Heritage values as a driver or obstacle for energy efficiency in Victorian and Edwardian buildings

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Abstract – This paper explores how homeowners living in Victorian and Edwardian homes within conservation areas in Cambridge balance aesthetic and heritage values against lower energy costs and improved comfort levels. Previous government initiatives aimed at saving energy and reducing CO^2 have drawn little interest from this group who are left to work through their own solutions. Through semi-structured interviews with homeowners, we examine the stages of energy efficient retro-fitting and the impact of their retro-fitting decisions on the heritage values and energy performance of their residence. A sample of retro-fit measures are checked by thermal imaging (in heatwave conditions) with no obvious problems being detected although further testing is recommended. It clearly becomes apparent that simple measures such as draught stripping and increased loft insulation with quality products are being overlooked. The designation of the conservation areas is also considered. Areas improve as road closures, parking restrictions and traffic calming reduces traffic volumes in the neighbourhood, but with this more onerous planning restrictions also follow, which may restrict those with aspirations to extend their homes.

Keywords – energy efficiency; heritage values; conservation areas; Cambridge; thermal comfort; residents

1. INTRODUCTION

There is limited research which seeks to understand how homeowners of Victorian and Edwardian buildings balance energy efficiency, keeping their homes warm and consideration of their own perceptions of the heritage values contained within their dwelling. Only recently, there has been some research [1] [2] [3], placing the homeowner or user of the building at the centre of the discussion where the issues of energy efficiency, maintaining a warm home and the buildings values are to be considered. This is important because dwellings built before 1919 represent one fifth of the total of 26 million dwellings in the UK [4] and this type of property is categorised as ‘hard to treat’ by the Building Research Establishment. Furthermore, schemes such as the Green Deal which the government launched to help homeowners insulate the outsides of homes offer very little to those within this group. Homeowners are therefore left to work through their own decisions and solutions.

It is the aim of this paper to examine the degree to which *‘heritage values’ associated with Victorian and Edwardian dwellings drive or prohibit energy efficiency?* The paper will do so by thematically analyzing 18 semi-structured interviews with homeowners of Victorian and Edwardian homes within conser-

vation areas in Cambridge who have undertaken varying degrees of retro-fitting to their homes. Thermal imaging has also been carried out on a sample of the group as a first step analysis investigating retro-fitted windows, doors and under-floor insulation; this therefore adds a quantitative element to the study.

2. METHODOLOGY

Our methodological approach is socio-technical. We have collected and analysed qualitative, social data regarding perceptions and attitudes of homeowners of traditional buildings in conjunction with scientific, thermal imaging data related to the performance of the building. Homeowners were recruited via 'snowballing' – that is via networks and personal contacts who could introduce the researchers to further participants. This is vital because there are certain health and safety issues when visiting residences of people who are unknown to the researchers. In addition, snowballing guarantees participation because it is based on trust. All interviews were transcribed and thematically coded resulting initially in 70 and then collapsed to 15 overarching themes including original features; physical conditions of original features; dissatisfaction; satisfaction; cultural/heritage values; interior insulation; personal interest in conservation; space; replication; cost of restoration compared with replacement; mortgage requirements; prior experience living with original features. Limited thermal imaging was carried out on a sample of the dwellings to test the effectiveness of retrofit measures that have been undertaken, and some preliminary findings are presented in the form of thermographic images. A Fluke thermal imaging camera (model No. TiR 105) was used on a sample of the homes within the study. The camera was used indoors where there was a much higher temperature outside. The objective was to identify any leakages of air from windows, doors or timber suspended floors particularly where retrofit measures have been undertaken. The use of thermal imaging cameras during heatwaves has been investigated by Cambridge Carbon Footprint, a charity who offer support to people around Cambridge with energy saving initiatives and have subsequently produced a guide on the subject. The exercise is intended to produce a first step analysis of the efficiency of retrofit measures. We acknowledge that the thermal imaging is limited but still provides a first snap-shot of the possible effects of certain interventions on the thermal and energy performance of the building. We thus use it as an illustration and also as a prompt to foster future similar studies that merge together qualitative data related to perceptions and values with more technical data related to the actual performance of the building. The collected data were mapped and analysed via system dynamics, a method used for mapping and modelling the dynamic interrelationships of variables shaping and affecting a phenomenon, system, behaviour, etc. [5] [6] as a method to map the dynamic interactions between heritage values and energy efficiency interventions. The coded information was presented via Vensim software in order to produce a causal map diagram (Figure 3).

