Assignment list for acoustic design in Finnish building construction projects

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In Finland acoustic design is recognized as an independent field in building construction projects. In 2015 an assignment list for acousticians, AKU12, was published. It included a list of acoustic design tasks and their outcomes in a building construction project. The list was published by the Finnish Building Information Group and it was a part of a RAKLI ry (The Finnish Association of Property Owners and Construction Clients) project, where many other assignment lists (architectural design, structural engineering, etc.) were updated. The general structure of the AKU12 assignment list was similar to the lists of other design fields.

In 2017 RAKLI started a project to update all the assignment lists. It had become evident that AKU12 also needed updating - the list had become partly outdated and had also been found to contain ambiguities and deficiencies, which needed correcting. The update project started in 2018 and the list was released in the spring 2020. The new list AKU18 aims to specify the acoustic design tasks more clearly and unambiguously than before and so that the tasks relevant to acoustics are dealt with in the right phase of the project. Hopefully the new assignment list AKU18 will further improve the understanding of the role and tasks of acoustic design in Finnish building construction projects as well as unify the practices among the companies and consultants working in the field.

1 Acoustic design in Finnish building construction

1.1 Acoustic design field and legislation

In Finland acoustics is recognized as an independent field of design in building construction. The number of acoustical designers and the size of the business in general has grown significantly in the past years [1]. This is can be partly attributed to changes in acoustics- and noise-related legislation and regulations as well as increased public awareness of the field in general. Rapid development of the processes, software and research related to acoustic design has also played a significant role.

The acoustic conditions of buildings and built environment in general are of great interest to the Finnish society and legislators, because acoustic environment has a significant impact on public health and economy. Consequently, acoustic design in Finland is rather thoroughly regulated. The basis of acoustic design today is determined in the Land Use and Building Act (132/1999, with amendment 222/2003) [2] which sets the essential technical requirements of buildings – these include noise control and acoustic conditions. The acoustic requirements are further elaborated in the Decree of the Ministry of the Environment on the Acoustic Environment of Buildings 796/2017 [3] which entered into force on the 1st of January 2018. The new Decree represented a significant change in acoustic legislation in Finland, since the preceding regulations were in force for almost 20 years, most notably of these being the Part C1 (1998) of the National Building Code of Finland [4].

1.2 The role of the acoustic designer

In a building construction project, the acoustic designer is responsible for the acoustic environment of the building as a whole. This consists of sound insulation, room acoustics, noise control and vibration control. The acoustic designer usually gets involved in the project at the latest in the final design phase before construction work begins. As the clients' awareness of the impact and importance of acoustic design has grown, however, it has become increasingly common that an acoustic designer is hired already in the early stages of the project.

The building construction process in Finland is divided into ten different phases, which can be generalized into four phases outlined in Chapter 2. The phases are uniform to all design fields, i.e., architectural design, structural engineering and so on. In practice, the different phases usually limit significantly and new forms of processes and organisation models in building construction processes are being implemented. Furthermore, it should be noted that the building construction process rarely goes through all the phases at once, and often the designers can also change between different phases.

1.3 The competence of the acoustic designer

According to the Finnish Land Use and Building Act 132/1999 [2] the person undertaking a construction project shall ensure that the project has qualified designers, and that the other persons involved have sufficient expertise and professionalism, taking into account the complexity of their tasks. The Finnish government has given regulations and guidelines on how to assess the complexity of the design tasks in a building construction project [5] and how to assess the competence of the designers [6]. This applies also to acoustic design as well. The competence of the acoustic designer is divided into four categories: conventional (T), difficult (V and V+) and exceptionally difficult (PV).

2 The phases of building construction projects in Finland

2.1 Survey and project planning phase

In the first phase of a building construction project, the survey phase, the need and justification for new spaces and functions is evaluated. This is followed by the actual planning phase during which the project objectives are defined. The budget of the project is often also defined at this stage.

The involvement of an acoustic designer in the survey and project planning phases varies depending on the project. Usually the need of an acoustic designer in these early phases is recognized if the building has special needs regarding acoustical conditions (e.g., theatres, concert halls, hospitals, sensitive laboratory spaces) and/or if the costs of the project need to be investigated thoroughly. The scope of acoustic design in these phases varies by project and can involve, e.g., investigations related to the acoustic conditions of the building site (e.g., traffic noise, traffic induced vibration) or the building itself (e.g., geometry, positioning of noise-sensitive spaces, material usage, need for special acoustic solutions).

