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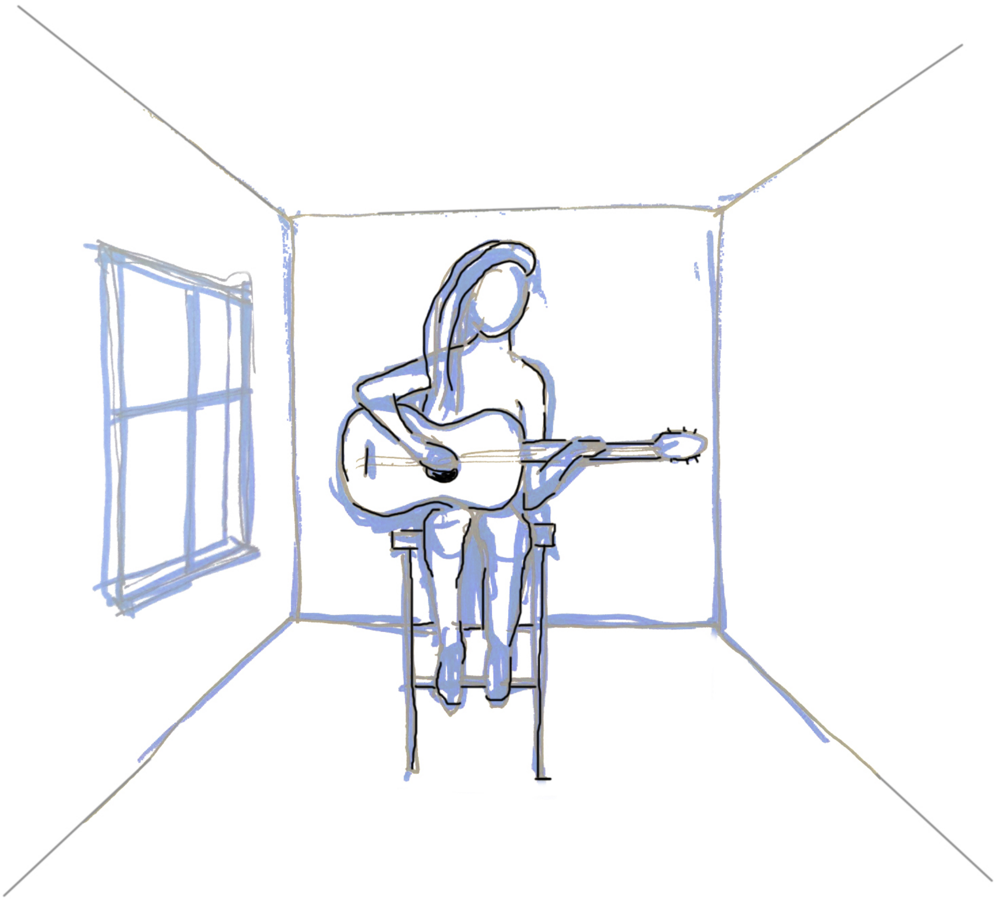

Rehearsal Rooms for Acoustical Instruments - Comparing Measurements and Subjective Experiences

Master's Thesis in Master Programme Sound and Vibration

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Master's Thesis ACEX30-18-66

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Abstract

The room acoustic conditions in rehearsal rooms are important for the musician's rehearsal experience. The Norwegian Standard NS 8178:2014 specifies differentiated criteria for rooms used for music rehearsal and performance. The criteria that are relevant for the room acoustics in rehearsal room for solo instrumentalists are specifications on room size and geometry, acoustic treatment, and reverberation time. There has been limited research on rehearsal room acoustics, and this thesis investigates the connection between subjective experience of a rehearsal room and the measurable characteristics.

This thesis deals with objective and subjective descriptions of six music rehearsal rooms intended for solo musicians playing an acoustical instrument, investigating the connection between the two. The objective characteristics of the rehearsal rooms are gained by four different means: Three kinds of measurements and a room acoustical simulation. The measurements are traditional impulse response measurements that yield common room acoustic parameters, stage parameter measurements in a defined playing position and reflection measurements to gain the frequency characteristics of the wall surfaces of the rooms. The impulse response measurements are used for calculating room acoustical parameters, as well as being studied in waterfall plots for visual examination. The simulations yield the reflectogram of the defined playing position of each rehearsal room. Subjective experiments are performed by introducing musicians one at a time to the rehearsal rooms, asking them to play in the room's defined playing position, after which they answer a questionnaire about the room acoustical conditions.
Comparisons between the objective and subjective results indicate that rooms where the impulse response has highly irregular amplitudes both over time and frequency during the first time interval are disadvantageous for the experience of the rehearsal room. Further, the results show that there is a subjective difference of the suitability for rehearsal between rooms despite the fact that they meet the criteria of the standard. The comparisons indicate that the values of the different parameters should be uniform over frequency. Short reverberation time, especially EDT, seem favourable. As do high clarity, either in the form of C_{80} or T_S. Finally, the investigations show that simple measurement techniques may explain why some rooms are experienced to have sharp and metallic sound.

Keywords: Room acoustics, rehearsal rooms, acoustical instruments, measurements, subjective experience, psychoacoustics

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Victoria Sandaker, Sandvika, June 2018

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Introduction

1.1 Background

Today, standards state few acoustical demands on rooms especially made for the use of music rehearsal, and those that exist are usually restricted to parameters like reverberation time, room geometry, background noise level and airborne sound insulation. However, other parameters are also important for the experience of a room. Earlier research has been done related to supplementary parameters, particularly in rooms intended for music performances. Some of these parameters are less compatible with the small rooms usually made for rehearsal, and rooms intended for practice require different characteristics than those indented for performances.

1.1.1 Earlier Studies

A great deal of research has been done on what is characterised as a "good room" when it comes to concerts, especially from the view of the audience. There has also been research on what makes a stage or concert hall good for the performers. Multiple studies have been performed on how room acoustics are affecting the musical performer; looking at different instrument groups, different parameters and how they affect the tempo, dynamic strength, vibrato and timbre [7]. Bolzinger, Warusfel and Kahle [8] found that high reverberation time in a room leads a piano performer to play slower. A similar effect is experienced in an anechoic environment.

Few studies have been performed with the rehearsal room as study object. One study that is close to this thesis' field of interest is performed by Wenzke and Ågren [9]. They have done a study regarding practice rooms and how musicians (here, drummers and percussionists) are changing their playing style to the room and what qualities a performer looks for in a practice room. The drummer adapts playing tempo and strength to the acoustical environment. Also, it is found that a clear and accurate acoustical feedback is of great importance, meaning it is good with short reverberation for practising these instruments. Wenzke and Ågren are recommending a mix of practise rooms to change between in order to avoid a "memory effect" that will affect the musician's playing style no matter how the acoustics in the room of performance are.

Kleiner and Tichy are discussing rehearsal rooms in the book *Acoustics of Small Rooms* [10]. They are addressing the issue that small rooms tend to have an amplifying effect of the sound in the room, or a high strength value, G. It is harmful to the ears to be exposed to high sound levels over a long period of time, and this is especially relevant for loud instruments like brass and drums, and ensembles. Other factors considered important for rehearsal rooms are that the room volume is large, that the sound insulation is high and low background noise levels. Kleiner and Tichy are, in addition, stating that the acoustics of rehearsal rooms and stage should be different, as to make the musicians accustomed to play loud enough to fill a concert hall. When rehearsing in a small room, where the early reflections come close and early compared to on a stage, there is a danger that the musician will become accustomed to play more silent and in a different way that what is needed in a performance setting.

The Norwegian Standard NS 8178:2014 demands a variety of criteria for rooms used for music rehearsal, which correspond well to Kleiner and Tichy's research [4]. There are demands on room size and geometry, what kind of absorbers should be in the room and where they are to be positioned, reverberation time in relation to the room volume, background noise and airborne sound insulation. Other than the reverberation time, there are no demands to room acoustical parameters in rehearsal rooms.

1.2 Our Investigation

This master thesis will examine the relation between what is subjectively experienced as a good rehearsal room for the musical practitioner, and the measurable qualities of the room. The thesis will study the importance of the early reflections and the traditional acoustical parameters for music rooms in relation to the perceived acoustic quality. It will also seek to answer the question whether a specific trait of the objective description of the room makes it suitable for rehearsal for acoustical instruments or not.

To examine the acoustics of the target rooms, standardised measurements of traditional acoustical parameters will be performed. In addition, reflection measurements of the wall surfaces will provide information about the frequency content of the first order reflections. Subjective impressions of the rooms will be sampled through introducing a musician to the room, the performance of a musical piece, and a survey especially designed for extracting the test subject's judgement of the room.

1.2.1 Aims

The objective of this investigation is to discover if there is a correlation between the subjective experience of a room and the reflection pattern and traditional parameters,then utilise this to indicate a better way to describe how a music room intended for rehearsal with an acoustical instrument should be designed.

1.2.2 Limitations

In order to limit the scope of the investigation, some limitations have been placed. One limitation is the type of rooms to be examined. The rooms are small rehearsal rooms intended for one to two musicians, and for the purpose of acoustical instruments. By excluding electrical instruments, challenges related to the instrument's high sound power level and tunable loudness, timbre and reverberation are avoided. Challenges related to interaction between two or more instrumentalists and their instruments are avoided by choosing to investigate only rehearsal rooms for solo instrumentalists. In addition, the rooms under investigation are intended for the use of rehearsal only, excluding the variation in room characteristics introduced by including living rooms, home studios and convertible rehearsal and performance rooms into the study.

1.3 Thesis Outline

This thesis has the following structure. Firstly, theory is presented that may be needed in order to understand the contents of the report. Secondly, the rehearsal rooms of study are introduced, and the methods used for measurements, modelling and the subjective experiments are explained. The results are presented for one kind of examination at a time, and the rooms are grouped dependent on their location. The discussion section compares the results of each of the objective examinations to the questionnaire results, and present suggestions for further work. Lastly, there is a concluding section which summarises the important discoveries.

2

Theory

This chapter presents a basic introduction to theory that may be needed in order to understand the contents of this report.

2.1 Sound Pressure and Sound Pressure Level

Sound travels as waves in a medium. In gases and fluids, these waves are longitudinal. Longitudinal waves are characterised by the wave oscillation being in the same direction as the wave propagation, and in the case of propagating sound waves, the wave is varying the local medium density and pressure of the sound molecules from its equilibrium level [10]. The variation from the equilibrium pressure is the sound pressure caused by the propagating sound wave. The distance between two pressure maxima is one period, and is described as the wavelength of the sound. Shorter wavelength means higher frequency.

Sound pressure is measured in pascals (Pa), but is often denoted on a logarithmic scale due to the human ear's large sensitivity range [10]. The sound pressure level (SPL) L_p is expressed in decibel (dB) by

$$L_p = 20 \log \left(\frac{p_{rms}}{p_0} \right) [\mathrm{dB}] \tag{2.1}$$

where p_{rms} is the root-mean-squared pressure, and $p_0 = 2 \cdot 10^{-5}$ Pa is the standardised reference value for sound waves in air, which is the hearing threshold of the human ear at 1000 Hz [10].

2.2 Frequency Bands

In many cases, it is interesting to look at a sound signal's characteristics in larger blocks than per frequency unit. These larger units can be, typically, octave bands and 1/3-octave bands, having the bandwidth of one octave and 1/3 of an octave, respectively. An octave is a doubling of frequency. The sound characteristic, for instance sound pressure level, is averaged over the frequency band in question, yielding one value for the whole range within the band. The center frequencies of the octave bands and the third octave bands are internationally standardised. They are

$\leftarrow$ ..160 200 **250** 315 400 **500** 630 800 **1000** 1250 1600.. $\rightarrow$

the bold numbers being the center frequencies of the octave bands [2].

2.3 Sound Propagation

Sound propagating away from a source rarely does so in a uniform pattern. The directivity of a source is dependent, among other things, of the frequency and the geometry and direction of the source. Low frequencies are more omnidirectional than high frequencies, meaning the sound pressure of low frequencies will be more uniform in the different directions around the source. The sound speed in air is the same for all frequencies, but varies with temperature and humidity. At 20 °C, the speed of sound in air, c_0, is 343 m/s. The frequency of a pure tone is related to the wavelength of the tone and the speed of sound.

2.4 Room Acoustics

Sound in a confined space will be reflected from the boundaries of the space and create a complicated sound field. This section will briefly explain basics of room acoustics and present room acoustical parameters relevant for this project.

2.4.1 Reflection and Absorption

When a sound wave meets an obstacle, it can either be reflected or diffracted, depending on the size of the wavelengths compared to the size of the obstacle. If the obstacle is small compared to the incoming wavelengths, they will bend around the obstacle. This is called diffraction. If the wavelengths are of comparable size or smaller than the obstacle, they will be reflected. Reflection can be either specular or diffuse, again dependent on the size of the wavelength. Short wavelengths compared to the size of the obstacle are reflected specularly, like light in a mirror. Longer wavelengths are scattered more or less universally in different directions from the scattering surface.

When sound is being reflected by a surface, some of the energy is absorbed by the material of the surface. Which frequencies are absorbed, and how much, depends on the structure of the material and the way it is mounted. The sound energy changes to heat energy by different mechanisms. Porous absorbers converts the acoustical energy into heat by the viscous behaviour of air flowing in pores and pockets in the material. Examples of porous absorbers are thick curtains and mineral wool. Resonance absorbers have acoustical and mechanical constructions that are set in motion by sound. The absorption by these absorbers relies on the losses in their constructions. Thin panels, windows and Helmholtz absorbers are examples of this type. The audience is also quite absorbing [2].

2.4.2 Impulse Response

The impulse response of a room is, quite literally, the room's response to an impulse. It is a time recording of the sound in the position of the microphone, given a certain room and certain positions of the microphone and the sound source. The impulse response consists of the direct sound between the source and the receiver, and multiple reflections caused by the boundaries of the room. A reflectogram is a diagram showing the amplitude of the reflections over time, where the impulse response is the actual recording of a room's response of a sound. The reflections are usually grouped into early and late reflections or reverberation, based on their delay with respect to the direct sound. An example of a reflectogram is shown in Figure 2.1. In addition to their time delay, each reflection is specified by its level with respect to the direct sound, and the direction of which it comes from to the receiving point, as well as the spectrum content [1]. The spectrum content and amplitude of the reflections are affected by the absorption characteristics of the surfaces.

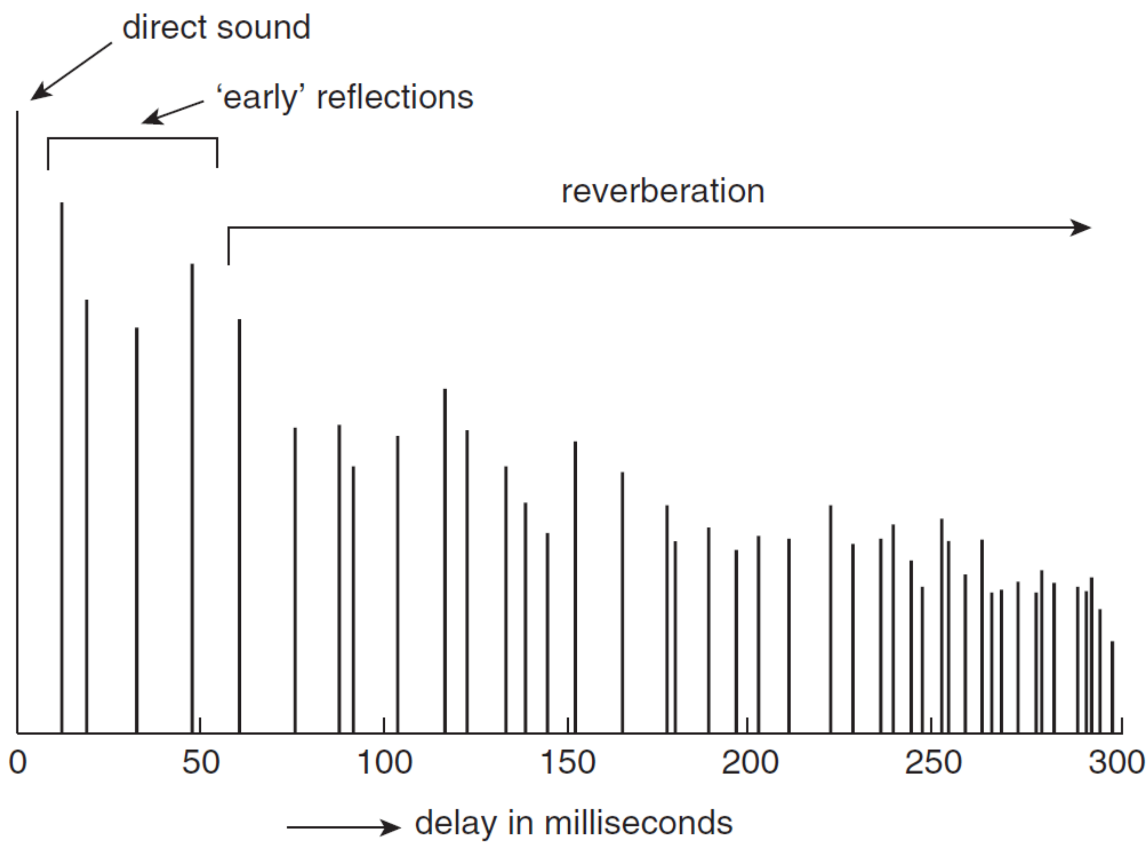


Figure 2.1: The figure shows an example of a reflectogram with its impulses classified into direct sound, early reflections and reverberation [1].

2.4.3 Magnitude Spectrum

The frequency characteristics of a signal can be gained by using Fourier analysis on the time signal. A detailed explanation on the Fourier transform can be found in a high level mathematics book, or in a book about signal processing. The output of this operation is the frequency spectrum, or the power content as a function of frequency, of the time signal. Doing this on an impulse response of a room will yield information about the frequency response of the room. This can be used to detect possible problematic room modes (see Section 2.4.4) or to check the balance between the different frequencies. Studying the magnitude spectrum of a single reflection from the impulse response yields information about the material of the surface from which the reflection comes.

2.4.4 Room Modes

The wave theoretical approach to acoustics uses wave theory to find the sound pressure distribution in a room. Assuming a room has parallel, reflective walls, there will be a sound pressure build-up as sound is reflected back and forth between two walls, creating standing waves. These are called oscillation modes, eigenfunctions, or simply modes. The modes always have maxima at the walls. Between the maxima, there are minima. This means there are positions in the room where the frequency of the mode will be very prominent, and other positions where it will be inaudible. Figure 2.2 shows one mode for a rectangular room. The frequency of each mode is determined by the speed of sound and the room dimensions, and they have more energy than frequencies for which there are no modes. For a rectangular room with rigid walls, the eigenfrequencies are given by

$$f_{q_x,q_y,q_z} = \frac{c_0}{2}\sqrt{\left(\frac{q_x}{l_x}\right)^2 + \left(\frac{q_y}{l_y}\right)^2 + \left(\frac{q_z}{l_z}\right)^2} \tag{2.2}$$

where q_x, q_y and q_z are natural numbers 0, 1, 2,..., the combination of them is the mode index, and l_x, l_y and l_z are the dimensions of the room [2].

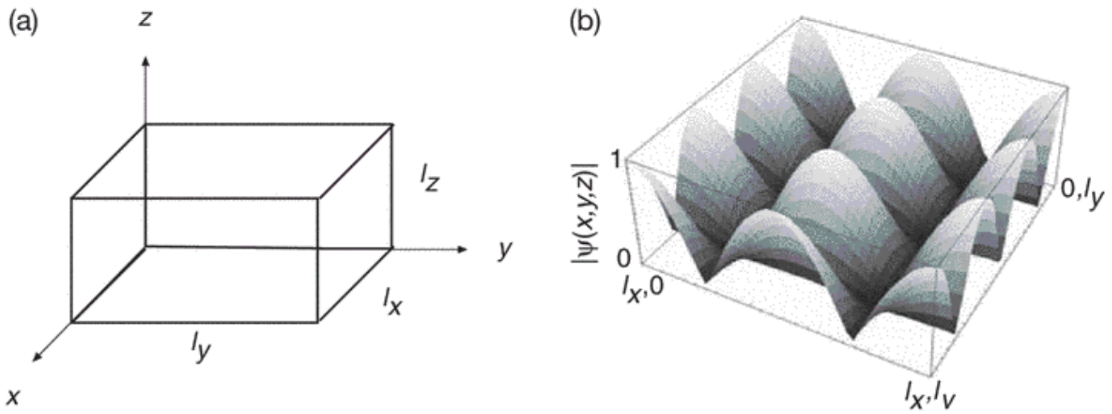


Figure 2.2: The figure shows a rectangular room and its coordinate system (a), and the normalised magnitude of the eigenfunction $|\Psi(x, y, z)|$ for the mode $q_x : q_y : q_z = 3 : 2 : 0$ (b) [2].

The number of room modes per frequency, the modal density, is increasing with the frequency. This means that there are discrete peaks for low frequencies in the magnitude spectrum where there are more energy than for other frequencies. As the frequency increases, these peaks are closer and closer together, until they can no longer be distinguished from one another. In this range, the energy is approximately evenly distributed between the different frequencies. In the low-frequent range, however, the discrete peaks causes some frequencies to dominate the sound field. The low-frequent room modes can be clearly heard as a "booming" sound when excited, and can be quite the disturbance for understanding speech, or listening to or performing music.

Prominent room modes can be avoided by canting walls so that they are no longer parallel. This will lead the reflected sound further down the wall for each reflection, avoiding the pressure build-up in fixed points that would otherwise happen. If canting the walls is not possible, the modes can be attenuated by absorbers in the corners of the room, so-called bass absorbers. The reason the absorbers are placed in a corner, is because many modes have maxima here, and will therefore be better damped.

2.4.5 Diffuse Field and the Schroeder Frequency

Statistical room acoustics is one way of analysing the wave propagation in a closed space. A condition for using this approach, is that the sound has a wide frequency range, and that we are interested only in looking at a frequency band consisting of many frequencies. The basis for statistical room acoustics is that after a time, steady state conditions are reached. The steady state can be viewed as a superposition of resonant room modes. The reflections have bounced off many walls and are, on average, equally strong from all directions. This is called a diffuse field, and is characterised by equal energy density at all positions, reflections can come from all directions with equal probability, and the phase of all reflections is random [2]. In reality, this is never the case in all positions in a room, or for all frequencies. The Schroeder frequency is a limit above which a diffuse field can be assumed for a certain room. It is approximated by

$$f_S \approx 2000\sqrt{\frac{T}{V}} \tag{2.3}$$

2.4.6 Comb Filter Effects, Coloration and Flutter Echos

Comb filter effects arise from interference between two coherent signals where one is somewhat delayed. The positive and negative interference leads to some frequency components being amplified and others cancelled, the pattern similar to the shape of a comb when the frequency response is plotted linearly. An example of this amplitude variation is shown in Figure 2.3.

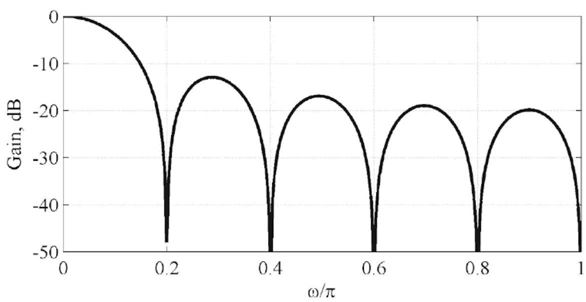


Figure 2.3: The figure shows an example of a comb filter frequency response [3].

For white noise, time delays under 0.1 ms cause the coloration of the sound caused by the comb filter is perceived as a timbre change of white noise. For delays between 2-20 ms, the coloration effect gets a tonal character [10].

Multiple repetitions of the same sound causes other effects than one repetition does. If the direct sound is longer than most of the repetitions, the coloration will be perceived as a timbre change. If the sound is much shorter than the delay interval, the time structure of repetitions will be audible. This is called a flutter echo, and can be described as sounding metallic. Flutter echos are common in small rooms where reflections are reflected back and forth between two hard, parallel surfaces [10].

2.4.7 Reverberation Time

The reverberation time (T) is the most commonly used parameter for describing the acoustical properties of a room. Reverberation time is defined as the time it takes for the energy density in a room to decrease by 60 dB compared with the start of the decay after a sound source is turned off. Since rooms seldom have ideally diffuse sound fields, the reverberation time will be different in different positions in the room. When a decrease of 60 dB is difficult to measure, a line fitted to the reverberation curve between -5 dB and -35 dB is extrapolated to a decay of 60 dB. This way of representing the reverberation time is often called T_{30}. One can estimate the T of a room using Sabine's formula, under the assumptions that the absorption is evenly distributed among the surfaces of the room, the shape of the room is not extreme, and the average sound absorption coefficient α of the room is less than 0.3. Sabine's formula is given by

$$T \approx 0.161 \frac{V}{A_S} \tag{2.4}$$

where V is the volume of the room, and A_S is the total absorption area of the room.

Different reverberation times are needed for different rooms, depending on their intended use. Different kinds of music and speech each have a recommended range for the reverberation time in relation to the room volume. Figure 2.4 shows the design criteria set by the Norwegian Standard on the acoustics of rooms for music rehearsal and performance [4]. The reverberation time given in the figure is the mean of the reverberation time for 500 Hz and 1000 Hz, T_m. The area marked 1 in the figure shows the upper and lower limit for weak music in performance rooms, 2 is the limits for powerful music in performance rooms, 3 is amplified music in performance rooms. The areas 4, 5 and 6 are the limits for rehearsal rooms for weak, powerful and amplified music, respectively.

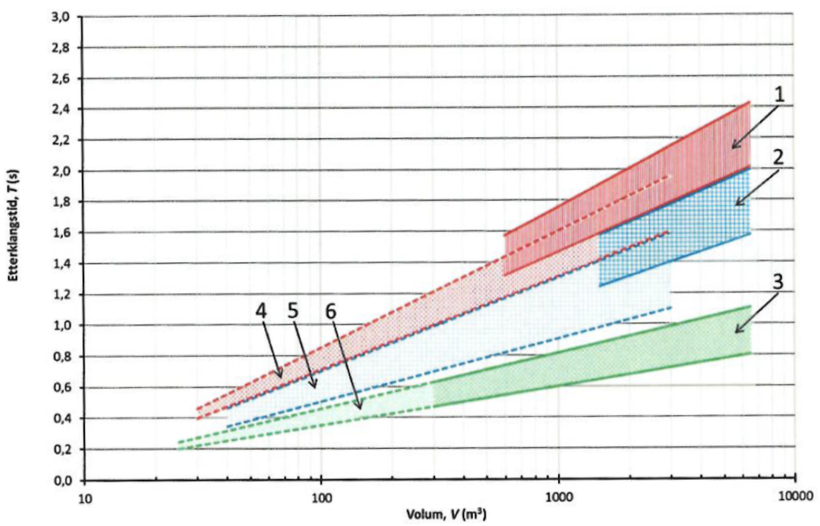


Figure 2.4: The figure shows the reverberation time, T, in relation to the room volume, V, for different forms of music, as demanded by the Norwegian Standard NS 8178 [4]. The solid lines indicate rooms for performance, and the dashed lines indicate rooms for rehearsal. The red shaded area is for weak music, the blue area for powerful music, and the green area corresponds to amplified music.

In addition to a demand on the mean value of the 500 Hz and 1000 Hz octave bands, there are demands on the evenness of the reverberation time over frequency. Figure 2.5 shows the frequency dependent tolerance limits for the factor T/T_m in the octave bands from 63 Hz to 4 kHz for acoustical weak and powerful music, both in rooms for performance and rehearsal.

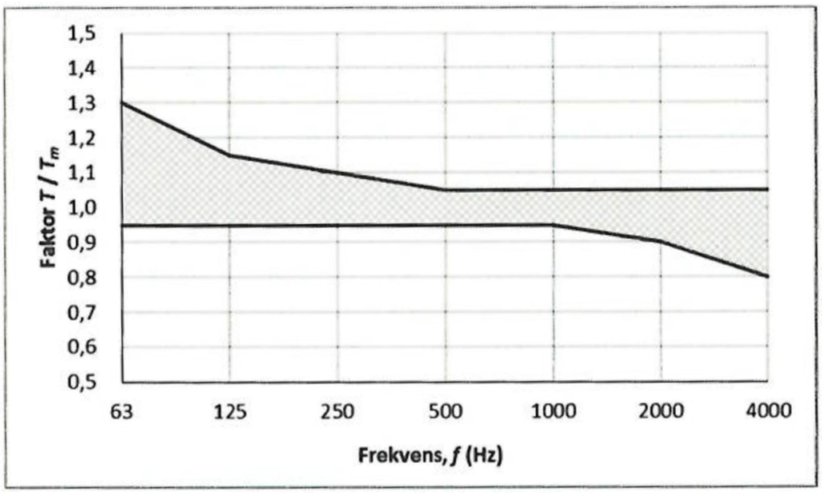


Figure 2.5: The figure hows the frequency dependent tolerance limits for the factor T/T_m in the octave bands from 63 Hz to 4 kHz for acoustical weak and powerful music, both in rooms for performance and rehearsal [4].

Human ability to perceive changes in reverberation time is excellent, as a change of reverberation time of less than 5 % is noticeable for frequencies around 1-3 kHz. When listening to running music or speech, the hearing is focused on the first 0.15 s of the reverberation process. This means the geometrical design of a room is very important, as the initial reflections from the walls are essential for the first part of the reverberation process. The early decay time (EDT) is a reasonably good measure of this perceived RT, and is calculated from a line fitted between the initial level and -10 dB and extrapolated to a decay of 60 dB [2].

Many of the traditional parameters used in room acoustics are highly correlated to the impulse response, and therefore the reverberation time, of a room.

2.4.8 Clarity

Clarity is a measure that compares the energy in the early part of the impulse response to the late part of the impulse response, using the time limit of 80 ms. It is used for music, and is based on the Deutlichkeit parameter with time limit 50 ms used for speech. The difference in the time limit between the two signals is caused by the fact that music reflections are less detectable than speech reflections [1]. Clarity, or C_{80}, is given by

$$C_{80} = 10 \log \left(\frac{\int_{0\text{ms}}^{80\text{ms}} h^2(t)dt}{\int_{80\text{ms}}^{\infty} h^2(t)dt} \right) [\text{dB}] \tag{2.5}$$

where $h(t)$ is the impulse response of the room.

2.4.9 Centre-of-Gravity Time

The way the C_{80} is dividing the impulse response into two parts assumes a sharp limit between useful and non-useful reflections. Other measures on the clarity or "clearness" of a room that avoid this sudden border are the center-of-gravity time or a variety of C where the transition between useful and detrimental reflections is gradual [1]. The center-of-gravity time T_S is the time before and after which there is an equal amount energy in the impulse response, and it is defined as

$$T_S = 1000 \left(\frac{\int_{0\text{ms}}^{\infty} t \cdot h^2(t)dt}{\int_{0\text{ms}}^{\infty} h^2(t)dt} \right) [\text{ms}] \tag{2.6}$$

where t is the time in milliseconds.

2.4.10 Stage Support

The support parameter ST is a measure of how much of the sound energy that is returning to the musicians on a stage, and is used when describing concert halls and other performance locations. The early support ST_{early} describes how well musicians hear their own instrument as well as the whole ensemble, and is the reflected sound energy level of 20-100 ms relative to the initial 0-10 ms direct sound. The late support, ST_{late}, is the level of the 100-1000 ms reflected sound relative to the 0-10 ms direct sound, and describes how much of the reverberant sound the performer on the stage hears [11]. The typical range of values when these parameters are measured on orchestra platforms are: ST_{early}: -24 dB to -8 dB, and ST_{late}: -24 dB to -10 dB [6].

Table 2.1 summarises the room acoustical parameters used in this thesis.

Name	Symbol
Reverberation time	T_{30}
Early decay time	EDT
Clarity	C_{80}
Centre-of-gravity time	T_S
Early support	ST_{early}
Late support	ST_{late}

Table 2.1: The table summarises the acoustical parameters to be used.

2.4.11 Rehearsal rooms

There are many recommendations for rooms intended for music in general. Some general recommendations are low background noise, optimal sound level, suitable clarity, good spatial and temporal distribution of the early reflections, and appropriate reverberation time for the intended music [2]. These are criterion for auditoria, but are equally useful for other rooms intended for musical performance. Rehearsal rooms are typically much smaller than auditoria, and issues related to large room sizes are often avoided. These could be large time gaps between the early reflections, echos and too low sound levels.

Modes largely affect the properties of small rooms. The room response in low frequencies can be irregular due to little damping and large frequency intervals between the modes [10]. These irregularities can be seen both for different frequencies and for different positions in the room, as described above. A study by Halmrast [12] indicates that the absence of room modes can be more important than the plain reverberation time criteria in a rehearsal room, especially for musicians playing a low-pitched instrument. When playing high-pitched instruments, the "shimmering" is the largest problem.

In a small room like a rehearsal room, the walls are relatively close to the occupant regardless of the position. Comb filter coloration is strongest close to the walls, and in a small room it can be difficult to get far enough away from the walls to avoid this effect. Another problem related to small rooms is high sound level at the musician's ear.

Musicians' preferences regarding rehearsal rooms are not limited to room acoustical characteristics. Visual and acoustical isolation is important, as well as low noise from installations and no rattling from loose parts inside the room. Regarding reverberation, a reverberation time between 0.5 and 0.9 seconds is preferred, although different instrument groups have different preferences [10]. The preferred difference in reverberation time for different instrument groups is included in the Norwegian standard NS 8178, where reverberation criteria are divided between amplified music, loud acoustical music and silent acoustical music [4]. Musicians tend to like dampened rehearsal rooms better than reverberant rooms [12]. Both in rehearsal rooms and in concert halls musicians prefer to have support in a mirror image source [10]. This means that diffusing surfaces should not be exaggerated.

2.5 Human Hearing

The human auditory system is very complex and is made up of the ear, the auditory nerves and the brain. The ear can be subdivided into three parts: the outer ear, the middle ear and the inner ear. Humans can hear sound with pressure between 10 μPa and 100 Pa, and frequencies between 20 Hz and 20 kHz [10]. This section will give a brief introduction to phenomena judged to be of relevance for the project.

2.5.1 Just Noticeable Differences

Studies have been performed on how much the value of a certain parameter needs to change for the human hearing to be able to detect the change. The resulting values are called Just Noticeable Differences (JND). Table 2.2 shows the JND values for the relevant parameters.

Parameter	JND
T_{30}	Rel. 5 %
EDT	Rel. 5 %
C_{80}	1 dB
T_S	10 ms

Table 2.2: The table shows the Just Noticeable Difference for some of the parameters used in this report [6].

2.5.2 Reflections, Echo and Timbre Changes

Reflections can change the way a sound is perceived, as was seen with timbre change in the case of comb filter effects. A detected reflection of low levels can, in addition, increase the loudness of the total sound signal or increase the apparent size of the sound source. When the level of the reflection is higher, it can be detected as an echo. Whether a reflection will be perceived as an echo or not also depends on how much it is delayed [1]. The human ear is more sensitive to reflections arriving from the side than from the front, back, and above. Figure 2.6 shows how an added reflection from the side affects the perceived sound when the direct sound is coming from the front.

