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AkuLite, AcuWood and Silent Spaces – summary of results

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The Swedish Project AkuLite is still running, on its last year. Currently a lot of data from the project are analyzed and compiled. In parallel to AkuLite, the European project AcuWood and the Interreg project Silent Spaces are running and the analyzing phase will soon start also in these projects. The projects are not completely similar in size or content. Nevertheless, the projects interact and they can be divided into some different main topics. The main topics are; 1. Laboratory listening tests of different structures; 2. Modeling a walker on a light floor structure; 3. Calculation model of light structures; 4. Field questionnaire and measurement survey of various housing areas; 5. Vibration analysis of a number of different floor structures. In AkuLite, the results are now compiled in the last two Work Packages in order to formulate an idea of target values for light weight structures in multi-family houses. AcuWood will later extend the results to comprise some other European countries.

1 Introduction

The largest Swedish research project for building acoustics for a long time, AkuLite, is now approaching the final stages, although there is still almost one year left on the project. AcuWood - a parallel European project, launched one year later has now reached approximately half way. And finally the “Interreg” project Silent Spaces has approximately one year left. All projects are “on track” and now we need to take care of all data collected, twinning the projects and deliver good results. The results already emerging from AkuLite mean today that we met some of the objectives set in the action plan that followed us since the start, December 1, 2009.

2 Results so far

2.1 Project progress

The most notable progress to date, are the methods developed for field surveys of subjective experience of sound and vibration, control measurements and laboratory listening tests, which is now also used in other parts of Europe. This development gives the Swedish and the Nordic Industry and also Nordic research a lot of attention. This implies an advantage in the further development of lightweight construction systems, let us seize it. Through the smaller European project, AcuWood and parallel ongoing European COST networks (primarily FP 0702 and TU 0901), the methods from AkuLite are developed to fit also to other countries cultures. This expands the knowledge base in all of Europe, in terms of experienced noise and vibration in light construction systems and in buildings in general. AkuLite has been very important for the rebuilding of Swedish building acoustic research. In parallel with Silent Spaces, AcuWood, two COST actions, FP 0702 and TU 0901, and some other smaller projects, a lot has happened the last few years that must be taken care of.

Within the project AcuWood there are a number of ongoing parallel activities, primarily in Germany, Switzerland and Finland. In Silent Spaces, Denmark is involved to a large extent. This means a lot of synergy effects with AkuLite. Another important initiative was taken by the Forest Industries and the organization Building With Wood, who set up a European Workshop held in Stockholm on October 17 to 18, 2011. The interest in current research is large and the outcome from the workshop is collected and presented in an SP Report [1]. The report can be used in order to have an idea of how the research should be carried on. Further positive effects worth mentioning are expanded partnerships with industry research partners, both nationally and internationally (including USA and Canada). Behind AkuLite, AcuWood and Silent Spaces, there is a coherent effort from the industry to work towards the same goal. It is to improve the understanding of the acoustic appearance of light structures in multi-storey buildings and to consider this new knowledge in the design, in order to minimize the impact of noise and vibrations on habitants.

2.2 Current work

Since the start of AkuLite a lot of building system development has been carried out by the industry, largely in collaboration with AkuLite, AcuWood and Silent Spaces. Manufacturing companies contribute with building material, building components and also entire buildings, they participate in the implementation of master theses work, initiate and contribute to research in different work packages of the projects (including vibration characteristics). Moreover, they further develop their own building systems and their construction techniques. During the period 2009-2011, AkuLite has put much time in method development. In the autumn of 2011 analyzes have also begun within the last two work packages, which ultimately will provide new evaluation criteria proposals.

An important part of the method development within the projects, initiated by Simmons Acoustics & development and the Development Fund of the Swedish Construction Industry (SBUF) along with AkuLite, is the expansion of a questionnaire template and methodology of the surveys. Questionnaire templates [2] have been used in several completed construction projects and the first study was reported in AkuLite Report 2 [3]. The study was performed in five wooden structure houses and five traditional concrete buildings, all with similar results in terms of objective figures. Subjective evaluation, however, differ. The results thus confirm the suspicion that existed at the start, namely that the experience of sound insulation in “light” houses and heavy houses differ, even if objective measurements exhibit similar results. AkuLite´s (and AcuWood) main goal is to develop new evaluation criteria that describe how the objective evaluation should be performed in order to achieve a perceived sound insulation that is as equal as ever possible, independently of the frame system in use, in multifamily residential buildings.