2.2 Design phase

The design phase of a building construction project starts by preparation tasks, including defining the design organisation and assignments. The actual design work begins with a preliminary design phase where the different options and variations of design solutions are compared. In the next phase, a viable solution meeting the set requirements is chosen and developed further. The application for the building permit is usually based on these designs. The tasks of the acoustic designer up to the building permit phase typically include, e.g., determining the acoustical target values of the project (e.g., sound insulation, room acoustics, sound levels), investigating the acoustical effects of the positioning of spaces, functions and equipment, as well as defining the sound insulating structures preliminarily, and outlining the required room acoustical solutions and materials.

In the final design phase preceding the construction works, the design solutions are developed into sufficient level of accuracy for implementation. In this phase the acoustic designer must ensure that the solutions fulfil the set acoustical requirements. This involves generating the necessary calculations, reports, drawings, etc. The tasks of the acoustic designer include, e.g., making precise detail drawings of the joints and penetrations of sound insulating structures, defining the room acoustical materials and structures to be implemented, determining the solutions for ventilation and other building services systems regarding sound insulation, as well as drafting implementation instructions regarding construction methods, acoustical products, materials and quality.

2.3 Construction and completion phase

The construction phase begins with preparation tasks, including negotiating with different contractors and agreeing on the assignment and its costs. After the contractor has been selected, the construction work begins. The contractor usually presents alternative methods, products and materials for the acoustic designer, who needs to assess whether they meet the set acoustical requirements or not and, as a result, either accept or reject the proposals. In some cases, the acoustic designer also makes inspections at the construction site and assesses the execution of the plans. Acoustic measurements may be carried during the construction stage for quality-control purposes and to check that the implemented solutions work as planned. Additional measurements may be performed when the construction is completed to ensure that the acoustic requirements are satisfied; these final measurements are in some cases required in the building permit.

2.4 Warranty period

The tasks of the acoustic designer during the warranty period may include, e.g., demonstrating the acoustic performance of spaces/constructions or problem solving. The assignments usually involve measurements and, in the case that the acoustical requirements are not met, designing improvements.

3 Development of assignment list for acoustic design

3.1 AKU12 – where it all started

Acoustic design in Finland was, for long, not well documented and handled by just a small number of consultants. The processes and contents of acoustic design varied a lot between different parties. By the 2010s or so, as the acoustic design field in Finland continued to grow and develop, it had become evident that the processes of acoustic design should be more unified. A need was recognized to ensure that all the necessary tasks affecting the acoustical quality of a building are properly documented and performed at the right time in the project. Furthermore, the clients' work to commissioning acoustic design and specifying the design tasks needed to be made easier and more systematic. It was also wished that unifying the processes would ultimately lead to acoustic design offers more similar in content and work amount.

The assignment list as a concept had already been developed and was in use with other major fields of building design, such as architectural design and structural engineering; thus, the same approach could be adopted to acoustic design. The project for making the first assignment list for acoustic design was started by the Finnish acoustician Heikki Helimäki, from the firm Helimaki Acoustics. The idea was brought to the Acoustical Committee of the Finnish Association of Civil Engineers, RIL, which became the forum to steer the project forward. The assignment list for acoustic design, called AKU12 [7], was released in 2015. The list was published by the Finnish Building Information Group. AKU12 was part of a larger project led by RAKLI ry (The Finnish Association of Property Owners and Construction Clients) aiming to update the assignment lists of other design fields.

The assignment list AKU12 was the first document to officially compile all the tasks of acoustic design in a building construction project and, in doing so, was a major step forward in unifying the acoustic design processes in Finland. AKU12 soon became a standard document used in the tendering procedures of acoustic design, as well as a tool for acousticians to defining and managing the acoustic design tasks at the various phases of the project.

3.2 Development of AKU18

The assignment list AKU12 represented significant a milestone in the development of the acoustic design field in Finland. Having been used for a few years, however, it had become evident that AKU12 could be improved in many respects. The content of AKU12 had also been partly outdated by the new acoustic regulations which came into force in 2018 [3]. A development scheme to update all the assignment lists had been already started by RAKLI. This provided a good opportunity to start the development of the new acoustics assignment list as well – later to be named AKU18.

The AKU18 development project started in 2018. A project group was gathered from within the Acoustical Committee of RIL to steer the development forward. The group consisted of representatives from three Finnish companies involved in acoustic design as well as participants from RAKLI and the Finnish Building Information Group. The AKU18 project group was led by Sitowise Oy / Helimaki Acoustics and the other companies involved were Akukon Ltd and AINS Group.