3. FINDINGS

3.1 BALANCING HERITAGE VALUES AND ENERGY RETRO-FITTING

Many of the interviewees have come to Cambridge to live and work, they have bought houses and settled in the city, many have then moved again often within close proximity to their former home. In view of this, we could state that the participants are favourably pro heritage. However, even so, this group of respondents is of interest because their responses can be juxtaposed to other groups of interviewees who do not hold a special interest in heritage (see Fouseki and Bobrova in this volume and Koukou and Fouseki in this volume). The age group of the interviewees is between thirty and seventy years of age. 13 out of 18 interviewees have lived in Cambridge for 22 years or more, with 6 having been in their current property for over 29 years contributing to a high sense of area attachment as the following quote indicates [7]. As one of the interviewees pointed out "*We love the houses, we love the neighbourhood, it's a real community, we don't want to leave"* (Interviewee 1: Female, 30–35, Professional). They also assigned high heritage and aesthetic values. Almost all of the homeowners interviewed undertook some form of 'stock check' when they bought their homes, making an early assessment of what original features they had and what condition they were in. Houses ranged from virtually untouched with most original features remaining to those with very few or features that were damaged or in a state of decay. Whether the house had been bought 38 years ago or more recently there was always a strong recollection of the features homeowners had started out with. Indeed, almost all homeowners indicated that it was important to preserve the original features that they had 'inherited', but other values not just aesthetic were found to be important:

> *'I think people who want these sorts of houses want them with as many period features as they can have'. 'I love the high ceilings and the big windows, the big garden I like, it's got an expansive hallway with stairs leading up, I quite like things like the cornicing and the roses, things like that'.* (Interviewee 1: Female, 30–35, Professional).

Other aspects of the house that homeowners considered important were; its location, the spatial qualities of the house; its amenity value; the amount of light or its orientation to the sun, along with walled gardens. Features that homeowners most commonly thought important and worth preserving were the sash window, fireplaces, cornicing, roses and other plasterwork, stained glass, original glass, staircases and skirtings:

> *'I am quite passionate about preserving the old glass, if you lose that, you lose the beautiful ripply effect that you get with old glass.'* (Interviewee 16: Male, Photographer, 60–65)

3.2 BALANCING RETRO-FITTING WITH SPACE

Around half of the homeowners interviewed had undertaken a programme of modernisation on buying their homes. This typically included upgrading of the services for example, re-wiring, plumbing, replacement heating, new kitchens and bathrooms along with other works such as rectifying failed damp proof courses,

making good ceilings and plaster surfaces. Many homes had been purchased with rear extensions constructed; few homes had many retro-fit measures installed.

The interviews suggest that space planning is an important consideration even in the larger more prestigious 3 storey semi-detached Victorian and Edwardian homes, this may be that the cellular room layouts do not meet the requirements for modern family living. The smaller 2 storey terraced houses are generally considered to be too small in their original layout.

Of the 18 Victorian and Edwardian homeowners interviewed, 14 houses had extensions. Retrofitting is generally undertaken by homeowners incrementally. In two instances retrofitting, renovation and modernisation was undertaken at outset, the major construction works lasting two years in duration. The reason that most retrofitting occurs is initially because of thermal comfort, energy saving is deemed to be a secondary concern but once a level of comfort is achieved energy saving moves more into focus. Most interviewees had experienced the cold in their homes or in previous properties; interviewees did not mind sharing their experiences of the cold;

Retrofitting can take place over many years and in the case of a retired couple (Interview 19) who in retirement are having replacement sash double glazed windows fitted this month 33 years after moving into their property. There becomes a convergence between the retro-fitting of homes and how those homes are used. A common situation that emerges is that homeowners in the course of constructing a large living family room including the kitchen, will also upgrade the overall insulation and heating standards of this space mainly as a result of the necessity to meet the current building regulation requirements, and taking this opportunity to enhance the living area with for example underfloor heating or secondary forms of heating such as wood burners. A large living family area has been created by 8 of the homeowners. Their comments indicate satisfaction with the results they have achieved;

In creating large living family spaces, or in the general extending of the home, the consideration of heritage and aesthetic values arises. The majority of the extensions extend beyond the existing footprint of the building and this may result in the loss of historic building fabric and potentially heritage features, for example chimney breasts, rear bays, windows and doors.

The decision to extend by (interview 2) whose large living family area has been recently completed was held up by heritage concerns; *'We made a compromise we kept an old fireplace and took out a chimney breast that was to get the kitchen in and extended at the back'. 'It took us 4 years of debate that one, because of altering the features'.* (Interview 2: Retired Couple).

