

Sensitivity analysis in the rehabilitation of historic timber structures on the examples of Greek Catholic Churches in Polish Subcarpathia

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ABSTRACT

Timber log houses were typical constructions in many regions of Europe and beyond. Nowadays, the necessity of maintenance, renovation and reinforcement of historical structures including walls and joints yields need of the analysis of mechanical behaviour of the structural members [1].

This work concerns structural and sensitivity analysis of carpentry joints used in historic wooden buildings in south-eastern Poland and western Ukraine. These are primarily sacred buildings and the types of joints characteristic for this region are saddle-notch and dovetail joints. Thus in the study the authors focus on this type of corner log joints.

The research is aimed at showing the differences and similarities in the behaviour of both types of joints and the indication of their advantages and disadvantages. In addition, the authors try to indicate which type of joint is the most susceptible to damage and what elements are failing first. The authors also propose numerical models of the tested joints defined by means of Finite Element Method and perform simulations and experiments.

The paper also describes the current condition of corner log joints which form the wall corners of the Greek Catholic Churches of wooden construction in Polish Subcarpathia. Four structures representing the two different types of log corner joints are considered in the study. The buildings are examined e.g. for damage, wood moisture content, out-of-vertical deviations and geometry of the walls. The study is based on in-situ examination and structural analysis of the joints. Numerical models of the joints are defined and finite element simulations of their statics is carried out. Moreover a sensitivity analysis is performed in order to describe how the change of material properties including humidity of some structural members, caused during potential repairs, affect the structural behaviour of the whole connection [1,2]. This represents the situation when some degraded logs are exchanged into new wood combining old damp wood with new and dry logs.

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