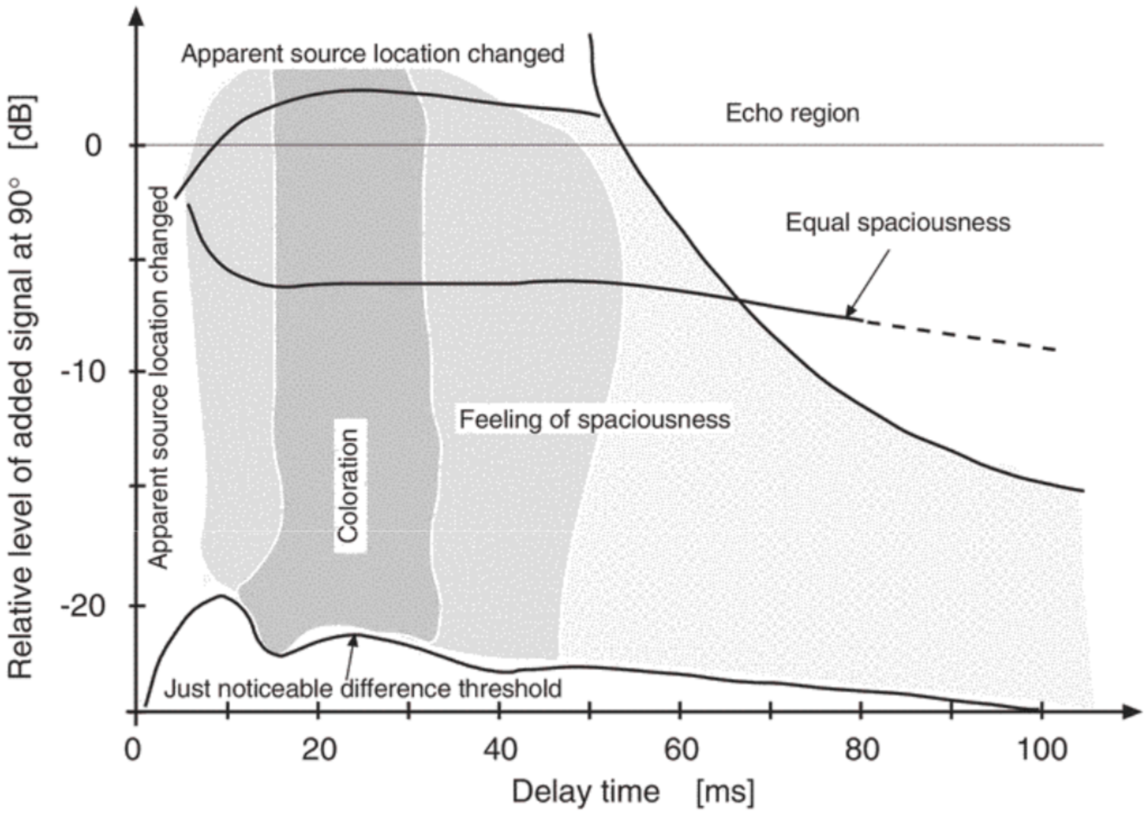


Figure 2.6: The figure shows various subjective effects of adding a sound field component at 90°, for various levels and time delays relative to the direct sound [2].

Figure 2.6 shows an area between about 10 and 30 ms delay that is named Coloration. This is a change of timbre caused by comb filter effects, as described in Section 2.4.6. Timbre is closely related to the harmonic structure of a tone and makes it possible to distinguish between two tones that have the same duration, pitch and loudness, but sound different. In addition to the harmonic structure, is timbre dependent on the tone's attack, decay and sustain [13].

2.6 Subjective Investigations

In order to understand how different sounds or sound qualities are perceived, listening tests are an important tool. By exposing people to a sound and giving them a way to respond or explain with words how they perceive the sound, one can study subjective listening impressions. The field of humans' perception of sound is called psychoacoustics. Research in this field differs from the physical branch of acoustics in the way that it doesn't yield clear and consistent answers. The major reasons for this is a lack of a good vocabulary and ability to describe subjective impressions, the complexity of the human hearing organ, the difficulty of differentiating between a subjective impression from the ears and from another sense, for instance sight, and different listeners hearing habits and personal aesthetic sensitivity [1].

2.6.1 Listening Tests

When designing a listening experiment, some of the questions to be answered are [14]:

- Who should be a participant?
- Which sound properties should be assessed?
- How to request judgements?
- How to perform statistics?

The two most common methods for investigating subjective effects of complex sound fields are to synthesise sound fields and let test subjects judge them, or to judge directly the acoustical qualities of existing sound fields in rooms, halls and soundscapes of interest [1]. When assessing the acoustics in a room, there are many uncertainties to consider. If multiple rooms are to be compared, the memory of the test subject is one uncertainty. The listeners may have limited qualification or experience, or the different listeners' experiences may differ. Rooms to be compared may also differ in more ways than the parameter to be compared, in both acoustical parameters, visual impression, lighting, temperature and more. All these things make subjective impressions difficult to study.

The design of the experiment can be within-subjects design (repeated measures design) or between-subjects design. Within-subjects design means that the same subjects judge multiple stimuli, while each participant in between-subjects experiments judge one stimulus. The disadvantage of the first is that the order the subject is presented the data may affect the results. This effect can be avoided by changing the order of the stimuli for each participant, as the order effect will be evened out between the participants. The disadvantage of the between-subjects design is that the data sets are huge. The design of the experiment is chosen dependent on the object of investigation, and the statistics have to be chosen according to the choice of design [14].

When performing the experiment, it is important that the experimental leader has a neutral behaviour as not to affect the judgement of the test subjects. The general run of an experiment starts with a welcome, followed by instructions. It is common to have a training session where the subjects get to know the questions and the form of the experiment. After the test proper is performed, there can be an interview to collect additional information to the questionnaire, or as the sole source of information. The experiment is ended with a good-bye. It is important to note that "poor performances" can occur. These can be caused by missing experience, different expectations in the group of test subjects, or heterogeneity of the test group [14].

There are different ways to gather information from the test subjects about their impressions of a room. One of these is verbal description, in which the subjects are required to describe verbally the sounds they perceive. This can be done by a questionnaire, questions to be answered with free text or by oral description [15]. It is easy to compare the answers from multiple test subjects when the information is gained by use of a questionnaire. The collected data is easily translated into numbers to perform statistical analyses on.

2.6.2 Questionnaire

When making a questionnaire, there are many ways to ask the questions. One way is by indirect scaling methods, for instance by paired comparison. An example is "Which of the two sounds is louder?". Direct scaling method include ranking or rating the stimuli according to a certain criteria or using category scales. The scales can be of different design: bipolar, just right, unipolar, or magnitude estimation. A Likert scale is bipolar and has five categories: "Agree strongly", "Agree", "Neither Agree nor Disagree", "Disagree" or "Disagree Strongly" [16]. By including the possibility to add comments in free text regarding the perception of the acoustical environment, additional data is gained [17].

2.7 Statistics

Two major branches of statistics are Descriptive and Inferential statistics. Descriptive statistics are methods to summarise features to see patterns in a set of information, while inferential statistics are using a small set of known information to draw conclusions about unknown values with a certain degree of probability [16].

Collected data can be categorised in four levels. These are nominal data, ordinal data, interval data and ratio data. Nominal data is data that can be sorted into mutually exclusive categories, for example male/female, rich/poor, and so on. Ordinal data is data that are categories with different values compared to each other [16]. An example is data gathered by a questionnaire where a statement is judged by the Likert scale. Interval data is data that has the same characteristics as ordinal data, but where the the distances between the categories are equal and there is no meaningful zero. Ratio data is the same as interval data, but with a meaningful zero value on the scale.

One limitation when collecting data in a questionnaire with the ordinal scale described above, is that the distance between the categories are judged differently by each test person, even though they seem equally spaced. Creating an average over the answers will therefore represent the test persons' response inaccurately. It is, however, common to treat ordinal data as interval data, especially for standardised questions [16]. This means that one assumes the categories to be equidistant, and mathematical operations can thus be used to analyse the numbers assigned to represent the response categories.

2.7.1 Mean, Median and Mode

The mean M, or arithmetic average, of a set of data is one of the basic statistical analyses. It expresses a central tendency of the data set, and is given by

$$M = \frac{\sum X}{N} \tag{2.7}$$

where X is the values of the data, and N is the number of values in the data set [16].

Other measures of central tendency are used in special cases. If some values in a data set are extreme compared to the majority, these may greatly affect the mean, shifting it away from the center of the data set. In these cases, the median is useful. The median is the middle score among a set of scores. If the data is clustering together in more than one group, the mode is a useful measure. The mode is the most frequent occurring value in a data set, and there can be multiple modes, indicating different clusters of the data. While the mean can only be used with interval data, the median and mode can be used also with ordinal and nominal data. [16].

2.7.2 Standard Deviation

The standard deviation (SD) is a measure of how much the values in a data set differ from the mean value [16]. Standard deviation is given by

$$SD = \sqrt{\frac{\sum(X - M)^2}{N}} \tag{2.8}$$

This is the SD as calculated in descriptive statistics, where the data is considered a complete set. In inferential statistics, the data is considered a sample of a population, and therefore, the inferential SD is different [16].

2.7.3 Confidence Interval

The confidence interval (CI) is the range of values within which the mean of the true population will fall with a certain certainty [16]. In the case of a 0.95 confidence interval, the certainty is 95 %. Assuming a t distribution, the 0.95 confidence interval is given by

$$CI_{0.95} = \pm t(0.05) + M \tag{2.9}$$

where $\pm t$ is the value of t from a statistical table that recognises the appropriate degrees of freedom according to the sample size and M is the sample mean [16].

3

Method

This chapter describes the methods used for calibration of measurement equipment and the procedures for the different measurements, the post-processing of the reflection measurements, and the design of the questionnaire and the subjective experiments.

3.1 The Objects of Study

The rehearsal rooms to be tested in this project is selected based on ease of access and difference in design criteria. Askim Kulturskole was willing to help because of earlier cooperation with Asplan Viak AS, and the University of Oslo was prepared to help with a master thesis project. The former was finished in 2016, and designed especially for musical use, and the latter was earlier an office building where some offices were converted into rehearsal rooms during the late 1990's. There were different recommendations for design criteria at the two periods of time. In the 90's, there were no standardised design criteria in Norway, while the rooms in Askim are designed in accordance with ISO 8178. Pictures of the rooms are shown in Appendix A.

3.1.1 Askim Kulturskole

Askim Kulturskole is an arts school where children can get instruction in instruments, singing, theatre, dance and visual arts. The school is located in Askim, Norway, and was completed in 2016. The premises includes ten rooms for one-to-one tuition for different instruments, and out of these, four rooms have been selected as examples of rehearsal rooms for solo instrumentalists. The rooms have been especially designed for the instruments that are rehearsing there, based on the Norwegian Standard NS 8178 that came in 2014.

All the rooms have an acoustical ceiling and a floating floor with linoleum. The walls towards other rehearsal rooms are covered with three gypsum boards, the walls to the facade and corridor have two gypsum boards, and one wall in each room has a 0.6 m wide band of wall absorbers close to the ceiling. The walls are canted in order to avoid flutter echos and room modes. Each room has two doors in separate frames. All rooms are furnished with at least one piano, a mirror, a white board, a table and a small cabinet in addition to some chairs. Figure 3.1 shows an overview of the floor plan.

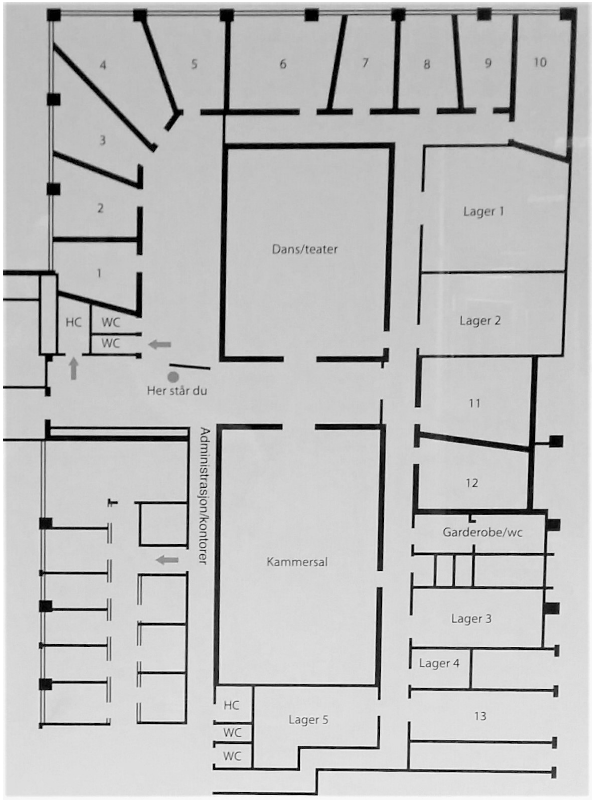


Figure 3.1: The figure shows an overview of the rooms at Askim Kulturskole. The rooms numbered from 1 to 10 are the rehearsal rooms.

3.1.1.1 Room 3

Room 3 is designed for brass instruments, and is 20 m^2 large. The height to the acoustic ceiling tiles is 2.50 m. The room has two large windows. A model of the room is shown in Figure 3.2.

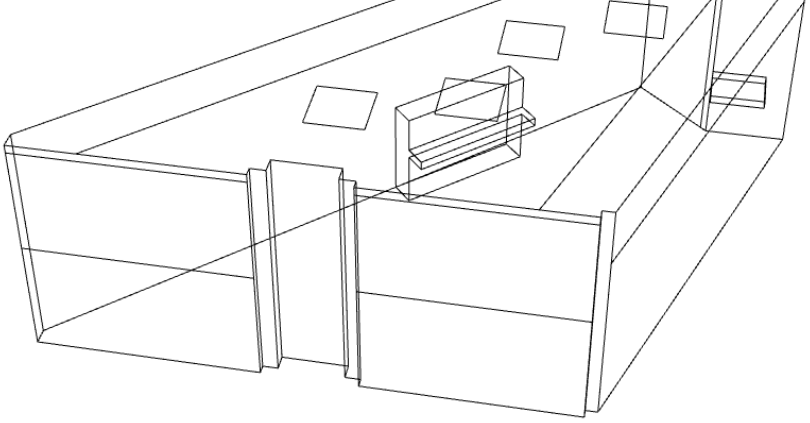


Figure 3.2: Room 3. The wall to the right in the figure has a wall absorber.

3.1.1.2 Room 7

Room 7 is designed for singing rehearsals. The floor area is $16\,\mathrm{m}^2$, and the height between the floor and ceiling tiles is 2.86 m. There is one window in the room. Figure 3.3 shows a model of the room.

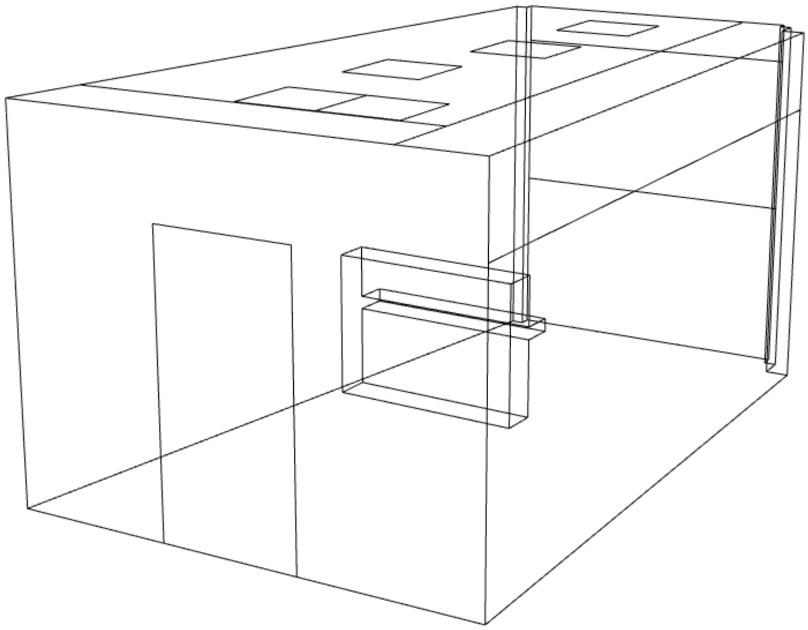


Figure 3.3: Room 7. The wall to the right in the figure has a wall absorber.

3.1.1.3 Room 9

Room 9 is designed for piano lessons, and has two pianos. There are two windows. The height to the ceiling tiles is 2.53 m, and the area of the room is $17\,\mathrm{m}^2$. The room is shown in Figure 3.4.

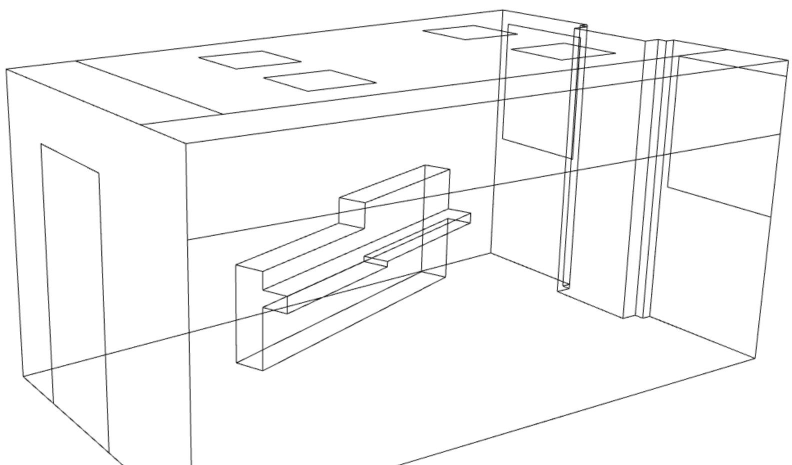


Figure 3.4: Room 9. The wall in the foreground in the figure has a wall absorber.

3.1.1.4 Room 10

Room 10 is also designed for piano lessons, and there are two pianos here, as well as one window. The room area is $23\,\mathrm{m}^2$, and the ceiling height to the tiles is $2.51\,\mathrm{m}$. See Figure 3.5 for a model of the room.

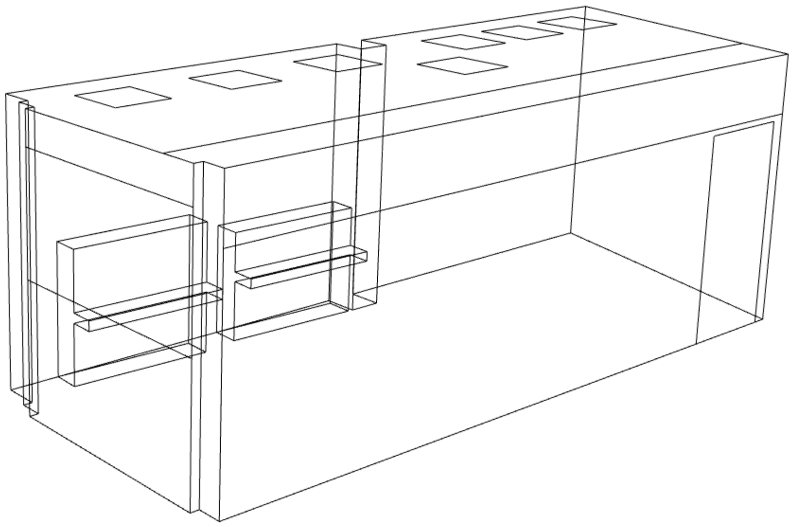


Figure 3.5: Room 10. The wall in the foreground in the figure has a wall absorber.

3.1.2 Rehearsal Rooms at the University of Oslo, Campus Blindern

The rehearsal rooms at the University of Oslo (UiO) are located at the Department of Musicology, Campus Blindern. Two rooms and an additional test room are chosen. The rooms are located at the fifth floor, where there are rehearsal rooms intended for acoustical instruments. None of them are designed for a specific instrument. These rooms are usually used by people who study for a bachelor or master's degree in musicology. Both of the rooms contain a piano and a mirror, and the ceiling is sloping upwards from the door until it flats out in front of the window. The materials of the rooms are gypsum walls and ceiling, linoleum floor, possibly on a floating concrete floor, and two wooden doors. The absorbers on the wall and in the corner are made from a slotted panel with a porous absorber behind, the corner absorber working as a bass absorber. Figure 3.6 shows an overview of the floor plan.

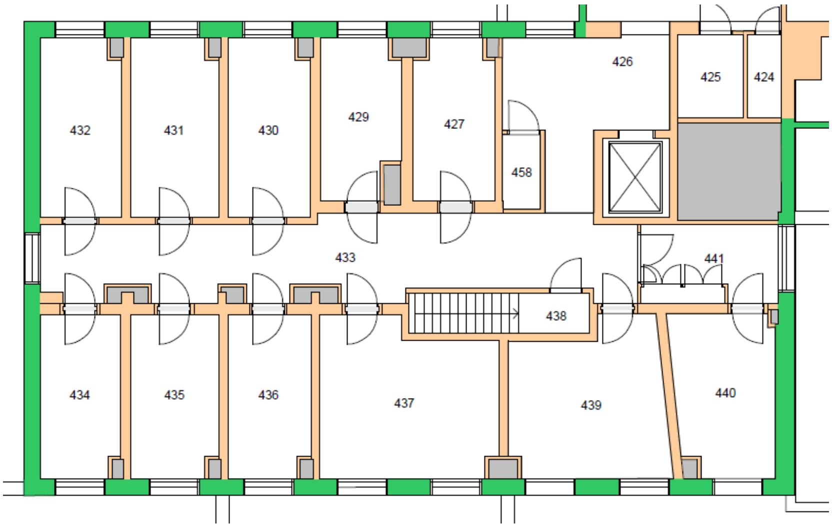


Figure 3.6: The figure shows an overview of the rooms at Blindern.

3.1.2.1 Room 431

The area of room 431 is 12 m^2, and the ceiling height varies between 2.22 m and 2.53 m. One wall and the corner have one kind of absorber, and the flat part of the ceiling has another absorber where there is no recessed lighting. In front of the window, there is a bay window which is beginning 0.47 m above the floor, with the same depth. A model of the room is shown in Figure 3.7.

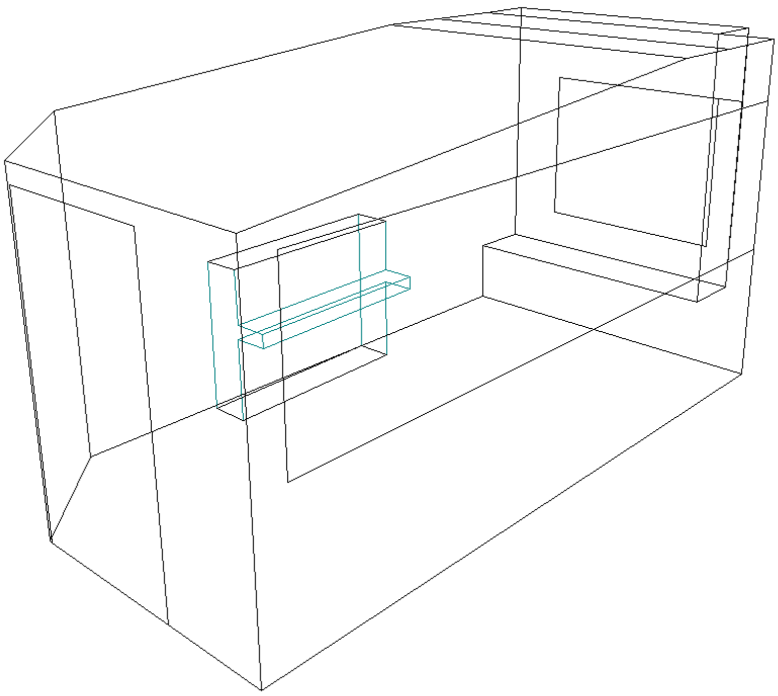


Figure 3.7: Room 431. The wall in the foreground in the figure has a wall absorber.

3.1.2.2 Room 435

Room 435 has an area of $11\,\mathrm{m}^2$. The lowest part of the ceiling is 2.22 m high, whereas the highest part is 2.48 m. The room has the same bay window as in room 431, and there are absorbers along one wall, in the corner by the door, and on the flat part of the ceiling. Figure 3.8 shows a model of the room.

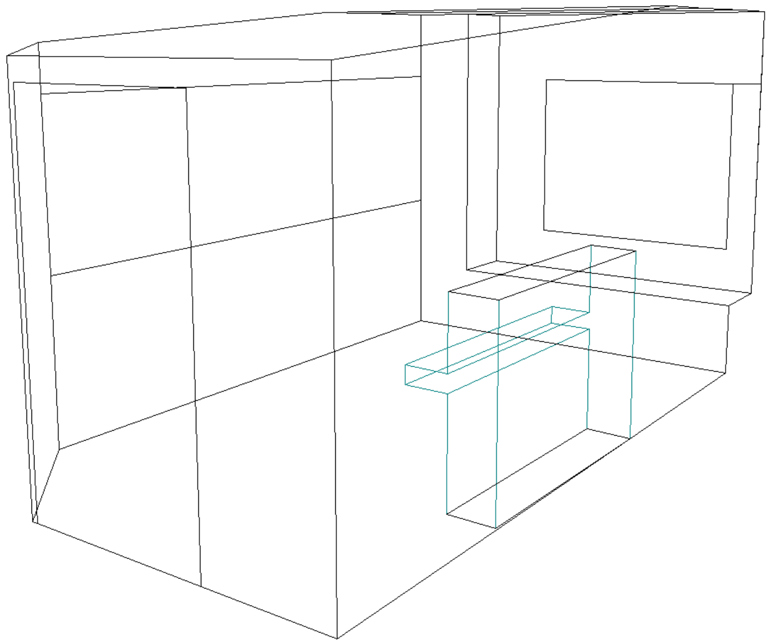


Figure 3.8: Room 435. The wall in the background in the figure has a wall absorber.

3.2 Measurements

Three kinds of measurements are performed in each rehearsal room:

- Traditional impulse response measurements
  - To map room characteristics and design criteria
  - To make waterfall plots and study impulse response
- Stage support measurements
  - Usually used for rooms for performances with a stage. Are they meaningful here as well?
- Surface reflection measurements
  - To map frequency content of the first order reflections

The equipment and procedures of the measurements are described in the following.

3.2.1 Equipment

The equipment used is listed in Table 3.1. All of the equipment fulfil the requirements of the ISO 3382 standard.

Device	Manufacturer and Model	Serial Number	Units
Recording Program and Sound Generator	Computer with Bruel & Kjær, Dirac		1
Sound Card	Roland Studio Capture, UA-1010	B7G1822	1
Microphone (1/4 inch)	iSEMcon, EMX 7150	3021818	1
Calibrator	iSEMcon, SC-1	1801048	1
Omnidirectional Loudspeaker	Bruel & Kjær, Type 4292-L	60008	1
Power Amplifyer	Bruel & Kjær, Type 2734	75001	1
Post Processing	Computer with Matlab		1
Microphone Stand			1
Loudspeaker Stand			1
XLR cable		10 m	1
SpeakON cable		10 m	1
Jack to male XLR cable			1
Distance measurement eq.			1

Table 3.1: Equipment used for measurements.

Figure 3.9 shows a schematic diagram of the equipment set-up. The computer with the Dirac software is both sound generator and recording device.

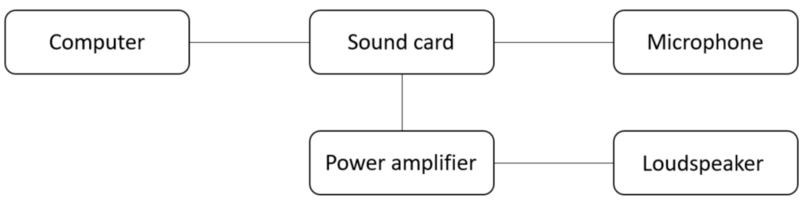


Figure 3.9: The figure shows the equipment set-up.

3.2.1.1 Loudspeaker Limitations

The Type 4292-L Bruel & Kjær omnidirectional loudspeaker is a dodecahedron with 12 loudspeakers. The directivity of the loudspeaker is taken from the product data, and is shown in Figure 3.10.

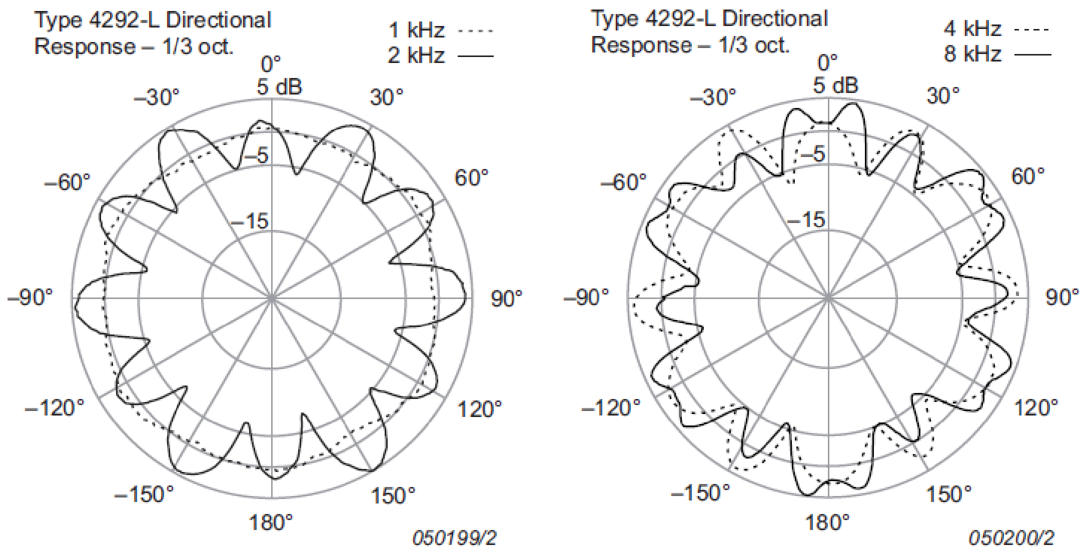


Figure 3.10: The figure shows the directional response of Type 4292-L in the horizontal plane, measured in 1/3-octave bands. Below 1 kHz there is no significant deviation from omnidirectionality [5].

The figure shows that for frequencies above 1 kHz, the directivity deviates from omnidirectional with about 10 dB radiated sound power from maxima to minima. The directivity pattern is influenced both by the directivity of each loudspeaker element, and the interference between the individual loudspeaker elements. The deviations are small enough for the loudspeaker to satisfy the requirements of DIN 52210, ISO 140 and ISO 3382 standards [5]. Even so, the deviation from omnidirectionality for the frequencies above 1 kHz will result in different frequency content radiating in different directions. This will not affect the traditional acoustical measurements to a high degree, as the whole impulse response of the room is used for calculating the parameter values. It will, however, affect the reflection measurements, where only certain parts of the impulse response is used. This will be discussed further later.

3.2.2 DIRAC

Using the Dirac software, two calibrations must be performed. These are the input level calibration and the system calibration [18]. The measurement chain needs to be calibrated for measurements of parameters described in ISO 3382-3, but improves the accuracy for other measurements as well. This calibration can be performed using the diffuse-field method or the free-field method. The diffuse-field method is most accurate at low frequencies, and requires a reverberation room. The free-field method yields the most accurate results, and needs an anechoic room. The free-field method can also be preformed as an in-situ calibration in a large room, although the results from this option is less accurate than the anechoic measurements. The method used for this thesis is the free-field method in a large room.

The free-field calibration measurements was performed in a sports hall. The external input and output gains in dB was entered on the Gain tab of the Measurement window in DIRAC before each measurement [18]. Eleven impulse response measurements were carried out at a fixed distance of 2 m from the source, using equally spaced microphone positions around the source. The source and receiver height was 1.5 m, and the excitation signal used was an exponential sine sweep of 10.9 seconds' duration. The first reflection was from the ground and was attenuated with respect to the direct sound because of the soft flooring of artificial turf. The calibration measurements are used to calibrate the system as described in the Dirac help manual [18].

The microphone input level calibration is performed before each measurement session. The procedure is well explained in the Dirac help manual [18].

3.2.3 Measuring Traditional Acoustical Parameters

The measurements of reverberation time and other traditional acoustical parameters are done with the Dirac software in accordance with ISO 3382 Measurement of room acoustic parameters [6]. An exponential sine sweep is used as excitation signal, and the computer with Dirac software is the signal generator. The sine sweep is chosen because of its wide frequency range, good signal-to-noise ratio and high immunity against distortion and time variance [1]. Dirac calculates the parameter values automatically from the measured impulse responses. Limitations related to these measurements are that traditional parameters are based on statistical acoustics and assume diffuse field, which is not true for most positions of the room or for all frequencies. However, it is common to assume diffuse field at positions more than half a wavelength away from wall surfaces in practical engineering [2].

3.2.4 Reflection Measurement

The reflection measurements are done in order to obtain the frequency content of the reflections of the different wall surfaces of the room. The traits of each surface are measured with a specific setup of source and receiver, planned such that the reflection coming from the surface of interest is not contaminated by other reflections, and that the time gap between this reflection and others is large. The positions were planned using the Odeon room acoustic software by method of trial and error. A certain source and receiver position was chosen, and the reflectogram calculated using Odeon. Changes were done to the positions as needed until the reflection to be studied had at least 2 ms clearance before and after to other reflections or the direct sound. With the specified setup, an impulse response measurement is made in the room of study using the Dirac software and an exponential sine sweep as excitation signal.

Figure 3.11 shows one example of the source and receiver positions used when measuring the surfaces of room 3. The other source and receiver positions are shown in Appendix B. The crosses in the figure are the source positions, while the circles are the receiver positions.

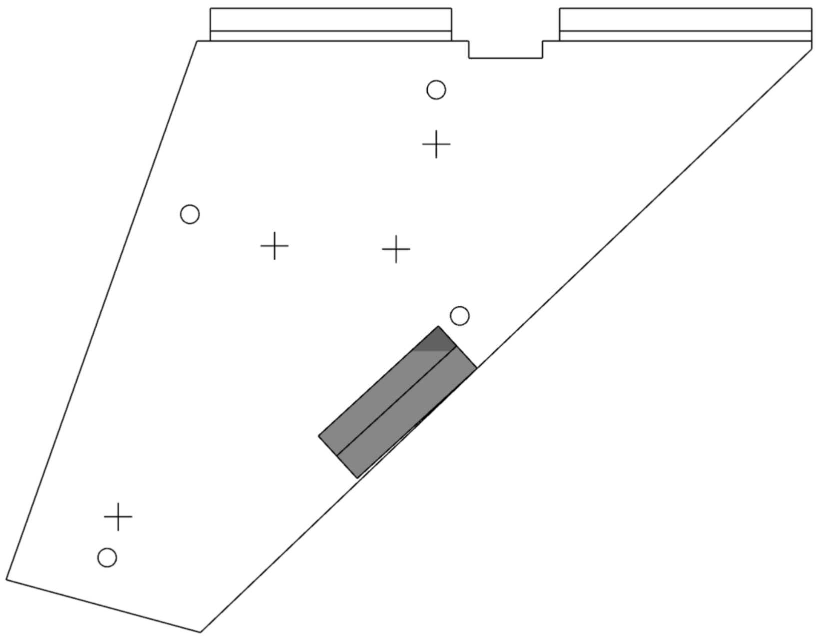


Figure 3.11: The figure shows the surface measurement positions used in room 3. The crosses are the source positions, and the circles are the receiver positions.

3.2.4.1 Post-processing

The post-processing of the reflection measurement files was done in Matlab, using the impulse response view in Dirac as a tool to locate the beginning and duration of the direct sound and reflection from the surface of interest. Dirac yields more detailed information about the distance the sound has travelled than the time of arrival. Therefore, the distance travelled from the source is the measure used for identifying time intervals and reflections. Matlab was used to single out the time signal of the direct sound and the reflection, calculate the magnitude spectra of the two, and subtract the spectrum of the direct sound from that of the reflection. Doing this obtained the frequency content of the reflection relative to the direct sound, showing the reflecting characteristics of the surface.

Matlab's built-in spectrogram function was used to produce matrices to plot waterfall plots for closer inspection of the impulse responses. The spectrogram function needs, in addition to the input signal, a window as input, to divide the signal into segments and preform windowing. Testing different windows yielded small differences. The window chosen in this thesis is the Blackman window with 128 points, because it has good SNR and a narrow main lobe. The Matlab function written to gain the reflection's frequency content is shown in Appendix C.

The choice of time intervals for the reflection and the direct sound is done manually, and therefore there is a possibility of error. However, it also adds a visual control and it's believed the method yields the most accurate results when done in a proper way. With this in mind, an exploration of the spectrum sensitivity is made. As a starting point, a suitable start time and duration is chosen for the reflection and direct sound, and the subtracted spectrum is calculated. The start time of the direct sound is held constant through this examination, but the duration is changing together with the estimated duration of the reflection. Changes in time are done as changes in the sound's travel distance. Keeping the length of the time interval constant, the estimated beginning of the reflection is changed with ±2 cm. This proves to affect the frequency spectrum a great deal. Closer examination shows that choosing the beginning of the time interval as close as possible to the beginning of the impulse that is the reflection yields small differences in the spectrum, indicating this is the true spectrum of the reflection. A similar examination was performed changing the length of the time interval in which the reflection is estimated to be located. Changing the length of the interval by ±2 cm yields minimal change. Shortening the time interval by 26 cm changes the spectrum only by being less detailed, especially for low frequencies. The conclusion is that as long as the interval begins very close to the first reflection peak, the spectrum calculated is reasonably accurate. It is important to make sure that the time interval only contains the direct sound or the reflection of interest.

3.2.4.2 Limitations

There are limitations related to the difference in travelled distance between the direct sound and the different reflections. The time delay between the different reflections needs to be such that it is possible to distinguish them from one another. The small size of the rooms of study makes it difficult to obtain a large time delay between the direct sound, the reflection of interest and the following reflections. This, in turn, limits the frequency range possible to view. When the time window of the uncontaminated reflection is limited, there is not enough information to represent low frequencies in a good way. The time window must be at least half a period of the frequency we want to study in order to get any information about it. The shortest travel distance difference available in the surface measurements is 0.43 m. Considering this as half the period, the corresponding frequency is approximately 400 Hz. The results are therefore not valid below this frequency.

