Superelvated wooden truss - Increase of load bearing capacity and stiffness

Matthias BRAUN*, Benjamin KROMOSER[a]

*corresponding author

University of Natural Resources and Life Sciences, Vienna
Kromoser research group
Peter-Jordan-Straße 82, 1190 Vienna, Austria
*m.braun@boku.ac.at
[a]benjamin.kromoser@boku.ac.at

Abstract

Today, the main girders of hall constructions are mostly built using plate girders out of glulam timber, while timber truss structures are barely used any more. Reason for this are the high effort for the design and production. However, less material effort is required for a timber truss with similar stiffness and load bearing capacity compared to plate girders with equal span. Thus, the authors are pursuing to industrialize the design and manufacturing process of timber truss systems to be able to compete with the common plate girder systems. In detail, the complete process starting from the design, static optimization, static proofs according to the standards, work preparation to production process will be cumulated in a continuous digital approach.

The stiffness of a timber truss depends mainly on the mechanical behavior of the truss joints. Thus, in the first step, some compression tests on wood-wood connections with different shapes were performed. In addition to traditional wood joints and engineer-type wood joints, also completely new shapes of connections, which were enabled by use of digital fabrication tools, have been tested.

In the next step three embodiments of a timber truss were designed. The timber truss was superelevated by a specific shortening the compression struts to maximize the load bearing capacity and stiffness under distributed load. In detail, the bending moment curve in the chords due to cambering acts exactly against the bending moment curve caused by the subjected load. The calculation results show, that the chords are mainly stressed by normal forces and the utilization of the cross section increases. Threaded rods have been used for the tension frame members. Finally, all three configurations were built in scale 1:1 and their maximal bending load bearing capacity was examined in experimental investigations. The tension frame members of specimen 1 (Figure 1) were made of wood and were prestressed with threaded rods. Specimen 2 was similar to specimen 1 without superelevation. Specimen 3 was similar to specimen 2 but the wooden tension frame members were removed (naked threaded rods). Within the paper the design and production process will be described. In addition, the experimental setup as well as the results of the test will be explained.

Figure 1: Specimen 1, superelevated truss with the help of shortening or lengthening their lacings depending on the subjected load with a span length of 4.80m