The 8th European Congress on Computational Methods in Applied Sciences and Engineering
ECCOMAS Congress 2022
5 – 9 June 2022, Oslo, Norway

ANALYSIS OF RESIDUAL STRESS IN CURVED GLULAM BEAMS CONSIDERING MATERIAL UNCERTAINTIES

Taoyi Yu[1], Ani Khaloian[1], and Jan-Willem van de Kuilen[1,2]

[1] Technical University of Munich, Professorship of Wood Technology, Winzererstr. 45, 80797 Munich, Germany
[2] Faculty of Civil Engineering and Geosciences, Delft University of Technology, Delft, Netherlands

Key Words: *Residual stress, Material uncertainties, Curved glulam, Finite element analysis*

The manufacturing process of a curved glulam beam involves mechanical bending of the lamellas and the fixation of the lamellas in a deformed state after hardening of the adhesive. Residual stresses are present in each lamella, which influence the stress distribution over the cross section in the complete beam when loaded after installation. This consequently affects the load-carrying capacity of the beam. Moreover, due to the natural growth process, wood is an anisotropic and inhomogeneous material, and the variation of properties in different lamellas can be considered for numerical simulations, using probabilistic approaches [1], as they will influence the stress state.

In this paper finite element analysis is used to study stress developments in curved glulam beams, considering manufacturing process, wood anisotropy, growth ring effects, and wood fiber deviation around knots. The effects of hydro-expansion and adhesive properties are considered for simulations as well. In addition, the effect of the parameters' uncertainties on the stress development as well as different beam configurations are analysed.

As a result, stress distribution in each individual lamella is significantly influenced when taking material variability into consideration. Moreover, the location of the critical stress is redistributed inside each lamella, which may influence the damage and failure initiation.

REFERENCES

[1] G. Kandler, J. Füssl, and J. Eberhardsteiner, Stochastic finite element approaches for wood-based products: theoretical framework and review of methods. *Wood science and technology*, 49(5), pp.1055-1097. 2015.

Corresponding Author: Taoyi Yu, yu@hfm.tum.de