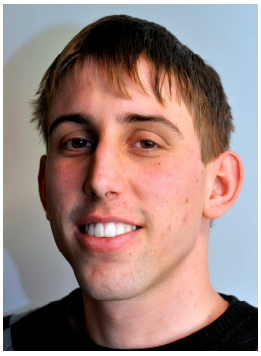
Bern University
of Applied Sciences

Bachelor of Science in Wood Engineering

Timber Structures and Technology

Vibration analysis of a long-span timber floor system

In modern timber construction, large floor-spans are required to accommodate the owner's desired building occupancy and functionality. This affects the vibration behaviour of floors which was analyzed.



Signer Stefan

Structurecraft Builders
8279 River Way
Delta, BC
Canada
www.structurecraft.com

H/1200/903/16/5

Initial Situation

Building mass timber floors is experiencing a big boom around the world. To push the edge in the timber construction and create efficient structures, it's essential to know as much as possible about the system used. Long-span floor systems are required more often which affects among other things the vibration behaviour. At the same time the comfort requirements of the users have increased. Analyzes of human induced, vertical floor vibration with the focus on a mass timber floor system called "Nail-laminated-timber" (Fig. 1) were carried out.

Fig. 1: Nail-laminated-timber panel

Purpose

The purpose of the study is to understand the lightweight construction product NLT better in terms of vibrations. It is valuable to be able to predict the behaviour of structures and by creating and analysing calculation models, it is possible to obtain useful information such as the natural frequency of a structure. There is much experience in calculations for heavy floor buildups, but there is a lack of knowledge when it comes to establishing reliable calculation models of lightweight floor buildups. A calculation tool on the basis of the collected knowledge will allow for a quick and accurate estimation of the natural frequency and vertical accelerations with given inputs of span, loading and damping.

Approach

There is already a lot of information existing in the literature. Nevertheless in-situ test are conducted and analysed (Fig. 2). All tested panels are in the range of six meter spans. The experimental data was processed and evaluated to obtain various characteristic values (Fig. 3). Further to this, theoretical calculations were carried out to verify the results and classify them.

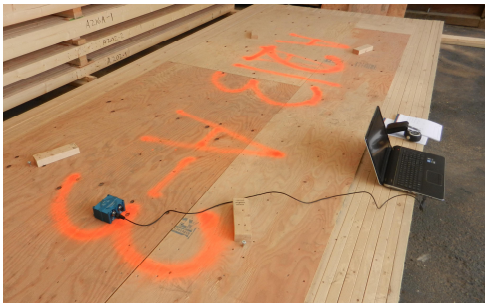


Fig. 2: Vibration testing

Conclusion

The results lead to the conclusion that the determined characteristics with tests are equivalent or better than calculated with the help of standards. The determination of the natural frequencies and damping ratios are central points, either with tests or with calculation models. The goal to analyze long-span floor system appropriately has been achieved.

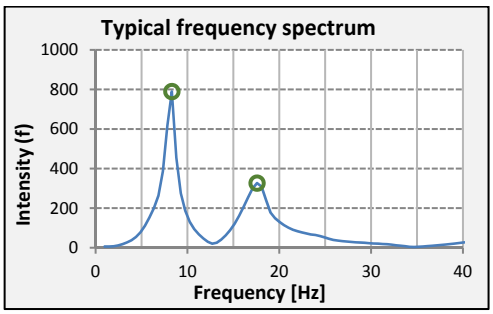


Fig. 3: FFT output from a heel drop data input