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Metamodel assisted optimization of GLT systems by reordering laminations using metaheuristic algorithms

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An more efficient use of the raw material in GLT beams is commonly achieved by inserting lamellas of lower quality in less stress areas, usually near the middle place of a beam. However, this rather simple method leaves room for improvement. In particular disregarding the real morphology of a board and its location in the final beam setup can be significant, since only this information together with the actual loading situation allows for a proper evaluation of weaknesses in the GLT beam. For this reason, an optimization strategy was developed, able to take actual mechanical property distributions as well as the occurring stress states in the final GLT beam within each board into account.

To achieve this, subsequent to an automatic reconstruction of knot geometries and the determination of the effective local stiffness distribution of each board [1–3], the GLT beams are analyzed using a two dimensional FE model. This information is further exploited to find optimal GLT beam setups out of a defined sample of wooden boards. As the complexity of this combinatorial optimization task quickly increases with the number of beams and wooden boards, metaheuristic optimization methods were applied [4, 5]. Additionally, the evaluation of the computationally costly FE model is bypassed by defining two types of metamodels, which are capable of approximating the FE model's deflection. Comparing the results obtained from various optimization approaches to commonly used methods within the production of GLT beams, on average a reduction of the maximum deflection of 15 % to 20 % could be achieved.

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