
Fused glass deposition modelling: Quality of joining area

Philipp Chhaddeh^{*1}, Kerstin Thiele, Peter Hof², Matthias Oechsner², Jens Schneider, Ulrich Knaack, and Matthias Seel

¹Institute of Structural Mechanics and Design, Technical University Darmstadt – Germany

²Center for Structural Materials, MPA-IfW, Technical University Darmstadt – Germany

Abstract

To investigate the potential of additive manufacturing of glass, the Glass Competence Center, located at Technical University Darmstadt develops a machine which additively applies glass on a flat glass plate using fused glass deposition modelling.

First successful studies for the deposition of glass on glass were performed at the Massachusetts Institute of Technology, see (1). Here it was shown that glass can form a material bond and become a monolithic component by extrusion of glass layers on top of each other.

The goal of this research is to extend this method to printing on and forming a material bond with a float glass plate.

In most additive manufacturing techniques, irregularities in the geometry are the weak point of the object due to the layer-by-layer manufacturing process. This also applies to additive manufacturing of glass. In fused glass deposition modelling, glass shards are heated to a viscosity of 104 dPa·s, the working point of glass. This fluid glass is extruded through a funnel on to a heated glass plate. The glass plate must also be heated in order to create this substance-to-substance bond between the glass plate and the additively fused glass. Especially for soda-lime-silica glass, see (2), and borosilicate glass, see (3), the glass plate must be heated globally to the glass transition temperature to avoid thermal breakage, and locally to an even lower viscosity to create a bond between the two components. The joining temperature, which is related to the viscosities of the glass, is a key parameter for fused glass deposition modelling. A weak bond will result if the joining viscosities of the materials do not match. (4)

The objective of this study is to find the temperature ranges that result in a strong bond while maintaining the shape of the geometry, with the goal of creating the smoothest surface possible, focusing on the substance-to-substance bond with a float glass plate. Therefore, optical studies of the geometry and mechanical tests are performed to determine the maximum load carrying capacity.

References

(1)

^{*}Speaker

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