2.2.1 Questionnaire survey, measurement methods and laboratory tests

Through Silent Spaces, AcuWood and COST networks, survey template is now made available in six different language , namely German, French, Italian, Spanish, English and Swedish. This shows the enormous need for the research and the great interest that exists in other countries. Simultaneously an electronic version of the questionnaire template is developed in AcuWood and available in German. This implies that you will be able to answer the survey questions directly online on the computer. It will be interesting to follow future performance and all that we can learn about the experience of sound and vibration in residential buildings. This is a huge progress as this kind of investigation was lacking in the past, especially coordinated between countries. Cooperation between Simmons acoustics & development, Lund University and the Linnaeus University in Växjö has also led to a questionnaire template to subjectively evaluate even vibrations in the field in various types of buildings. This questionnaire has not been used but it will be in future building projects.

Parallel to field questionnaire studies there are also "controlled" laboratory / listening tests conducted on two typical structures. Within AkuLite this is done in a specially designed test rig at Chalmers [4] and preliminary results have been presented internally within the AkuLite project meetings. These results will be presented in a separate article during this year. Furthermore, objective measurements made according to a specific measurement template developed by Luleå University of Technology have been implemented and are made available in English. Measurements according to the template are used in order to understand the structural behavior of various buildings, and to correlate the data to the subjective responds. Unfortunately, it has been very difficult to obtain buildings for measurements since those are time consuming and in many cases must take place in existing buildings fully occupied by habitants. After all, we expect to provide enough measurements as basis for satisfying analysis to reach the project goals.

2.2.2 Other ongoing activities

SP Acoustics is working with a contact model between impact sound and floor in order to describe how energy is transferred to a floor structure from a person walking on a floor. Furthermore, special vibration and springiness tests have been made on a number of floor structures in laboratory environments in Växjö and in Lund. These investigations

are part of method development, but also used to verify the calculation methods that have progressed during work within Silent Spaces. Everything will be included in the overall analyzes, that will lead to new proposed requirements criteria for light weight structures, usable in future standard proposals.

A first input to international standardization within the ISO has been delivered to the working group, currently a draft, AkuLite report no 3 (currently not printed). One important goal of AkuLite is to translate the results so that these can be used directly in the new standards, hence to deliver results that can be applied in reality.

3 Summary

3.1 What happens in 2012

Even if some data collection still remains within the projects, the data analyses have started within AkuLite. The various tests / work packages will run in conjunction in order to finalize the collection of data. Comparisons between objective measurements and subjective evaluations will be performed. This is an extensive work that will require much creativity and innovation. As far as possible the data from the parallel project, AcuWood will be included. The first AcuWood results regarding subjective and objective evaluation of impact noise sources in wooden and heavyweight floor constructions will be presented in ICSV 19 in Vilnius 2012.

We must also ensure adequate reporting so that we do not lose important data for future research. It must be ensured that the knowledge remains available and that the results can be used for future research and development. Thus, it is also important to present a plan for what to do next, next project, training in universities / colleges, and to make sure to further develop interest about acoustics in lightweight structures. In order to promote the use of wood by developers in multifamily residential buildings, a handbook is to be published "Avoid mistakes with light constructions". This publication is financed by the Development Fund of the Swedish Construction Industry (SBUF) as part of AkuLite and will primarily be aimed at small and medium sized contracting companies that build multi-family residential houses in wood and other lightweight structures. In the beginning of 2013 a final seminar is planned, probably in Växjo. Meanwhile, an electronic knowledge portal will be established and launched this summer – a first “draft” is already prepared at the address www.acuwood.com . More information about this portal is presented in a separate paper in BNAM 2012. Information about ongoing projects will be available on this site.

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