The sample frequency limits the higher limit of the frequency range. According to the Nyquist theorem, the highest frequency possible to depict is the sample frequency divided by two. This is because frequencies above this limit are sampled with too coarse resolution, and they will be read as lower frequencies than they really are. This is called aliasing. To be certain to avoid aliasing, the upper frequency limit is set to $f_s/2.56$, which is 18 750 Hz. This upper limit does not exclude a lot of important information, as human hearing is limited to 20 000 Hz [2]. For comparison, the traditional parameters, as described in standards NS 8175 to NS 8178, only includes frequency bands up to the 4000 Hz octave band.

Another limitation is related to the rooms themselves. The size is such that the direction of the lowest frequencies is difficult to establish because of their long wavelengths compared to the room dimensions. However, most of the instruments that play in these rooms do not have a frequency range where these low frequencies are included, so they do not excite the low room modes to a high degree.

The variations in sound power level radiated from the source with direction shown in Figure 3.10 means that the rotation of the loudspeaker affects the measurements. The direct sound from the loudspeaker to the microphone will have different frequency spectrum dependent on the rotation of the source. The same is true for the reflections.

In addition to this, there will be interference between the sound radiating from the different loudspeaker elements to a certain position, because of the time delay caused by different travel distances. This means that the spectra of the reflections relative to the direct sound of that specific case will be different for different rotations of the source. Because of this uncertainty, only the general trend of the frequency content of a certain reflection can be found using this method. To make the effect of the directivity smaller, a smaller loudspeaker can be used, in order to minimise the time delay from the different loudspeaker elements. However, as long as there are multiple loudspeaker elements, there will always be interference between them. One solution is to use a loudspeaker with only one element for this kind of measurement, but due to practicality and to get results that can easily be compared with measurements done in accordance with ISO 3382, it was decided to use the omnidirectional sound source.

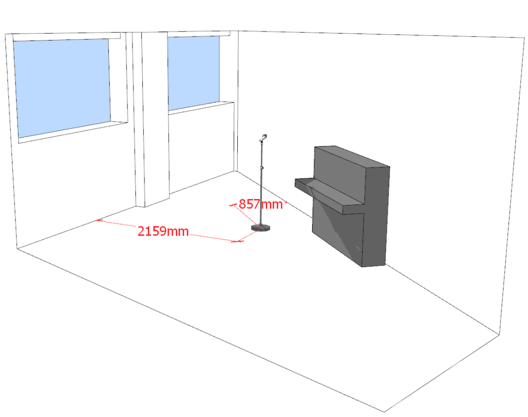
3.3 Modelling

To examine the reflection pattern over time as experienced for the musician in the playing position, the rooms are modelled. The aim is to get the reflections' distribution in time, and how they are varying in amplitude. The rooms are modelled in SketchUp, and Odeon is used to obtain the reflectogram of the defined playing position. The materials assigned to the surfaces in Odeon are the actual materials used in the room. The position in the horizontal plane was given by the room and its furnishing, and is approximately where the students are located when using these rooms. The playing positions of each room are illustrated in Figure 3.12. The height is 1.5 m above the floor. To get the reflectogram approximately as experienced as the musician, the source and the receiver is located in the same position. The source used in the model is an omnidirectional point source. This is not entirely precise, as the real instrument is not a point source, not omnidirectional, and not in the same position as the ears. However, it will yield a good impression as to how the reflections are distributed in time. Table 3.2 shows the calculation parameters used when calculating the reflectogram.

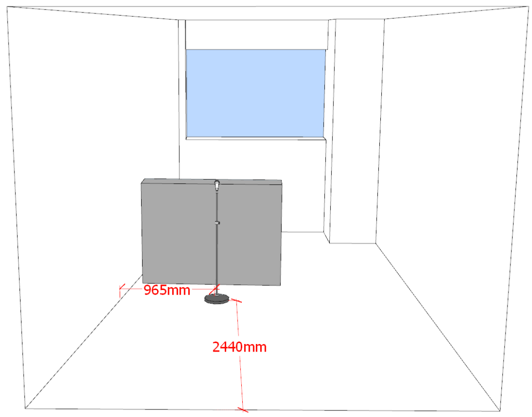
Setting	**Quantity**
Impulse response length	1000 ms
Number of late rays	16000
Max. reflection order	10000
Impulse response resolution	1.0 ms
Min. distance to walls	0.0 m
Early reflections transition order	4
Manual number of early rays	8000
Number of early scatter rays (per image source)	100
Angular absorption	Soft materials only
Screen diffraction	On
Surface scattering	Actual
Oblique Lambert	On
Reflection based scatter	Enabled
Key diffraction frequency	707 Hz
Interior margin	0.00 m

Table 3.2: A table showing the calculation parameters used in Odeon when calculating the reflectogram.

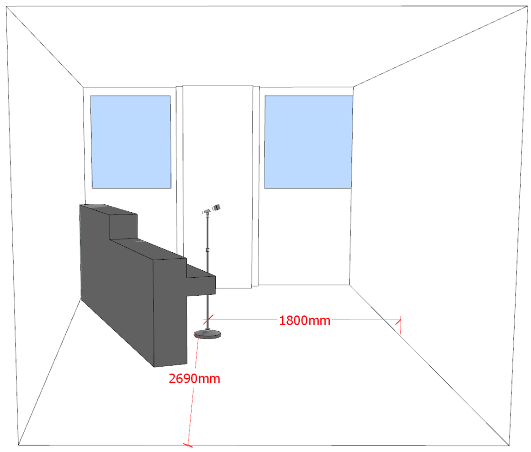
The positions of the musicians in the rooms are a matter of uncertainty. Even if they are asked to stand or sit on the red mark on the floor, which is defined as the playing position, the accuracy of which they are standing on the spot differs. In addition are some of the musicians sitting while preforming the experiment, and they are of different height. All of this means that the exact position of the instrument and the ears are unknown. The exact reflection pattern and response of the room as the test subjects experience them are unknown as well.



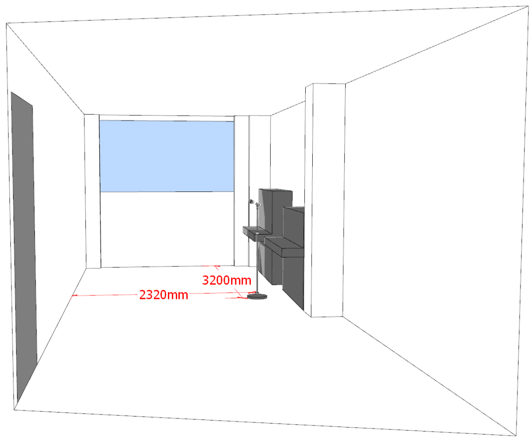
(a) Room 3



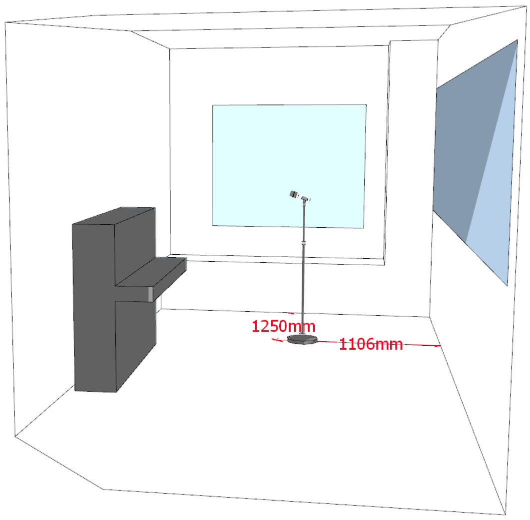
(b) Room 7



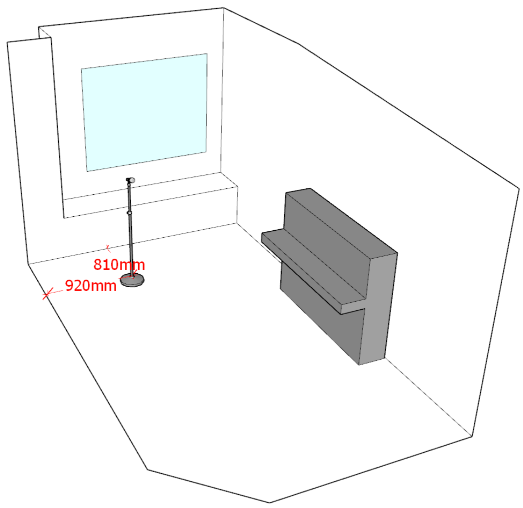
(c) Room 9



(d) Room 10



(e) Room 431



(f) Room 435

Figure 3.12: The figure shows the source and receiver position illustrated by the microphone for the reflectogram simulations for all the rooms of study. The height is 1.5 m in each of the cases.

3.4 Subjective Experiments

Music and sound quality are subjective experiences, and are difficult to anticipate by physics alone. As mentioned earlier, the human hearing system is not linear, and preferences are highly individual. To gain data of the experience of the rehearsal rooms, subjective experiments are performed. A questionnaire is made to gather data in a way that make it possible to compare the experience of different people, and to be able to relate the perceived experiences to the physical measurements. This project is focusing on the musician's perception of a rehearsal room, and therefore their experience is what is being investigated. Musicians have a standpoint, both mentally and in space, different than the listener. The experiment was, essentially, to let musicians rehearse in the rehearsal rooms of study, and answering the questionnaire afterwards.

3.4.1 Questionnaire

The questionnaire has questions about aspects of room acoustics thought to be important for music in general, and for the satisfaction of the musicians in a rehearsal situation. It has three main parts; the first section collecting data of the participant, the second section is collecting data on each of the rehearsal rooms, and the third is a summary of the experiment. It is designed using different answering scales. The first part is answered mainly by nominal data, for instance the participant answers whether they have normal hearing or not or which instrument they are playing. This part is slightly different for the experiments done at Blindern compared to the ones done in Askim, due to the different groups of participants and the normal use of the rooms. In the second part, which is a set of questions repeated for each of the rooms, most of the questions are answered with a five point scale, of which there are two versions: a bi-polar scale, and a uni-polar scale, ranging from "agree completely" to "disagree completely" and "very important" to "not at all important", respectively. For all questions, there is also an option of choosing "I don't know", so as not to force the test persons to choose an alternative they don't feel represent their perception of the room. In addition to the five point scale questions, section two also has two questions where the test persons are asked to decide if a supposed change of sound quality is of a positive or negative character. The third and final section of the questionnaire collects data on how affected the participants are by change in room acoustics, what is important to them in a rehearsal room and which room they liked best. Most of these questions are answered in free text. The questionnaire used during the experiment is in Norwegian to avoid misunderstandings regarding the language. The Norwegian version with all test subject answers and an English translation of the questionnaire are enclosed in Appendix E.

Using a five point scale will yield, as explained above, ordinal data. This is because the five categories of the scale may not seem equidistant to the participants answering the questionnaire. However, this thesis will assume equidistant categories for the questions where the five point scale has been used. This assumption is made to be able to calculate mean values and other statistical characteristics, and therefore compare the answers between the subjects and draw conclusions on them.

3.4.2 Experiment

The people to assist in the subjective experiment are different people on the different premises. At Askim Kulturskole, the participants are teachers at the school. They are teaching their own instruments to the children, and are musicians. To avoid issues where the teachers answer differently based on how well they know the rooms from earlier use, the rooms chosen for study are rooms that none of the participants are using in their teaching. However, this means that none of the musicians will play in rooms designed for their specific instruments. At Blindern, the participants are students at the Department of Musicology. Some of the students have played in the rooms of study before, but they are all varying where they rehearse.

The participants are asked in advance to prepare approximately five minutes of music to play in the experiment. It is favourable if the piece contains both forte and piano, slow and fast rhythms, to test the rooms in different ways. Upon meeting the participants, they are welcomed and asked whether they need to warm up before the experiment starts. If needed, the warming up is done either in their own rehearsal room (in the case of Askim), or in the corridor or a rehearsal room not used in the experiment (in the case of Blindern). The participants themselves chose the place of warm up. Information about the procedure is given, and then the investigation begins. Each participant plays the prepared piece in one room at a time, answering the associated part of the questionnaire after each of the rooms. The defined playing position is marked with a red X on the floor, and the participants are encouraged to stand on the mark. If the participants would rather use a different position, they are allowed to, as long as they explain why they chose a different position. The first room the participants enter is seen as a test room where the participant gets comfortable with the procedure and the questions, and the answers for this room is not used. After the test room, the participants are invited to ask questions to clarify the questions or procedure. The next room they enter is the first room of the real investigation. After playing in all rooms and answering the corresponding questions, including the final questions, verbal comments are delivered from some of the participants. These are written down as supplement to the questionnaire. Finally, the participants are thanked for their participation.

3.4.3 Analysing Questionnaire Answers

The questionnaire scales were converted into numbers between 1 and 5, and the answers of all the participants were collected in different tables for each room. The tables were imported into Matlab, which was used to calculate the mean values of each question, as well as the standard deviation and 95 % confidence interval. Matlab was also used to plot the mean of the answers to the different questions.

3.4.4 Participants

There are four participants at Askim Kulturskole; three male and one female. The average age is 38 years old, and the average time of experience on the instrument used during the experiment is 30.8 years. The subjects have been working at the music school for 1.3 years, on average, and all reported that they play "very often" in rooms with highly different acoustics. The instruments represented are the flute, classical guitar, clarinet, and a snare drum.

At Blindern, there are three participants with normal hearing; all of them male. The average age of the participants is 24.7 years old, and they have, on average, 14.7 years of experience on their instruments. On average, they are often playing in rooms with highly different acoustics. The instruments represented are one tenor saxophone and two classical guitars.

4

Results

This chapter contains the results from the measurements, simulations and the questionnaire. The results are presented and described, and are ordered according to the room to which they apply. Each result section is divided into two: One section for the rooms in Askim and another for the rooms at Blindern. The last parts of the chapter compares the results from the different investigations to each other.

4.1 Traditional Parameters

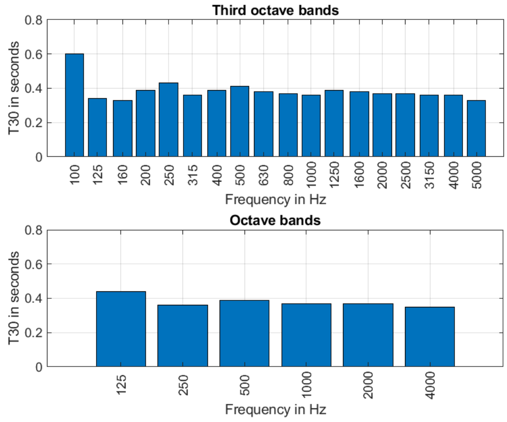
Traditional parameters are calculated from the impulse response measurements using the Dirac software, as described in the Method section. The resulting values for the rooms are illustrated in the following, and are also listed in both octave bands and 1/3-octave bands in tables in Appendix D. The octave bands go from the 125 Hz band to the 4000 Hz band, and are the standardised octave bands for acoustical parameters according to ISO 3382 [6]. The 1/3-octave bands presented are the thirds of the standardised octave bands, ranging from the 100 Hz to the 5000 Hz band. The parameters chosen to describe the rooms are the following: T_{30}, EDT, C_{80} and T_S. In addition is the playing position in each room described by ST_{early} and ST_{late}.

4.1.1 Askim

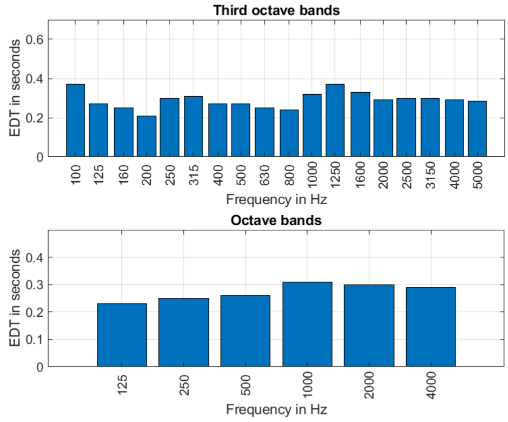
The following section shows the traditional parameters for the rehearsal rooms at Askim Kulturskole.

4.1.1.1 Room 3

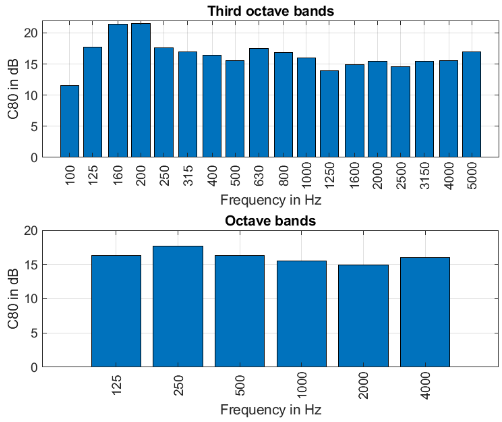
Figure 4.1 illustrates the parameter values for room 3 in 1/3-octave and octave bands.



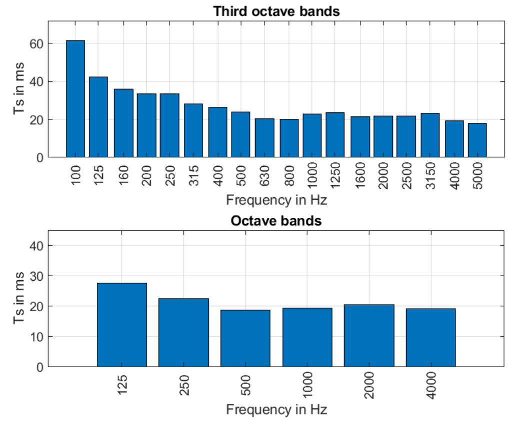
(a) T_{30}



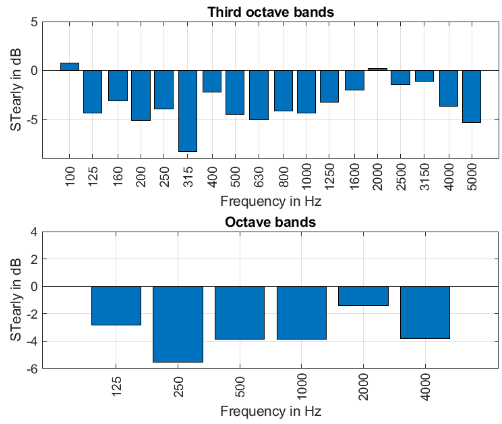
(b) EDT



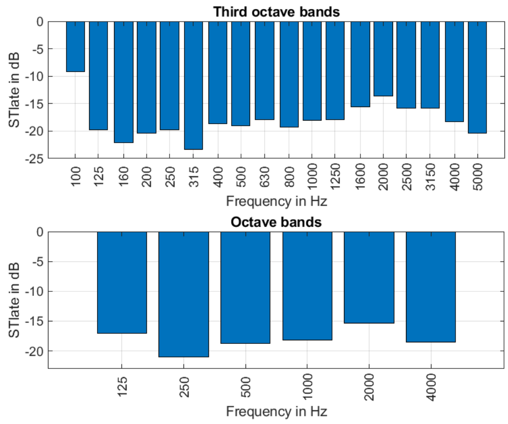
(c) C_{80}



(d) T_S



(e) ST_{early}



(f) ST_{late}

Figure 4.1: The figure shows the acoustical parameters calculated from the impulse response measurements in room 3, in both octave bands and 1/3-octave bands.

Figure 4.1a shows the reverberation time T_{30} in room 3 over frequency. The octave bands have very even values that lie between 0.36 and 0.39 seconds, with the exception of 0.44 seconds in the 125 Hz octave band. The third octave bands also have mostly similar values, varying between 0.33 and 0.43 seconds. The 100 Hz third octave band has a reverberation time of 0.6 seconds. As the 125 and 160 Hz bands are very low, it can be surmised that the high value of the 100 Hz 1/3 octave band is the main contributor to the slightly increase seen in the 125 Hz octave band.

The EDT is another way of studying the reverberation of a room. The values over frequency are shown in Figure 4.1b, and are varying somewhat more between the different frequency bands than for the T_{30}. In addition, the EDT values are a little lower by comparison. This means that the decay is faster in the first part of the energy loss of the room.

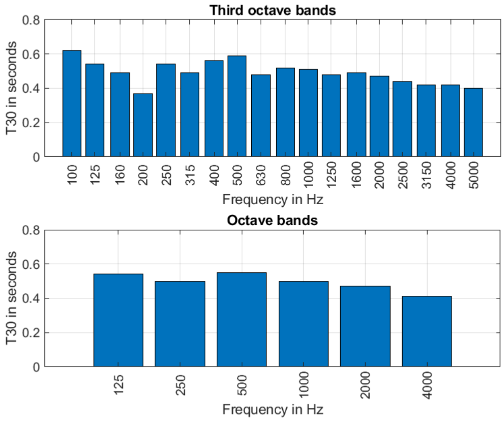
The clarity of the room, C_{80} is shown in Figure 4.1c. The octave band plot is quite flat, ranging between 15 and 17.6 dB, while the clarity differs more in the 1/3-octave bands, between 11.6 and 21.5 dB. There is higher variation in the lower frequency bands than in the middle and high frequency bands. When comparing the C_{80} plots with the ones of T_{30}, it can be seen that there is some relation between the two. Where the reverberation increases, the clarity decreases, and vice versa. This is to be expected, as the clarity is reduced when there is more energy after the first 80 ms of the impulse response. This can be seen by studying Equation (2.5).

Figure 4.1d shows the centre-of-gravity time of room 3. For both the octave and third octave bands, the values are fairly even above 500 Hz - around 20 ms - , below which there is an increase towards low frequencies.

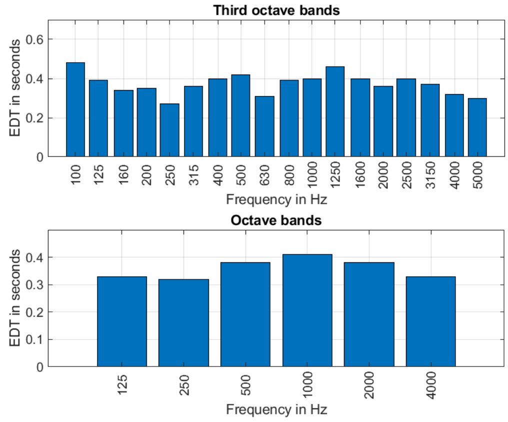
The stage support parameters ST_{early} and ST_{late} can be though of as the ensemble conditions and perceived reverberance, respectively. The ST_{early} octave band values varies between -5.6 dB and -1.4 dB, being above the typical range when measured on a stage in a concert hall. The ST_{late} varies between -21.1 dB and -15.4 dB for the octave bands, meaning it lies inside the typical range.

4.1.1.2 Room 7

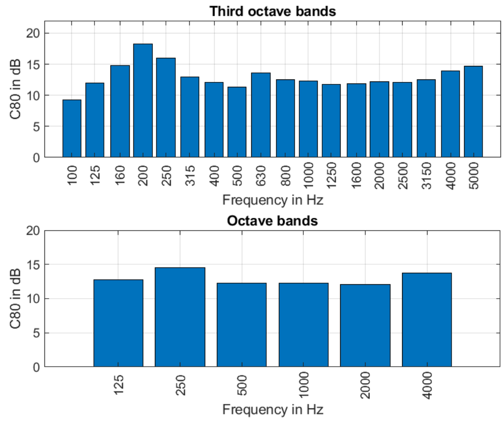
Figure 4.2 illustrates the parameter values for room 7 in 1/3-octave and octave bands.



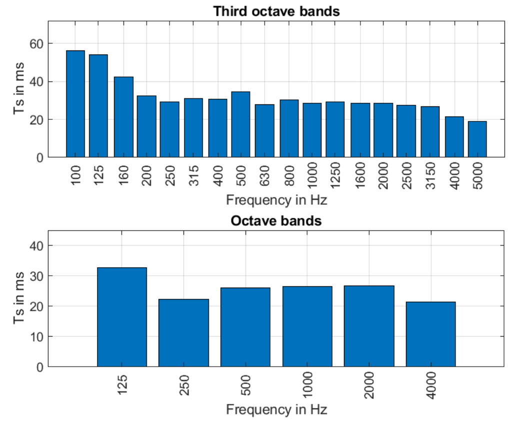
(a) T_{30}



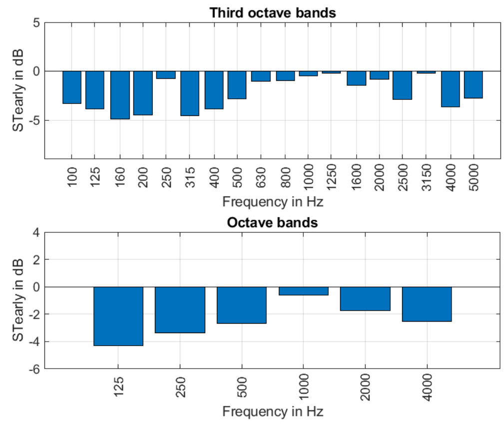
(b) EDT



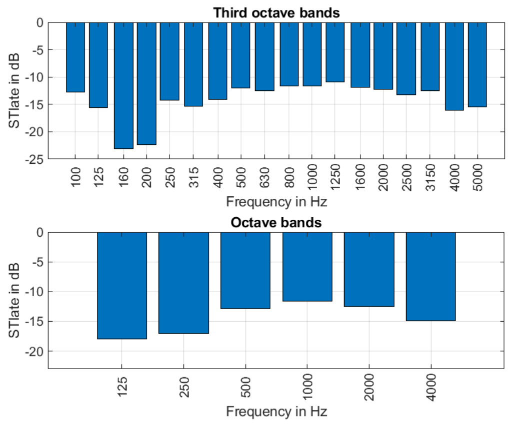
(c) C_{80}



(d) T_S



(e) ST_{early}



(f) ST_{late}

Figure 4.2: The figure shows the acoustical parameters calculated from the impulse response measurements in room 7, in both octave bands and 1/3-octave bands.

The values for the T_{30} parameter measured in room 7 is shown in Figure 4.2a. The values for the octave bands vary from 0.41 to 0.55 seconds, and the highest octave bands have the lowest values and the reverberation time is decreasing with frequency. The same trend can be seen in the third octave bands, which vary between 0.37 seconds and 0.62 seconds.

The early decay time, which is plotted in Figure 4.2b, is varying between 0.32 and 0.41 seconds for the octave bands and between 0.27 and 0.48 seconds in the 1/3-octave bands. These values are lower than for the T_{30} parameter, meaning that the energy is decaying fast initially, before becoming less steep with time.

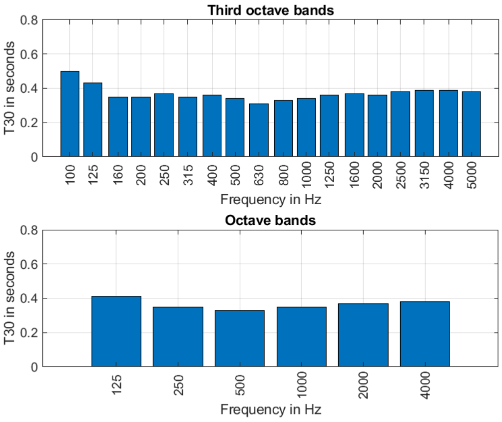
The clarity of the room ranges from 12.1 dB to 14.6 dB for the octave bands, as can be seen in Figure 4.2c. The 1/3-octave bands have uniform levels from 800 Hz to 3100 Hz, and a slight increase for the two highest bands, as well as a peak for the 200 Hz frequency band and a decrease below this. Also for this room can be seen the phenomena that the C_{80} and the T_{30} parameters have a negative dependency.

Figure 4.2d shows the values for T_S. The third octave bands from 100 Hz to 160 Hz have higher values than the remainder bands, and the middle and high frequency bands are quite stable around 30 ms. The 4000 and 5000 Hz third octave bands are the exception, with low values. The general shape of the 1/3-octave bands is mirrored in the octave band values.

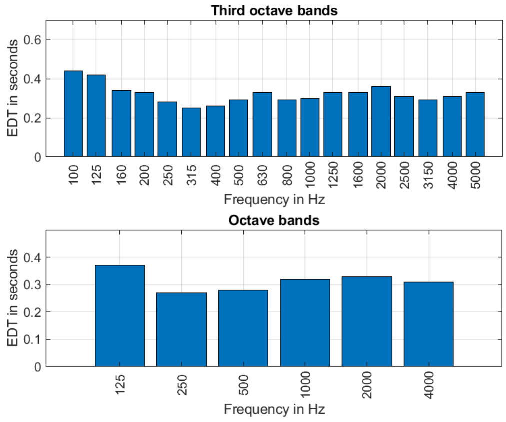
The ST values are shown in Figure 4.2e and Figure 4.2f. The octave bands for the ST_{early} range from -4.3 dB to -0.6 dB, and the third octave bands from -4.9 to -0.2 dB, fluctuating slightly more than the octave bands. The ST_{late} octave bands vary between -18.0 dB and -11.6, and the third octave bands between -23.2 and -10.9 dB. The ST_{early} values are above the typical range for concert halls, but the ST_{late} lies within. Both of the parameters have highest values around 1 kHz, where the human ear is most sensitive.

4.1.1.3 Room 9

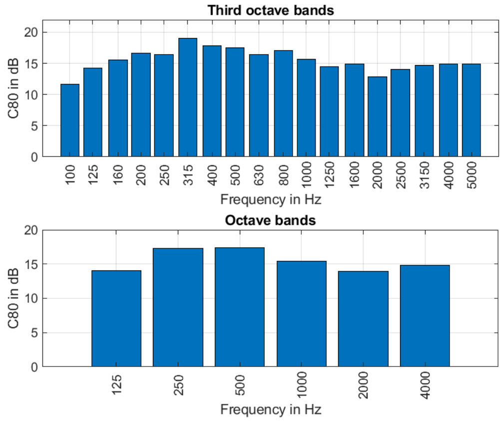
Figure 4.3 illustrates the parameter values for room 9 in 1/3-octave and octave bands.



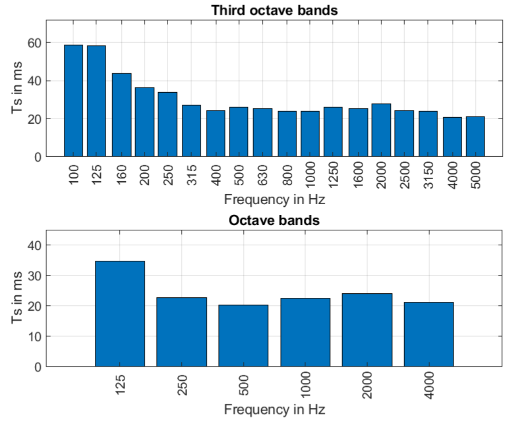
(a) T_{30}



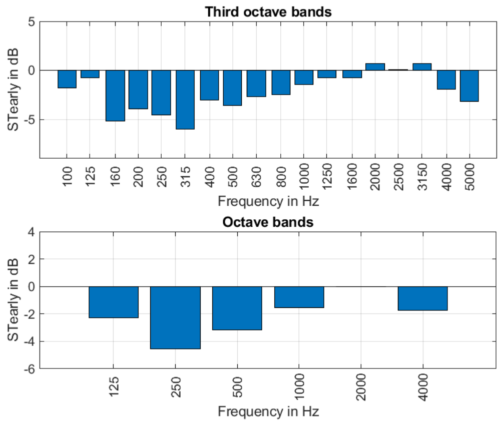
(b) EDT



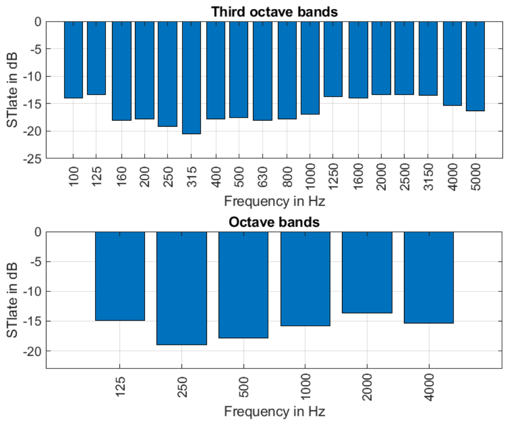
(c) C_{80}



(d) T_S



(e) ST_{early}



(f) ST_{late}

Figure 4.3: The figure shows the acoustical parameters calculated from the impulse response measurements in room 9, in both octave bands and 1/3-octave bands.

Figure 4.3a shows that the T_{30} values for room 9 are extremely even. There is a slight increase for the lowest frequencies that can be seen in the plots of both the octave band values and for the 1/3-octave frequency bands. The octave band values range from 0.33 to 0.41 seconds, and the third octave band values range from 0.31 to 0.5 seconds, the highest value being, in both cases, the lowest frequency band.

Ranging from 0.27 to 0.37 seconds for the octave bands, and from 0.25 to 0.44 seconds for third octave bands, the EDT shown in Figure 4.3b is almost as even as the T_{30}. The values themselves are slightly lower than for T_{30}, meaning that room 9 is attenuating the sound energy faster in the beginning of the decay.

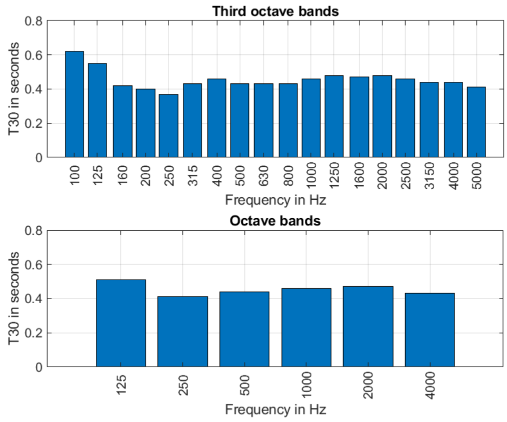
The clarity of room 9 is shown in Figure 4.3c. The octave band C_{80} values range between 14.0 dB and 17.4 dB, while the third octave band values range from 11.7 to 19 dB. The clarity is highest in the 250 Hz and 500 Hz octave bands.

Centre-of-gravity time for the room is shown in Figure 4.3d. It is quite even for most frequency bands, being around 20 to 25 ms, but has an increase for low frequencies. The value of the 125 Hz octave band is 34.8 ms, and the 1/3-octave bands 100 Hz and 125 Hz have values 58.7 and 58.2 ms, respectively.

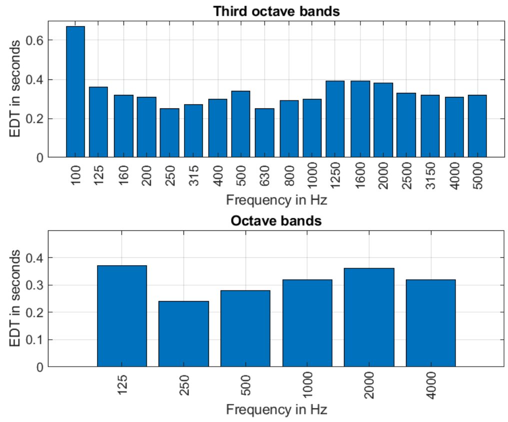
Figure 4.3e and Figure 4.3f shows the ST values for the playing position in room 9. ST_{early} calculated for octave bands is varying from -4.5 dB to 0 dB, and the third octave bands have values between -6.0 and 0.7 dB. The third octave band values for ST_{late} range from -20.5 to -13.4 dB, while the octave bands range from -19.0 to -13.6 dB. This means that ST_{late} is in the range typical for concert hall stages, while ST_{early} lies above.

4.1.1.4 Room 10

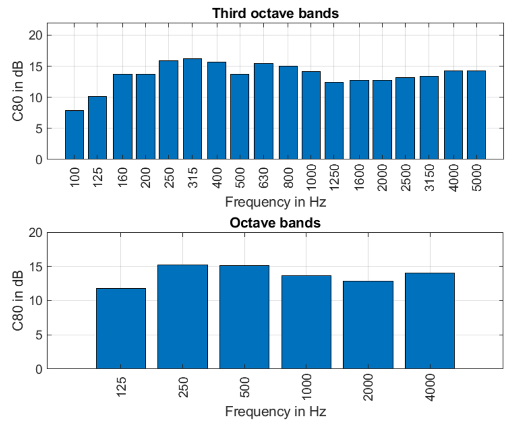
Figure 4.4 illustrates the parameter values for room 10 in 1/3-octave and octave bands.



