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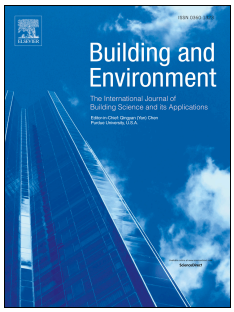

A socio-mathematical approach to exploring conflicts between energy retrofit and perceived heritage character

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A socio-mathematical approach to exploring conflicts between energy retrofit and perceived heritage character

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Abstract

Improving the energy efficiency of buildings is a key climate change mitigation strategy. The application of which will require substantial improvements in the pre-existing stock; a subset of which are buildings of historic importance. Retrofitting such buildings is controversial, as historic elements might be altered or covered up, thereby changing the character of the building. In this work, we introduce a novel socio-mathematical method to aid the resolution of this controversy. Firstly, we garner in a new way the views of 116 members of the public about the acceptability of 15 common retrofit measures. Secondly, the public's ranking of the acceptability of the measures with respect to heritage impact is compared to a ranking of the energy saving given by the measures when analysed using a dynamic thermal simulation of the building. No simple correlation is found; hence it is concluded that measures that present greater energy savings are not de facto more intrusive, and that there is the potential for a constructive dialogue between those inspired by a conservation agenda and those targeting carbon savings. Finally, by using a Pareto front approach, a new theory is developed of how to identify measures that are sensible in the eyes of both parties. This new three-stage process will be of use to those in Government attempting to resolve such conflicts or set national guidance.

Highlights:

A new method to address the conflict between conservation perception and energy retrofit.

Photographs used to extract the views of 116 members of the public.

Results compared to a thermal simulation.

Retrofit measures classified as logical or not.

Key words: historic buildings, Pareto front, energy efficiency, conservation, retrofit

1. Introduction

Buildings consume about 40% of the energy and emit 36% of the anthropogenic greenhouse gas emissions in Europe [1] , and many countries have ambitious targets to reduce these emissions [2]. These targets are challenging for new buildings and even more so for the pre-existing stock. In the UK for example, 20% of dwellings were built before 1919 and a further 20% between 1920 and 1939 [3]. In addition, there are many World Heritage cities, such as Bath (UK), Graz (Austria), Trogir (Croatia), Verona (Italy), Valletta (Malta), Safranbolu (Turkey), Cuzco (Peru) and, Quito (Ecuador) where large areas are considered historically highly sensitive.

Alongside the conservation agenda, there is also the need to ensure suitable environmental conditions in these older properties, particularly wintertime temperatures. The average temperature