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INFLUENCE OF STIFFNESS VARIATION IN TIMBER BOARDS ON EFFECTIVE BEHAVIOR OF GLT BEAMS

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Wood is a naturally grown material and, thus, the mechanical properties of structural timber boards – particularly stiffness and strength – are subject to high variability. Within this work, the impact of this material property variability on the effective stiffness of wood-based products, such as glued laminated timber (GLT), is investigated.

Therefore, 50 GLT beams (with 4, 7, and 10 laminations) were tested under four-point-bending. Before assembly, each lamella was marked so that their location and orientation is traceable within the final GLT product. The fibre orientation within the lamellae could be obtained through high resolution WoodEye® laser scans on all four surfaces of each lamella. A micromechanical model was used to predict the clear wood stiffness from microstructural characteristics of wood, e.g. such as mass density and microfibril angle [1, 2]. With the 3D fibre orientation and the clear wood stiffness at hand, an estimation of the stiffness distribution in longitudinal direction of each lamella was determined, similar to [3].

Knowing the stiffness profile of each lamella and its location within the GLT assembly allowed for an accurate finite element model of the investigated structural elements. Thus, the four-point-bending tests could be reconstructed virtually, with the numerical test results concurring well with experimental tests, as is shown in Figure 1.

Therefore, the stiffness model based on laser scans combined with a finite element procedure is a valid approach for designing and optimizing structural timber elements. Furthermore, the longitudinal stiffness profiles are used for estimating the properties of a random process model, which in turn serves as input for a probabilistic approach.

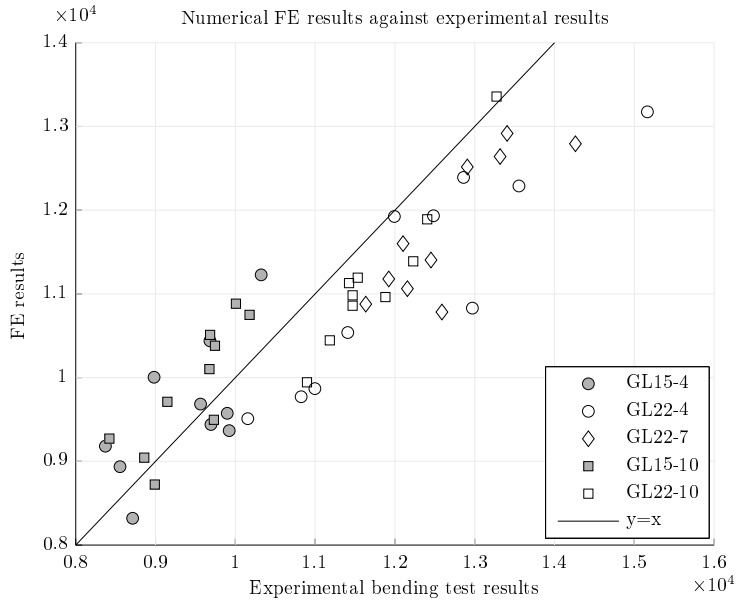

Figure 1: Numerical results vs. experimental results for grading classes LS15 and LS22 and 4, 7, and 10 layers.

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