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Thermal Performance of Solar Facade Concepts Applying Selective and Transparent Insulation Functions: Preliminary Experimental Study

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Abstract—Recent scientific progress in the field of building science and building engineering deals with current challenges and future directions in buildings, sustainability and creation of healthy built environment. One of the major factors contributing to this issue is application of new advanced materials, concepts and technologies. Such approach can contribute to the development of new building materials and innovative building envelope concepts. Solar façade principles are adequate for relevant utilizing of solar energy technologies when designing sustainable energy sources in buildings. This study focuses on an experimental analysis of a proposed non-ventilated solar facade concept to integrate the need for this sustainable energy design approach for buildings. A new solar façade prototype based on transparent insulation material and a selective absorber is tested experimentally and contrasted with conventional insulation and a non-selective type of absorber, respectively. The presented study focuses on an experimental non-ventilated solar type of façade exposed to solar radiation both in the laboratory and in outdoor tests. Based on solar wall principles, the key intention is to monitor temperature response within proposed components at small scale level. Due to the high solar absorbance level of the façade, high- and low-emissivity contributions were primarily studied. All the implemented materials were contrasted from the thermal aspects point of view. Temperature response is monitored by means of a solar simulator whilst outdoor testing employs real solar radiation exposure. The main objective of this analysis resides on i. Monitoring of temperature response within proposed components; ii. Analyzing the thermal benefits of optical properties involved in components; iii. Measurements of a comparative nature with solar radiation incidence; iv. Experimental confrontation between laboratory and outdoor testing. The resultant temperature growth within proposed concepts was specifically analyzed. The maximum level of the measured temperatures in proposed concepts is more than 100°C, thus the solar radiation received and transferred into the thermal energy has appreciable extent. The results of the solar-based experiments show with small-scale experimental prototypes that high potential of solar energy may be involved when designing sustainable energy sources in buildings.

Keywords—Solar wall; Solar façade; Selective absorber; Transparent insulation material; Thermal performance; Solar simulator; Outdoor test