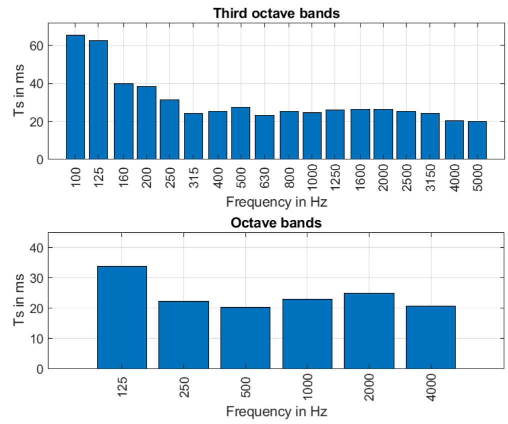
(a) T_{30}



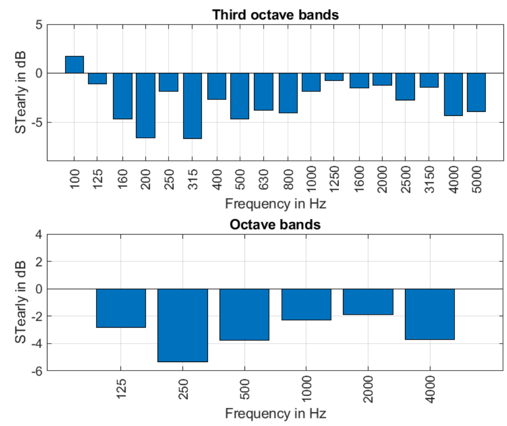
(b) EDT



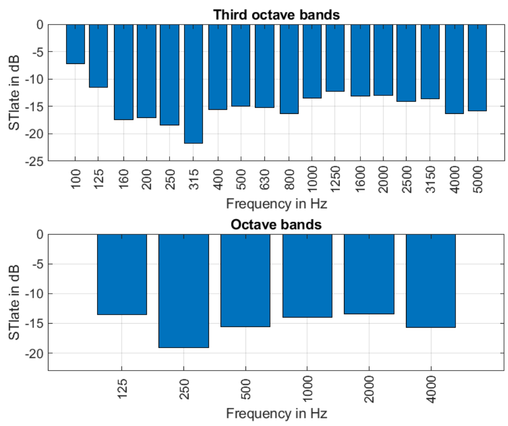
(c) C_{80}



(d) T_S



(e) ST_{early}



(f) ST_{late}

Figure 4.4: The figure shows the acoustical parameters calculated from the impulse response measurements in room 10, in both octave bands and 1/3-octave bands.

The reverberation time in room 10, calculated as T_{30}, is shown in Figure 4.4a. For 1/3-octave bands are the values ranging from 0.37 seconds to 0.62 seconds, with the highest values in the lower frequency bands. Most of the bands have values around 0.45 seconds. The octave band values vary between 0.41 and 0.51 seconds.

The *EDT* is shown in Figure 4.4b, and is varying between 0.24 and 0.37 seconds for the octave bands, and 0.25 and 0.67 seconds for the third octaves. This highest value is in the 100 Hz 1/3-octave band, and the frequency band with the second highest *EDT* value has a value of 0.39 seconds.

The C_{80} values for room 10 are shown in Figure 4.4c. The third octave band values range between 7.9 dB to 16.2 dB, while the octave band values range from 11.8 dB to 15.2 dB, with the lowest value for low frequencies.

Figure 4.4d shows the centre-of-gravity time for room 10. The graphs are quite flat in the middle and high frequency range, with increased values for low frequencies. In the case of the third octave bands have the majority of the bands a T_S value of around 25 ms, and most of the octave bands lie between 20 and 25 ms. The highest value for the third octave bands is 65.4 ms, and for the octave bands, the highest value is 33.9 ms.

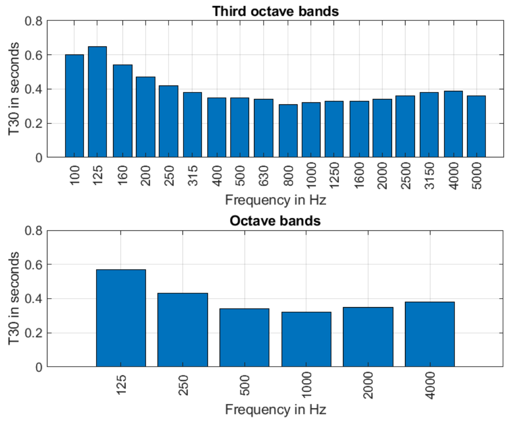
ST_{early} and ST_{late} for the playing position are shown in Figure 4.4e and Figure 4.4f. ST_{late} varies between -19.1 dB and -13.5 dB in the case of the octave bands, meaning it corresponds with typical values for concert hall stages. ST_{early} has octave band values in the range -5.3 dB to -1.88 dB.

4.1.2 Blindern

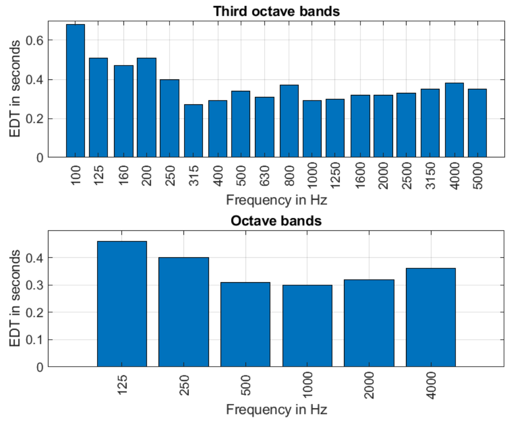
The following section shows the traditional parameters for the rehearsal rooms studied at Campus Blindern, University of Oslo.

4.1.2.1 Room 431

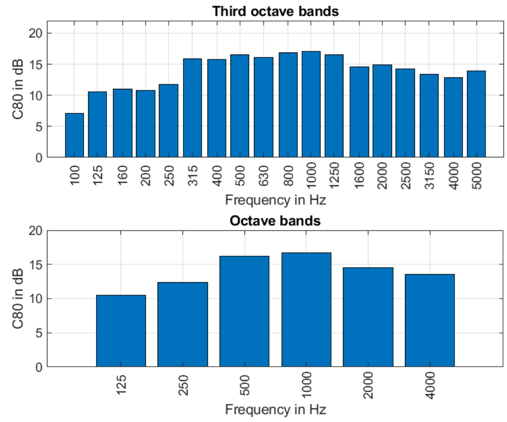
Figure 4.5 illustrates the parameter values for room 431 in 1/3-octave and octave bands.



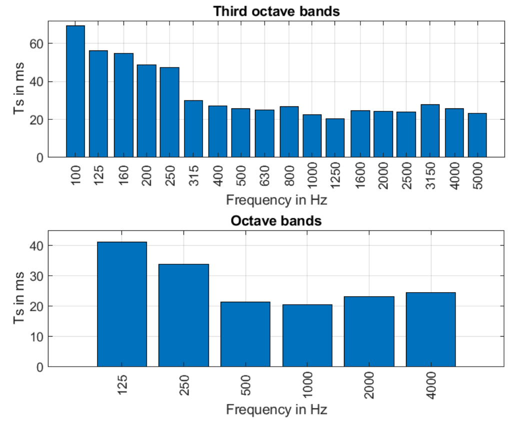
(a) T_{30}



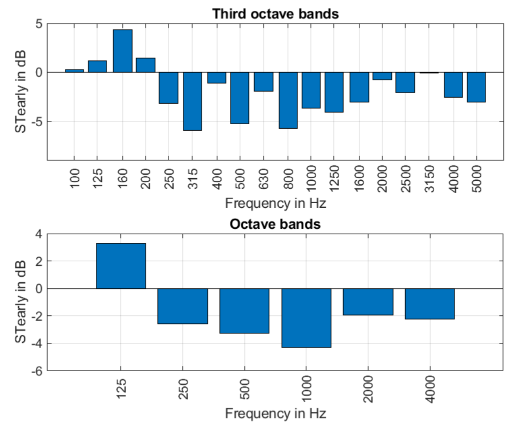
(b) EDT



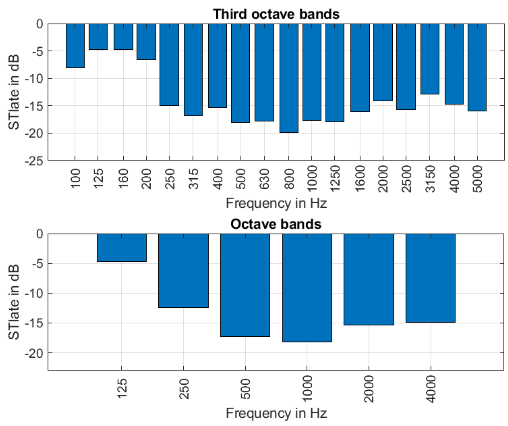
(c) C_{80}



(d) T_S



(e) ST_{early}



(f) ST_{late}

Figure 4.5: The figure shows the acoustical parameters calculated from the impulse response measurements in room 431, in both octave bands and 1/3-octave bands.

The reverberation time T_{30} of room 431 at Blindern is shown in Figure 4.5a. In general, the values are lower for the middle frequencies, a little higher for the high frequencies, and highest for the low frequencies. The values for the third octave bands range from 0.31 seconds to 0.65 seconds. The octave band values vary between 0.32 seconds and 0.57 seconds.

Figure 4.5b shows the early decay time of the room. The general shape and values are similar to that of the T_{30}, but there is more variation between the single third octave bands.

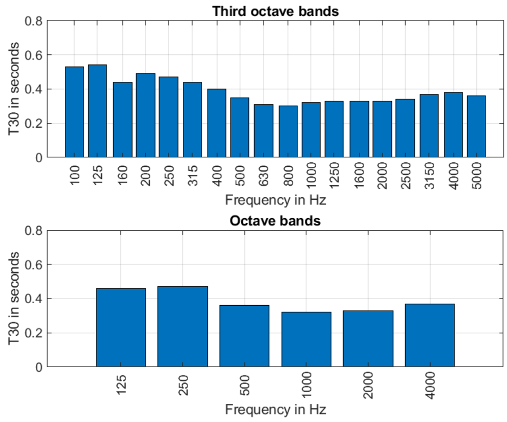
The C_{80} is shown in Figure 4.5c, and the third octave bands have values that range between 7.1 and 17.0 dB. The highest clarity is in the middle frequencies.

The T_S has the same general shape as the T_{30} and EDT, as can be seen in Figure 4.5d. The octave band values range from 20.4 ms and 41.1 ms.

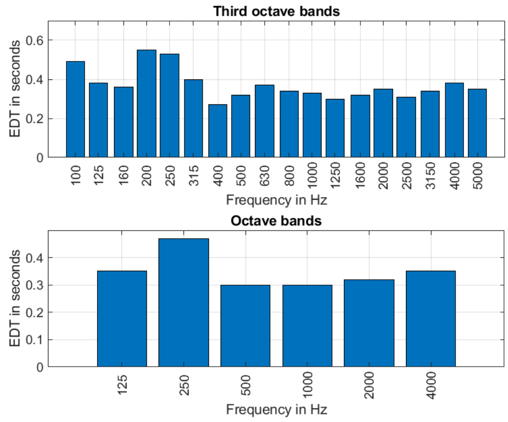
ST_{early} and ST_{late} for the playing position are shown in Figure 4.5e and Figure 4.5f. The ST_{early} has values ranging from -5.9 dB to 4.4 dB for the third octave bands. The values for the third octave bands for ST_{late} are between -20.0 dB and -4.8 dB.

4.1.2.2 Room 435

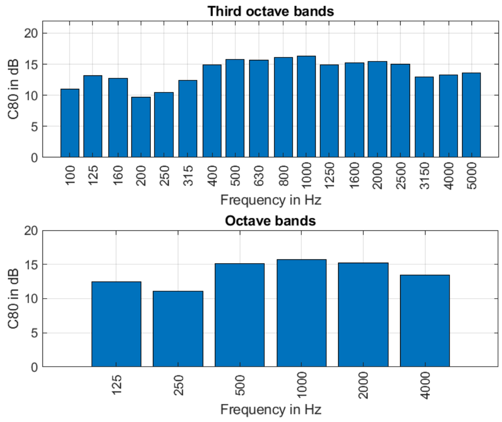
Figure 4.6 illustrates the parameter values for room 435 in 1/3-octave and octave bands.



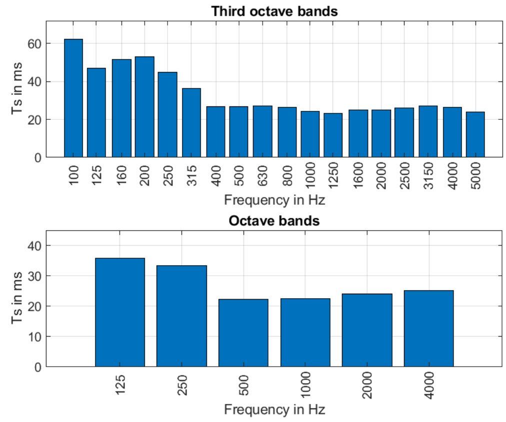
(a) T_{30}



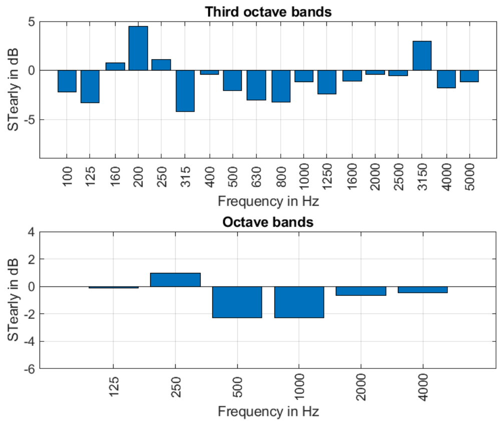
(b) EDT



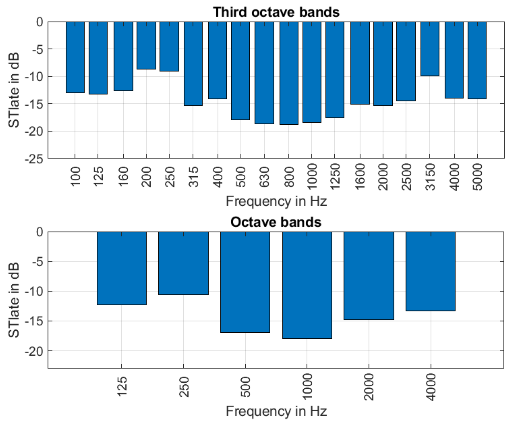
(c) C_{80}



(d) T_S



(e) ST_{early}



(f) ST_{late}

Figure 4.6: The figure shows the acoustical parameters calculated from the impulse response measurements in room 435, in both octave bands and 1/3-octave bands.

Room 435's reverberation time T_{30} is shown in Figure 4.6a, and has, similarly to room 431, lowest values for the middle frequencies, an increase in reverberation time for higher frequencies, and highest values for the lowest frequencies. The octave bands has values from 0.32 seconds to 0.47 seconds.

The *EDT* values, shown in Figure 4.6b, are similar, except that the lowest octave band has a lower value than for the T_{30} parameter.

The clarity of the room, C_{80}, is shown in Figure 4.6c. The highest values are for the frequency bands between 400 and 2500 Hz, and are around 15 dB. The frequency band with the lowest value is the 200 Hz band with 9.7 dB.

Figure 4.6d shows that the centre-of-gravity time has values around 25 ms above 400 Hz. Below this frequency band, there is an increase, with the highest value in the 100 Hz third octave band as 62.3 ms.

Figure 4.6e and Figure 4.6f shows the values for ST_{early} and ST_{late}, respectively. The third octave band values for ST_{early} range from -4.2 dB to 4.5 dB, while the octave band values are between -2.3 dB and 1.0 dB. The third octave band values for ST_{late} vary from -18.8 dB to -8.6 dB, while the octave band values range from -18.0 dB to -10.7 dB.

4.1.3 Comparison Between the Rooms

To compare the parameter values of the different rooms, the 1/3-octave band values for four parameters are plotted with all the rooms in the same figure. The rooms in Askim and at Blindern are compared separately, in Figure 4.7 and Figure 4.8, respectively.

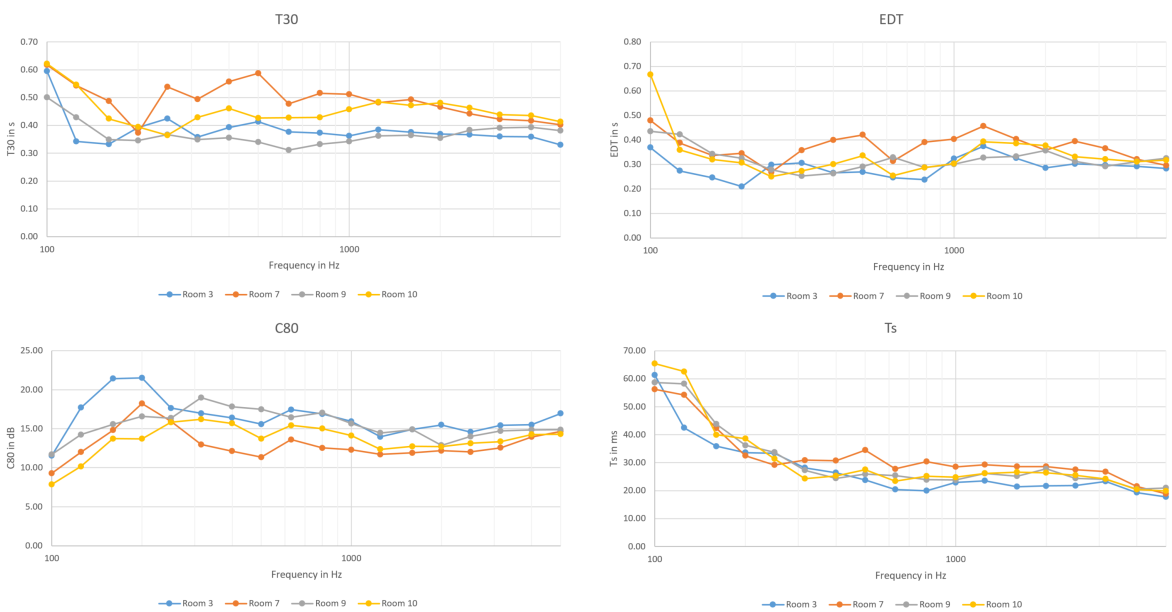


Figure 4.7: The figure shows the third octave band values for some room acoustical parameters for all the rooms in Askim.

Room 9 has the lowest values for the T_{30} parameter of the rooms in Askim, while room 7 has the highest. Room 3 has values close to those of room 9, and room 10 are almost identical to room 7 for frequencies above 1000 Hz. The lowest values for the *EDT* parameter belong to room 3, followed by room 9 and 10, which are comparable. Room 7 has the highest EDT values. There is large variation between the rooms in C_{80} values for low frequencies. Room 3 has the lowest values when considering the whole frequency range. Room 10 have slightly higher values, while room 3 and 9 are relatively similar and have the highest clarity. T_S is a different way of measuring clarity, where low values indicate a high degree of clarity. Room 3 have the lowest values, followed by room 9 and 10 with indistinguishable values, while room 7 has the highest values and therefore the lowest clarity.

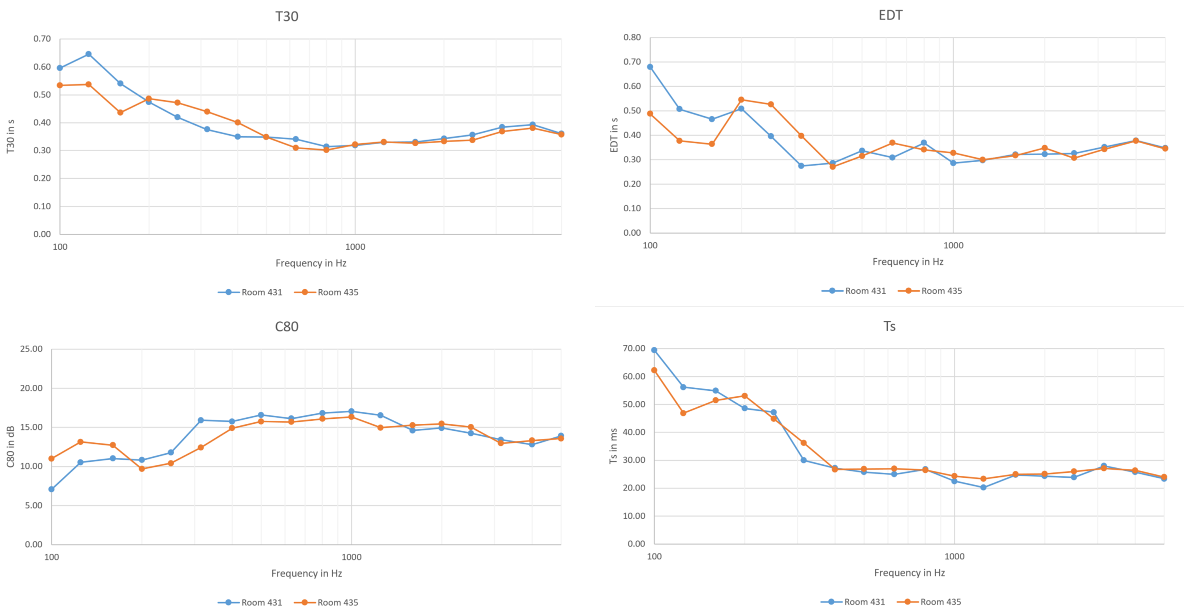


Figure 4.8: The figure shows the third octave band values for some room acoustical parameters for both the rooms in Blindern.

It is quite evident by studying Figure 4.8 that the two rooms at Blindern are very similar. The general trend is that the rooms have values in the same order of magnitude, but that the values for room 435 are varying less with frequency than the values for room 431. The differences between the rooms are smaller than the just noticeable difference (JND) for most of the frequency range.

Room 3, 7 and 10 in Askim lies within the demands to flat reverberation time curves of NS 8178, which are shown in Figure 2.5. Room 9 is above the limits in the 125 Hz, 2 kHz and 4 kHz octave bands. The rehearsal rooms measured at Blindern are not within the demands to even reverberation over frequency.

4.2 Waterfall Plots

The following section includes two kinds of waterfall plot. The first variety shows the first 0.6 s of the impulse response, and the other shows the first 20 ms. The long impulse response waterfall plots are shown for room 3 and 7 only. The first 20 ms of impulse responses of the rehearsal rooms are interesting because the human hearing focuses on the first 15 ms of the impulse response in running music [6]. The results are ordered according to location and room number.

4.2.1 Askim

The waterfall plots for the rooms in Askim are shown below.

4.2.1.1 Room 3

The first 0.6 s of the impulse responses measured in six different positions in room 3 are shown in Figure 4.9. Multiple of the positions show a resonance around 3000 Hz late in the impulse response. Frequencies above 1000 Hz are attenuated faster than the frequencies below.

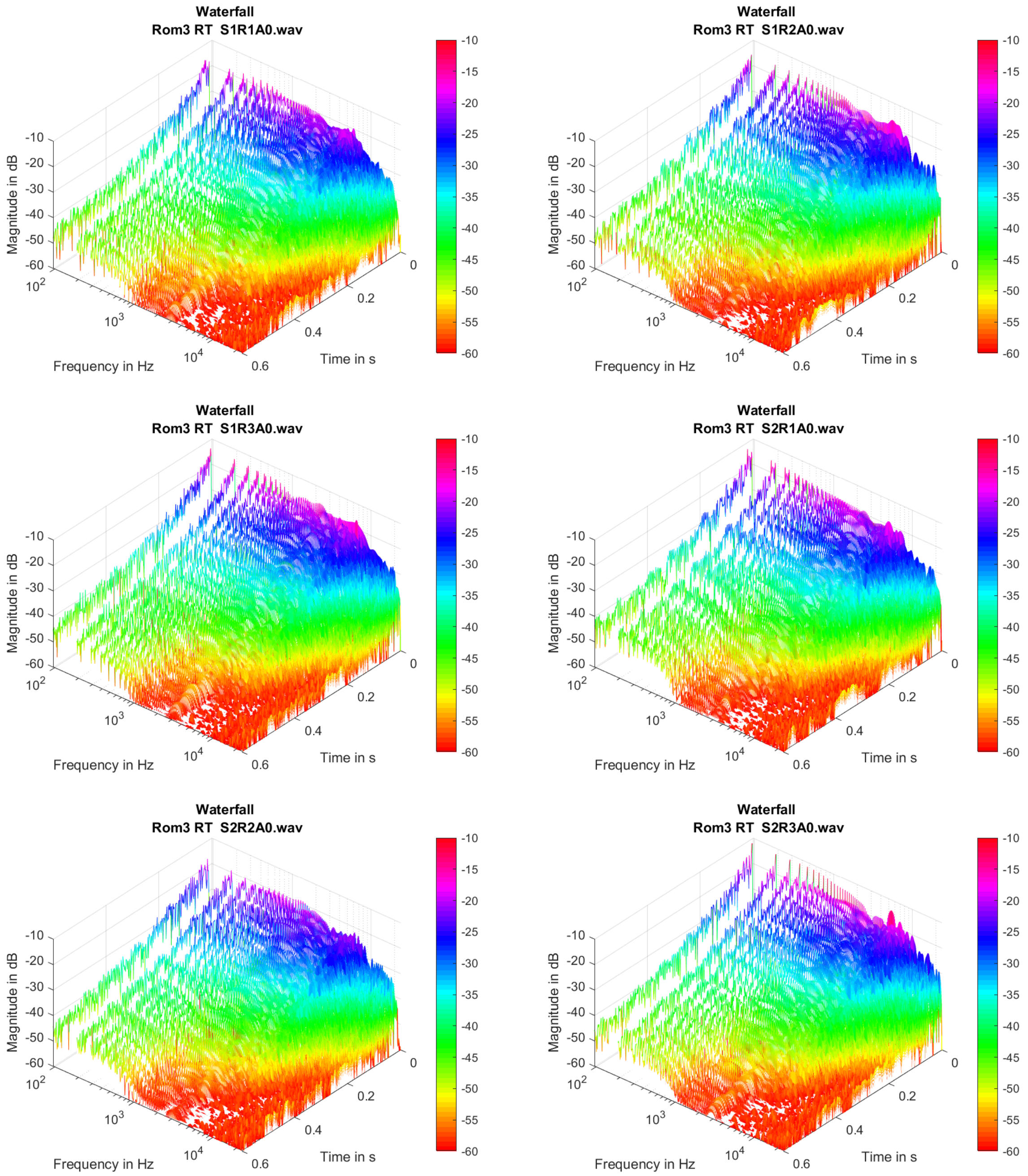


Figure 4.9: The figure shows the waterfall plots for the first 0.6 s of the impulse response in six positions in room 3. The frequency axis spans from 100 Hz to 18750 Hz.

The first 20 ms of the impulse responses of room 3 are shown in Figure 4.10. Two of the six positions have high amplitudes for the first reflection, after which the amplitude of the impulse response is relatively smooth over both time and frequency. This evenness can be observed in the entire time interval for the four remaining positions.

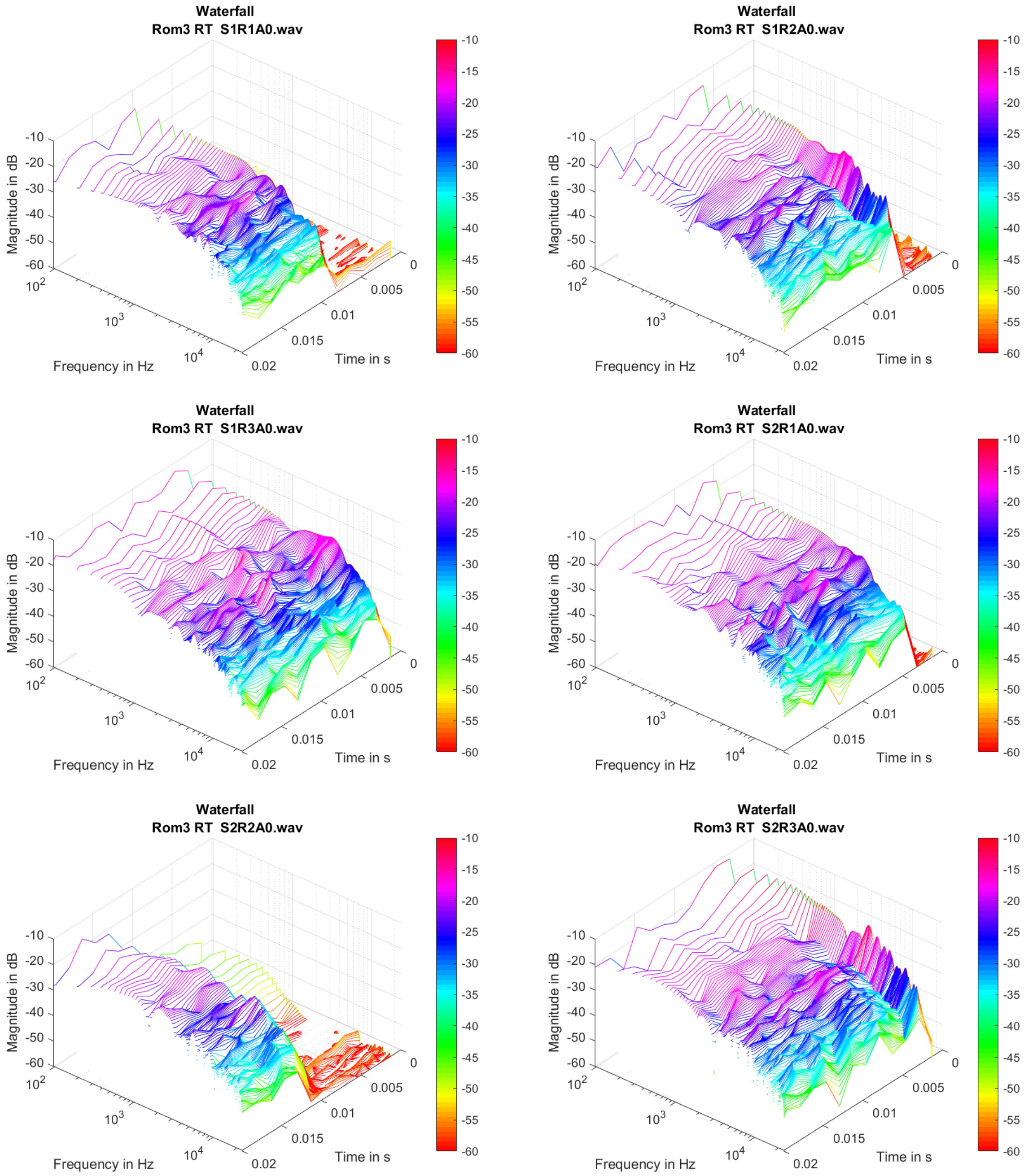


Figure 4.10: The figure shows the waterfall plots for the first 20 ms of the impulse response in six positions in room 3. The frequency axis spans from 100 Hz to 18750 Hz.

4.2.1.2 Room 7

The first 0.6 s of the impulse responses measured in six different positions in room 7 are shown in Figure 4.11. Frequencies below 2000 Hz are less attenuated than frequencies above.

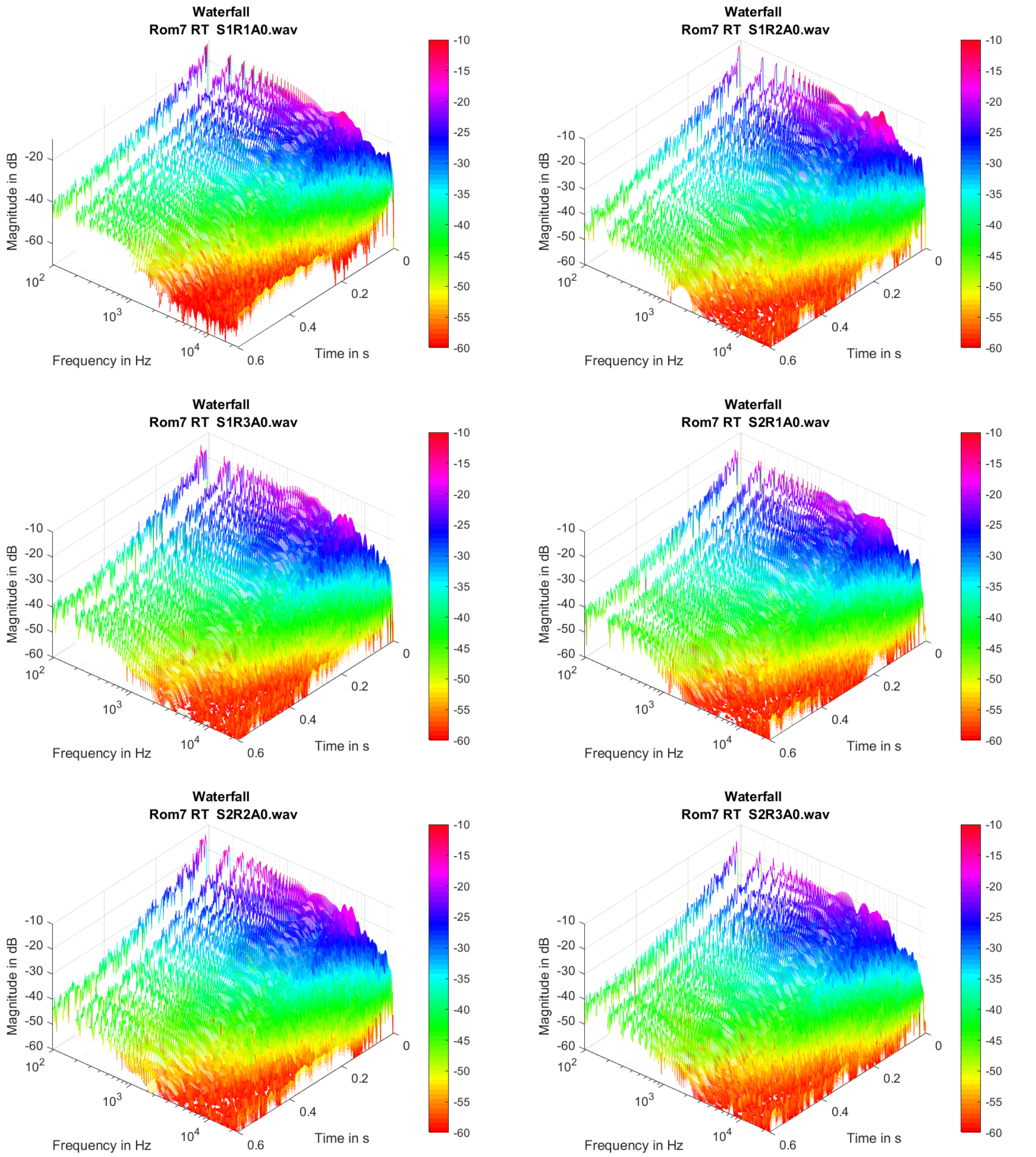


Figure 4.11: The figure shows the waterfall plots for the first 0.6 s of the impulse response in six positions in room 7. The frequency axis spans from 100 Hz to 18750 Hz.

Figure 4.12 shows the first part of the six impulse responses of room 7. The waterfall plots are characterised by high variations in amplitude, both over time and frequency, which can be recognised as ridges along the frequency axis with valleys between and peaks along these ridges. In two of the six positions is the first reflection less prominent than in the remainder.

