# THERMAL PERFORMANCE OF TWO INNOVATIVE MATERIALS APPLIED TO HISTORIC WALLS: AEROGEL INSULATION AND RADIATION SELECTIVE COATING

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**ABSTRACT** The research has been conducted in the European Research Project "Energy efficiency of EU historic district sustainability" (EFFESUS), which aims at developing solutions and tools for improving the energy efficiency of historic buildings and districts, respecting their heritage value. The paper aims at assessing the thermal performance and the conservation compatibility of an advanced aerogel insulation and a radiation selective coating, applied to typical historic masonries respectively in cold and hot climates. First, we verified the thermal behavior of the insulation material made by polyester fiber and aerogel dust, using both laboratory tests and thermal simulations. This material has been developed to be blown into the air cavities of historic solid masonries, to optimize the thermal insulation in terms of energy benefits, reduction of used space, easy installation, minimum disruption, and reversibility of the intervention. The steady state thermal performance of a large scale mock-up of a traditional stonewall has been evaluated before and after the application of this material. This tests has been performed in a hot box apparatus, according to the standard procedure EN 1934 for moderate inhomogeneous walls. Its applicability to non-homogeneous and massive walls has been verified with the 2-D thermal simulation using the software Delphin 5.8. The thermal conductance is reduced to 1/3 after the application of the aerogel. Also, the benefits on human comfort has been performed in a reference room, for comparing energy and environmental performances of the material. Second, the radiation selective coating made by metal oxides is interesting for historic buildings in hot climates. The material, thanks to the high infrared (IR) reflection, has been developed to reduce the amount of solar heat absorbed by the building surfaces and to decrease the cooling energy consumptions during summer, ensuring the appearance of the façade, preserving the original finishing and guarantying the reversibility of the interventions. Its dynamic thermal performance has been tested and simulated to demonstrate the actual performance in terms of contribution to energy demand and indoor air temperature reduction. The evaluation of its thermal effects has been simulated in a reference room using the software EnergyPlus 7.2, with different conditions (climatic conditions, surface orientation, internal use, building stratigraphy, internal summer ventilation, solar heat gains through the windows). Then, the dynamic thermal performance of a large scale mock-up of a traditional brick wall has been tested in a hot box, before and after the application of the coating using an innovative "non-standard" test. The results of these works will be presented, discussing also the compatibility of these materials with the preservation of the historic values.

**Parole chiave/Key-words:** innovative material, historic buildings, aerogel, radiation selective coating