The work started by gathering feedback of the previous version AKU12 from the companies within the project group as well as via a web questionnaire, which was widely distributed to Finnish construction companies, contractors, other design

firms, associations and authorities. Based on the feedback and discussions within the project group, three main goals were set for the new acoustic assignment list AKU18, in comparison to the previous version:

- AKU18 should be more appropriate to acoustic design,
- AKU18 should be more user-friendly and unambiguous,
- AKU18 should lead to acoustic design offers which are more similar in content and work amount.

The appropriateness of the new assignment list was considered paramount, as AKU12 had been found to be lacking in this respect. This meant that AKU18 should better guide conducting the right design tasks at the right stage of the project, should not contain tasks irrelevant to acoustic design and should more clearly indicate what types of design documents are to be created. Clarity and unambiguity were also important factors to be considered, as experiences with AKU12 had shown some of the design tasks to be too ambiguously stated – as a result, their detailed meaning was not always clear even among acoustic professionals, let alone clients with little knowledge of the field. The user-friendliness of the assignment list also needed to be improved so that the clients would better understand how and why the document should be used.

It soon became evident that improving the assignment list significantly enough would require it to be totally renewed. A decision was made to dramatically modify the basic structure of the previous assignment list. One of the main reasons for the unclarity and ambiguity of AKU12 was that the acoustic phenomena to which the different design tasks relate were not nearly always clear. To overcome this problem, the design tasks in AKU18 were divided into categories based on the associated acoustic phenomenon.

The work of drafting the new assignment list based on phenomenon-based structuring continued by workshops in the spring 2019. The outcomes of the workshops were put together and finalized during the summer to early autumn 2019. A short introductory section with acoustic concepts and definitions was also written. In November 2019 the assignment list was in such a form that it could be published as a draft to get feedback [8]. The list was sent with wide distribution to design companies, authorities and other parties. The new assignment list received positive feedback and some improvement suggestions. The list was further revised based on the feedback and was finalized and released in the spring 2020.

4 Assignment list AKU18

4.1 Purpose and content

The assignment list AKU18 is meant for defining the content and scope of acoustic design tasks in building construction projects. The list allows the selection of project-specific acoustic designers to perform the design assignments. The list is intended to be used for all types of projects and with all forms of acquisitions and commissions. The list is can be used for, e.g., defining the acoustic design scope, managing the design entities as well as a tool for project management and design quality assurance. The list is usually attached to the design contract and its status as a contract document is defined in the Finnish General Terms and Conditions of Consulting KSE2013 [9].

The AKU18 list includes the acoustic design tasks and their results for conventional building construction projects. The tasks are bundled as entities suitable for design commission. The delimitation of tasks in relation to other design activities in the building project is based on other assignment lists used by the client in the project. Other parties in the project, such as designers and experts, are presented in the Project Data Card [10].

4.2 General guidance, concepts and definitions

There was strong consensus among the project group from early on that the new assignment list AKU18 should contain a section where the acoustic terms and concepts would be explained. The introductory section would also provide general guidance to the client, e.g., regarding the role and competence of an acoustic designer as well as the documentation of acoustic design tasks. This was considered necessary, as the acoustic design field is often not well known by clients and other designers. The fact that the previous assignment list, AKU12, did not contain such an introductory section was considered a deficiency which needed to be corrected.

Some of the concepts that are defined in the introductory section of the AKU18 include:

- Noisy spaces and activities

- Noise-sensitive spaces and activities
- Spaces requiring high room acoustical quality
- Spaces requiring traffic noise control
- Spaces requiring traffic induced vibration control
- Spaces and functions causing noise and vibration
- Room acoustical modelling
- Noise modeling, noise measurements

The terminology defined in the introductory section is systematically used in the tasks presented later in the assignment list. The aim of this is to make the task descriptions unambiguous, which was not the case with AKU12.

4.3 Structuring by acoustical phenomena

The original assignment list AKU12 was quite similar in structure to the assignment lists of other design fields, such as architectural design and structural engineering. Despite having advantages also, this was mainly considered problematic as the basic structuring and headings borrowed from other assignment lists were in most cases illogical and imprecise from the perspective of acoustic design.

To improve the situation, the new assignment list AKU18 was structured in a similar way as acoustic designers tend to structure their work – by acoustical phenomena. The design tasks were divided into five categories according to the associated acoustical phenomenon: 1) sound insulation, 2) room acoustics, 3) building service equipment noise and vibration control, 4) traffic noise control and 5) traffic induced vibration control. The categories were treated individually throughout the phases of the building construction project, so that as the project advances the design tasks in each category get more detailed.