3.3 RETRO-FITTING AND BALANCING RETRO-FIT WORKS

Homeowners were asked what retrofit measures they had installed in their homes and how they had balanced retro-fit works in the context of the features and materials of their homes that they found important or significant. Most of the

interviewees had some or all of the original sash-windows in their homes (14 out of 18) which may be explained by the fact that this is a conservation area and clearly contradicts with non-conservation areas (see Fouseki and Bobrova in this volume) where the picture is exactly the opposite.

Most homeowners had considered heat loss through the roof and in many cases had taken some action to top-up the loft insulation, however this had often been completed some time ago and the current depth and product types were rarely known. In 11 cases, loft insulation fitted but may not be up to recommended levels while in seven cases fitted Celotex or similar insulation under rafters was part of roof maintenance works or loft extension work.

The fitting of insulation under the floorboards of suspended timber floors was raised as a theme by five homeowners when only three homeowners had installed such insulation. The impact of this can be illustrated by the results emerging from the thermographic imaging of floors (Figure 1).

In Figure 1 the thermography results show the perimeter of the floor around the skirting board at a temperature cooler (blue) than that more central area of the bay (yellow) where the wooden floorboards may have been warmed by heat radiation through the windows (Figure 2).

A floor-joist can also be detected running top to bottom of the image. When this image is compared to the thermographic results from the comparison property which has no insulation under the floorboards, warm air can be seen to be channelled into the house from an area which corresponds with an airbrick on

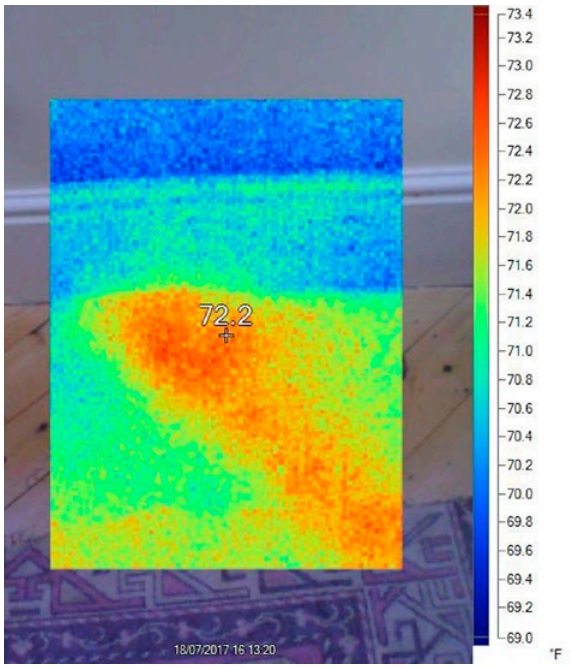

Figure 1. Thermographic image uninsulated suspended timber floor–Bay window area of the Edwardian comparison house.

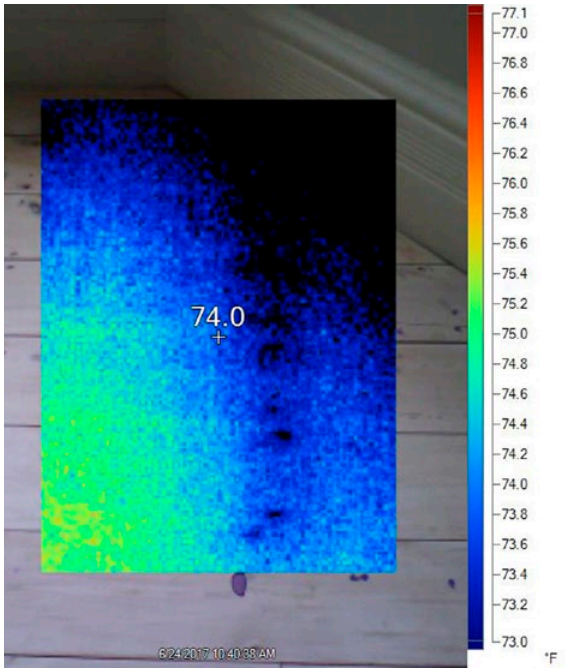

Figure 2. Thermographic image of the Bay window area.

the outside of the property. This is warming the floorboards in the immediate bay area, with warm air also seeping through the gaps in the floorboards.

