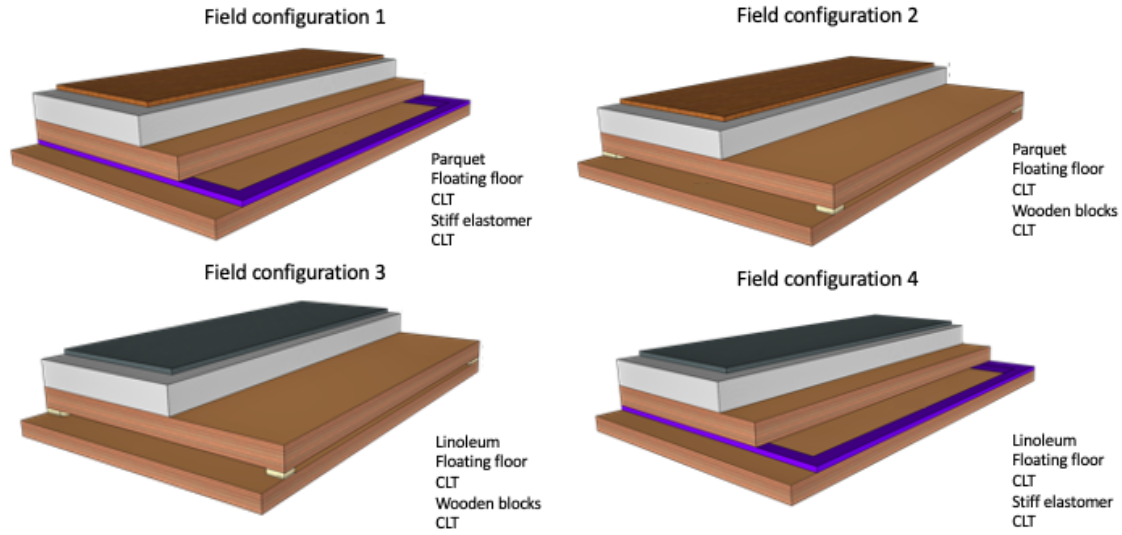
Acoustic performance of Timber Volume Elements and floor structures used in them

By: Oliver Olsson

Acoustic solutions for timber based buildings are still being developed and evaluated. While some construction methods yield satisfying acoustic performance others might not be as effective as once thought.

As of 1994 an update of Swedish building regulations has allowed for the use of load-bearing structural elements made of timber in multi-storey housing. The new regulations together with the rising demand for sustainable housing has led to increased research and development of timber based construction materials. Timber is a more environmentally friendly and sustainable construction material than other frequently used building materials such as concrete. Since the use of timber is rather new, acoustic solutions for timber based buildings are still being developed and evaluated.



Selection of configurations tested in factory conditions

The cost of correcting an error in a finished building is far greater than correcting it during the early phases of planning. Because of this it is of great importance to analyze existing acoustic solutions to find possible improvements and to identify ineffective construction methods early in the planning phase of construction. This report is made in an attempt to further the understanding of the acoustics of timber based buildings. Timber Volume Elements in particular. A popular construction method in Nordic countries is to use large Cross-Laminated Timber slabs as load bearing elements. The slabs are assembled into modules also known as Timber Volume Elements that can be combined vertically and horizontally to fulfill the desired function of the building. An entire module can be produced in factory settings to later be transported to the construction site where it and other modules are combined to a finished building. For these modular buildings different intermediate layers consisting of elastomers of different stiffness is used to limit the spread of vibrations between adjacent modules. These elastomer intermediate layers increase the cost of production significantly and the quality of their performance over the course of time is in question.

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Supervisor: Delphine Bard
Assistant supervisor: Nikolaos-Georgios Vardaxis

In this report several different floor configurations with a CLT base are evaluated in laboratory. Furthermore the efficiency of intermediate elastomer layers between two vertically adjacent timber volume elements are investigated in factory conditions. As a comparison intermediate layers consisting of wooden planks cut into different shapes are also tested and compared to the elastomer. A floating floor construction is also evaluated during factory measurements. The acoustic performance of both cases are evaluated using standardized measurement procedures.

Field configuration nr.	Components top to bottom	$D_{nT,w,50\text{-}3150}$ [dB]	$L_{nT,w,50\text{-}2500}$ [dB]
1	Parquet, Floating floor, CLT slab (floor), Stiff elastomer intermediate layer, CLT slab (roof)	50	52
2	Parquet, Floating floor, CLT slab (floor), Wooden blocks intermediate layer, CLT slab (roof)	50	53
3	Linoleum, Floating floor, CLT slab (floor), Wooden blocks intermediate layer	50	56
4	Linoleum, Floating floor, CLT slab (floor), Stiff elastomer intermediate layer, CLT slab (roof)	49	54
5	CLT slab (floor), Soft elastomer intermediate layer, CLT slab (roof)	43	70
6	CLT slab (floor), Wooden plank intermediate layer, CLT slab (roof)	45	67

Single value descriptors for all factory measurements

The results of the factory measurements show that elastomer intermediate layers do in fact perform better than wood based intermediate layers but the improvement provided by the elastomer layers are not as significant as expected. Especially if the increased performance of the elastomer is weighed against the financial cost. Factory measurements also show that floating floor constructions are an effective solution for increasing the acoustic performance of timber volume elements.

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