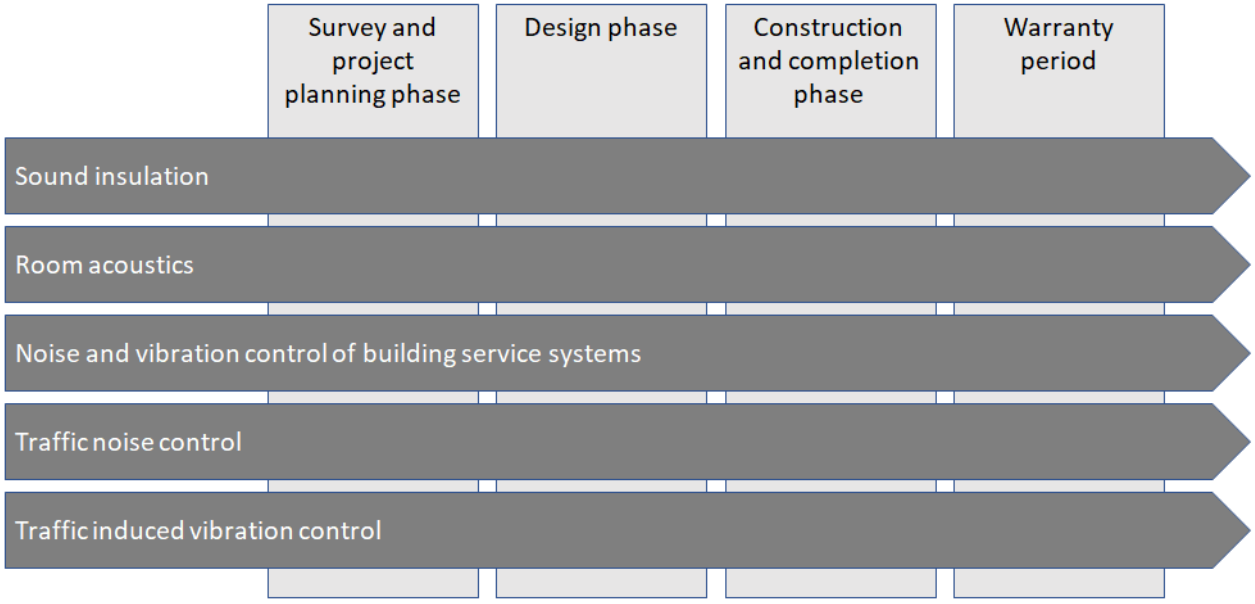

Figure 1: The categorization of acoustic design tasks in AKU18 based on the acoustical phenomenon.

The category “sound insulation”, for example, covers the design tasks related to the phenomena of airborne and impact sound insulation within the building. In the early stages of the project the demand for sound insulation is recognized by regulations, recommendations and the needs by the client. Proper requirements as numerical values are defined and reported by the acoustic designer. The acoustic designer gives recommendations regarding the positioning of noise-sensitive and noisy spaces, functions and equipment. The sound insulating properties of structures are calculated, structural systems are defined, and joints and other details are designed and drawn. In the construction phase the contractor

is instructed and supervised if necessary. Acoustic measurements can be made during the completion phase as well as the warranty period.

The other categories/phenomena are treated in an analogous way – the design starts with defining the acoustical requirements based on prerequisites advancing from there all the way to implementation design, construction phase and completed building. Additionally, some general tasks are identified in AKU18 which are not related to any of the five categories in particular, including, e.g., finding out the general design prerequisites, participating in the crosschecking of the plans, commenting the schedule of works and other general documents from acoustical perspective, and carrying out the acoustical investigations related to environmental certification systems. Some special tasks are also listed which are needed only in rare occasions, including, e.g., the assessment of environmental noise (other than traffic induced) and designing the vibration control measures of sensitive research equipment.

5 Conclusions

The assignment list AKU12 was important a milestone in the development of the acoustic design field in Finland. It is the wish of the authors that the renewed assignment list AKU18 will further improve the understanding of the role and tasks of acoustic design in Finnish building construction projects, unify the practices among the companies and consultants working in the field, as well as increase the general awareness of the acoustic design field. As AKU18 is still new, it remains to be seen how well it will ultimately be received and adapted by the Finnish building industry. The authors hope, however, that the reforms made in the new assignment list will prove to be well adaptable to building construction projects and stand the test of time.

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