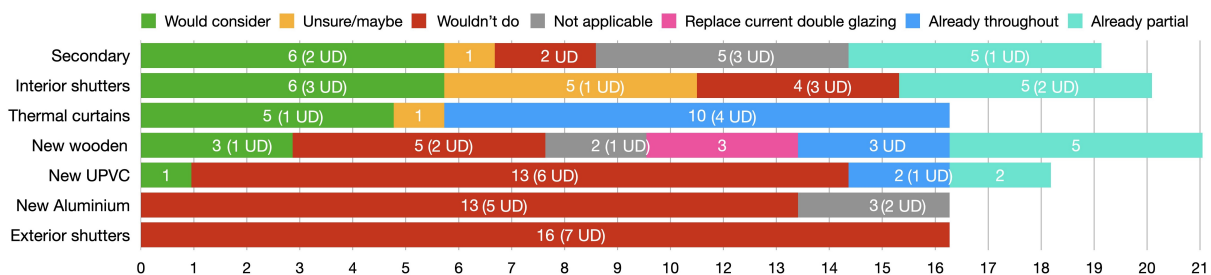


FIGURE 3. Acceptability of fenestration retrofits.

identified that they felt that these provided significant thermal benefits.

- CS1: “We’ve got functioning shutters in two of the downstairs rooms which is great ... they make a massive difference.” (1820, Grade II (GII))
- CS7: “They’re not thermal curtains but they’re heavy and lined ... the rooms do get warmer quicker [when we close them]” (1789, UD)
- CS14: “They [the shutters] haven’t got locking bars on them so they don’t sit flat but they do make a remarkable amount of difference.” (mid-1700s, UD) (Figure 2)

Some residents considered these features so useful that they installed similar modern shutters to additional rooms, with CS6 adding shutters to their bathroom despite having modern double glazing. In addition, some residents also appreciated the thermal comfort offered by shutters in warm weather.

- CS6: “It was one thing that we wanted to do, to get them [the shutters] back into operation ... you’re looking at quite thick timber there, and ok, they don’t meet tightly, but certainly they are effective. We also put shutters in the bathroom.” (c.1700 CA) (Figure 2)
- CS16: “The house is brilliant actually, so when it was really, really hot in the summer you could close the shutters and yeah ... you can stay inside and be fairly comfortable.” (C1800 UD)

### 3.2. ACCEPTABILITY OF FENESTRATION RETROFITS AND BARRIERS TO RETROFITTING

Residents’ combined responses for fenestration retrofit options are shown in Figure 3 (note that some cases had multiple window types so the total for some categories is higher than 16). The proportion of the cases for each category that are undesignated (UD) is also shown, suggesting that there is little difference in the acceptability of measures between the nine designated, and seven undesignated, cases.

It can be seen that the most acceptable options were those that were additions to existing windows rather than complete window replacement. The option that the most residents already had was thermal curtains (10), followed by modern, timber windows (8, including partial); these were mostly double glazed, although some were single glazed replicas. The majority found UPVC and aluminium double glazing unacceptable, something which participants took the opportunity to emphasise in the interviews:

- CS2: “It’s the absolute antithesis of what we’ve been talking about... I’m dead set against UPVC.” (c.1740, Grade II\*)
- CS5: “We try to maintain that [the character and heritage value] by not putting in horrible plastic windows or whatever it might be! (1897, UD)”
- CS12: “Plastic windows everywhere and the wrong proportions simply because that’s what the fitters fit. It just destroys the character of buildings ...” (c.1700 CA).

Participants mainly viewed internal shutters positively, especially those who already had experience of them. External shutters, however, were universally considered inappropriate for Cumbrian heritage buildings, because participants felt that they did not fit the character or architectural style of the area.

- CS4: “Exterior shutters would be too continental here.” (c1850, UD)
- CS11: “Exterior shutters wouldn’t look right on this.” (c1760, UD)
- CS16: “I don’t think we’d do that, it’s very different in Cumbria, you’d be doing for the cold wouldn’t you, like in the south of France, everywhere has shutters ...” (c1800, UD).

