

# Experimental Study on Using Thermal Treatment for Stress Relief in Thermally Tempered Glass

Vlad-Alexandru Silvestru

Steel and Composite Structures, Institute of Structural Engineering, Department of Civil, Environmental and Geomatic Engineering, ETH Zurich, Switzerland, [silvestru@ibk.baug.ethz.ch](mailto:silvestru@ibk.baug.ethz.ch)

## Abstract

Reuse and remanufacturing of glass products are, beside recycling, feasible circular economy solutions for flat glass. Currently, research addresses mostly the separation of materials in insulating glass units and laminated glass, as well as the condition assessment of end-of-life monolithic annealed glass panels. Still, end-of-life thermally tempered glass panels will also increasingly be available in the future. Such glass exhibits a residual stress state, which is advantageous from a structural point of view but impedes mechanical processing like cutting. This contribution focuses on applying thermal stress relief treatment to allow mechanical processing of recovered end-of-life thermally tempered glass. A furnace that allows temperature control was used to heat monolithic thermally tempered glass panels with different temperature curves. New glass panels were used to identify the most suitable temperature curve due to their easier availability in uniform size. End-of-life glass panels will be used later to assess the transferability of the results to aged glass. Thickness and residual stress measurements were conducted both before and after thermal treatment, allowing the evaluation of the degree of stress relief and eventual undesired geometry modifications for the different applied temperature curves. Finally, most samples were tested in four-point bending to analyse the tensile bending strength and the fracture pattern, while part of the samples was subjected to cutting processes. The results of the experimental study showed that thermal stress relief treatment can be applied successfully to allow mechanical processing of previously thermally tempered glass panels. Treatment at 550 °C for 2 hours, followed by natural cooling overnight in the furnace, allowed a full relief of the residual stresses in fully tempered glass. With treatment at 400 °C, either for 2 °hours or for 8 °hours, only a partial relief of the residual stresses was obtained.

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## Keywords

Thermal stress relief treatment, Thermally tempered glass, Reuse of glass, Residual stress measurement, Four-point bending test, Fracture pattern, Cutting thermally stress-relieved glass

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