

Abstract

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Research on the performance characteristics of a newly designed door frame with a reduced thermal transmittance.

Modern construction emphasizes energy efficiency these days. The growing environmental awareness of consumers and the tightening of building energy-saving regulations forces window and door manufacturers to continuously improve their solutions. Not only high aesthetic standards and customization of contemporary products must be met but, above all, heat loss minimization is required. This expects the development of new designs and the use of technologically advanced materials to ensure appropriate thermal insulation parameters.

The main goal of the presented work is to design and develop a door frame with a reduced thermal transmittance, according to the requirements established by the Polish Ministry of Transport, Construction and Maritime Economy in the regulation dated July 5, 2013. This regulation says that the thermal transmittance must not exceed $1.3 \text{ W/m}^2\cdot\text{K}$, which is a significant challenge for a door construction based on metal profiles.

Based on the analysis of prototypes being made from materials with a low thermal transmittance, various design and material concepts were developed as a part of this project. Initial tests are carried out to investigate the properties of the proposed solutions. The thermal transmittance is calculated during these tests as well as the tensile strength and thermal expansion of individual structural components.

Based on the results gained, a comparative analysis is conducted to select the most effective design-material solution. The selected solution is then taken to a series of tests simulating a real operating condition. The tests include, among others, an assessment of the tensile strength of the door frame cross-section, analysis of shear resistance and evaluation of the material suitability used in the thermal break, which is a key element of the frame construction.

Next stage of the project includes industry-standard tests carried out in compliance with applicable regulations for window and door joinery which are necessary for certification and market approval. The analysis covers airtightness, resistance to mechanical loads, and operational durability of the structure.

In the final phase of the work, the developed design solution is compared with a standard market-available solution. This makes possible to clearly determine the advantages of the newly designed profile.

The outcome of the conducted research and analysis is the development of an innovative steel door frame profile with a reduced thermal transmittance.