4. MAPPING THE DYNAMIC INTERACTION BETWEEN SPACE, HERITAGE VALUES AND ENERGY EFFICIENT RETROFITTING

The next step of the thematic analysis of our interviews was to map the systemic and dynamic interactions between heritage values, space and energy retro-fitting decisions on Vensim, a software commonly used for system dynamic analyses, in order to identify the critical variables that determine certain decisions on certain energy efficiency measures. Here, the wider context is a conservation area with which homeowners are attached. It is within this context that we need to understand the systemic interactions of the aforementioned variables. Figure (3) shows a causal-loop map designed on Vensim – this is a map that illustrates the causes and effect of a phenomenon in loops. Loop 1 (R1) indicates that the more original features in an old building, the higher the cultural values, and the higher the satisfaction. However, once the physical condition of the original features deteriorates over time homeowners are choosing between three main options including replacement, restoration/preservation and replication with modern materials (see boxes in the diagram). The option will very much depend on the type of intervention. Interior insulation seems to be preferred for increasing thermal comfort if space allows (see Balancing loop B4). However, if space

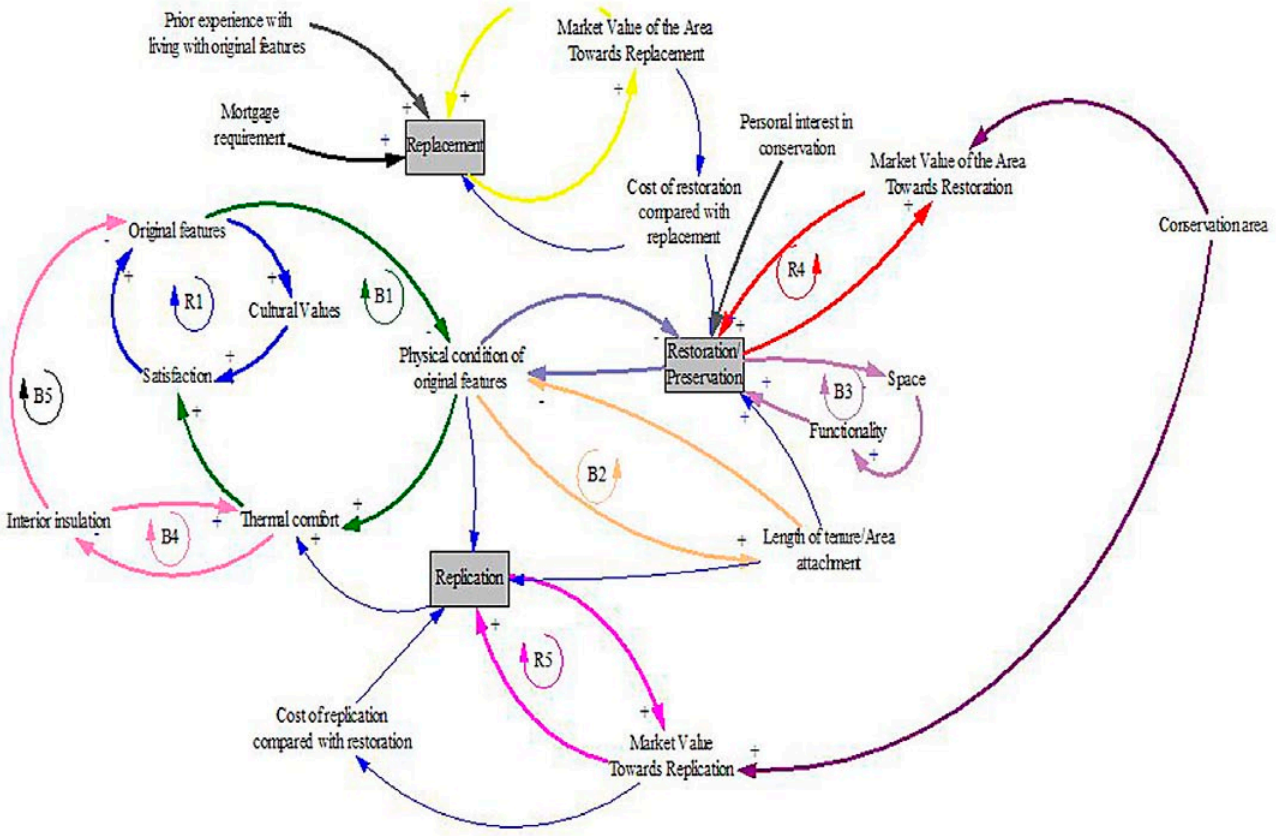

Figure 3. Causal-loop diagram of interactions on Vensim.

is limited (see Balancing loop B3 in the diagram) there is more preference on restoring/preserving rather than interior insulation. It is worth pointing out here that exterior insulation is not an easy option in conservation areas. Restoration and preservation is also dictated by personal interest in conservation, the wider area and how it values the market value of original features (see R4 in the diagram) and the costs. Finally, replacement will mainly be driven in the conservation area by either mortgage requirements or prior negative experiences with living with original features.