Some participants however were unsure about interior shutters, although the reasons varied: CS3 was concerned that they might not match the “spare” style of the house; CS10 was concerned about ease of use; and CS13 felt they would suit the building well but was worried that privacy would be reduced as the current blinds could be angled to provide light and privacy while shutters would have to be fully open to allow daylight in. CS8, meanwhile, felt that interior shutters would be an excellent idea but:

- “You have to have built them in, in my opinion, and whether nowadays, for a sensible price you can find a carpenter who can put them in, I have some doubts about that.” (1871, CA).

Residents considered secondary glazing to have high potential, with only two who would not consider it. Even CS15 thought secondary glazing might be an effective improvement to reduce traffic noise through his poor quality UPVC double glazing. Some concerns were revealed in the interviews, however, CS2 felt that secondary glazing would be “warmer but less aesthetically pleasing” as an addition to their original sash windows. CS3 and CS9 were both concerned about the impact on the character of their original glass, with CS3 concluding against and CS9 tentatively in favour:

- CS3: “An architect friend pointed out what I think I’d already intuited anyway, which is that when you look at leaded windows from a distance, or indeed anything that isn’t float glass, it looks different and as soon as you put a piece of glass on it looks like a piece of glass...” (1928, CA)
- CS9: “It depends on how it would look across the front window, it might be all right, but we’d need more information to decide” (1896 CA).

CS5 and CS8 meanwhile were concerned about the impact of secondary glazing on ventilation. CS5 had installed homemade fixed secondary glazing on one façade but felt that if further secondary glazing was installed it would need to be openable to allow for ventilation which would increase costs, while CS8 already had secondary glazing at the front of the house

but were concerned about reducing the air supply for their woodburning stove if it was installed on the rear sitting room windows. Both were in favour of secondary glazing but felt it needed some thought. CS14 would not consider secondary glazing, feeling that, because their house suffered from moisture issues, any reduction in infiltration would be detrimental. Instead of window replacement or additions CS14 preferred window refurbishment but was concerned about finding appropriately skilled craftspeople.

- CS14: “I would get the windows refurbished, they worry me ... they do need work and I would like it to be done by someone very careful and um, skilled at handling, some of the glass is very old indeed. The problem is, the people who really know their stuff tend to work in the really, really spectacular buildings, so you wouldn’t get them for a near nothing building like this ... But if we get those windows redone, I want them done really well.” (mid-1700s, UD).

Residents of Listed building meanwhile, identified difficulties or expected difficulties with planning restrictions in considering window alterations.

- CS1: “When we moved in, the upstairs [rear] windows were not very nice, not in very good condition, [1970s] transept windows, not in keeping with the house, and the process of getting them through planning, because the house had been listed with those windows in, was actually quite tricky and long winded and expensive ... they did not like the fact that we wanted to put double glazed sashes in.” (1820, GII).
- CS2: “[replacement windows] No, The National Park wouldn’t allow it ... secondary glazing ... it is a possible option that The [Heritage] Trust and the National Park would accept ... I know that it would have to go through planning.” (1740, GII\*)
- CS13: “I think we’d probably try for it [slim line double glazing] I’m not sure we’d get it, but yeah, if we got them done again, particularly the upstairs one which is obviously less visible so we might get away with that ... it’s just so tall, it looks lovely but (laughter).” (1834, GII). (Currently has replica single glazed sashes installed by previous occupants in the 1990s).

Several participants also highlighted the cost of window retrofits, especially if they were looking for something specialised or unusual. Residents generally appeared willing to pay significant amounts for options that were acceptable to their heritage values but some lacked the capital to be able to do so.

- CS1: “Secondary glazing, yes, expensive, we had a quote to replace everything, it was over £4000 ... and that’s for three windows!” (1820, GII)

- CS3: “I think it [secondary glazing] was more than a £1000 a piece, it was quite outrageous . . .” (1928, CA).
- CS9: “It [hardwood replica sash in modern extension] was quite eye wateringly expensive, but, you know! So yes, if we can afford it, yes, we have the right thing done but it’s a question of money really.” (1896, CA).
- CS12: “We didn’t want to replace them even though they are only single glazed, so I spent a huge amount of money getting designed and built, the folding glazed shutter in the living room . . . I suppose our windows are triple glazed . . . the glazing bars line up, so that you don’t have glazing bars in front of your windows.” (c1700, CA). (Figure 2)

#### 4. DISCUSSION

This research showed that participants in buildings of varying ages, styles, and levels of heritage designation, including undesignated buildings, clearly value their original windows. Residents especially valued the character of traditionally made “wavy” glass, and also appreciated original window features such as shutters which they recognised as having thermal benefits as well as heritage values. These findings agree with research highlighting windows as features of value to residents [16, 17] and is supported by the previous survey work which identified that, out of 147 Cumbrian participants, 43 % retained at least some of their original windows, and that 13 % of respondents specifically noted the importance of their original windows (again covering a wide range of types and styles) [10].

