

Towards efficiency in constructive timber engineering - design and optimization of timber trusses

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1 Abstract

Currently, laminated timber is widely used. The gluing allows for higher part length and involves an advantageous behavior regarding deformations due to shrinkage and lead to better, more regular mechanical properties. The drawback is a low material utilization factor. Starting from a tree trunk, only 25-30 % are part of the final product. Thus, the high-quality product has to be used as efficient as possible.

At moment mostly, plate girders made of laminated timber are used as a result of the efficient industrialized manufacturing process. If in comparison a truss system is used, a similar load bearing capacity and stiffness can be achieved with much less material effort. The aim of the authors is to industrialize the design and manufacturing process of timber truss systems to be able to compete with the common plate girder systems. The complete process starting from the design, static optimization, work preparation to production process will be cumulated in a continuous digital approach. The paper describes the research approach and experiments about the digital production (by use of a robot arm) and load bearing behavior of different wood-wood connections as first development step. In addition, the design of 1:1 load tests at different timber trusses as well as comparable plate girders is presented.

Keywords: Engineered wood products, Timber engineering, Timber truss, digital process chain, Digital Production

2 Introduction

Engineered wood products like laminated timber and cross laminated timber provide advantageous properties in comparison to classic sawn timber [1]–[3]. Wood is a natural inhomogeneous anisotropic material with discontinuities due to defects like for example pitch pockets, branches, fiber twist etc.

The machining process and gluing allows for a compensation of these defects to get smoother and finally better material properties. In addition, geometry changes due to a change of the equilibrium moisture can be reduced. The drawback is that the production process of these products is accompanied by many subtractive machining processes. If sawn timber is produced from a tree trunk the yield rate is about 55%. The rest are by-

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