Using the ultrasonic tomography method to study the condition of wooden beams from historical building.

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ABSTRACT

The need to evaluate the integrity of wooden structural elements is constantly increasing. Non-destructive methods are becoming more popular in this field of research. One type of non-destructive testing is the ultrasonic imaging method, which allows the analysis of internal wood structures without changing their condition. Ultrasound tomography is a practical method to detect cracks, voids and other discontinuities in solid materials [1–3]. To achieve acceptable results, test methods should take into account the anisotropic nature of the wood, which includes the shape of annual rings, as well as the location of the core in cross-section. To adopt methods based on physical effects, profound knowledge of wood physics is needed, particularly knowledge of interdependence.

In this study, we are interested in assessing the effect of anisotropy conditions in the wood on the ultrasound time of flight (TOF). The research was carried out on wooden beams which are obtained from historical building. Wooden elements of roof trusses and ceilings were replacement due to their poor technical condition. With reference to a decayed and partialised cross-sectional slice of a historic timber beam, the laboratory experimental works presented here are aimed at correlating the results of the ultrasound tomography examination with the results of visual inspection. The aim is to establish a relationship between results of NDT and mechanical parameters or the position of the rings. The obtained results were compared with the results for the healthy beam. Experiments with healthy wood showed that the orthotropic behaviour resulted in curved rays from the transmitter to every receiver, compared to the straight-line paths for the isotropic case. Moreover the radial direction presents a higher wave velocity. Defects inside the wood caused low velocity propagation areas that modified trajectories compared to a healthy case. The experimental results are represented by grid-based velocity map and it can not characterize rapid changes or discontinuities in the area of defects.

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