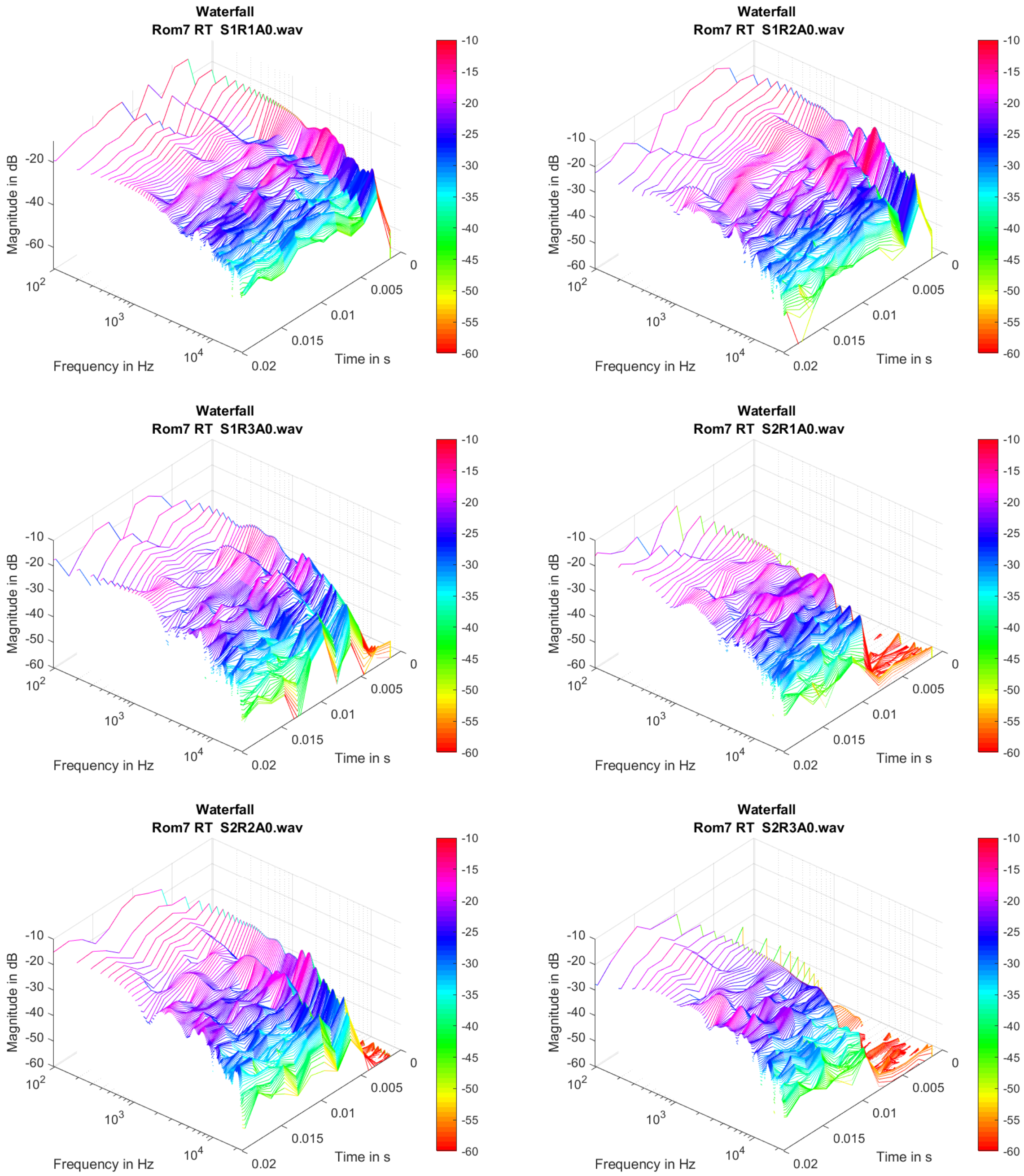


Figure 4.12: The figure shows the waterfall plots for the first 20 ms of the impulse response in six positions in room 7. The frequency axis spans from 100 Hz to 18750 Hz.

4.2.1.3 Room 9

The first part of room 9's impulse responses are plotted in Figure 4.13. Two of the positions show a prominent first reflection, and indications of ridges along the frequency axis are visible. In the other positions, the variation of amplitude is less significant, although not as flat as for room 3.

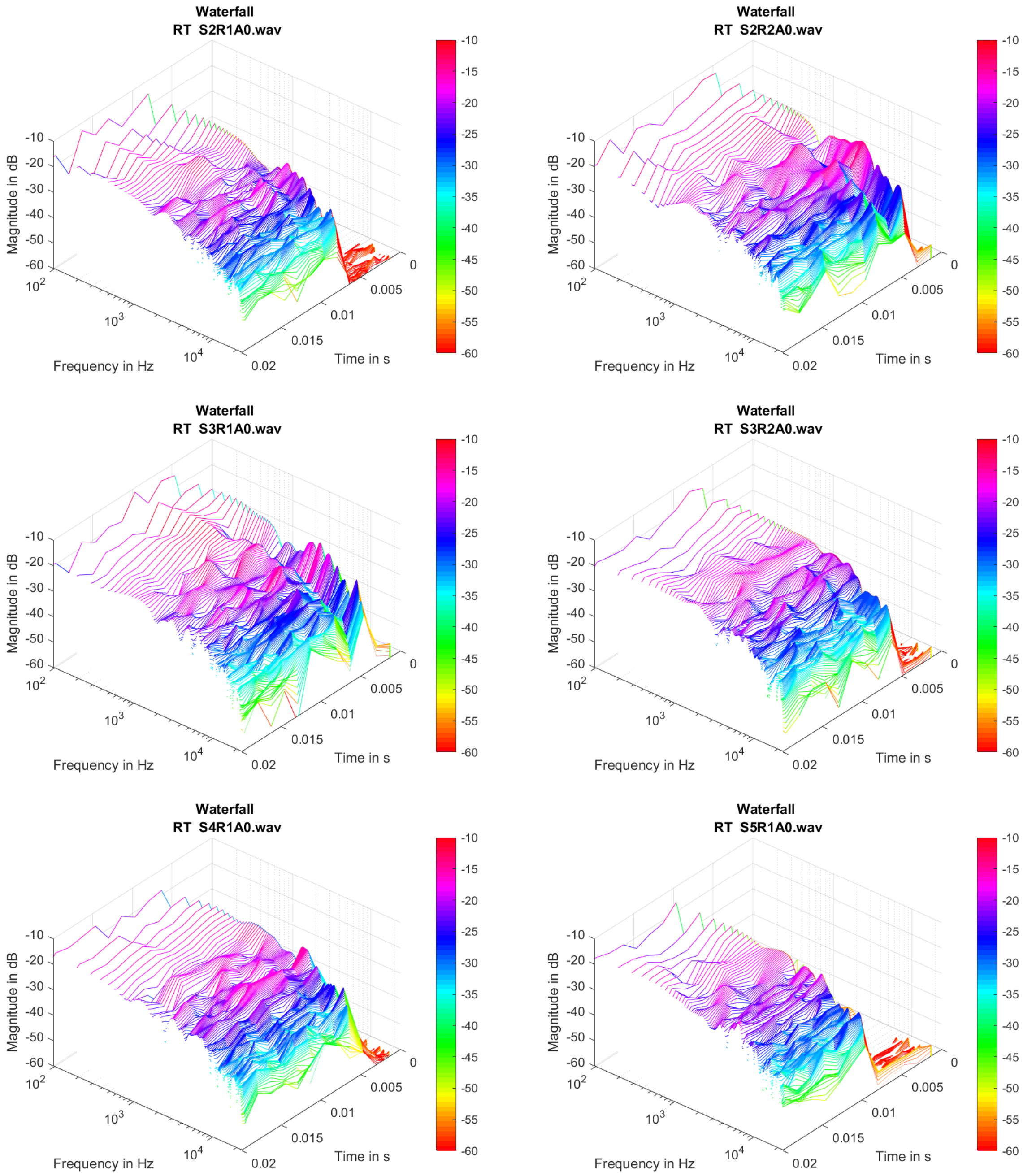


Figure 4.13: The figure shows the waterfall plots for the first 20 ms of the impulse response in six positions in room 9. The frequency axis spans from 100 Hz to 18750 Hz.

4.2.1.4 Room 10

The 20 first ms of the impulse responses measured in room 10 are plotted as waterfall plots in Figure 4.14. In four of the positions, ridges caused by the incoming reflections can be observed. They are, however, not very tall. The general amplitude variation for room 10 is moderate compared to the other rooms in Askim.

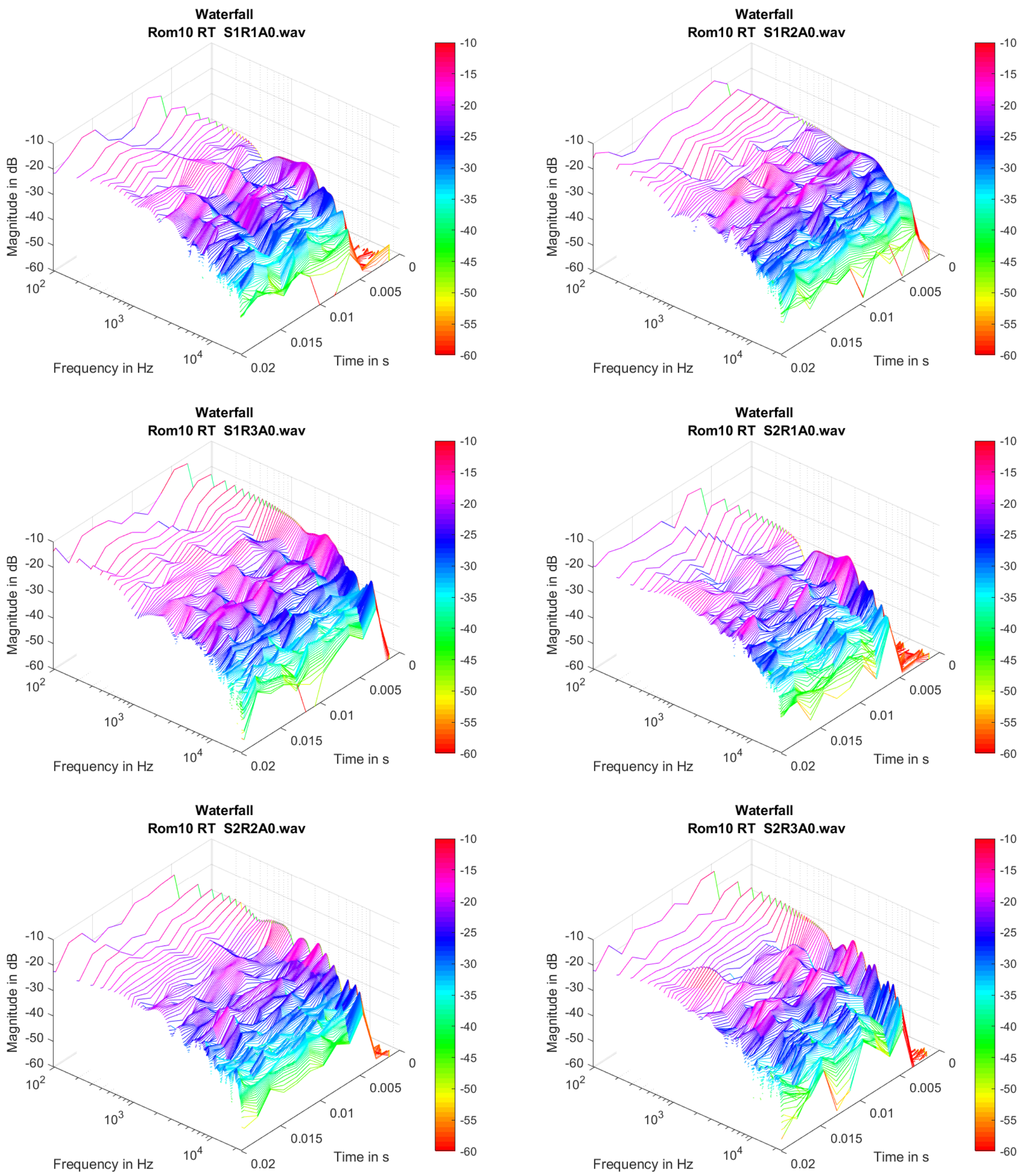


Figure 4.14: The figure shows the waterfall plots for the first 20 ms of the impulse response in six positions in room 10. The frequency axis spans from 100 Hz to 18750 Hz.

4.2.2 Blindern

The waterfall plots of the impulse response measured in the rooms at Blindern are shown in the following section.

4.2.2.1 Room 431

Figure 4.15 shows the first 20 ms of the impulse responses of room 431. The first reflection is not especially prominent in any of the six positions. The amplitude is varying somewhat both over time and frequency, camouflaging the ridge pattern of the incoming reflections.

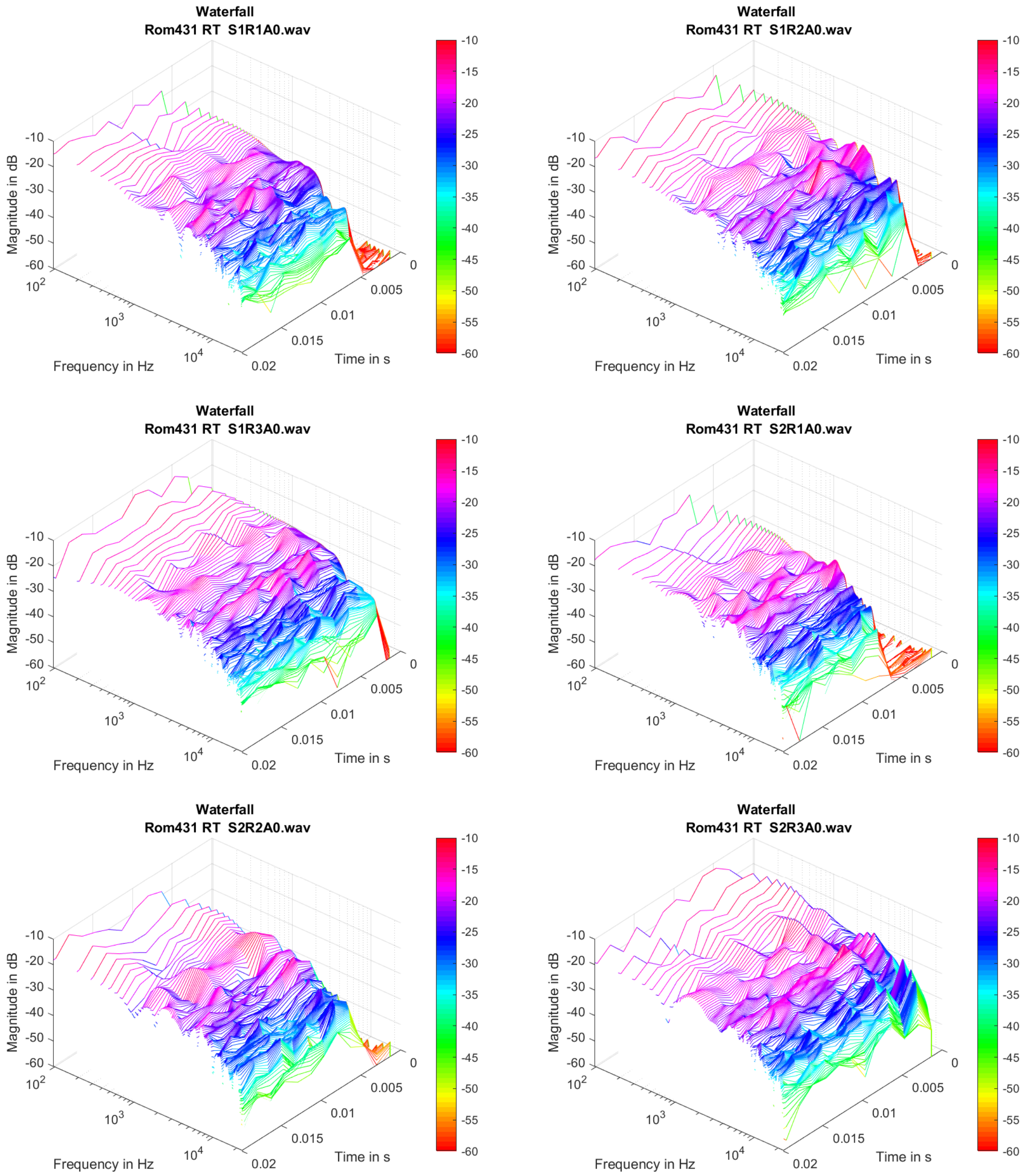


Figure 4.15: The figure shows the waterfall plots for the first 20 ms of the impulse response in six positions in room 431. The frequency axis spans from 100 Hz to 18750 Hz.

4.2.2.2 Room 435

The impulse responses of room 435 are shown in Figure 4.16. The first reflection is standing out in one of the six positions, having higher amplitude than the following reflections. There is no evident ridge pattern along the frequency axis for room 435, and the amplitude is varying moderately apparently without any strict pattern.

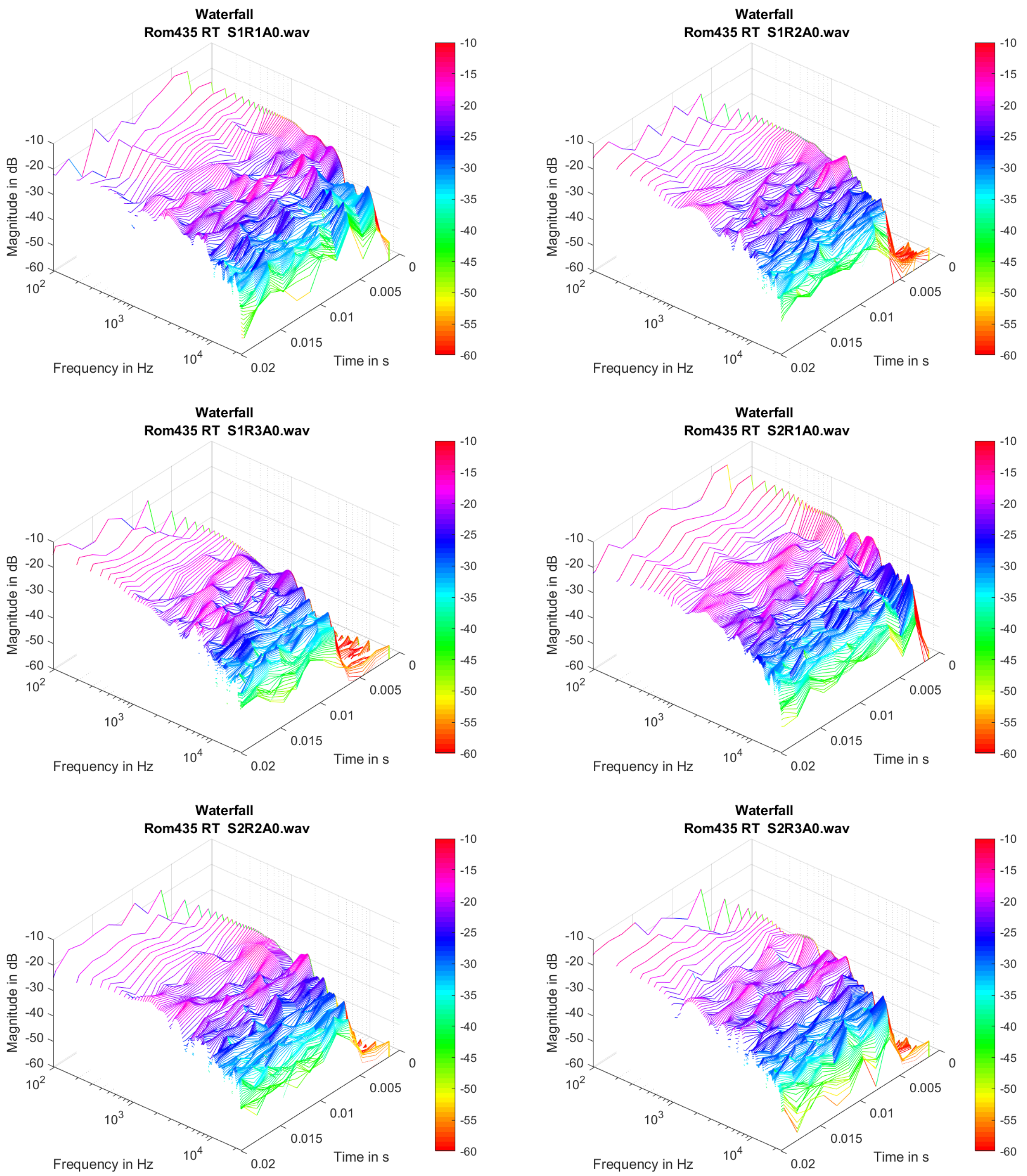


Figure 4.16: The figure shows the waterfall plots for the first 20 ms of the impulse response in six positions in room 435. The frequency axis spans from 100 Hz to 18750 Hz.

4.3 Simulations

This section shows the simulated reflectogram for each room in the defined playing position, in which the participants of the subjective experiments were standing while playing. The reflectograms contain the early reflections only. It is assumed that the simulated reflectograms are close to the actual reflection pattern in the room. The simulations assume source and receiver in the same position, both of which are single points. The first impulse in each reflectogram is the first reflection from a surface in the room, and the time of each impulse is relative to the source excitation. As Odeon calculated the reflectogram for different frequency bands, the ones shown below are the reflectograms for the 1000 Hz octave band. This frequency band is chosen because the human ear is more sensitive in the 1000 Hz band than in the remaining frequency range. The rooms are divided in two sections: one for Askim and one for Blindern.

4.3.1 Askim

The following section shows the reflectograms resulting from the room acoustical simulations for the rooms at Askim.

4.3.1.1 Room 3

Figure 4.17 shows the simulated reflectogram in the playing position in room 3, defined as in Figure 3.12a. The reflection pattern is quite even, the exception being the pause between 37.64 ms and 49.51 ms. The first reflection arrives at 5 ms after the excitation, and the last of the early reflections arrives at 52.90 ms. The magnitude of the impulses is decaying steadily. There is a cluster of reflections between 21.07 and 37.64 ms.

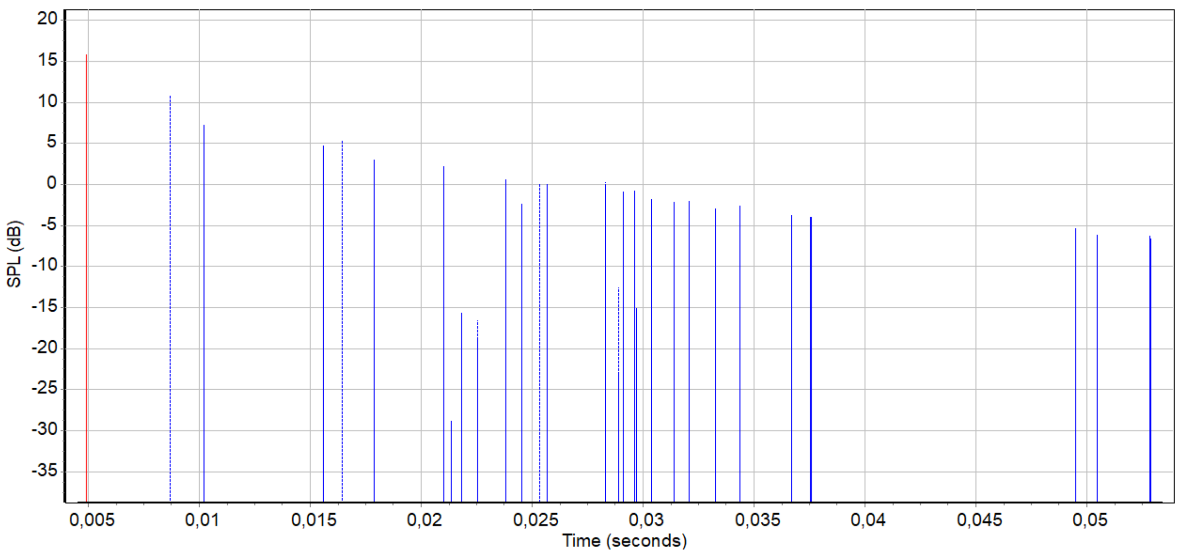


Figure 4.17: The figure shows the reflections over time calculated for a playing position in room 3.

4.3.1.2 Room 7

The playing position in room 7 is defined as shown in Figure 3.12b, and the simulated reflectogram in this position is shown in Figure 4.18. The first few reflections are evenly spaced, and the cluster of reflections between 16.07 and 24.79 ms is not especially dense. The first reflection arrives at 5.55 ms, and the last of the early reflections at 35.55 ms. There are two interruptions in the reflectogram between 24.79 and 29.49 ms and 29.49 and 34.16 ms. These are, however, quite brief. The decay of the reflections' magnitude is quite stable.

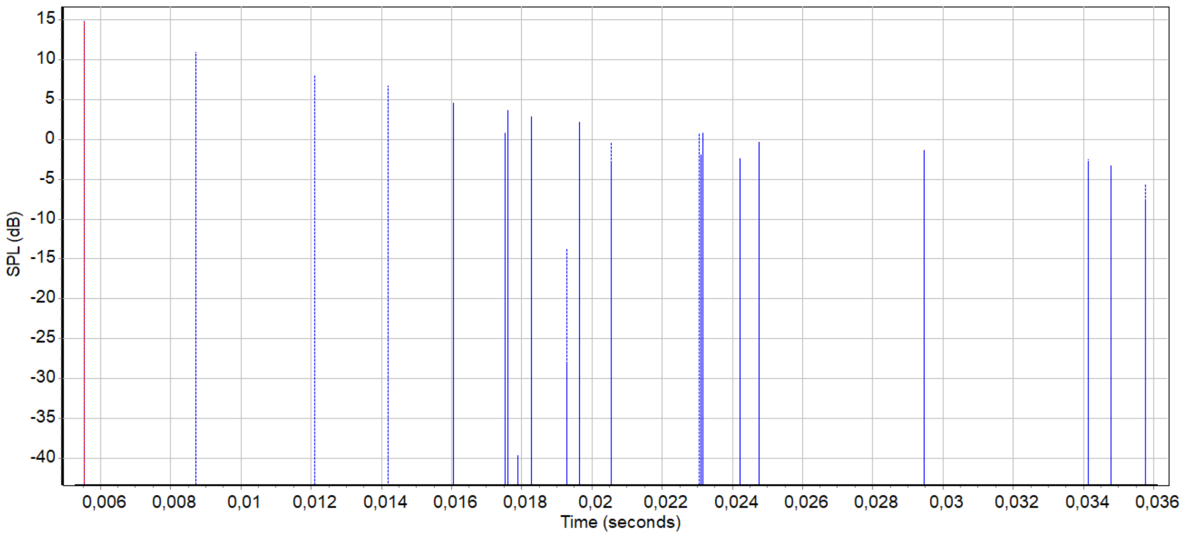


Figure 4.18: The figure shows the reflections over time calculated for a playing position in room 7.

4.3.1.3 Room 9

Figure 4.19 is the simulated reflection pattern of the early reflections arriving in the playing position defined in Figure 3.12c above. There are four reflections arriving within the first 10.5 ms, the first of which at 6.12 ms, and they have similar amplitude. After this, there is a cluster between 15.57 and 37.33 ms, and the last of the early reflections arrives at 60.50 ms after the sound is emitted from the source. There is a pause in the reflectogram of 14.57 ms before the last reflection arrives. Except for the first four reflections, the amplitude is decreasing evenly.

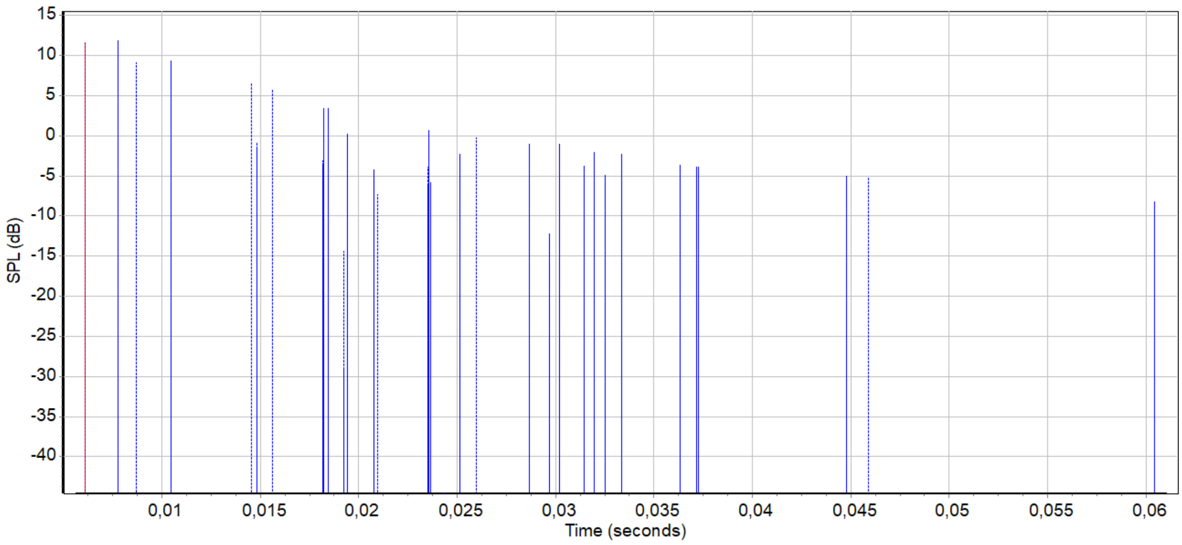


Figure 4.19: The figure shows the reflections over time calculated for a playing position in room 9.

4.3.1.4 Room 10

Figure 4.20 shows the reflectogram for the playing position for room 10, defined in Figure 3.12d. The first reflection arrives at the playing position at 4.22 ms after the excitation of the room. The first four reflections are equally spaced up to 17.74 ms, after which the main part of the early reflections are located. Between 31.26 and 44.84 ms there is an interval with only two reflections arriving. The last of the early reflections is arriving at 50.91 ms. The decay of the reflections is quite uniform over time.

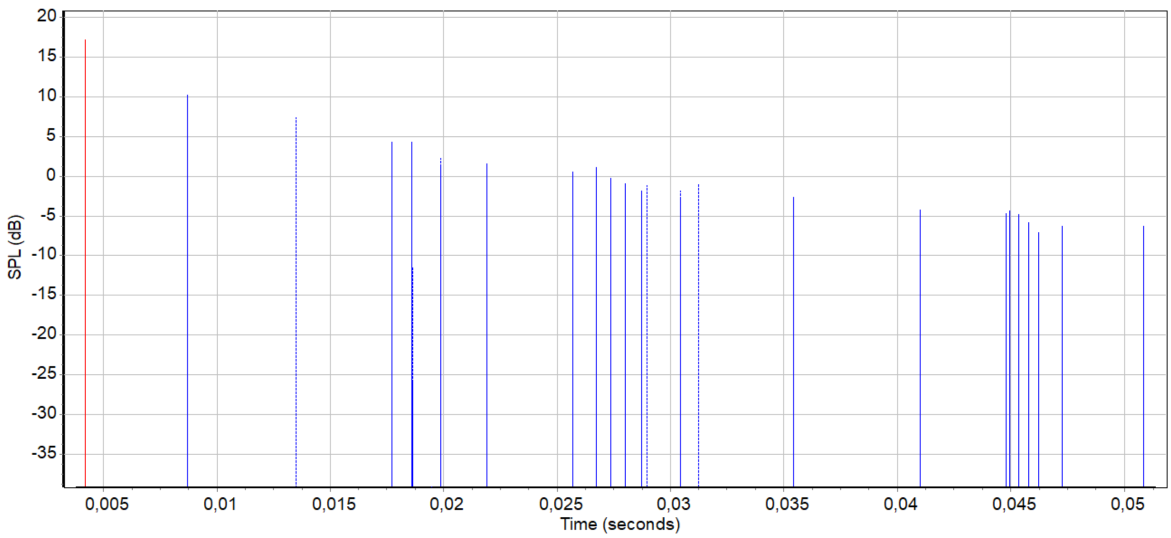


Figure 4.20: The figure shows the reflections over time calculated for a playing position in room 10.

4.3.2 Blindern

The following section shows the reflectograms resulting from the room acoustical simulations for the rooms at Blindern.

4.3.2.1 Room 431

The playing position in room 431 is defined in Figure 3.12e. The reflectogram in this position is shown in Figure 4.21, and some of the reflections have a very small amplitude compared to the general trend of the reflectogram. The first reflection arrives at 5.97 ms, and the main part of the reflectogram is from this until 33.81 ms after excitation. There are three discrete reflections arriving at 40.44, 50.82 and 60.84 ms. Except for the reflections of rather low amplitude, the decay is even over time.

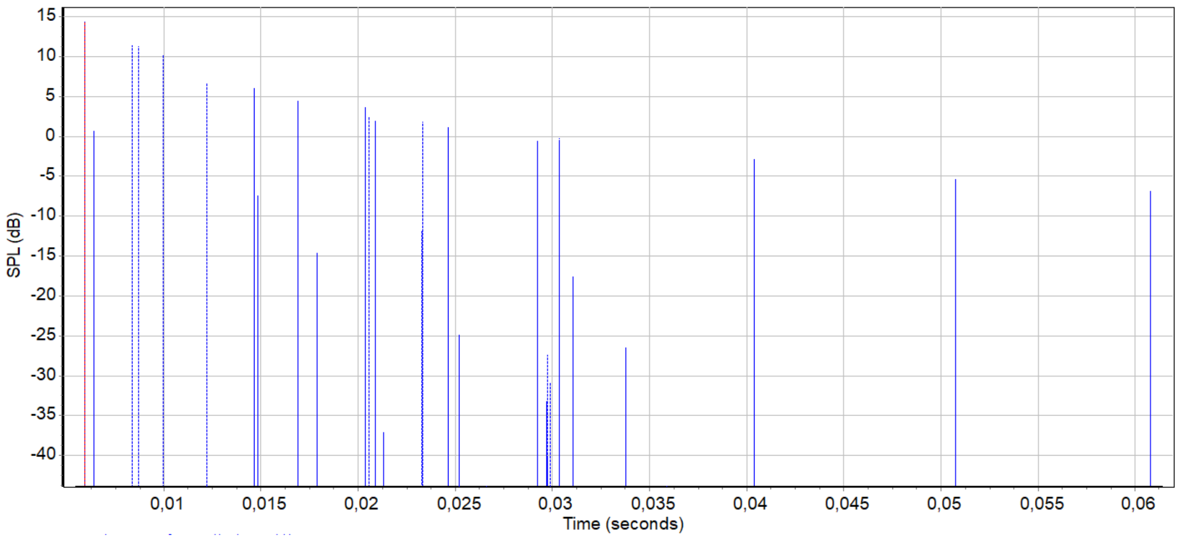


Figure 4.21: The figure shows the reflections over time calculated for a playing position in room 431.

4.3.2.2 Room 435

The reflectogram of room 435's playing position is shown in Figure 4.22, and the defined playing position is shown in Figure 3.12f. The first impression of the reflectogram is that the reflections have quite uneven amplitudes. The first reflection arrives at 5.34 ms after the room excitation, and its amplitude is smaller than that of the following reflections. The time intervals between the reflections are varying, and there is no clear cluster of reflections. The last of the early reflections arrive at 37.14 ms.

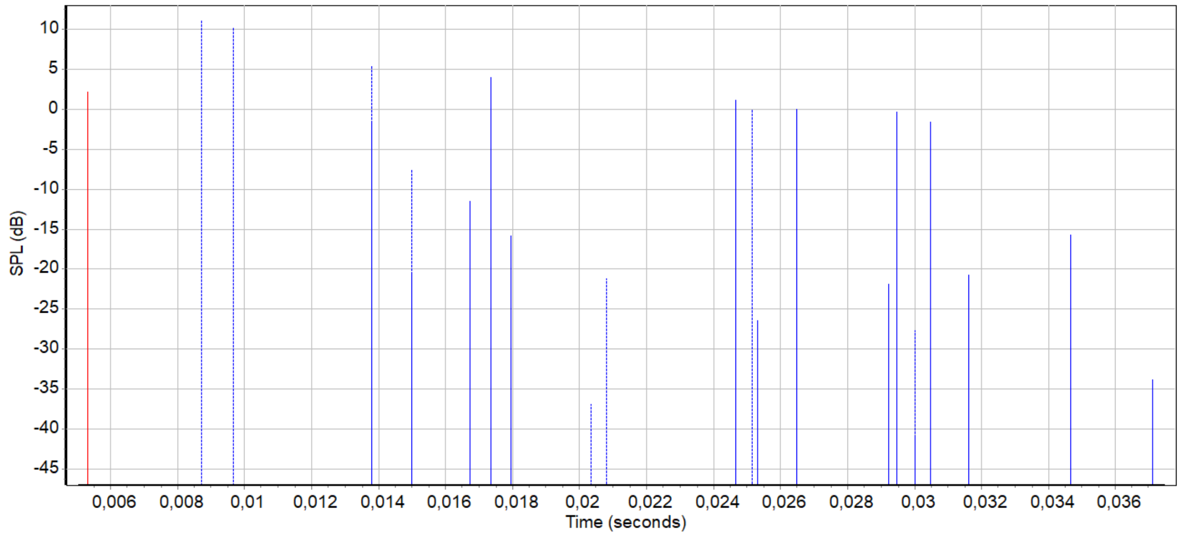
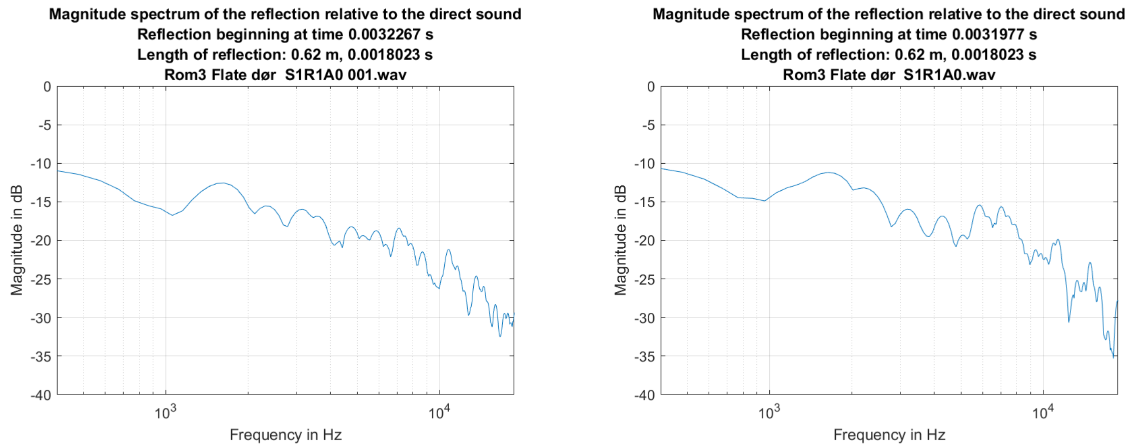


Figure 4.22: The figure shows the reflections over time calculated for a playing position in room 435.

