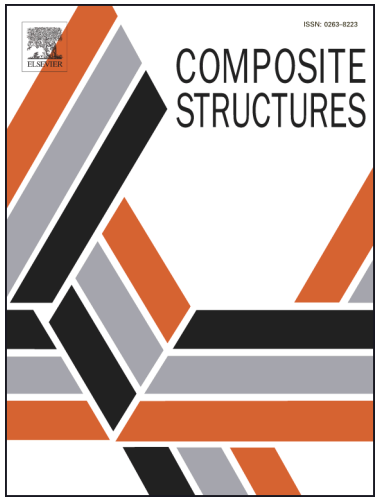

Analysis of heat flow in composite structures used in window installation

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ANALYSIS OF HEAT FLOW IN COMPOSITE STRUCTURES USED IN WINDOW INSTALLATION

Abstract

In the paper, the influence of sill beam material and its construction on heat flow through an external wall with a window was analysed. Such beams are used as the support elements in window installation in the thermal insulation layer. The beams were made of fibre-reinforced polyurethane composites. Some of them were reinforced with metal profiles. Taking into consideration the material properties such as specific strength, heat transfer coefficient and corrosion resistance, in addition to typical steel materials, reinforcements made of aluminium and titanium alloys were also analysed.

Numerical calculations were performed with the ADINA System, which is based on the finite element method (FEM). The process of heat exchange between the interior with the constant temperature of 20°C and the external environment with the temperature of −20°C was simulated. Temperature distribution in the wall as well as the course of the 0^{o} isotherm and the possibility of condensation in the wall were analysed. Moreover, corrosion and the economic aspects connected with the application of metal profiles used as reinforcements were taken into consideration. The numerical model for the sill beam without reinforcement was verified in experiments.

Keywords: window installation, warm installation, heat transfer, numerical analysis, metal reinforcement

1. Introduction

Many of the new technologies introduced into the construction industry are designed to reduce the energy consumption needed to heat buildings. This is because investors increasingly pay attention not only to the global investment costs but also to the operating costs. It is also dictated by legal requirements which are defined in Directive 2010/31/EU of the European Parliament and of the Council of the European Parliament of 19 May 2010 on the performance of buildings [1] and in the national regulations [2] concerning the technical requirements for buildings and their location. Eliminating thermal bridges is one of the methods to save energy. The authors of works [3] and [4] emphasize the importance of building energy simulations due to the possibility of analysing two- and three-dimensional heat flow as well as determining heat losses caused by thermal bridges. The area where a window is connected to an external wall is the thermal bridge most exposed to heat