Thermal performance evaluation and comfort assessment of advanced aerogel as blown-in insulation for historic buildings

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TITLE
THERMAL PERFORMANCE EVALUATION AND COMFORT ASSESSMENT OF ADVANCED AEROGEL AS BLOWN-IN INSULATION FOR HISTORIC BUILDINGS

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ABSTRACT
Research and development of cost-effective, high-performance thermal insulation materials for the construction sector has to be focused on their final application. In particular, solutions for refurbishing historic buildings, which represent 40% of the European building stock, have to offer a good compromise between environmental quality, energy efficiency and conservation aspects. In this paper, the experimental assessment of an insulation material based on aerogel technology, recently developed in the European project EFFESUS, is presented with regard to the material’s thermal performance, compatibility with historic fabric and reversibility. The overall results obtained in laboratory testing on a real-size mock-up and in a real-world case application indicate that the new material is a promising solution for retrofitting historic buildings, thanks to its thermal properties, easy application, reversibility and material compatibility.

1. INTRODUCTION
More than 40% of the European residential buildings have been constructed before the 1960s [1] and more than 50% before the 1970s [2]. European households are responsible for 68% of the total final energy use in buildings, mainly related to heating, cooling, hot water, cooking and appliances [1]. Most of the residential stock from before the 1970s is owner-occupied (from 46% to 97%), with a smaller but still substantial portion rented out (from 37% to 54%) [2]. The large proportion of occupied dwellings has an important role in the retrofit programs for reducing energy bills and costs, as well as for improving energy efficiency and human comfort. The European Directives 31/2010/CE [3] and 2012/27/EU [4] have shown the big potential to achieve energy savings and CO\textsubscript{2} emissions reduction through the refurbishment of existing buildings, besides the construction of new low-energy buildings [4]. The energy use is highest in those European countries which have the largest proportion of old buildings, such as the United Kingdom (UK), Denmark, Sweden, France, Czech Republic and Bulgaria [1]. In the case of historic buildings, the intervention should respect their historic values, balancing the needs of energy efficiency, human comfort, heritage preservation and long-term sustainability. This challenge is particularly relevant in the countries with the world’s largest historic building stock, namely Italy, Spain and UK [5].
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