4.4 Surface Measurements

The magnitude spectrum of two measurements done in the same position, but with different rotation of the source, will be different. This is discussed in Section 3.2.4. Figure 4.23 shows two different spectra calculated from two measurements in the same position. As can be seen by the figure, the magnitude differs between the two for certain frequencies. However, the general trend is the same, and the spectra of the surfaces can yield some information about the material.



(a) Empty side towards receiver

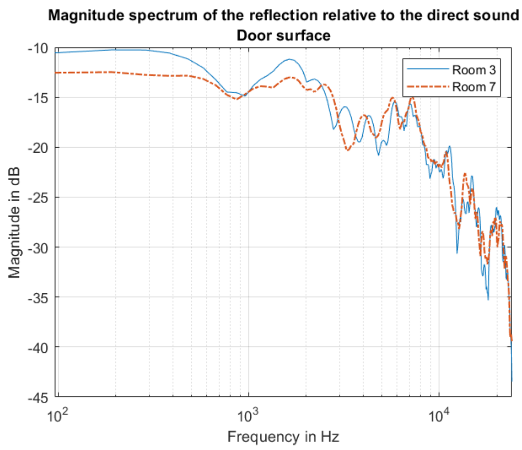
(b) Loudspeaker element towards receiver

Figure 4.23: The figure shows two spectra calculated from measurements done with different rotation of the source towards the receiver. The spectra are of the door in room 3.

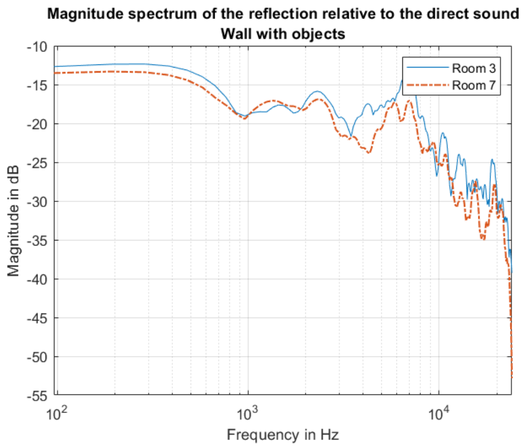
The resulting frequency spectra for the surface measurements are shown in the following, grouped by location and room. The spectra shown below are calculated from the measurements done with the loudspeaker element directed towards the microphone. The spectra are plotted between 400 Hz and 18750 Hz, being the lower and upper limit set by the time interval of the reflections and the sample frequency, respectively.

4.4.1 Comparison Between Room 3 and 7

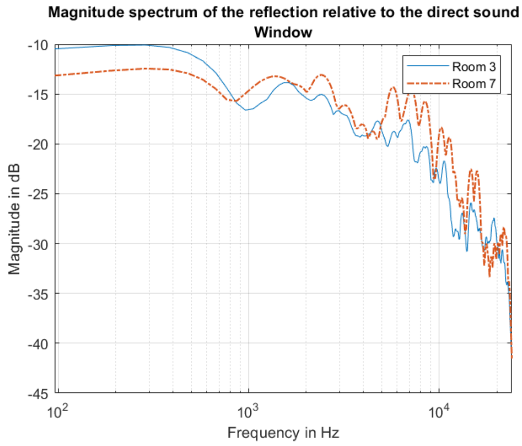
In order to study the differences in the reflections' frequency spectra, the spectra of similar surfaces in room 3 and room 7 are compared. These rooms have proven to be the most different of the rooms in Askim, based on the traditional parameters, the waterfall plots and the reflectograms. It is therefore assumed that if there are major differences between the surfaces of the rooms, it will be most evident in a comparison between room 3 and 7. Figure 4.24 shows the frequency spectra for the wall surfaces in the rooms 3 and 7 in Askim.



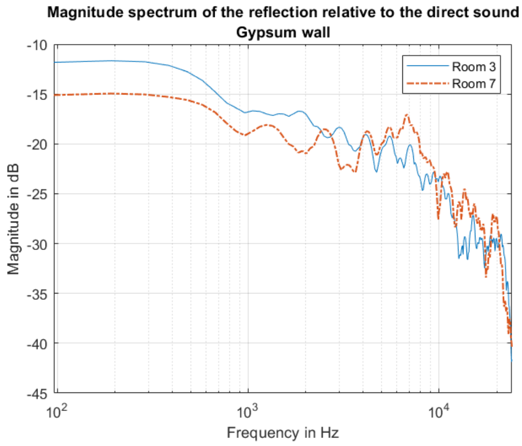
(a) Door



(b) Wall with mirror and piano in room 3, wall with whiteboard in room 7



(c) Window



(d) Gypsum wall

Figure 4.24: The figure shows the frequency spectra of the different surfaces in room 3 and 7. The spectra are calculated from the measurements done with the loudspeaker element directed towards the microphone.

The figure shows that the general trend is the same for each of the surfaces. The amplitude difference between the frequency spectra of the first order reflections in the two rooms is at most about 4 dB. This is below the difference in amplitude variations due to the directivity of the source, which can be up to 10 dB depending on angle and distance.

4.5 Questionnaire

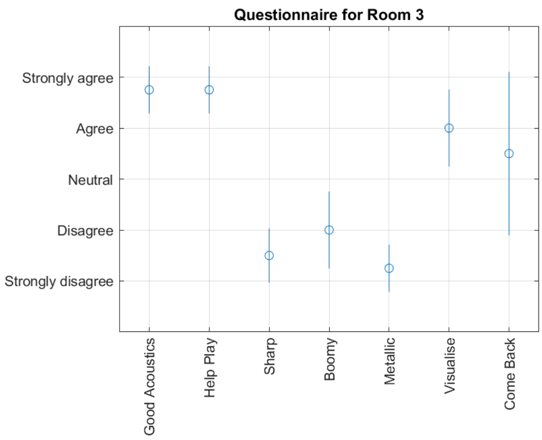
The answers from the questionnaire are collected, and the mean value and 95 % confidence interval (CI) are calculated for each room for the questions that were answered with a five point scale. Two questions are related to how the musician is changing his/her way of playing and how the timbre of their instrument is changing. These questions are asked in such a way that the answers yield nominal data, and it is therefore not meaningful to calculate the mean value or confidence intervals for these. The answers to the nominal data questions are shown in the figures below as red circles, the size of which are relative to the number of answers they represent. For instance will the size of the circle be larger if two persons answer that the timbre was changed in a positive way than if only one person choose this answer. The rooms are divided into sections depending on their location.

4.5.1 Askim

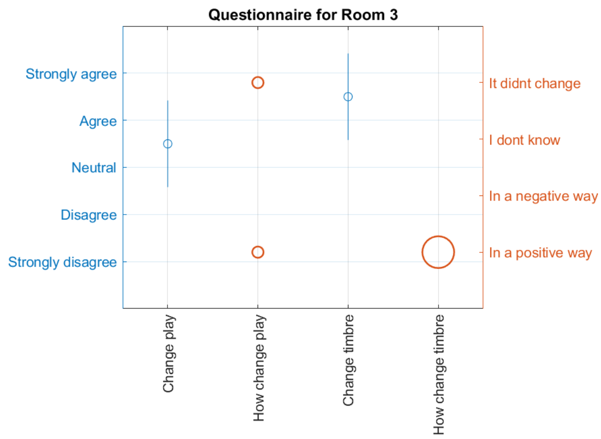
The following section is showing the results from the experiment performed in Askim.

4.5.1.1 Room 3

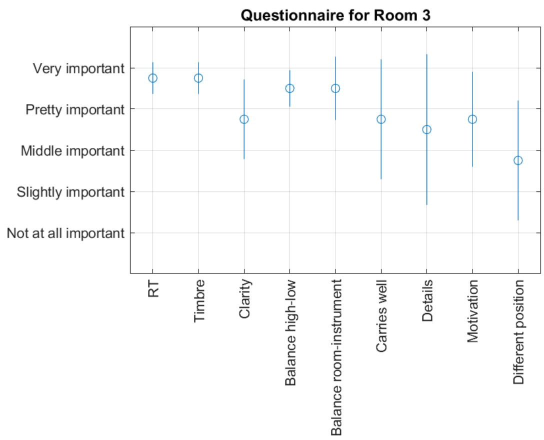
The answers from the questionnaire for room 3 at Askim Kulturskole are collected and shown graphically in Figure 4.25.



(a)



(b)



(c)

Figure 4.25: The figure shows the mean value and 95 % confidence intervals of the scale answers of the experiment in room 3 in blue, and the answers to the nominal questions in red. The size of the red circles are relative to the amount of answers choosing that specific category.

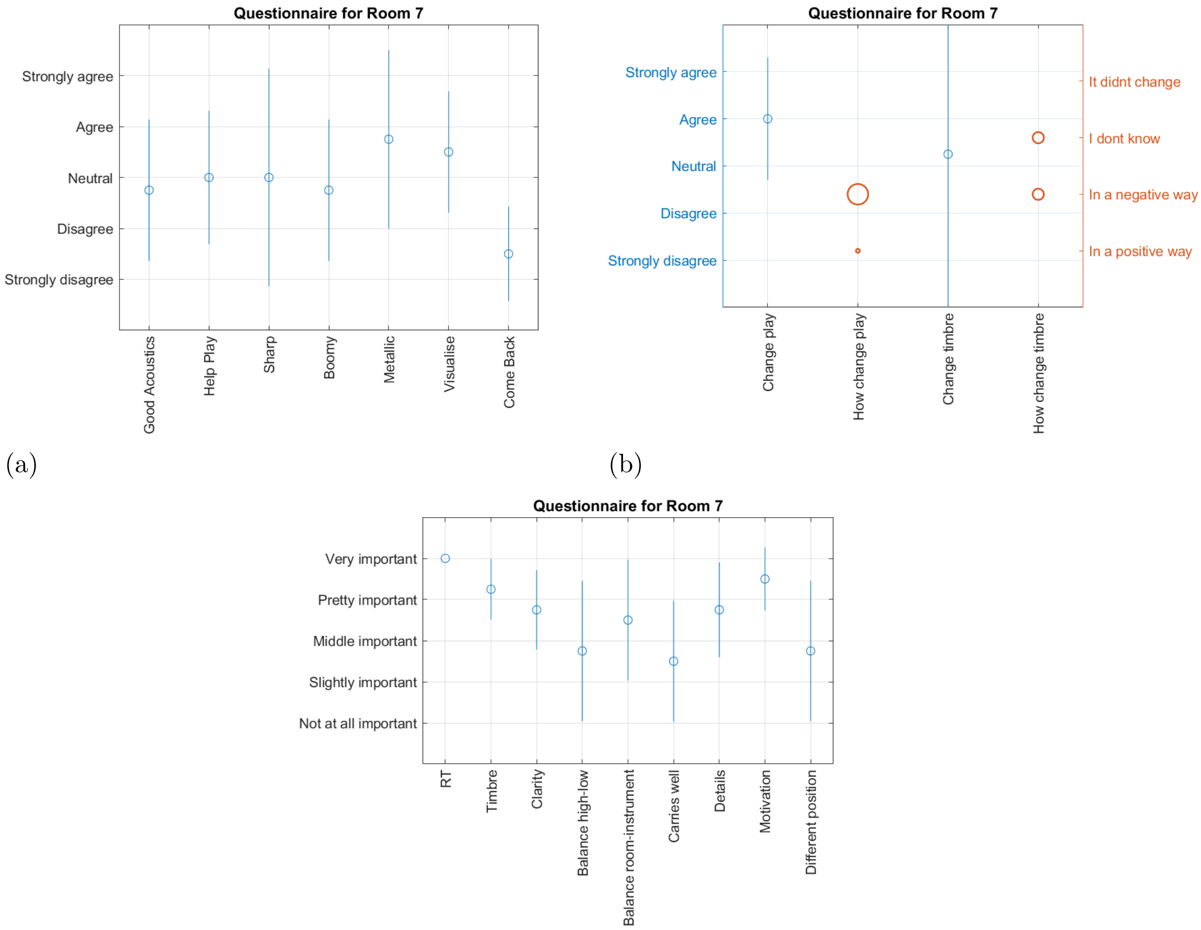
Figure 4.25a shows the part of the questionnaire that are answered by how much the participant agrees to a certain assertion. The participants judge that the room has generally good acoustics, and helps them play. This can be seen by both the very high mean value for both of these questions, as well as the narrow CI. Sharp, "boomy" or metallic sound is considered dissatisfactory, and are caused by poor balance between high and low frequencies, room modes or flutter echos. According to the test persons, room 3 has low degrees of these acoustical artefacts. They agree that they are able to produce the sound they visualise in the room. On the question on whether they would like to come back and rehearse in this room "as often as possible", the mean answer lies between "Neutral" and "Agree". The CI for this question is, however, quite wide. This means that the mean value of this small sample of musicians may be relatively far away from the mean of a large population of musicians.

The part of the questionnaire related to change of playing and timbre is shown in Figure 4.25b. This plot has two axes; the left blue axis belongs to the mean values and CI, and the right axis, which is red, belongs to the red circles showing the occurrence of the corresponding answers. The mean value of the answer to the assertion "I feel I am changing how I play the piece based on how the piece sounds like in the room" lies between "Neutral" and "Agree", with a CI of medium width. When asked in what way their way of playing was changed, an equal number of participants answers "In a positive way" and "It didn't change". "I feel like the room is changing my instrument's timbre" is answered between "Agree" and "Strongly agree", also with a medium wide CI. All participants agrees that the timbre is changed in a positive way.

Figure 4.25c shows how important different acoustical properties are for the participants when judging whether they would like to come back often to rehearse in room 3. The general trend is the less important a property is judged, the wider is the CI. The reverberation of the room, as well as the timbre are the most important for this room, being judged to be close to "Very important". Balance between high and low frequencies and balance between the sound from the room and the instrument come close behind, judged between "Pretty important" and "Very important". Clarity, motivation and whether the sound carries well in the room follow right below "Pretty important". Possibility to hear details in the music are judged to be between "Middle important" and "Pretty important", while the difference in sound dependent on the position and direction is judged least important of these properties, being slightly less than "Middle important".

4.5.1.2 Room 7

The answers from the questionnaire for room 7 at Askim Kulturskole are collected and shown graphically in Figure 4.26.



(a) (b) (c)

Figure 4.26: The figure shows the mean value and 95 % confidence intervals of the scale answers of the experiment in room 7 in blue, and the answers to the nominal questions in red. The size of the red circles are relative to the amount of answers choosing that specific category.

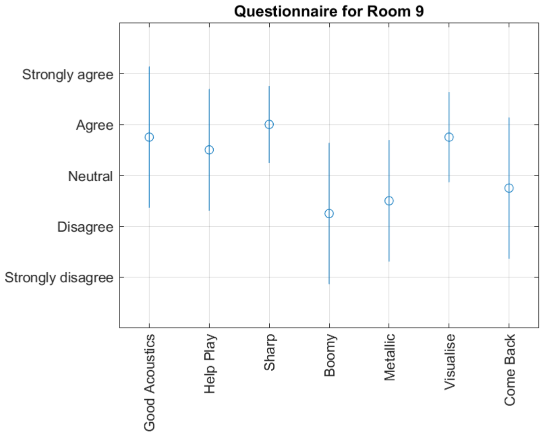
The questions answered by degrees of agreement are shown in Figure 4.26a. In general, the answers are varying around "Neutral" for most of the questions, and the CIs are quite wide. The participants judge the room to have a slightly metallic sound. Even if the mean answer lies between "Neutral" and "Agree" on whether they are able to produce the sound that they are visualising, it is quite clear that they do not want to rehearse often in room 7.

As can be seen in Figure 4.26b, the participants agree that they change the way they play based on how the room responds, and most have answered that the change is negative. The mean value for the answers to "I feel like the room is changing my instrument's timbre" lies just above "Neutral". The CI for this mean is extremely wide, meaning this answer might not at all be representative for a large group of musicians. An equal number has answered that the timbre was changed in a negative way and that they don’t know how the timbre was changed.

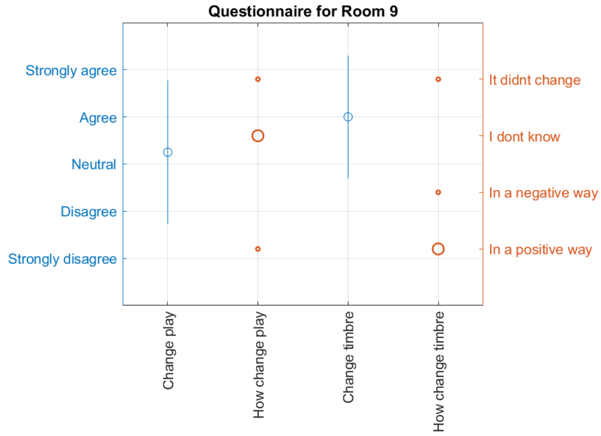
How important certain acoustical properties are when answering the question "I want to come back here to rehearse as often as possible" is shown in Figure 4.26c. The reverberation is judged "Very important", and the CI is empty. Motivation and timbre follows, between "Pretty important" and "Very important". Clarity, balance between room and instrument and possibility of hearing details in the music, all lie between "Middle important" and "Pretty important". Between "Slightly important" and "Middle important" lies the balance between high and low frequencies, whether the sound carries well, and differences in sound dependent on position and direction. Whether the sound carries well in the room lies slightly below the other two, making it the least important of these properties when judging whether the participants want to come back often to rehearse in room 7.

4.5.1.3 Room 9

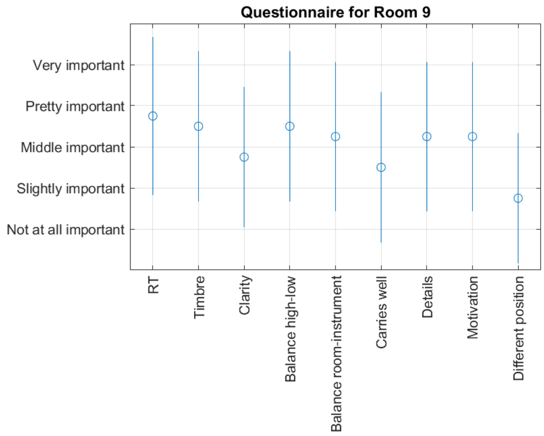
The answers from the questionnaire for room 9 at Askim Kulturskole are collected and shown graphically in Figure 4.27.



(a)



(b)



(c)

Figure 4.27: The figure shows the mean value and 95 % confidence intervals of the scale answers of the experiment in room 9 in blue, and the answers to the nominal questions in red. The size of the red circles are relative to the amount of answers choosing that specific category.

The questionnaire answers to the assertion "I generally think the acoustics are good" lie right below "Agree", but with a wide CI. The participants' judgement of whether the room helps them to play is between "Neutral" and "Agree", also with a wide CI. They agree that the room has a sharp sound, but are between disagreeing and neutral to whether the room has a boomy or metallic sound. The result of "The room makes it possible to recreate the sound I visualize" lies right below "Agree", and the musicians answer right below "Neutral" to the question on whether they would like to rehearse in room 9 as often as possible.

"I feel I am changing how I play the piece based on how the piece sounds like in the room" is met with an answer just above "Neutral", with a wide CI. Most of the participants answered either "It didn't change" or "I don't know" to the question in what way their playing was changed. They "Agree" that the timbre of their instrument is changed by the room, and more people answered that the timbre was changed in a good way than any of the other options.

The participants are asked to rate how important some acoustical properties of the room affected their answer to the assertion "I want to come back here to rehearse as often as possible". What is apparent, is that none of the acoustical properties are rated above "Pretty important" for this room. The most important is the reverberation, which lies close to "Pretty important", with timbre and balance between high and low frequencies following close behind. Balance between the room and the instrument, possibility to hear details and motivation are all judged above "Middle important". Below this option, there are clarity, whether the sound carries well in the room, and lastly, below "Slightly important" is the difference in acoustics dependent on the position and direction of playing in the room.

4.5.1.4 Room 10

The answers from the questionnaire for room 10 at Askim Kulturskole are collected and shown graphically in Figure 4.28.

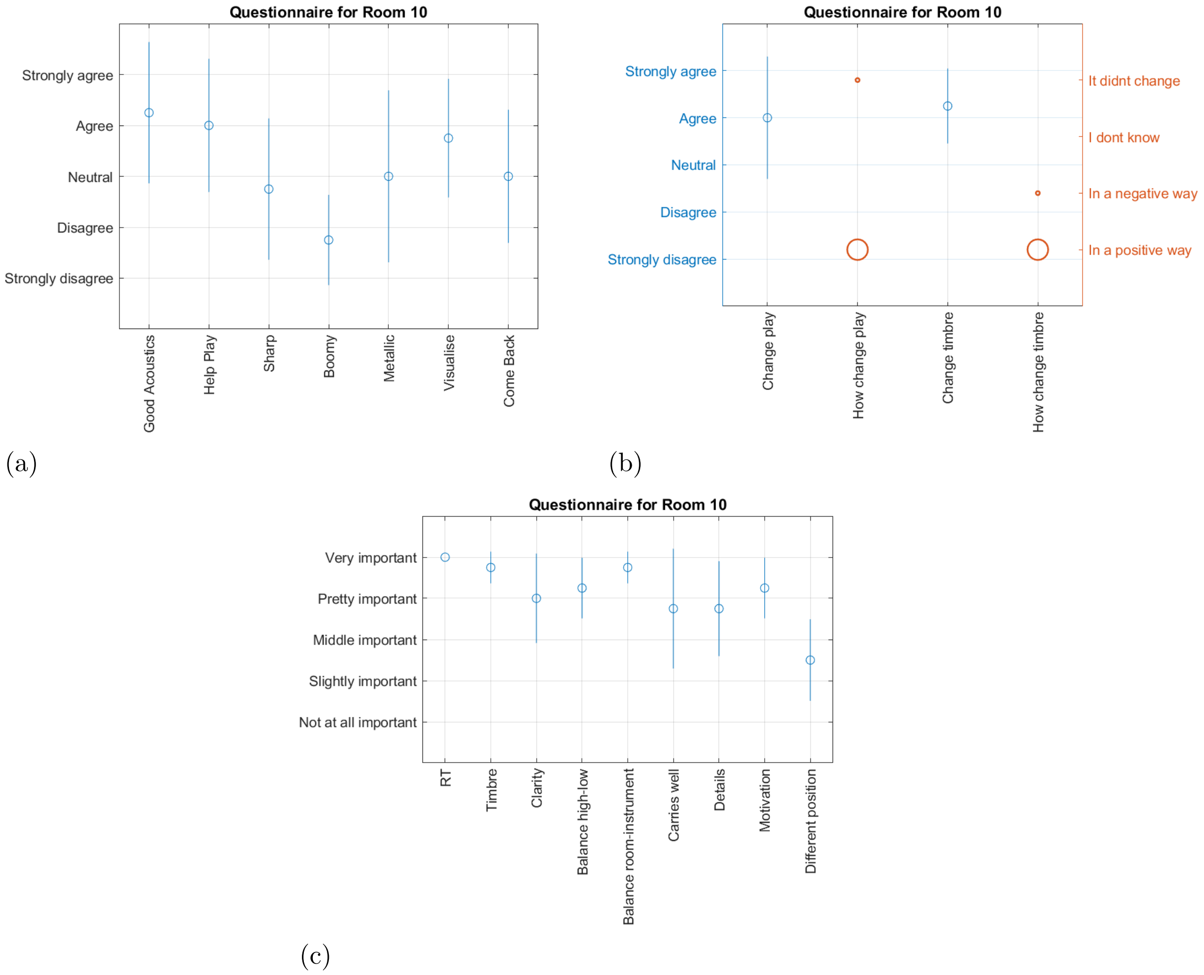


Figure 4.28: The figure shows the mean value and 95 % confidence intervals of the scale answers of the experiment in room 10 in blue, and the answers to the nominal questions in red. The size of the red circles are relative to the amount of answers choosing that specific category.

The CI for the questions with an agree scale are, for room 10, quite wide, as seen in Figure 4.28a. The participants more than agree that the general acoustics of the room are good, and agrees that the room helps them to play. Both sharpness, "boomyness" and the metallic sound of the room lie on the negative side of the scale, ranging from below "Disagree" to "Neutral". The room makes it slightly possible to create the sound the musician is visualising, but they are "Neutral" about wanting to rehearse in room 10 as often as possible.

According to the answers illustrated in Figure 4.28b, the room is changing how the musicians are playing, and in a good way. The same is true for the change of timbre in the instrument done by the room.

The reverberation of room 10 is "Very important" when the musicians decide if they want to rehearse in this room often. As can also be seen in Figure 4.28c, the CI for the reverberation is empty. This means this result is very reliable. The timbre and balance between the room and the instrument are also important properties, followed by the frequency balance and motivation the room acoustics provide. The clarity, whether the sound carries well and the possibility of hearing details are all close to "Pretty important". The least important factor for this room is how the acoustics are different in different position and directions, and it is between "Slightly" and "Middle important".

4.5.2 Blindern

The following section is showing the results from the experiment performed at Blindern.

4.5.2.1 Room 431

The answers from the questionnaire for room 431 at the Blindern Campus are collected and shown graphically in Figure 4.29.

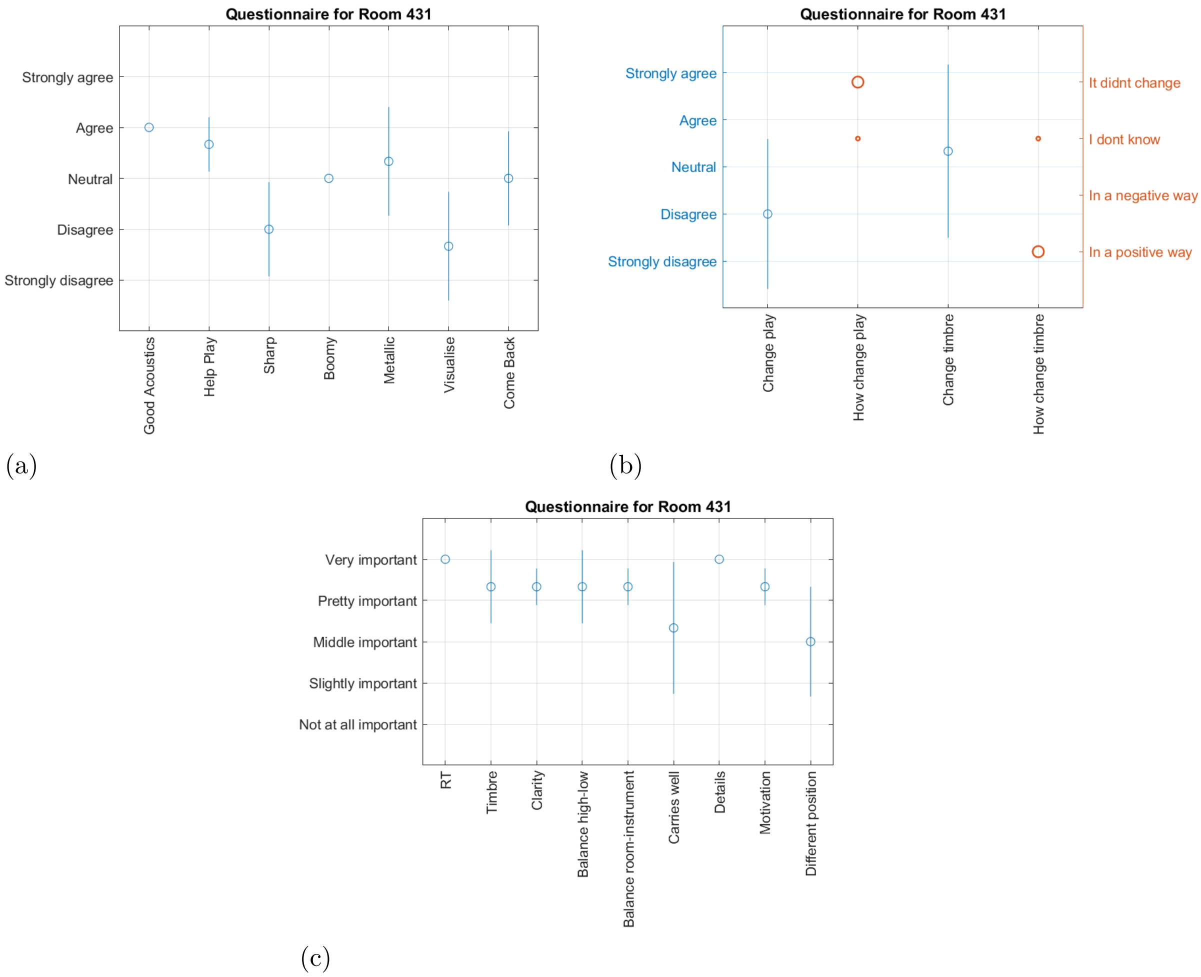


Figure 4.29: The figure shows the mean value and 95 % confidence intervals of the scale answers of the experiment in room 431 in blue, and the answers to the nominal questions in red. The size of the red circles are relative to the amount of answers choosing that specific category.

The participants' judgement lies at "Agree" for whether room 431 has generally good acoustics, as can be seen in Figure 4.29a. It is slightly lower when asked if the room helps them to play. The musicians are answering "Disagree" when asked if the room has a sharp sound, "Neutral" for boomy sound, and between "Neutral" and "Agree" for metallic sound. The room's ability to help the musicians create the sound they visualise is rated between "Strongly disagree" and "Disagree", and they are "Neutral" about coming back to rehearse here.

The CI for whether the musicians changed their way of playing is very wide, as shown in Figure 4.29b. When asked how their playing was changed, they think it either didn't change, or they don't know. The musicians judged between "Neutral" and "Agree" for the question that asked if their instruments' timbre was changed, and they think it was changed in a positive way.

Figure 4.29c shows how important different acoustical properties were rated by the test subjects when judging whether they would like to come back to room 431 and rehearse there as often as possible. As for room 10 in Askim both the reverberation and possibility to hear details are rated "Very important" with empty CIs. On a shared second place of importance are timbre, clarity, frequency balance, room-instrument balance and motivation. Whether the instrument carries well in the room is between "Middle important" and "Pretty important", and the difference in position follows close behind, at "Middle important".

4.5.2.2 Room 435

The answers from the questionnaire for room 435 at the Blindern Campus are collected and shown graphically in Figure 4.30.

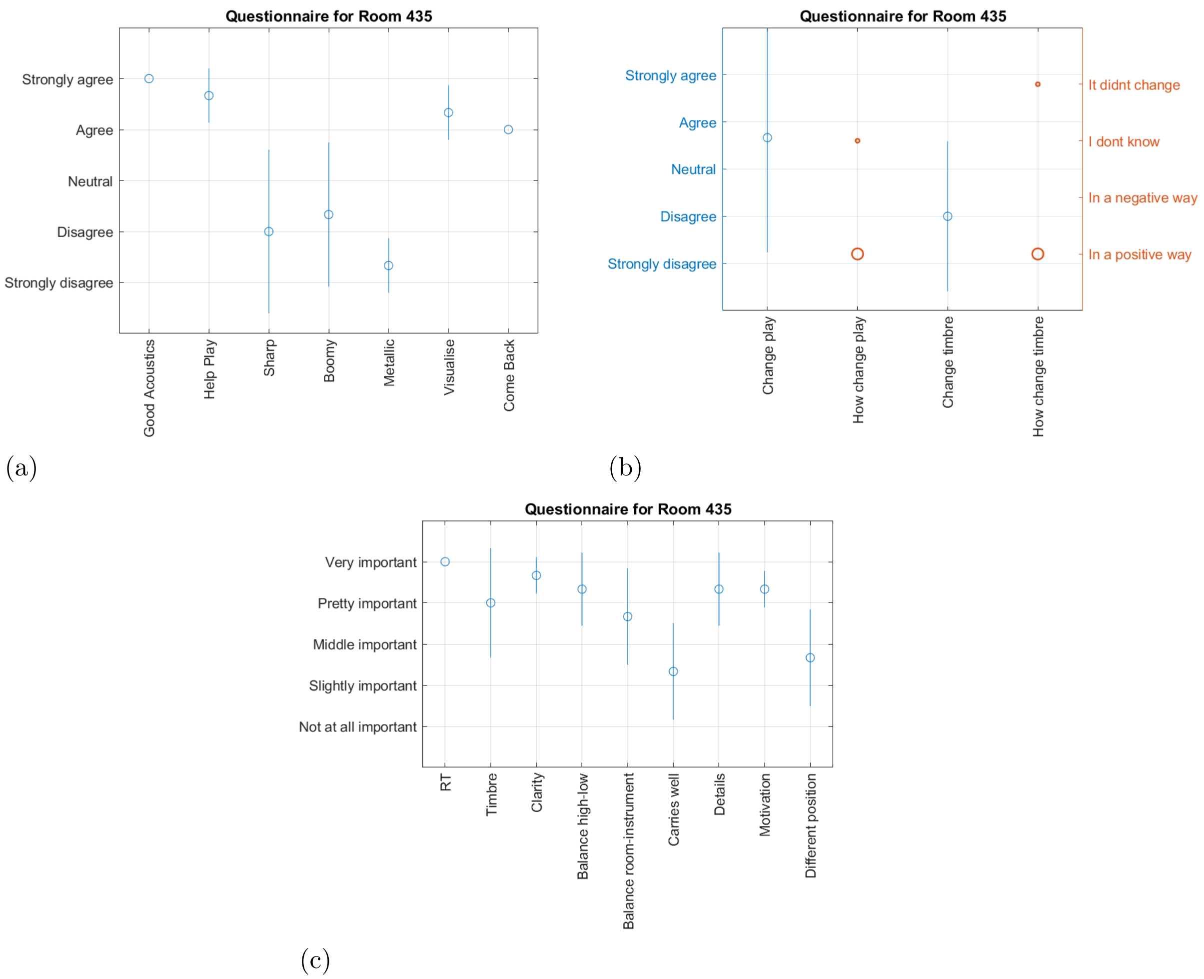


Figure 4.30: The figure shows the mean value and 95 % confidence intervals of the scale answers of the experiment in room 435 in blue, and the answers to the nominal questions in red. The size of the red circles are relative to the amount of answers choosing that specific category.

Figure 4.30a shows the degree of which the test subjects were agreeing to statements in the questionnaire regarding room 435. The statement saying the general acoustics are good is met with the judgement "Strongly agree", and with an empty CI. The CI for the next question is fairly narrow, and the mean value of the answers lies between "Agree" and "Strongly agree". Both the sharpness and boomy character of the room are judged around "Disagree", while the musicians have a meaning between "Strongly disagree" and "Disagree" about whether the room has a metallic sound. The test subjects report above "Agree" that they can create the sound they visualise, and they rate the statement saying they want to come back to rehearse to "Agree" with an empty CI.

How the musicians reported that they changed their way of playing based on the room acoustics, and how the room affected their instruments' timbre are illustrated in Figure 4.30b. They answered below "Agree" that they change the way they play, and the change is in a positive way. Whether there is a change of timbre is rated "Disagree", and there are most answers for a positive change of timbre.

Figure 4.30c shows that the reverberation is "Very important" for the test subjects when deciding if they want to rehearse in room 435 as often as possible. The clarity are almost as important. Between "Pretty important" and "Very important" are the frequency balance, possibility for hearing details and motivation located. Timbre is "Pretty important". Between "Middle important" and "Pretty important" is the balance between the room and the instrument. Whether the sound carries well in the room and the difference in acoustics for different positions or directions are rated between "Slightly important" and "Middle important", the former being judged slightly below the latter.

