World Academy of Science, Engineering and Technology
International Journal of Architectural and Environmental Engineering
Vol:14, No:03, 2020

Retrofitting Insulation to Historic Masonry Buildings: Improving Thermal Performance and Maintaining Moisture Movement to Minimize Condensation Risk

Authors : Moses Jenkins

Abstract : Much of the focus when improving energy efficiency in buildings fall on the raising of standards within new build dwellings. However, as a significant proportion of the building stock across Europe is of historic or traditional construction, there is also a pressing need to improve the thermal performance of structures of this sort. On average, around twenty percent of buildings across Europe are built of historic masonry construction. In order to meet carbon reduction targets, these buildings will require to be retrofitted with insulation to improve their thermal performance. At the same time, there is also a need to balance this with maintaining the ability of historic masonry construction to allow moisture movement through building fabric to take place. This moisture transfer, often referred to as 'breathable construction', is critical to the success, or otherwise, of retrofit projects. The significance of this paper is to demonstrate that substantial thermal improvements can be made to historic buildings whilst avoiding damage to building fabric through surface or interstitial condensation. The paper will analyze the results of a wide range of retrofit measures installed to twenty buildings as part of Historic Environment Scotland's technical research program. This program has been active for fourteen years and has seen interventions across a wide range of building types, using over thirty different methods and materials to improve the thermal performance of historic buildings. The first part of the paper will present the range of interventions which have been made. This includes insulating mass masonry walls both internally and externally, warm and cold roof insulation and improvements to floors. The second part of the paper will present the results of monitoring work which has taken place to these buildings after being retrofitted. This will be in terms of both thermal improvement, expressed as a U-value as defined in BS EN ISO 7345:1987, and also, crucially, will present the results of moisture monitoring both on the surface of masonry walls the following retrofit and also within the masonry itself. The aim of this moisture monitoring is to establish if there are any problems with interstitial condensation. This monitoring utilizes Interstitial Hygrothermal Gradient Monitoring (IHGM) and similar methods to establish relative humidity on the surface of and within the masonry. The results of the testing are clear and significant for retrofit projects across Europe. Where a building is of historic construction the use of materials for wall, roof and floor insulation which are permeable to moisture vapor provides both significant thermal improvements (achieving a u-value as low as 0.2 Wm^2K) whilst avoiding problems of both surface and intestinal condensation. As the evidence which will be presented in the paper comes from monitoring work in buildings rather than theoretical modeling, there are many important lessons which can be learned and which can inform retrofit projects to historic buildings throughout Europe.

Keywords : insulation, condensation, masonry, historic
Conference Title : ICGB 2020 : International Conference on Green Building
Conference Location : Paris, France
Conference Dates : March 26-27, 2020