Residents had clear views on the types of fenestration retrofits they would consider acceptable. Complete window replacement with timber double glazing was not acceptable to many residents and modern materials such as UPVC and aluminium were almost completely unacceptable; once again this was true in both designated and undesignated buildings. Alternative options, such as secondary glazing and traditional window additions such as shutters and thermal curtains, were viewed more positively by the majority of residents, although there were still concerns about the impact of secondary glazing on the character of original glass. Interior shutters were considered acceptable or potentially acceptable to many residents. However exterior shutters were universally regarded as inappropriate for Cumbrian heritage buildings. This finding highlights the importance of local context when considering potential retrofits, as what may be seen as appropriate in one area may be unacceptable in another.

Other research has identified the energy savings that traditional window alterations can have, with secondary glazing and interior shutters being shown to reduce the heat loss from sash windows by 63–73 % [11]. These types of changes have less impact on heritage values, appear more acceptable to residents

and may even have the potential to enhance or restore heritage values. They may also have better lifecycle carbon impacts than full window replacement [19]. Lifecycle carbon includes both the embodied carbon costs required for raw materials, manufacture, transport, installation and end of life disposal, as well as the operational carbon savings that a retrofit may produce [20]. Some retrofit options which reduce operational carbon may nevertheless increase lifecycle carbon [19, 20]; this offers a further benefit for existing windows additions, as they are likely to have lower embodied carbon than window replacement.

Participants identified several barriers to making fenestration alterations. Key themes were: the cost of changes; obtaining planning permission; and finding suitably skilled tradespeople to undertake the work. In many cases these issues were exacerbated when residents tried to apply measures that were more in keeping with their heritage values. Residents are likely to require support with these challenges if significant progress is to be made, with both financing and a lack of skilled tradespeople identified as important barriers both from the previous survey [10] and at a European level [15]. In addition to these main barriers, residents also identified individual circumstances that might affect the acceptability and appropriateness of retrofits, such as concern about privacy or maintaining ventilation.

These findings suggest that retrofit approaches for heritage buildings should consider window additions rather than replacements, because they are likely to be more acceptable to residents, while also having clear potential for carbon savings. Greater awareness of the effect that residents’ values can have on the changes that they will enact is needed and it should not be assumed that window replacement will be acceptable merely because a building is undesignated. Barriers such as cost and availability of skilled tradespeople also need to be addressed to achieve high levels of retrofit, both for windows and more broadly. These findings emphasise the need for a holistic approach considering both residents and buildings as interconnected systems [6] and accounting for specific contexts to design appropriate whole house solutions rather than applying individual measures in a vacuum. Further research is currently underway to quantitatively assess, via modelling and lifecycle assessment, the potential lifecycle carbon impact to the case studies of a range of retrofit measures, including those considered above.

#### 5. CONCLUSIONS

This study has examined the importance of historic windows to the residents of 16 heritage building case studies in northwest England. Residents of a wide range of building types and ages were found to invest significant heritage value in their original windows, including residents in undesignated older buildings.

Residents generally considered complete window replacement to be unacceptable to their heritage values, especially UPVC replacement windows. However, less invasive options such as secondary glazing, thermal curtains and interiors shutters were considered more acceptable. These options may have significant potential to reduce carbon by reducing heat loss from windows in older buildings, especially if lifecycle, rather than just operational, carbon is considered. Residents identified barriers to retrofitting such as excessive costs, lack of skilled tradespeople and obtaining planning permission, as well some concerns about the need to maintain ventilation pathways, especially in buildings with moisture challenges. There is a need for support for residents to negotiate these challenges, and these findings highlight the need to consider specific options as part of a holistic approach to building retrofitting that accounts for both the condition of the building and residents' values. The other key finding is that residents in undesignated buildings also invest heritage values in their historic windows which effect the acceptability of retrofits. It is therefore necessary to consider heritage sensitive measures in a wider range of buildings than just those which are officially designated, if carbon reduction efforts are to succeed at the required scale.

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