4.5.3 Comparison Between the Rooms

The data from the question where acoustical properties are rated with different importance is collected from all rooms of each location and combined in order to see what the test subjects rated most important in general.

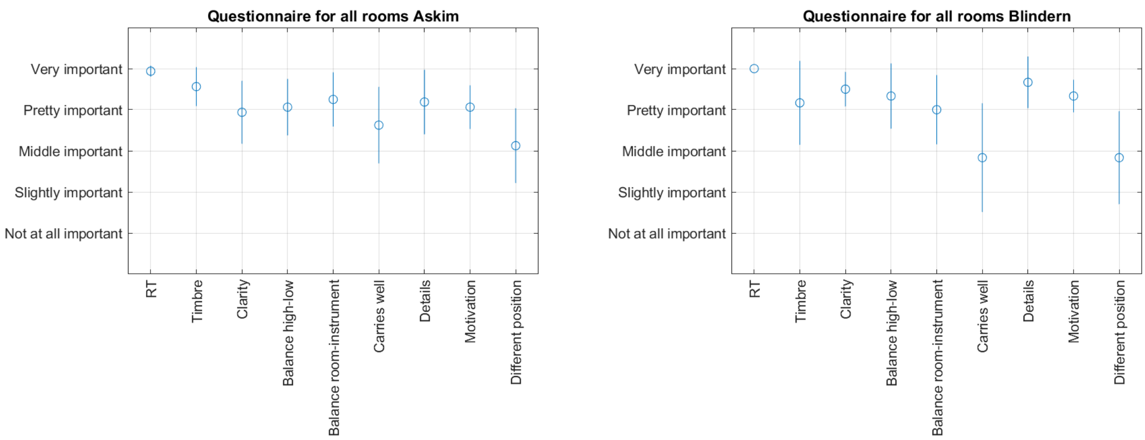


Figure 4.31: The figure shows the mean value and 95 % confidence interval of all the rooms in Askim and Blindern separately of the scale answers to what acoustical properties are most important when judging whether the test subjects want to come back to the room to rehearse.

The reverberation time is considered to be of high importance in all the rooms. This is not surprising, as it is an important characteristic of a room, as well as a well-known one. For the rooms in Askim on average, the timbre of the room was judged to be the second most important characteristic when deciding whether the room was good for rehearsal. The balance between the room and the instrument and the possibility of hearing details are judged highly as well. The two factor that are least important both in Askim and at Blindern is that the sound carries well, and similar acoustics in different positions and directions. In general, the CI for each property is narrow, meaning the true mean value for a large population of musicians will lie close to the calculated mean of the experiment.

After all the rooms were validated, the participants were asked to rank the rooms in their preferred order, from what room they liked most to the one they liked the least.

Table 4.1 shows the rooms in Askim in the ranked order, together with the mean value of their ranking. The table also includes the order in which the rooms where judged to have good acoustics, help the test subject to play well, and whether they want to come back and rehearse in the room as often as possible. The number 1 means first place, in other words the best ranking of the rooms, and 4 means fourth place, or the worst of the rooms. Table 4.2 shows the same ranking of the rooms at Blindern.

Askim

Room	Ranking	Good acoustics	Help play	Come back
3	1.25	1	1	1
10	2.50	2	2	2
9	2.50	3	3	3
7	3.75	4	4	4

Table 4.1: The table shows the different rehearsal rooms of the experiments in Askim ranked according to which room he participants liked best, their average ranking, as well as the order of highest average judgement on three questions regarding the acoustical quality of the room.

Blindern

Room	Ranking	Good acoustics	Help play	Come back
435	1.00	1	1	1
431	2.00	2	2	2

Table 4.2: The table shows the different rehearsal rooms of the experiments at Blindern ranked according to which room he participants liked best, their average ranking, as well as the order of highest average judgement on three questions regarding the acoustical quality of the room.

5

Discussion

The results are discussed in the following chapter. The discussion is divided into sections based on the main object of the current discussion. However, comparisons are made with data other than indicated in the section title.

5.1 Traditional Parameters

The traditional parameters calculated from the standardised impulse response measurements show that there is a difference between the rooms in Askim. This is natural, as each room is designed for a different instrument or instrument group according to the different music types defined in NS 8178. This affects the ideal reverberation time according to the standard, with powerful acoustical music demanding less reverberant rooms than weak acoustical music. The two rooms at Blindern are very similar. It is reasonable to assume that the rooms were intended to have the same acoustical characteristics, as there is no indication that the rehearsal rooms on the fifth floor at Blindern are designed for a more specific instrument group than acoustical instruments. The mean values of the reverberation time are according to standard NS 8178 for all the rooms. The traditional parameters also seem to indicate that the rooms with the least variation in parameter values over frequency are preferred. This corresponds well to the demand in NS 8178 that the reverberation time curves should be quite even over frequency. The evenness of the curves over frequency is not according to standard for room 9 in Askim and neither of the rooms at Blindern. If similar values over frequency would be the most important factor for perception and preference, room 9 would be the lowest rated of the rooms in Askim. This is, however, not the case. The test subjects rated room 7 lower than room 9. Room 7 has a much higher reverberation time than room 9, and was reported to have a metallic sound. Whether it is the high reverberation time or the unwanted sound characteristic that makes the difference, is difficult to tell at this point. For the rooms at Blindern, the parameter values are nearly undistinguishable, except that room 435, which is preferred by the test subjects, has less variation over frequency for both T_{30} and the other parameters. This indicates that similarity over frequency is important, but not the only important factor.

The EDT parameter values rank the rooms in Askim in the same order as the test subjects through the questions of the questionnaire, with the lowest EDT values for the rooms the test subjects liked best. The T_{30} parameter shows similar rating, with the exception of room 9 being the least reverberant. Studies show that the human hearing is focused only on the first 15 ms of the reverberation in running music and speech, and that the EDT is a good approximation to the perceived reverberation time. That the EDT and preference of the rooms show a negative correlation, supported by the fact that EDT is closer than T_{30} to the perceived reverberation, indicates that low early decay times are preferable to high values in a rehearsal room.

The order of the lowest to highest T_S values show the same phenomenon. The T_S, centre-of-gravity time, is lowest for the room that is ranked best in the subjective experiment, and has the same order of the rooms up to the least preferred room, which has the highest T_S value. This indicates that low centre-of-gravity time is advantageous in a room intended for music rehearsal, meaning the sound is more clear. This makes it easier to hear details in the music, like intonation, timbre and rhythms. The C_{80} parameter is not ranking the rooms in the same order as the subjective questions. Room 3 has the highest clarity, and room 7 has the lowest, but room 9 is much more clear than room 10 according to this parameter. This does not correspond to the subjective perception of the rooms. The T_S parameter does not discriminate between helpful and harmful reflections with a strict border between the two, like the C_{80} parameter does. The results from this project indicates that T_S may be a better measure for the clarity of a room.

The stage parameters ST_{early} and ST_{late} are energy comparisons between the direct sound (defined as the first 0 to 10 ms) and later energy, 20 to 100 ms and 100 to 1000 ms, respectively. The ST_{early} parameter values for all the rooms that have been studied are higher than typical values on a stage in a concert hall. This is not surprising, as the rehearsal rooms are small and with low reverberation times compared to concert halls, and the energy in the time interval 20 to 100 ms is therefore low compared to the first 10 ms. The ST_{late} values for the rooms are in the range typical to concert halls. This concurrence is related to the relative size and reverberation time of concert halls and rehearsal rooms, which may lead to a similar energy level in the time interval from 100 to 1000 ms. The ST_{late} parameter is not meaningful in small rooms, as the time interval being compared to the direct sound is extremely late in the impulse response of small rooms, but may be quite early in the impulse response of a large room. ST_{early} is also a irrelevant parameter for rehearsal rooms. This is due to the small size and short reverberation time in this kind of room, making it evident that the early energy level will be higher than the energy at a later time. The stage parameters are clearly attuned to large concert halls, and do not yield useful information about a rehearsal room of small proportions.

5.2 Waterfall Plots

The waterfall plots show the both the first 0.6 s of the impulse responses measured to calculate the room acoustical parameters for rooms 3 and 7 and the first 20 ms of the impulse responses for all of the rooms. The resonances seen in the long waterfall plots for room 3 are seemingly unimportant, as the test subjects did not report any resonances or similar in the room. On the other hand, room 7 was reported to be metallic, but no resonances can be seen in the long waterfall plots of this room. The short waterfall plots focus on the first few reflections of the rooms. The general trend is that the less amplitude variation over time and frequency in this early part of the decay, the higher the room is rated in the subjective experiment. This can be seen by comparing the waterfall plots of room 3 and 7. Room 3 has less amplitude variation for the first 20 ms than room 7, which seem furrowed and uneven by comparison. This unevenness might cause coloration of the sound in a way that sound metallic, and is a possible explanation of the reported metallic sound in room 7. Rooms 9 and 10 have amplitude variation somewhere in between room 3 and 7. This corresponds with the results from the subjective experiments, and indicates that small amplitude variations over time and frequency are to be preferred over large variations. Based on the theory that human hearing is focusing on the first 15 ms of the reverberation in a running time signal, an hypothesis is that the amplitude evenness is most important in the first 15 ms of the impulse response. This requires further investigation.

5.3 Simulation of Reflection Pattern in Playing Position

The reflectograms presented in the Results chapter are illustrating the reflection pattern in the playing position of the room. The first reflection of the reflectogram of each room tells how close the nearest surface is to the playing position. The first reflection arrives between 4.22 and 6.12 ms for all the rooms, which means the closest surface is between 1.45 and 2.01 m away from the playing position. This corresponds well to figures 3.12a to 3.12f. In the same way will the length of the reflectogram be affected by the size of the room. The last of the early reflections will arrive at the playing position earlier for small rooms than for large, as the distance travelled is shorter. The unevenness of the amplitudes of the reflections in room 431 and 435 can be explained by the presence of an absorber that covers most of the surface of one of the walls in the room. The absorber will dampen each reflection that travels via this surface.

The reflections in room 3 seem to come with random time intervals. This is caused by its atypical geometry; a long room where none of the walls are normal to each other or parallel. As opposed to this, the first reflections of room 7 seem to arrive with quite even intervals. This repetition of reflections at certain intervals can be seen to continue even when other reflections that are not following this pattern are arriving. Repetitive reflections like these can cause colouration that is perceived as a metallic sound. Room 9 has a large number of reflections arriving early, while room 10 is more sparse. There are no obvious reasons why these two rooms are rated differently that can be concluded from the reflectograms alone.

5.4 Surface Frequency Response

The comparison between the surfaces of room 3 and 7 in Askim shows that the difference in amplitude between the two rooms is below the difference in amplitude that can be caused by the directivity of the source used in the measurements. This means that the differences seen between the frequency spectra of the surfaces can be caused by different rotation and distance to the source alone. Other possible factors are different distances to other surfaces, for instance to the window frames or other nearby objects that may cause diffraction. The surfaces of a room are usually combined by multiple materials in various quantities, and comparisons between different surfaces is therefore complicated. The actual reflection and absorption of sound energy is also varying with angle of incidence, so the reflected energy may be different when a musician is rehearsing in the room to the measurement conditions. If there is information in the frequency content of the reflections that is important to the perception of the rehearsal room, this needs to be further investigated. The sound source used in this project has an amplitude difference of 10 dB dependent on frequency and angle. In addition is this source not acting as a point source when measurements are done as close to the source as they were in this case. The diameter of the dodecahedron is almost half a meter, and when the measurements are done around half a meter away from the closest loudspeaker element of the source, the relative travel distance differences between the different loudspeaker elements are great. A different sound source that is more directional and with little to no amplitude difference depending on the frequency and direction would yield more accurate measurements. The characteristics of a better suited loudspeaker can be established in a closer study of this kind of measurement. This kind of surface measurements are time consuming and requires careful planning and execution, and it is unclear whether they provide useful information not attainable in an easier way.

5.5 Questionnaire

The subjective experiment was performed with few test subjects; four for the rooms in Askim and three for the rooms at Blindern. The results from the subjective tests are therefore not statistically representative, but act as indicators. The goal is to find indicators that can fine-tune rooms within the scope of the Norwegian Standard 8178. In order to get statistically representative results, the experiments must be preformed with a large number of rooms and test subjects.

The general trend of the questionnaire answers is that the rooms are rated higher on "Good acoustics", "Help play", "Visualise" and "Come back" whenever the sharp, boomy and metallic sounds (noise) are rated low. This is reasonable, as musicians may be disturbed by an unwanted sound, not being able to rehearse properly in the room. It is also evident that when the musicians perceive a positive timbre change of their instruments, the timbre is rated as important in their judgement of the room. For the rooms where there is no obvious timbre change, the timbre is judged less important. This indicates that the timbre change of the instrument is most prominent when it is a good change.

The survey question that asks the test subjects to rate the importance of different acoustical properties and phenomena when deciding whether they want to rehearse a lot in a room is central to this thesis. The object is, after all, to investigate what makes a room suitable for rehearsing, and this question invites the test subjects to give direct feedback as to what is most important to them. There is, however, a possibility that their conscious thoughts about what is important about the room's acoustics, is not coinciding with their subconscious perception. In general, the participants of the experiments did not use the entire scale for this question. All properties seem to be considered important to some degree, or the participants were reluctant to exclude any of the properties.

What was considered the most important room acoustical characteristic of the rooms were rated differently in Askim and Blindern. Whether this is due to difference in rooms, or the fact that the participants were different people with different amounts of experience at the two locations, is difficult to tell. The characteristic "Difference in sound dependent on the position and direction" was judged least important by all participants. This may be caused by the instruction from the leader of the experiment that told the test subjects to position themselves in a marked position, causing the participants not to move from this location. However, some of the test subjects reported that they did indeed move while rehearsing, or were trying out different positions before settling on one. This may unconsciously make them adjust to "the best" position in the room. Other reasons can be that the question was difficult to understand, or that the participants are not used to evaluate this characteristic of a room. It may also be because the musicians don't consider it to be important, because when they are rehearsing, they are either staying in one position, possibly choosing it unconsciously according to sound, light, or to be close to some equipment in the room, or they are moving around in the room constantly. That the sound carries well is also generally rated with a low degree of importance. As rehearsal rooms are small, and the rooms investigated in this thesis are intended for one musician, there is no risk of the musicians not being able to hear their instrument. The sound from the instrument is also not supposed to travel long distances to an audience, as would be the case in a room intended for performance. In fact, a known issue in small rehearsal rooms is that the sound level becomes too loud, endangering the hearing of the musicians when exposed to the high sound level for long time intervals.

The reverberation time is rated most important both in Askim and at Blindern. This indicates that this is, in fact, an important parameter to consider when designing a rehearsal room. The balance between the room and the instrument is related to the reverberation time. If the reverberation is short, the direct sound of the instrument will be the main part of the soundscape, and if it is long, the soundscape will be dominated by the reverberant sound in the room. Timbre and frequency balance are also highly rated, and may be connected. The timbre of the room is also connected to noise and comb filter effects. These kinds of timbre change are considered unwanted. To avoid comb filter effects in the playing position, it's important to design rooms that are large enough. The comb filter effects are smaller the further away from a reflective surface one is, and when the room is large, the area of the floor that has little to no timbre change is larger. The possibility of hearing details in the music is rated quite high. This characteristic is connected to the clarity of the room, which was also one of the parameters to be rated. Clarity is tightly connected to reverberation time, in the way that long reverberation often leads to poor clarity, and vice versa. Even if the clarity may be given by the reverberation time of the room, it is possible to change it by introducing reflective surfaces closer to the musician, for instance. Because of this, and because it is considered an important characteristic of a room, the design of rehearsal rooms can be improved by paying attention to this characteristic explicitly.

The "Motivation" characteristic of a room is a complex issue. It may be caused by a combination of different acoustical characteristics, and it may be individual what feels motivating. One hypothesis is that relatively high reverberation will make the instrument resonate in the room, making it sound good and cover up small mistakes, and that this may be motivating for some, boosting their confidence. Another hypothesis is that shorter reverberation time will increase the possibility to hear details, making the musician progress faster by hearing what can be improved, and thus be motivating. This is a field that needs to be investigated.

The ranking of the rehearsal rooms done by the participants of the experiment can be seen in Table 4.1 and Table 4.2. When comparing the results of the questions regarding the quality of the room acoustics and the rooms' usability as rehearsal rooms, it can be seen that the rooms are rated in the same order as when asked directly which room they prefer. This means that the results are reliable.

5.6 Further Work

There are many answers about the acoustics in music rehearsal rooms that are in need of answers. Suggestions for further work include to take a further look into the data collected in this project. There are possible connections and correlations between the subjective and objective data that are not yet investigated. It would be interesting to also do measurements in the position where the test subjects are playing, to capture the true response in that position and compare it to the questionnaire results. Such measurements could be performed with microphones close to the musicians' ears, or a similar setup. One could also do a similar experiment where one investigates the room acoustics in small rehearsal rooms in a teaching setting with one teacher and a student. How do the students perceive the room? How do the teachers perceive the students' playing? The frequency response of the surfaces in rehearsal rooms can be measured more accurate with equipment better suited for the task. Whether the amplitude evenness of the impulse response is important to human perception and impression of a room could be an interesting investigation, and which time interval is most important for the impression. The importance of the geometry of the rehearsal rooms can be further investigated. For instance could the effect of angling more than one wall and its relation to a metallic impression of the sound be studied. Other questions are also in need of answers. What makes rehearsal rooms and performance rooms motivating to play in? What acoustical conditions make the musician learn more from rehearsal? In order to get more reliable results that can work as stronger indicators, similar research needs to be performed on a large number of rooms and with a large number of test subjects.

6
Conclusion

The most important indications from the subjective experiments are that sound phenomena like sharpness or metallic sound are undesirable and should be avoided, the reverberation time is important, and it is important to have even parameter values over frequency. The clarity of a room also plays a major role. Another interesting discovery is that there is a perceived difference in the rooms that are fulfilling standard requirements, indicating that it is possible to design rehearsal rooms of even higher quality by refining the parameter values, geometry and reflection pattern of the room within the demands set by the standard.

The results indicate that the geometry of the rooms can, with advantage, be extreme. Even if all the rooms in Askim have walls that are angled according to the recommendations in the standard, one of them was perceived as metallic, which is often related to flutter echo. In room 3, which has the most extreme geometry of the rooms, no undesirable sound phenomena were reported, and the amplitude of the reflections are even over time and frequency for multiple positions in the room. This indicates that angling more than one wall and making sure none of the walls are parallel is preferable.

There are many factors besides the acoustical conditions that affect how humans perceive a rehearsal room in particular, and any room in general. The light conditions, how much of the light is daylight, the temperature of the room, whether the room feels cramped or open, the furniture, whether the room has the equipment needed for the activity at hand, and a multitude of other factors affect the general attitude towards the room, and colour the impression of the room's acoustics. These are factors that are not considered in this project, and they are rarely in the control of the acoustician. These factors are a part of the impression of the room even so, and keeping them in mind in the design phase can potentially improve the impression of the room as a whole.

The examinations performed for this thesis are not statistically large enough to establish absolute conclusions. However, there are indicators to what may be advantageous acoustical characteristics of rehearsal rooms. The most important are summarised here:

- Even response over frequency for all measured or calculated parameters
- Absence of noise. For instance metallic, sharp or boomy sound and rattling of loose objects is undesirable
- Reverberation time in the lower region of the standard requirements. EDT is a better measure of the perceived reverberation than T_{30}
- High clarity. T_S may be a better indicator than C_{80}
- Evenness in amplitude both over frequency and time for the first 15 ms of the

impulse response

- Canted walls. Walls can be canted even more than the lowest recommendation of 7 degrees
- Large rooms makes it both easier to get even parameter values over frequency, and avoid comb filter effects in the playing position

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A

Appendix 1

This appendix includes pictures of the rehearsal rooms studied in this thesis.

A.1 Askim

Figure A.1: The figure shows room 3.

Figure A.2: The figure shows room 7.

Figure A.3: The figure shows room 9.

Figure A.4: The figure shows room 10.

A.2 Blindern

Figure A.5: The figure shows room 431.

Figure A.6: The figure shows room 435.

B

Appendix 2

The measurement positions of the surface measurements are shown in figures B.1 to B.6.

B.1 Askim

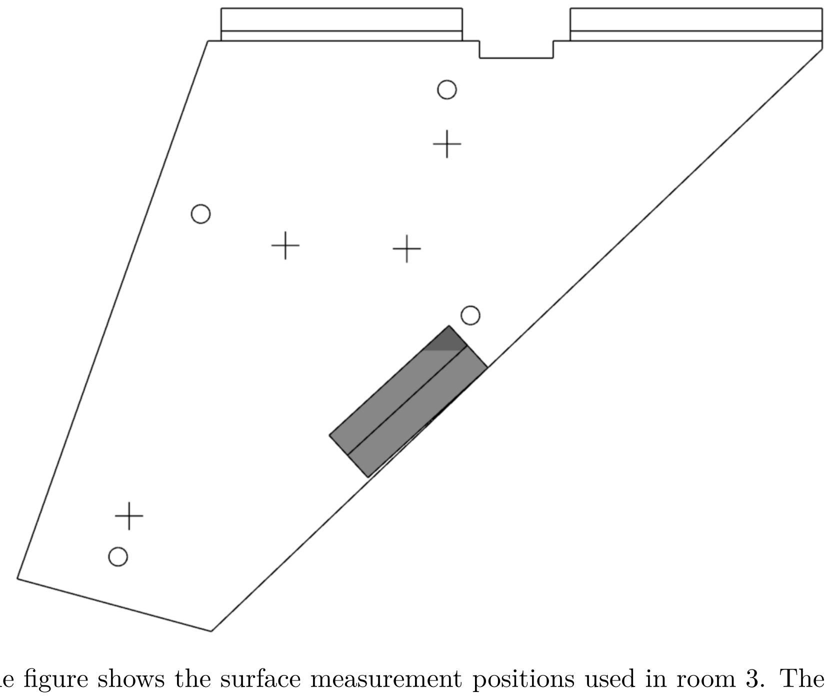

Figure B.1: The figure shows the surface measurement positions used in room 3. The crosses are the source positions, and the circles are the receiver positions.

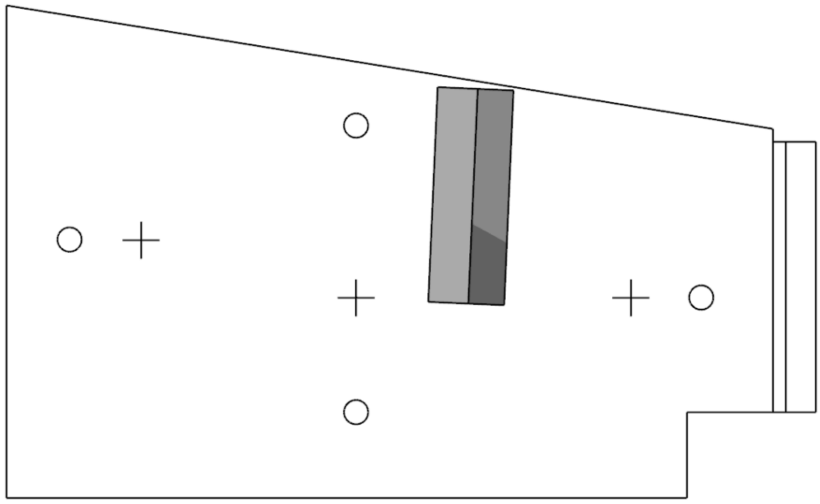

Figure B.2: The figure shows the surface measurement positions used in room 7. The crosses are the source positions, and the circles are the receiver positions.

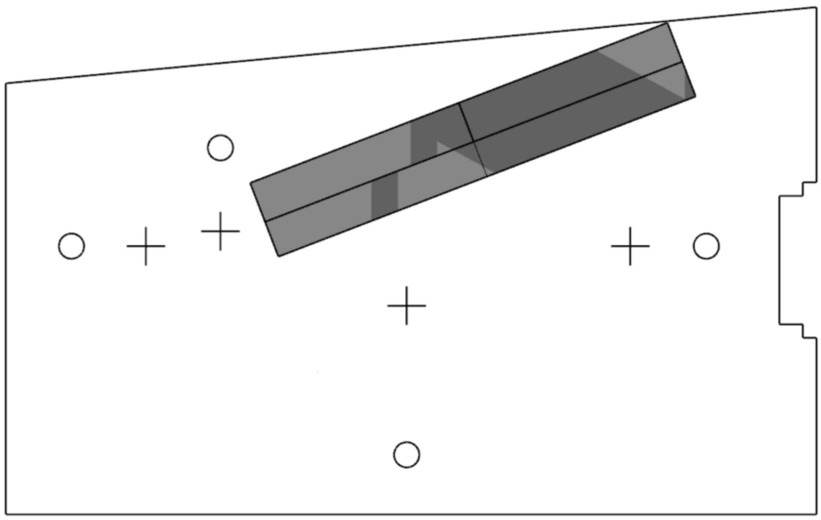

Figure B.3: The figure shows the surface measurement positions used in room 9. The crosses are the source positions, and the circles are the receiver positions.

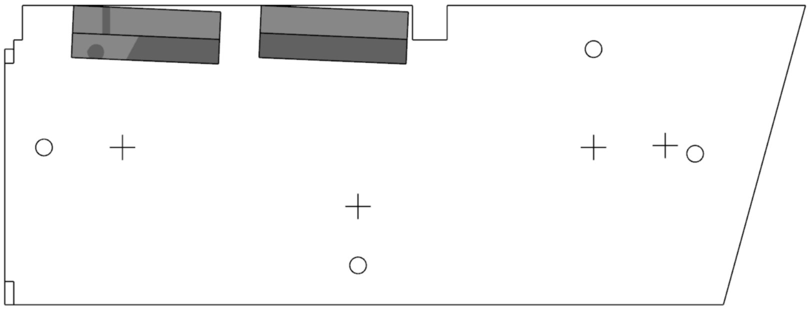

Figure B.4: The figure shows the surface measurement positions used in room 10. The crosses are the source positions, and the circles are the receiver positions.

B.2 Blindern

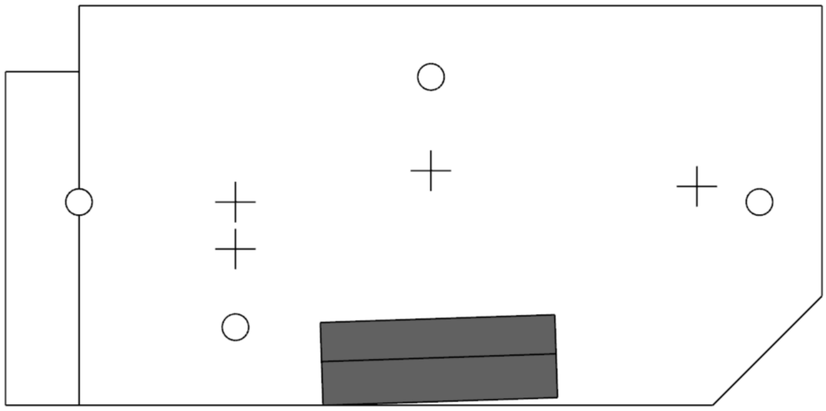

Figure B.5: The figure shows the surface measurement positions used in room 431. The crosses are the source positions, and the circles are the receiver positions.

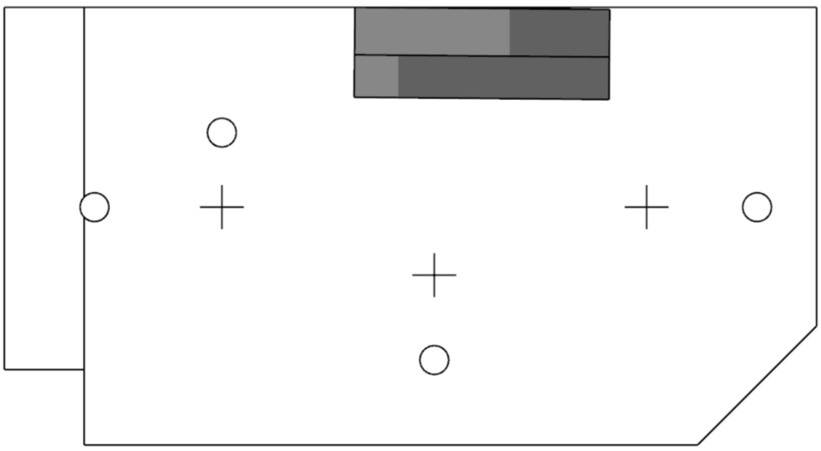

Figure B.6: The figure shows the surface measurement positions used in room 435. The crosses are the source positions, and the circles are the receiver positions.

C

Appendix 3

The Matlab function used for finding the frequency content of the reflection of a surface relative to the frequency content of the direct sound is as shown below.

```
function [fspect,meansub] = reflspect(filename,L,Lduration,Ld)
%REFLSPECT Takes an impulse response file, the travelled distance L in
%meters of a specified reflection, the duration Lduration of the
%reflection in meters and direct sound impulse and the travelled
%distance Ld of the direct sound as input.
%The output is the frequency spectrum of the reflection relative
%to the spectrum of the direct sound.


%load file
[y, Fs] = audioread(filename);
token = strtok(filename,'.');

%making a time vector
t = 0:1/Fs:(length(y)-1)/Fs;

%Finding these distances in the time vector
%speed of sound at 21-22 degrees Celsius
c = 344;
%the time of arrival in seconds for the reflection of interest
T=L/c;
%The index of t-vector of the beginning of the reflection of interest
Ib = find(t<=T & t>T-(1/Fs));
%the duration of the reflection in seconds
Tdur = Lduration/c;
 %The index of the last sample of the reflection
Ie = find(t<=(T+Tdur) & t>(T+Tdur)-(1/Fs));

%Finding these distances in the time vector
%the time of arrival in seconds for the reflection of interest
Tdir=Ld/c;
%The index of t-vector of the beginning of the direct sound
Ibdir = find(t<=Tdir & t>Tdir-(1/Fs));
%the duration of the direct sound in seconds
Tdur = Lduration/c;
%The index of the last sample of the direct sound
```

```
Iedir = find(t<=(Tdir+Tdur) & t>(Tdir+Tdur)-(1/Fs));

%Control of the limits
OK = 0;

while OK == 0
    %plotting the time signal
    figure(01)
    plot(t(Ibdir-10:Ie+10),y(Ibdir-10:Ie+10))
    grid on
    xlabel('Time in s')
    ylabel('Pressure in Pa')
    title({'Time signal of the impulse response';filename})
    hold on
    plot([t(Ib) t(Ib)], [-4e-3 4e-3],'r')
    plot([t(Ie) t(Ie)], [-4e-3 4e-3],'r');
    plot([t(Ibdir) t(Ibdir)], [-4e-3 4e-3],'m');
    plot([t(Iedir) t(Iedir)], [-4e-3 4e-3],'m');
    hold off

    answer = questdlg('Check if too much of the IR is included.', ...
        'Are the limits OK?', ...
        'Check Limits', ...
        'Yes','No','Cancel','No');
    % Handle response
    switch answer
        case 'No'
            disp(['Please enter new limits.'])
            prompt = 'What is the beginning of the reflection (in meter)? ';
            L = input(prompt);
            prompt = 'What is the beginning of the direct sound (in meter)? ';
            Ld = input(prompt);
            prompt = 'What is the duration of the reflection (in meter)? ';
            Lduration = input(prompt);

            %the time of arrival in seconds for the reflection of interest
            T=L/c;
            %The index of t-vector of the beginning of the reflection of intere
            Ib = find(t<=T & t>T-(1/Fs));
             %the duration of the reflection in seconds
            Tdur = Lduration/c;
             %The index of the last sample of the reflection
            Ie = find(t<=(T+Tdur) & t>(T+Tdur)-(1/Fs));

            %Finding these distances in the time vector
            %the time of arrival in seconds for the reflection of interest
            Tdir=Ld/c;
            %The index of t-vector of the beginning of the direct sound
            Ibdir = find(t<=Tdir & t>Tdir-(1/Fs));
            %the duration of the direct sound in seconds
            Tdur = Lduration/c;
```

```
            %The index of the last sample of the direct sound
            Iedir = find(t<=(Tdir+Tdur) & t>(Tdir+Tdur)-(1/Fs));

        case 'Cancel'
            close all
            return
        case 'Yes'
            OK = 1;
    end
end

%Waterfall
%Using the spectrogram to plot the waterfall
%Spectrogram
[s,fspect,tspect] = spectrogram(y(1:10000),blackman(128),120,500,Fs);
swater = 10*log10(abs(s));

figure(02)
waterfall(tspect,fspect,swater)
ylabel('Frequency in Hz')
xlabel('Time in s')
zlabel('Magnitude in dB')
view([121.8 46.1])
set(gca,'yscale','log')
ylim([10 Fs/2.56])
zlim([-50 -10])
title({'Waterfall plot of the first part of the impulse response';filename})

%Plotting only a part of the waterfall plot: the reflection in question
tlength = (length(y(1:10000))-120)/(128-120);

%Finding the indices for the reflection
%The index of tspect-vector of the beginning of the reflection of interest
Ib = find(tspect>=T & tspect<T+(tspect(end)-tspect(1))/tlength);
 %The index of the last sample of the reflection
Ie = find(tspect>=(T+Tdur) & tspect<(T+Tdur)+(tspect(end)-tspect(1))/tlength);

figure(04)
waterfall(tspect(Ib:Ie),fspect,swater(:,Ib:Ie))
ylabel('Frequency in Hz')
xlabel('Time in s')
zlabel('Magnitude in dB')
view([121.8 46.1])
set(gca,'yscale','log')
ylim([100 Fs/2.56])
zlim([-40 -10])
title({['Waterfall plot of the reflection']; ...
['Reflection beginning at time ',num2str(T),' s']; ['Length of reflection: ',
num2str(Lduration),' m, ', num2str(Tdur),' s'];filename})

%Subtracting the direct sound from the reflection
```

```
%Finding the indices of the direct sound
%The index of tspect-vector of the beginning of the reflection of interest
Ibdir = find(tspect>=Tdir & tspect<Tdir+(tspect(end)-tspect(1))/tlength);
if isempty(Ibdir)
    Ibdir = 1;
end
%The index of the last sample of the reflection
Iedir = find(tspect>=(Tdir+Tdur) & tspect<(Tdir+Tdur)+(tspect(end) ...
-tspect(1))/tlength);

figure(05)
waterfall(tspect(Ibdir:Iedir),fspect,swater(:,Ibdir:Iedir))
ylabel('Frequency in Hz')
xlabel('Time in s')
zlabel('Magnitude in dB')
view([121.8 46.1])
set(gca,'yscale','log')
ylim([100 Fs/2.56])
zlim([-40 -10])
title({['Waterfall plot of the direct sound'];
['Reflection beginning at time ',num2str(Tdir),' s'];
['Length of reflection: ', num2str(Lduration),' m, ',
num2str(Tdur),' s'];filename})

l=length(Ib:Ie);
ssubpressure = s(:,Ib:Ie)-s(:,Ibdir:(Ibdir+l-1));
ssubwater = 10*log10(abs(ssubpressure));

figure(06)
waterfall(tspect(Ib:Ie),fspect,ssubwater)
ylabel('Frequency in Hz')
xlabel('Time in s')
zlabel('Magnitude in dB')
view([121.8 46.1])
set(gca,'yscale','log')
ylim([100 Fs/2.56])
zlim([-40 -10])
title({['Waterfall plot of the reflection subtracted the direct sound'];
['Reflection beginning at time ',num2str(T),' s']; ['Length of reflection: ',
num2str(Lduration),' m, ', num2str(Tdur),' s'];filename})

%Taking the average over time of the spectrum
meansub = mean(ssubwater,2);

figure(07)
semilogx(fspect,meansub)
grid on
xlim([400 Fs/2.56])
ylim([-40 0])
xlabel('Frequency in Hz')
ylabel('Magnitude in dB')
```

```
title({['Magnitude␣spectrum␣of␣the␣reflection␣relative␣to␣the␣direct␣sound'];
['Reflection␣beginning␣at␣time␣',num2str(T),'␣s']; ['Length␣of␣reflection:␣',
num2str(Lduration),'␣m,␣', num2str(Tdur),'␣s'];filename})

% Saving figures
print('-f01',['Reflcheck␣' num2str(token)],'-dpng')
print('-f07',['Reflspectrum␣' num2str(token)],'-dpng')
end
```

D

Appendix 4

This appendix shows the detailed results from the traditional parameters for all the rooms.

