SEAP – Acoustic design tool for Stora Enso Building Solutions

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Introduction

- → **Stora Enso is developinfg a prediction tool in order to make CLT structures more competitive – a new design tool adapted only to their own building system**
  - SEAP – Stora Enso Acoustic Prediction tool
- → **Started with an extensive description of which various layups that have to be included in order to cover the system as a whole**
- → **It has to comprise frequency range between 50 – 5000 Hz**
  - ➔ It can include minimum regulations for Stora Ensos main markets, for direct comparisons if the regulations will be fulfilled
- → **Accuracy requirements ± 2 dB**
- → **First version will be launched autumn 2016, the final programming (updates) has started**

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Method

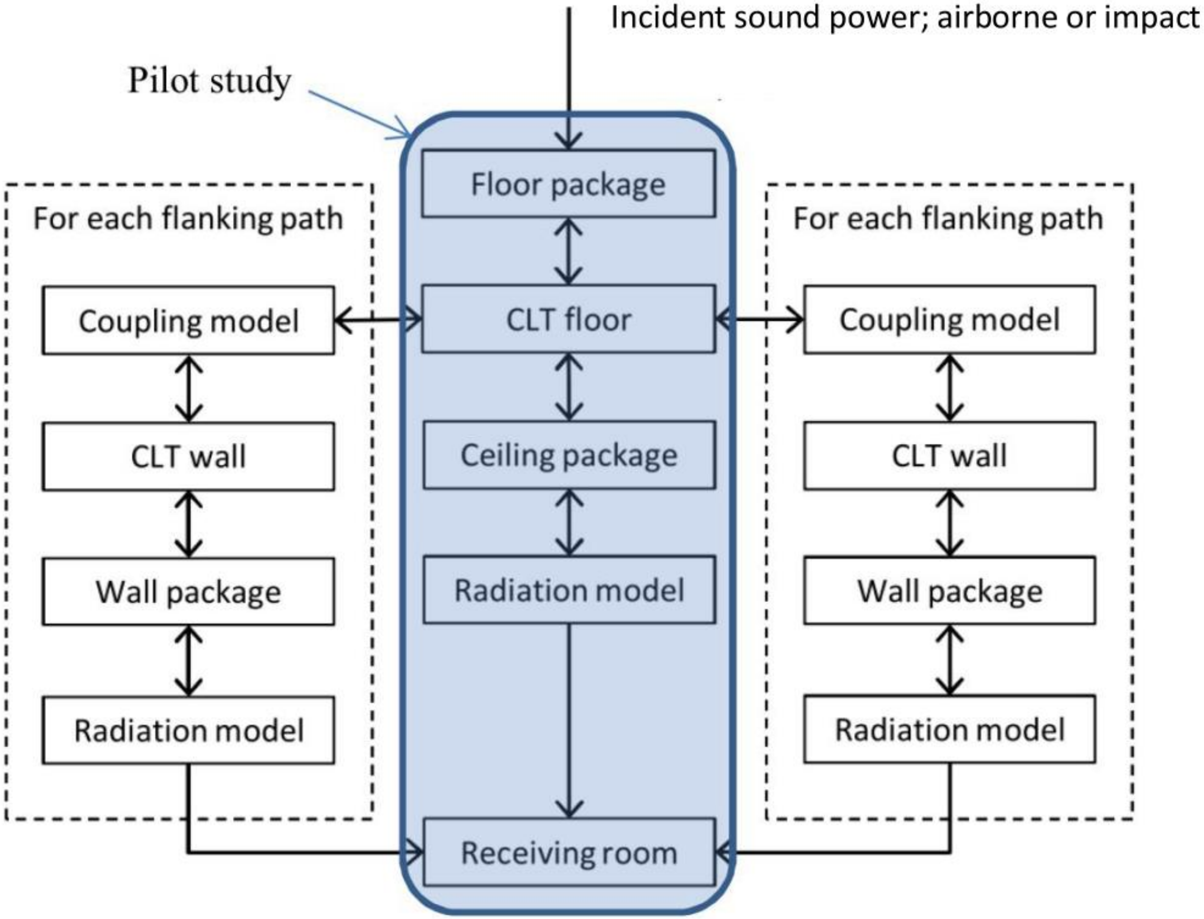
- The project started by collecting a number of measurements from different laboratories

- Some of them were selected to be used as basis for the first development in the pilot study

- We started with the CLT element itself and then adding predefined ”floor pacakges”, ceiling packages” and ”wall packages”

Method

→ **Modular approach – started with a pilot study**



Method

→ **The following steps have been carried out in the pilot study, and part 1 of the development**

- We have identify full compliance between the structural CLT elements of various thicknesses and the modelling results.
- Studying the effect of various vertical loading of wall elements
- Securing that the material input data used for various products in the floor and wall packages are correct and give results in agreement between calculated and measured results (e.g. improvements of sound insulation)
- For the latter, an additional measurement series, adapted to building systems by Stora Enso, have been carried out (presented in a parallel paper)

Results

→CLT elements

a) Impact sound level

- A specialized calculation model has ben developed. An empirircal model approach is used.