5. DISCUSSION

What the results above indicate is that homeowners' decisions on improving the energy performance of their residence will depend on multiple factors that are in interaction with each other. Hence, the decision-making on this matter is a complex and systemic process that moves beyond a simple tension between thermal comfort and heritage values/preservation. In addition, homeowner's decisions on retro-fit measures are facilitated by conferring with others in their streets for advice and seeking help from independent professionals such as architects. Retro-fitting is carried out incrementally and progress is generally over many years. All homeowners are reluctant to lose any heritage features and where windows are removed these are kept in most cases. This finding contradicts findings from other cultural and social contexts where residents are keen to sacrifice original features if they affect negative thermal comfort (see Fouseki and Bobrova in this volume and Koukou and Fouseki in this volume). Replacement joinery double glazed windows are a measure some have adopted and others have shown an interest in.

It emerged from the interviews that there are a high proportion of houses within the sample group that have a rear extension, 15 out of 20, many of these are used as large living family areas normally including the kitchen, many of these spaces are relatively new and will comply with more up to date building regulations and therefore potentially become the warmest space in the house.

In almost all cases original features are highly valued; all homeowners can remember what heritage features were contained within their house irrespective of how long ago it was bought, even if it was almost 40 years ago. Where houses are extended, a trade-off between heritage values and user comfort is required and this was found to be a process that was carefully thought through. This finding is reaffirmed by a similar study in the context of Cambridge carried out by Sunikka-Blank and Galvin [8] who also point out the careful and lengthy decision-making process that homeowners in Cambridge undertake as well as the diverse ways in which they express the idea of aesthetics and heritage values.

Many homeowners who had not created specific large living areas in their homes through construction works, spoke about the cold they endured in their homes. Retrofitting was undertaken as a means of providing comfort in the first instance. The need to save energy became secondary, but as homes became warmer as a result of more extensive retrofitting, energy costs moved more into focus.

6. CONCLUSION

From the sample of Cambridge homeowners interviewed, in almost all cases original features were highly valued. Where retrofitting is carried out incrementally and over many years there appears to be a high retention of original building fabric and features, although it is noticeable particularly with those in or around retirement age that replacement joinery windows are being installed and considered.

It is not clear when large scale contractor works are undertaken, which may include renovation and retrofitting, whether as much of the original building fabric and period features are saved as is possible. Irrespective of how keen homeowners are to preserve as much as they can, decision making on site may put historic features and materials at risk. This may be an area for future research.

Many homeowners who have expressed the most satisfaction with the comfort levels of their homes have created large living family spaces within and it is from this position retro-fitting continues and comfort levels improve further in other areas of the house as different measures work in an integrated way, for example, secondary double glazing, underfloor insulation and secondary forms of heating and zoning. There were no significant problems reported with any type of retrofitting, including those who had fitted internal insulation. There were some minor instances of condensation within secondary double glazing. These observations were further validated by spot-thermal imaging captures.

The main limitation of the research may lie within the demographic of the sample group of whom all were middle class and financially comfortable. Similar housing stock around the UK may not benefit from the levels of investment that Cambridge homeowners decide to make in their properties.

However, this piece of research is important in the wider field of sustainable heritage because it directly engages with a group of homeowners who, in giving a generous amount of their time, have allowed an insight into living in Victorian and Edwardian homes many of which display original features but which may have started out as being difficult to heat. These homeowners become custodians of heritage buildings and balance the values that are important to them with the underlying problems that they face. Ultimately, it is up to the homeowners to decide and justify, mainly to themselves, which measures are appropriate. Their often slow and careful steps seem to bring the desired results.

For future research, we would like to see more socio-technical studies that attempt to collect and synthesize social and technical data. There are certainly challenges in this approach, especially if applied in the context of everyday residences. Environmental data and thermal imaging data measured for at least a year as well as social data via interviews and other qualitative methods do take time and require the establishment of prior trust with the residents. However, it is worth starting developing longer-term studies of this type so that we will be able to better articulate how the complex system of a historic house changes over time

and what the best strategies to balance heritage significance and environmental sustainability are.

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