Influence of Notches in Corners of Casement Windows Under Thermal Load

J. Arfaoui[1], L. Fromme[1]

[1]University of Applied Sciences Bielefeld, Department of Engineering Sciences and Mathematics, Bielefeld, Germany

Abstract

Modern aluminum casement windows consist of an inner and outer profile made of aluminum, which are separated by an insulating bar made of polyamide (see Figure 1). Due to the low heat conductivity of the plastic material the thermal interaction between the living space and the surrounding is reduced significantly. Nevertheless, the thermal expansion of the different materials has to be taken into account. High stresses appear on the miter cut (see Figure 1), which could cause elastic or even plastic deformations of the aluminum parts. In addition, also the plastic material expands and causes an internal pressure on the aluminum profiles. As a consequence of those stresses the window profile deflects.
The deflection can be reduced by notches on the insulating bar. For this purpose, the influence of notches with different lengths (60mm, 100mm, 150mm and 200mm) on the appearing stresses shall be analyzed in this study. The analyzed aluminum casement windows profile was provided by the company "Schüco International KG".
The Thermal Stress physics interface in COMSOL Multiphysics® was used for the coupling between solid mechanics and heat transfer. The CAD geometry was imported in the STEP file format and user-defined material properties (polyamide) were defined for the insulating bar. The difference in temperature between the inner and outer profile was set to 60 degrees Celsius. The heat diffusion through the joinings was implemented using identity pairs at the contact surfaces (see Figure 2).
In a first step, the influence of the air domains between the profiles was analyzed. As expected, the results have shown that the air cavities do not influence the profile's thermal expansion, so they were neglected in the following studies with more complex casement window geometries.
The numerical results confirm the expected behavior: notches on the insulating bar reduce the appearing stresses in the aluminum profiles and therefore the deflection. On the basis of this simulation, it is possible to optimize existing systems.

Figures used in the abstract

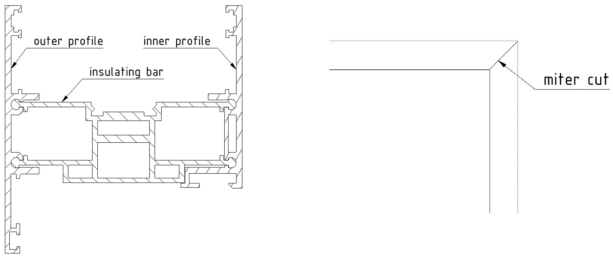

Figure 1: Left: section view ; right: miter cut.

Figure 2: Contact surface.