

## **Abstract**

Timber structures are exposed to adverse impacts associated with the variability of the surrounding environment. Apart from biological and chemical factors, the influence of physical parameters of the environment such as relative humidity and air temperature are substantial. Connections are the most sensitive place in a timber structure, which, in addition to natural notches, has weaknesses introduced during the assembly. The aim of the thesis was to answer the question whether, and under what humidity change of the glulam beams may be dangerous, causing delamination of the glulam layers in the vicinity of joints and connectors. The issue of delamination failure of glued laminated timber beams was presented on the selected examples from literature and the design practice was indicated. Selected experimental studies from the literature regarding the impact of humidity change on numerous aspects related to timber material were described. As a part of the thesis, experimental tests were carried out: moisture measurement of glulam and timber beams in natural conditions. Based on the available literature, a model of moisture transportation in wood was formulated, as well as a model of wood behavior, taking into account the influence of humidity change. The thesis also contains a description of the discretization and implementation of the used models in the FEM software. A number of simulations were carried out to verify the assumptions (e.g. with the usage of exact solutions of simple cases and experimental studies available in the literature). The thesis contains the description of the simulation of the influence of humidity change load on the large-size beam from glued laminated timber near the joints - the experiment was carried out with the usage of the data from the real project (geometry and static loads). Presented results of the study confirmed that the humidity change of the glulam beams in normal usage conditions, is dangerous and may cause delamination of the glulam layers in the vicinity of joints and connectors.

**Keywords:** timber structures, glulam, humidity, connections, delamination, modeling, finite element method.