- The rediation into the receiving room is calculated from the mean vibration velocity on the element surface using the concept of radiation efficiency

- Three other parameters considered
  - Internal damping of the plate
  - The surface softness of the plate
  - Transition from a plate to a volume

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Results

→CLT elements

a) Airborne sound insulation

- A CLT plate exhibits large differences in modulus of elasticity between its major and minor axis ➔ different critical frequencies depending on the angle of the incident sound wave.

- However diffuse field are ”forgiving”. The model calculate these two freq and also considers the thickness and density as R is evaluated

- The rediation into the receiving room is calculated (as for impact sound) from the mean vibration velocity on its surface using the concept of radiation efficiency

- Loading effects have been studied however no clear conclusion yet. Will be further evaluated in the next stage

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Results

→ **Floor packages**

a) Impact sound levels

- For impact sound level, the different floor packages are modelled using adapted mass-spring systems, the mass representing the surface mass of the floating floor, and the spring representing the resilient layer below.

b) Airborne sound insulation

- Calculations of the reduction index R of the bare CLT plate and the CLT plate with all respective floor packages have been precalculated and refined by comparing with results from software specialized for airborne sound insulation, and also with additional measurements.

→ **Ceiling packages**

- Similar as floor packages – an additional sound insulation

Analysis

→ **Laboratory data can differ – what is the correct value?**

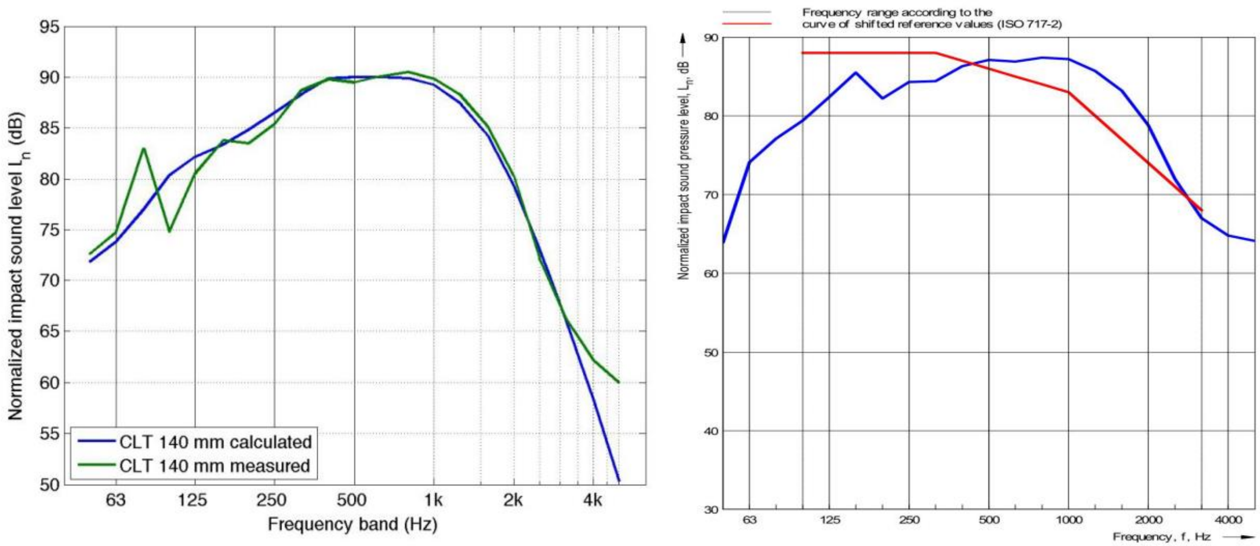

Figure 2: Laboratory measurements of bare CLT from two different accredited laboratories; 1. $L'_{n,w}$ = 89 dB, $L'_{n,w}+C_{I,50\text{-}2500}$ = 85 dB; 2. $L'_{n,w}$ = 86 dB, $L'_{n,w}+C_{I,50\text{-}2500}$ = 82 dB

Analysis

→ **Important notices**

- If comparing with laboratory measurements – Check the data mounting conditions in labortory

→ **Thickness above 220 mm ➔ not plates any more**

→ **Spring strips and connectors have to be described in detail ➔ unexpected results can appear**

Concluding remarks

→ **Version 01 available autumn 2016**

→ **It will include national regulations from**

- Finland,
- Austria,
- France,
- Germany,
- Sweden,
- Norway,
- Switzerland,
- UK and
- Italy
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→ **Next step is now to**

a) connect floors and walls by describing SEAP junctions

b) further develop the model to

- add more floor, ceiling and wall packages,
- add more countries with their minimum regulations.

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Thanks

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