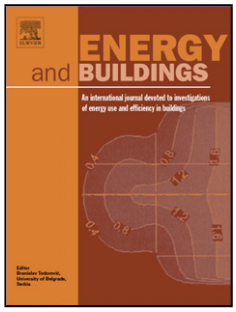

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Thermal performance of internally insulated historic brick building in cold climate: A long term case study

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ABSTRACT

Historic buildings built before 1945 make up a significant part of the building stock in the European Union. They also contribute to the greenhouse gas emissions due to high energy consumption. However, policy makers and building owners are facing “building energy efficiency-heritage value” dilemma when, on the one hand it is important to preserve a building’s heritage value and on the other hand, energy consumption should be reduced significantly. Internal insulation is one of the energy efficiency measures that can be applied. However, this is one of the most challenging and complex energy efficiency measures due to changes in boundary conditions and hygrothermal behaviour of the wall, especially in cold climate. We aimed to study the thermal behaviour of two internal insulation materials applied to historic masonry building in a cold climate. We carried out long term in-situ measurements of heat flux and temperature for internal insulation with aerogel and vacuum insulation panels (VIP) in the case study building in the historic quarter of Riga, Latvia. The original walls are made of 51 cm thick calcium silicate bricks. They were poorly maintained and heavily damaged by moisture before energy efficiency renovation. After renovation the external surface of walls was painted with self-cleaning, water repellent hydrophobic facade paint. The energy efficiency renovation also included insulation of floor and roof, change of windows, new ventilation and air heat pump installation. The analysis of the thermal behaviour show that the masonry part of the wall is exposed to freezing risk for a significant number of days during the winter. Calcium silicate bricks are very sensitive to freeze-thaw damage therefore we carried out computer simulation for the assessment of hygrothermal behaviour. Results show that the calcium silicate masonry part of the internally insulated wall in cold climate leads to exposure to freeze-thaw damage if the moisture content of the brick is higher than the capillary saturation. This process strongly depends on unfavourable outdoor conditions for wall types with and without water repellent hydrophobic paint.

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