D.1 Askim

D.1.1 Room 3

Table D.1: The table shows the values for some acoustical parameters for room 3 in octave bands.

	$T_{30}[s]$	EDT [s]	$C_{80}[dB]$	$T_s[ms]$	$ST_{early}[dB]$	$ST_{late}[dB]$
125	0.44	0.23	16.32	27.50	-2.82	-17.06
250	0.36	0.25	17.64	22.50	-5.55	-21.06
500	0.39	0.26	16.32	18.80	-3.85	-18.71
1000	0.37	0.31	15.47	19.40	-3.84	-18.21
2000	0.37	0.30	14.95	20.50	-1.40	-15.36
4000	0.35	0.29	16.01	19.20	-3.79	-18.54

Table D.2: The table shows the values for some acoustical parameters for room 3 in 1/3 octave bands.

	$T_{30}[s]$	EDT [s]	$C_{80}[dB]$	$T_s[ms]$	$ST_{early}[dB]$	$ST_{late}[dB]$
100	0.60	0.37	11.56	61.40	0.77	-9.16
125	0.34	0.27	17.71	42.50	-4.35	-19.78
160	0.33	0.25	21.43	35.90	-3.13	-22.07
200	0.39	0.21	21.54	33.60	-5.12	-20.40
250	0.43	0.30	17.65	33.40	-3.91	-19.80
315	0.36	0.31	16.97	28.20	-8.28	-23.39
400	0.39	0.27	16.41	26.40	-2.24	-18.71
500	0.41	0.27	15.60	23.80	-4.50	-18.99
630	0.38	0.25	17.46	20.40	-5.01	-17.86
800	0.37	0.24	16.90	20.00	-4.15	-19.32
1000	0.36	0.32	15.95	22.90	-4.32	-18.03
1250	0.39	0.37	13.96	23.50	-3.26	-17.90
1600	0.38	0.33	14.92	21.40	-2.01	-15.63
2000	0.37	0.29	15.49	21.70	0.23	-13.63
2500	0.37	0.30	14.58	21.80	-1.46	-15.77
3150	0.36	0.30	15.44	23.30	-1.13	-15.79
4000	0.36	0.29	15.51	19.30	-3.67	-18.31
5000	0.33	0.283	16.96	17.8	-5.29	-20.35

D.1.2 Room 7

Table D.3: The table shows the values for some acoustical parameters for room 7 in octave bands.

	$T_{30}[s]$	EDT [s]	$C_{80}[dB]$	$T_s[ms]$	$ST_{early}[dB]$	$ST_{late}[dB]$ [b]
125	0.54	0.33	12.74	32.60	-4.28	-17.99 [t]
250	0.50	0.32	14.57	22.20	-3.34	-17.02
500	0.55	0.38	12.23	26.10	-2.66	-12.89
1000	0.50	0.41	12.26	26.50	-0.59	-11.56
2000	0.47	0.38	12.05	26.70	-1.73	-12.51
4000	0.41	0.33	13.73	21.40	-2.55	-14.95

Table D.4: The table shows the values for some acoustical parameters for room 7 in 1/3 octave bands.

	$T_{30}[s]$	EDT [s]	$C_{80}[dB]$	$T_s[ms]$	$ST_{early}[dB]$	$ST_{late}[dB]$ [b]
100	0.62	0.48	9.30	56.20	-3.34	-12.76 [t]
125	0.54	0.39	12.01	54.20	-3.89	-15.53
160	0.49	0.34	14.82	42.40	-4.89	-23.15
200	0.37	0.35	18.23	32.50	-4.51	-22.31
250	0.54	0.27	15.97	29.20	-0.79	-14.22
315	0.49	0.36	12.98	30.90	-4.58	-15.34
400	0.56	0.40	12.13	30.70	-3.87	-14.16
500	0.59	0.42	11.36	34.50	-2.80	-12.03
630	0.48	0.31	13.61	27.80	-1.05	-12.54
800	0.52	0.39	12.54	30.40	-0.94	-11.69
1000	0.51	0.40	12.30	28.50	-0.49	-11.61
1250	0.48	0.46	11.71	29.30	-0.24	-10.91
1600	0.49	0.40	11.91	28.60	-1.47	-11.93
2000	0.47	0.36	12.18	28.60	-0.80	-12.25
2500	0.44	0.40	12.03	27.50	-2.87	-13.30
3150	0.42	0.37	12.57	26.80	-0.21	-12.52
4000	0.42	0.32	13.94	21.50	-3.64	-16.13
5000	0.40	0.30	14.67	18.90	-2.76	-15.44

D.1.3 Room 9

Table D.5: The table shows the values for some acoustical parameters for room 9 in octave bands.

	$T_{30}[s]$	EDT [s]	$C_{80}[dB]$	$T_s[ms]$	$ST_{early}[dB]$	$ST_{late}[dB]$ [b]
125	0.41	0.37	14.02	34.80	-2.26	-14.92 [t]
250	0.35	0.27	17.31	22.70	-4.54	-18.97
500	0.33	0.28	17.35	20.20	-3.19	-17.86
1000	0.35	0.32	15.43	22.50	-1.56	-15.76
2000	0.37	0.33	13.98	24.10	-0.02	-13.61
4000	0.38	0.31	14.82	21.20	-1.74	-15.32

Table D.6: The table shows the values for some acoustical parameters for room 9 in 1/3 octave bands.

	$T_{30}[s]$	EDT [s]	$C_{80}[dB]$	$T_s[ms]$	$ST_{early}[dB]$	$ST_{late}[dB]$ [b]
100	0.50	0.44	11.69	58.70	-1.81	-13.98 [t]
125	0.43	0.42	14.25	58.20	-0.77	-13.42
160	0.35	0.34	15.57	43.80	-5.20	-18.05
200	0.35	0.33	16.59	36.20	-3.96	-17.84
250	0.37	0.28	16.37	33.70	-4.58	-19.17
315	0.35	0.25	19.00	27.30	-6.01	-20.50
400	0.36	0.26	17.83	24.40	-3.05	-17.81
500	0.34	0.29	17.49	25.90	-3.60	-17.57
630	0.31	0.33	16.46	25.40	-2.67	-18.02
800	0.33	0.29	17.05	23.90	-2.48	-17.85
1000	0.34	0.30	15.66	23.80	-1.42	-16.91
1250	0.36	0.33	14.46	26.20	-0.78	-13.75
1600	0.37	0.33	14.89	25.20	-0.74	-14.01
2000	0.36	0.36	12.88	27.80	0.66	-13.41
2500	0.38	0.31	14.00	24.40	0.07	-13.37
3150	0.39	0.29	14.72	24.10	0.70	-13.50
4000	0.39	0.31	14.86	20.60	-1.96	-15.36
5000	0.38	0.33	14.87	21.00	-3.14	-16.34

D.1.4 Room 10

Table D.7: The table shows the values for some acoustical parameters for room 10 in octave bands.

	$T_{30}[s]$	EDT [s]	$C_{80}[dB]$	$T_s[ms]$	$ST_{early}[dB]$	$ST_{late}[dB]$ [b]
125	0.51	0.37	11.81	33.90	-2.83	-13.52 [t]
250	0.41	0.24	15.19	22.20	-5.34	-19.05
500	0.44	0.28	15.16	20.30	-3.78	-15.58
1000	0.46	0.32	13.65	23.00	-2.27	-13.96
2000	0.47	0.36	12.82	24.90	-1.88	-13.45
4000	0.43	0.32	14.01	20.70	-3.69	-15.64

Table D.8: The table shows the values for some acoustical parameters for room 10 in 1/3 octave bands.

	$T_{30}[s]$	EDT [s]	$C_{80}[dB]$	$T_s[ms]$	$ST_{early}[dB]$	$ST_{late}[dB]$ [b]
100	0.62	0.67	7.86	65.40	1.71	-7.26 [t]
125	0.55	0.36	10.17	62.60	-1.12	-11.53
160	0.42	0.32	13.74	40.00	-4.68	-17.42
200	0.40	0.31	13.71	38.60	-6.63	-17.02
250	0.37	0.25	15.83	31.40	-1.86	-18.45
315	0.43	0.27	16.22	24.30	-6.69	-21.69
400	0.46	0.30	15.69	25.30	-2.72	-15.58
500	0.43	0.34	13.74	27.50	-4.66	-14.96
630	0.43	0.25	15.44	23.40	-3.76	-15.22
800	0.43	0.29	15.01	25.20	-4.06	-16.33
1000	0.46	0.30	14.12	24.80	-1.85	-13.44
1250	0.48	0.39	12.36	26.20	-0.74	-12.21
1600	0.47	0.39	12.75	26.60	-1.53	-13.16
2000	0.48	0.38	12.71	26.40	-1.26	-13.00
2500	0.46	0.33	13.13	25.50	-2.76	-14.08
3150	0.44	0.32	13.35	24.20	-1.48	-13.57
4000	0.44	0.31	14.26	20.40	-4.34	-16.28
5000	0.41	0.32	14.30	19.90	-3.91	-15.79

D.2 Blindern

D.2.1 Room 431

Table D.9: The table shows the values for some acoustical parameters for room 431 in octave bands.

	$T_{30}[s]$	EDT [s]	$C_{80}[dB]$	$T_s[ms]$	$ST_{early}[dB]$	$ST_{late}[dB]$ [b]
125	0.57	0.46	10.53	41.10	3.31	-4.68 [t]
250	0.43	0.40	12.32	33.70	-2.57	-12.45
500	0.34	0.31	16.16	21.30	-3.26	-17.27
1000	0.32	0.30	16.66	20.40	-4.32	-18.18
2000	0.35	0.32	14.57	23.10	-1.92	-15.31
4000	0.38	0.36	13.52	24.60	-2.21	-14.88

Table D.10: The table shows the values for some acoustical parameters for room 431 in 1/3 octave bands.

	$T_{30}[s]$	EDT [s]	$C_{80}[dB]$	$T_s[ms]$	$ST_{early}[dB]$	$ST_{late}[dB]$ [b]
100	0.60	0.68	7.09	69.50	0.31	-8.09 [t]
125	0.65	0.51	10.52	56.20	1.15	-4.76
160	0.54	0.47	11.02	54.90	4.36	-4.78
200	0.47	0.51	10.83	48.60	1.43	-6.54
250	0.42	0.40	11.78	47.20	-3.16	-15.02
315	0.38	0.27	15.90	30.00	-5.93	-16.80
400	0.35	0.29	15.76	27.20	-1.11	-15.30
500	0.35	0.34	16.58	25.80	-5.21	-18.08
630	0.34	0.31	16.13	25.00	-1.92	-17.75
800	0.31	0.37	16.83	26.80	-5.75	-19.92
1000	0.32	0.29	17.04	22.50	-3.65	-17.62
1250	0.33	0.30	16.55	20.30	-4.07	-17.95
1600	0.33	0.32	14.61	24.80	-3.02	-16.02
2000	0.34	0.32	14.93	24.30	-0.76	-14.12
2500	0.36	0.33	14.25	23.90	-2.06	-15.69
3150	0.38	0.35	13.41	28.00	-0.08	-12.88
4000	0.39	0.38	12.80	25.80	-2.56	-14.66
5000	0.36	0.35	13.92	23.40	-3.04	-15.90

D.2.2 Room 435

Table D.11: The table shows the values for some acoustical parameters for room 435 in octave bands.

	$T_{30}[s]$	EDT [s]	$C_{80}[dB]$	$T_s[ms]$	$ST_{early}[dB]$	$ST_{late}[dB]$ [b]
125	0.46	0.35	12.49	35.90	-0.11	-12.32 [t]
250	0.47	0.47	11.08	33.30	0.98	-10.65
500	0.36	0.30	15.10	22.30	-2.26	-16.94
1000	0.32	0.30	15.67	22.40	-2.28	-17.99
2000	0.33	0.32	15.20	24.10	-0.64	-14.76
4000	0.37	0.35	13.42	25.10	-0.47	-13.26

Table D.12: The table shows the values for some acoustical parameters for room 435 in 1/3 octave bands.

	$T_{30}[s]$	EDT [s]	$C_{80}[dB]$	$T_s[ms]$	$ST_{early}[dB]$	$ST_{late}[dB]$ [b]
100	0.53	0.49	11.00	62.30	-2.20	-12.97 [t]
125	0.54	0.38	13.13	46.90	-3.28	-13.24
160	0.44	0.36	12.72	51.50	0.76	-12.59
200	0.49	0.55	9.68	53.10	4.51	-8.63
250	0.47	0.53	10.41	44.90	1.09	-9.05
315	0.44	0.40	12.43	36.20	-4.24	-15.31
400	0.40	0.27	14.91	26.70	-0.42	-14.10
500	0.35	0.32	15.75	26.90	-2.06	-17.87
630	0.31	0.37	15.70	27.00	-3.04	-18.65
800	0.30	0.34	16.09	26.50	-3.22	-18.78
1000	0.32	0.33	16.35	24.30	-1.20	-18.39
1250	0.33	0.30	14.95	23.40	-2.39	-17.50
1600	0.33	0.32	15.28	25.00	-1.08	-15.07
2000	0.33	0.35	15.46	25.10	-0.42	-15.35
2500	0.34	0.31	15.05	26.00	-0.55	-14.43
3150	0.37	0.34	12.97	27.10	2.94	-9.96
4000	0.38	0.38	13.31	26.40	-1.79	-14.00
5000	0.36	0.35	13.58	24.00	-1.15	-14.12

E

Appendix 5

E.1 English Questionnaire Used in Askim

The English translation of the questionnaire used during the experiment at Askim Kulturskole is shown below. The second section of the questionnaire is meant to be repeated for each room, but only shown once here.

Questionnaire

During this survey, you will play the same piece of music in 5 different rooms and do a listening test in which you are producing the sound. The first room is a test room where you will get to know the method and the questionnaire. Focus on the experience of the room and the interaction with your instrument when playing, and try not to focus on the questions to be answered. After you have played in a room, complete the form. There is one form per room.

1. **Participant ID (Choose four letters or numbers)**

   ____

2. **Age**

   ____

3. **Gender**

   ____

4. **Do you have normal hearing?**

   Markér bare én oval.

   - ( ) Yes
   - ( ) No

5. **What instrument to you teach?**

   ____

6. **For how long have you played this instrument?**

   ____

7. **How long have you taught on these premises?**

   ____

8. **Which rehearsal room(s) do you use regularly?**

Merk av for alt som passer

- [ ] Room 1: Clarinet/saxophone
- [ ] Room 2: Flute
- [ ] Room 3: Brass
- [ ] Room 4: Guitar
- [ ] Room 5: Guitar
- [ ] Room 6: Percussion
- [ ] Room 7: Singing
- [ ] Room 8: Violin/cello
- [ ] Room 9: Piano
- [ ] Room 10: Piano

9. **How often do you play in surroundings with very different acoustics?**

Markér bare én oval.

- Very often
- Often
- Sometimes
- Rarely
- Very rarely
- I don't know

The Rehearsal Rooms

This section is repeated for each room.
The following questions are assertions. Please choose how much you agree with the assertion when considering the room's acoustics in light of rehearsal conditions for you personally. Choose the alternative that comes closest to your view of the room.

10. **Which room is this?**

____

11. **I generally think the acoustics are good.**

Markér bare én oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree
- Don't know

12. **The room is helping me to play.**
Markér bare én oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree
- Don't know

13. **I feel I am changing how I play the piece based on how the piece sounds like in the room.**
Markér bare én oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree
- Don't know

14. **I change the way I play...**
Markér bare én oval.

- In a positive way
- In a negative way
- I don't know
- I did not change the way I play...

15. **I feel like the room is changing my instrument's timbre.**
Markér bare én oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree
- Don't know

16. **I feel like the timbre of the instrument was changed...**
Markér bare én oval.

- In a positive way
- In a negative way
- I don't know
- It wasn't changed...

17. **The sound in the room is sharp.**
Markér bare én oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree
- I don't know

18. **The sound in the room is boomy.**
Markér bare én oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree
- I don't know

19. **The sound in the room is metallic.**
Markér bare én oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree
- I don't know

20. **The room makes it possible to recreate the sound I visualize.**
Markér bare én oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree
- Don't know

21. **I want to come back here to rehearse as often as possible.**
Markér bare én oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree
- Don't know

22. **Evaluate how important the following characteristics were for your answer of the question above.**

For hver egenskap, vurder hvor enig du er i at den er viktig for deg når du avgjør om du ønsker å øve i dette rommet.

Markér bare én oval per rad

	Very important	Pretty important	Middle important	Somewhat important	Not at all important	I don't know
Reverb						
Timbre						
Clarity						
Balance between high and low tones						
Balance between the instrument and reverb						
If the room carries the sound well						
Hearing details like intonation and rythm						
Motivating to play here						
Difference in sound dependent on the position and direction						

Finally

23. **I am very influenced by the acoustics of a room when I play my instrument.**

Markér bare én oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree
- I don't know

24. **What is important to you with a good rehearsal room?**

25. **What room did you like best? Rank the rooms from which you liked best at the top to which you liked the worst at the bottom.**

26. **Do you have any further comments?**

Thank you!

E.2 English Questionnaire Used at Blindern

The first section of the Norwegian version of the questionnaire used during the experiment at Blindern is shown below. The rest of the questionnaire is identical to the one above.

Questionnaire

During this survey, you will play the same piece of music in 3 different rooms and do a listening test in which you are producing the sound. The first room is a test room where you will get to know the method and the questionnaire. Focus on the experience of the room and the interaction with your instrument when playing, and try not to focus on the questions to be answered. After you have played in a room, complete the form. There is one form per room.

1. **Participant ID (Choose four letters or numbers)**

____

2. **Age**

____

3. **Gender**

____

4. **Do you have normal hearing?**
   Markér bare én oval.

   - Yes
   - No

5. **What instrument to you play?**

____

6. **For how long have you played this instrument?**

____

7. **Where or in which room do you usually rehearse?**

____

8. **How often do you play in surroundings with very different acoustics?**
   Markér bare én oval.

   - Very often
   - Often
   - Sometimes
   - Rarely
   - Very rarely
   - I don't know

E.3 Norwegian Questionnaire Used in Askim

The Norwegian versions of the questionnaire with answers for the experiment at Askim Kulturskole are shown in their entirety below.

Spørreundersøkelse

Under denne undersøkelsen skal du spille det samme musikkstykket i 5 forskjellige rom og gjøre en lyttetest der du produserer lyden. Det første rommet er et testrom for at du skal bli kjent med metoden og spørreskjemaet. Fokuser på opplevelsen av rommet og samspillet med instrumentet ditt når du spiller, og prøv å ikke fokusere på spørsmålene som skal besvares. Etter du har spilt i et rom, fyller du ut skjemaet. Det er ett skjema per rom.

1. **Deltakeridentifikasjon (velg fire bokstaver eller tall)**

   1337

2. **Alder**

   31

3. **Kjønn**

   Mann

4. **Har du normal hørsel?**

   Markér bare én oval.

   - [x] Ja
   - [ ] Nei

5. **Hvilket instrument underviser du i?**

   Gitar

6. **Hvor lenge har du spilt dette instrumentet?**

   23 år

7. **Hvor lenge har du undervist i disse lokalene?**

   18 måneder

8. **Hvilke(t) øvingsrom bruker du regelmessig?**

   Merk av for alt som passer

   - [ ] Rom 1: Klarinett/sax
   - [ ] Rom 2: Fløyte
   - [ ] Rom 3: Messing
   - [x] Rom 4: Gitar
   - [ ] Rom 5: Gitar
   - [ ] Rom 6: Slagverk
   - [ ] Rom 7: Sang
   - [ ] Rom 8: Fiolin/cello
   - [ ] Rom 9: Piano
   - [ ] Rom 10: Piano

Hvor ofte spiller du i omgivelser med svært ulik akustikk?
Markér bare én oval.

- [x] Svært ofte
- [ ] Ofte
- [ ] Noen ganger
- [ ] Sjeldent
- [ ] Svært sjeldent
- [ ] Vet ikke

Testrom

Denne delen repeteres for hvert rom.
Spørsmålene nedenfor er utformet som en påstand. Velg hvor enig du er i påstanden når du vurderer rommets akustikk i lys av øvingsforhold for deg personlig. Velg det alternativet som kommer nærest ditt syn på rommet.

10. **Hvilket rom er dette?**

8

11. **Jeg synes generelt at akustikken er god.**
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [x] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

12. **Rommet hjelper meg med å spille.**
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [x] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

13. **Jeg føler jeg endrer hvordan jeg spiller stykket basert på hvordan stykket høres ut i rommet.**
Markér bare én oval.

- [x] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

14. **Jeg føler jeg endrer spillemåte på...**
Markér bare én oval.

- [ ] En positiv måte
- [x] En negativ måte
- [ ] Vet ikke
- [ ] Jeg endret ikke spillemåte...

Jeg føler at rommet forandrer klangfargen til instrumentet mitt.
Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

16.
Jeg føler at klangfargen til instrumentet ble forandret på...
Markér bare én oval.

- [ ] En positiv måte
- [x] En negativ måte
- [ ] Vet ikke
- [ ] Den ble ikke forandret...

17.
Lyden i rommet er skarp/skingrende.
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [x] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

18.
Lyden i rommet er "boomy"/buldrende/drønnende. (Boxy)
Markér bare én oval.

- [x] Helt enig
- [ ] ~~Delvis~~ enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

19.
Lyden i rommet er metallisk.
Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

Rommet gir meg mulighet til å gjenskape lyden jeg ser for meg i hodet mitt.
Markér bare én oval.

Helt enig
Delvis enig
Nøytral
Delvis uenig
Helt uenig
Vet ikke

21.
Jeg vil komme tilbake hit for å øve så ofte som mulig.
Markér bare én oval.

Helt enig
Delvis enig
Nøytral
Delvis uenig
Helt uenig
Vet ikke

22.
Vurder i hvilken grad de følgende egenskapene var viktige for svaret ditt på spørsmålet over.
For hver egenskap, vurder hvor viktig den er for deg når du avgjør om du ønsker å øve i dette rommet.
Markér bare én oval per rad

	Svært viktig	Ganske viktig	Middels viktig	Noe viktig	Ikke viktig i det hele tatt	Vet ikke
Romklang						
Klangfarge						
Tydelighet						
Balanse mellom mørke og lyse toner						
Balanse mellom instrument og romklang						
Om rommet bærer lyden godt						
Hører detaljer som intonasjon og rytmikk						
Motiverende å spille her						
Forskjell i lyd avhengig av plassering og retning						

Rom 1

Denne delen repeteres for hvert rom.
Spørsmålene nedenfor er utformet som en påstand. Velg hvor enig du er i påstanden når du vurderer rommets akustikk i lys av øvingsforhold for deg personlig. Velg det alternativet som kommer nærest ditt syn på rommet.

23.
Hvilket rom er dette?

3

24.
Jeg synes generelt at akustikken er god.
Markér bare én oval.

Helt enig
Delvis enig
Nøytral
Delvis uenig
Helt uenig
Vet ikke

Rommet hjelper meg med å spille.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

26.
Jeg føler jeg endrer hvordan jeg spiller stykket basert på hvordan stykket høres ut i rommet.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

27.
Jeg føler jeg endrer spillemåte på...
Markér bare én oval.

- En positiv måte
- En negativ måte
- Vet ikke
- Jeg endret ikke spillemåte...

28.
Jeg føler at rommet forandrer klangfargen til instrumentet mitt.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

29.
Jeg føler at klangfargen til instrumentet ble forandret på...
Markér bare én oval.

- En positiv måte
- En negativ måte
- Vet ikke
- Den ble ikke forandret...

30.
Lyden i rommet er skarp/skingrende.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

Lyden i rommet er "boomy"/buldrende/drønnende.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- ☒ Delvis uenig
- Helt uenig
- Vet ikke

32.
Lyden i rommet er metallisk.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- ☒ Helt uenig
- Vet ikke

33.
Rommet gir meg mulighet til å gjenskape lyden jeg ser for meg i hodet mitt.
Markér bare én oval.

- Helt enig
- ☒ Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

34.
Jeg vil komme tilbake hit for å øve så ofte som mulig.
Markér bare én oval.

- Helt enig
- ☒ Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

Vurder i hvilken grad de følgende egenskapene var viktige for svaret ditt på spørsmålet over.
For hver egenskap, vurder hvor viktig den er for deg når du avgjør om du ønsker å øve i dette rommet.
Markér bare én oval per rad

	Svært viktig	Ganske viktig	Middels viktig	Noe viktig	Ikke viktig i det hele tatt	Vet ikke
Romklang	X					
Klangfarge	X					
Tydelighet		X				
Balanse mellom mørke og lyse toner		X				
Balanse mellom instrument og romklang	X					
Om rommet bærer lyden godt	X					
Hører detaljer som intonasjon og rytmikk						
Motiverende å spille her			X			
Forskjell i lyd avhengig av plassering og retning		X				

Rom 2

Denne delen repeteres for hvert rom.
Spørsmålene nedenfor er utformet som en påstand. Velg hvor enig du er i påstanden når du vurderer rommets akustikk i lys av øvingsforhold for deg personlig. Velg det alternativet som kommer nærest ditt syn på rommet.

36.
Hvilket rom er dette?

7

37.
Jeg synes generelt at akustikken er god.
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [x] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

38.
Rommet hjelper meg med å spille.
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [x] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

39.
Jeg føler jeg endrer hvordan jeg spiller stykket basert på hvordan stykket høres ut i rommet.
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [x] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

Jeg føler jeg endrer spillemåte på...
Markér bare én oval.

- [ ] En positiv måte
- [x] En negativ måte
- [ ] Vet ikke
- [ ] Jeg endret ikke spillemåte...

41. **Jeg føler at rommet forandrer klangfargen til instrumentet mitt.**
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [x] Vet ikke

42. **Jeg føler at klangfargen til instrumentet ble forandret på...**
Markér bare én oval.

- [ ] En positiv måte
- [ ] En negativ måte
- [x] Vet ikke
- [ ] Den ble ikke forandret...

43. **Lyden i rommet er skarp/skingrende.**
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [x] Helt uenig
- [ ] Vet ikke

44. **Lyden i rommet er "boomy"/buldrende/drønnende.**
Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

45. **Lyden i rommet er metallisk.**
Markér bare én oval.

- [x] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

Rommet gir meg mulighet til å gjenskape lyden jeg ser for meg i hodet mitt.
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [x] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

47.
Jeg vil komme tilbake hit for å øve så ofte som mulig.
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [x] Helt uenig
- [ ] Vet ikke

48.
Vurder i hvilken grad de følgende egenskapene var viktige for svaret ditt på spørsmålet over.
For hver egenskap, vurder hvor viktig den er for deg når du avgjør om du ønsker å øve i dette rommet.
Markér bare én oval per rad.

	Svært viktig	Ganske viktig	Middels viktig	Noe viktig	Ikke viktig i det hele tatt	Vet ikke
Romklang	X					
Klangfarge	X					
Tydelighet		X				
Balanse mellom mørke og lyse toner				X		
Balanse mellom instrument og romklang			X			
Om rommet bærer lyden godt					X	
Hører detaljer som intonasjon og rytmikk			X			
Motiverende å spille her	X					
Forskjell i lyd avhengig av plassering og retning				X		

Rom 3

Denne delen repeteres for hvert rom.
Spørsmålene nedenfor er utformet som en påstand. Velg hvor enig du er i påstanden når du vurderer rommets akustikk i lys av øvingsforhold for deg personlig. Velg det alternativet som kommer nærest ditt syn på rommet.

49.
Hvilket rom er dette?

9

50.
Jeg synes generelt at akustikken er god.
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [x] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

Rommet hjelper meg med å spille.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

52. **Jeg føler jeg endrer hvordan jeg spiller stykket basert på hvordan stykket høres ut i rommet.**
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

53. **Jeg føler jeg endrer spillemåte på...**
Markér bare én oval.

- En positiv måte
- En negativ måte
- Vet ikke
- Jeg endret ikke spillemåte...

54. **Jeg føler at rommet forandrer klangfargen til instrumentet mitt.**
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

55. **Jeg føler at klangfargen til instrumentet ble forandret på...**
Markér bare én oval.

- En positiv måte
- En negativ måte
- Vet ikke
- Den ble ikke forandret...

56. **Lyden i rommet er skarp/skingrende.**
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

Lyden i rommet er "boomy"/buldrende/drønnende.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

58.
Lyden i rommet er metallisk.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

59.
Rommet gir meg mulighet til å gjenskape lyden jeg ser for meg i hodet mitt.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

60.
Jeg vil komme tilbake hit for å øve så ofte som mulig.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

Vurder i hvilken grad de følgende egenskapene var viktige for svaret ditt på spørsmålet over.
For hver egenskap, vurder hvor viktig den er for deg når du avgjør om du ønsker å øve i dette rommet.
Markér bare én oval per rad

	Svært viktig	Ganske viktig	Middels viktig	Noe viktig	Ikke viktig i det hele tatt	Vet ikke
Romklang						
Klangfarge						
Tydelighet						
Balanse mellom mørke og lyse toner						
Balanse mellom instrument og romklang						
Om rommet bærer lyden godt						
Hører detaljer som intonasjon og rytmikk						
Motiverende å spille her						
Forskjell i lyd avhengig av plassering og retning						

Rom 4

Denne delen repeteres for hvert rom.
Spørsmålene nedenfor er utformet som en påstand. Velg hvor enig du er i påstanden når du vurderer rommets akustikk i lys av øvingsforhold for deg personlig. Velg det alternativet som kommer nærest ditt syn på rommet.

62. **Hvilket rom er dette?**

10

63. **Jeg synes generelt at akustikken er god.**
Markér bare én oval

- [x] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

64. **Rommet hjelper meg med å spille.**
Markér bare én oval

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

65. **Jeg føler jeg endrer hvordan jeg spiller stykket basert på hvordan stykket høres ut i rommet.**
Markér bare én oval

- [x] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

Jeg føler jeg endrer spillemåte på...
Markér bare én oval.

- [x] En positiv måte
- [ ] En negativ måte
- [ ] Vet ikke
- [ ] Jeg endret ikke spillemåte...

67.
Jeg føler at rommet forandrer klangfargen til instrumentet mitt.
Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

68.
Jeg føler at klangfargen til instrumentet ble forandret på...
Markér bare én oval.

- [x] En positiv måte
- [ ] En negativ måte
- [ ] Vet ikke
- [ ] Den ble ikke forandret...

69.
Lyden i rommet er skarp/skingrende.
Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

70.
Lyden i rommet er "boomy"/buldrende/drønnende.
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [x] Helt uenig
- [ ] Vet ikke

71.
Lyden i rommet er metallisk.
Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

Rommet gir meg mulighet til å gjenskape lyden jeg ser for meg i hodet mitt.
Markér bare én oval.

- Helt enig
- [x] Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

73.
Jeg vil komme tilbake hit for å øve så ofte som mulig.
Markér bare én oval.

- Helt enig
- [x] Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

74.
Vurder i hvilken grad de følgende egenskapene var viktige for svaret ditt på spørsmålet over.
For hver egenskap, vurder hvor viktig den er for deg når du avgjør om du ønsker å øve i dette rommet.
Markér bare én oval per rad

	Svært viktig	Ganske viktig	Middels viktig	Noe viktig	Ikke viktig i det hele tatt	Vet ikke
Romklang	X					
Klangfarge	X					
Tydelighet	X					
Balanse mellom mørke og lyse toner		X				
Balanse mellom instrument og romklang	X					
Om rommet bærer lyden godt		X				
Hører detaljer som intonasjon og rytmikk			X			
Motiverende å spille her		X				
Forskjell i lyd avhengig av plassering og retning				X		

Helt til slutt

75.
Jeg blir svært påvirket av akustikken i et rom når jeg spiller på instrumentet mitt.
Markér bare én oval.

- Helt enig
- [x] Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

Hva er viktig for deg med et godt øvingsrom?

At lyden bærer godt
Fysisk størrelse
Inneklima

77.
Hvilket rom likte du best? Ranger rommene i rekkefølge fra likte best øverst til likte dårligst nederst.

~~8~~ 3
10
9
7
(8)

78.
Har du noen ekstra kommentarer?

Tusen takk!

Spørreundersøkelse

Under denne undersøkelsen skal du spille det samme musikkstykket i 5 forskjellige rom og gjøre en lyttetest der du produserer lyden. Det første rommet er et testrom for at du skal bli kjent med metoden og spørreskjemaet. Fokuser på opplevelsen av rommet og samspillet med instrumentet ditt når du spiller, og prøv å ikke fokusere på spørsmålene som skal besvares. Etter du har spilt i et rom, fyller du ut skjemaet. Det er ett skjema per rom.

1. **Deltakeridentifikasjon (velg fire bokstaver eller tall)**

   XY2A

2. **Alder**

   28

3. **Kjønn**

   Mann

4. **Har du normal hørsel?**

   Markér bare én oval.

   - [x] Ja
   - [ ] Nei

5. **Hvilket instrument underviser du i?**

   Slagverk

6. **Hvor lenge har du spilt dette instrumentet?**

   begynte som 7åring

7. **Hvor lenge har du undervist i disse lokalene?**

   9mnd

8. **Hvilke(t) øvingsrom bruker du regelmessig?**

   Merk av for alt som passer

   - [ ] Rom 1: Klarinett/sax
   - [ ] Rom 2: Fløyte
   - [ ] Rom 3: Messing
   - [ ] Rom 4: Gitar
   - [ ] Rom 5: Gitar
   - [x] Rom 6: Slagverk
   - [ ] Rom 7: Sang
   - [ ] Rom 8: Fiolin/cello
   - [ ] Rom 9: Piano
   - [ ] Rom 10: Piano

Hvor ofte spiller du i omgivelser med svært ulik akustikk?

Markér bare én oval.

- [x] Svært ofte
- [ ] Ofte
- [ ] Noen ganger
- [ ] Sjeldent
- [ ] Svært sjeldent
- [ ] Vet ikke

Testrom

Denne delen repeteres for hvert rom.

Spørsmålene nedenfor er utformet som en påstand. Velg hvor enig du er i påstanden når du vurderer rommets akustikk i lys av øvingsforhold for deg personlig. Velg det alternativet som kommer nærest ditt syn på rommet.

10.

Hvilket rom er dette?

testrom 8

11.

Jeg synes generelt at akustikken er god.

Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

12.

Rommet hjelper meg med å spille.

Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [x] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

13.

Jeg føler jeg endrer hvordan jeg spiller stykket basert på hvordan stykket høres ut i rommet.

Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

14.

Jeg føler jeg endrer spillemåte på...

Markér bare én oval.

- [x] En positiv måte
- [ ] En negativ måte
- [ ] Vet ikke
- [ ] Jeg endret ikke spillemåte...

Jeg føler at rommet forandrer klangfargen til instrumentet mitt.
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [x] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

16.
Jeg føler at klangfargen til instrumentet ble forandret på...
Markér bare én oval.

- [ ] En positiv måte
- [ ] En negativ måte
- [ ] Vet ikke
- [x] Den ble ikke forandret...

17.
Lyden i rommet er skarp/skingrende.
Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

18.
Lyden i rommet er "boomy"/buldrende/drønnende.
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [x] Helt uenig
- [ ] Vet ikke

19.
Lyden i rommet er metallisk.
Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

Rommet gir meg mulighet til å gjenskape lyden jeg ser for meg i hodet mitt.
Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

21.
Jeg vil komme tilbake hit for å øve så ofte som mulig.
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [x] Helt uenig
- [ ] Vet ikke

22.
Vurder i hvilken grad de følgende egenskapene var viktige for svaret ditt på spørsmålet over.
For hver egenskap, vurder hvor viktig den er for deg når du avgjør om du ønsker å øve i dette rommet.
Markér bare én oval per rad

	Svært viktig	Ganske viktig	Middels viktig	Noe viktig	Ikke viktig i det hele tatt	Vet ikke
Romklang	✓					
Klangfarge				✓		
Tydelighet				✓		
Balanse mellom mørke og lyse toner			✓			
Balanse mellom instrument og romklang		✓				
Om rommet bærer lyden godt				✓		
Hører detaljer som intonasjon og rytmikk					✓	
Motiverende å spille her		✓				
Forskjell i lyd avhengig av plassering og retning						✓

Rom 1

Denne delen repeteres for hvert rom.
Spørsmålene nedenfor er utformet som en påstand. Velg hvor enig du er i påstanden når du vurderer rommets akustikk i lys av øvingsforhold for deg personlig. Velg det alternativet som kommer nærest ditt syn på rommet.

23.
Hvilket rom er dette?

10

24.
Jeg synes generelt at akustikken er god.
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [x] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

Rommet hjelper meg med å spille.
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [x] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

26.
Jeg føler jeg endrer hvordan jeg spiller stykket basert på hvordan stykket høres ut i rommet.
Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

27.
Jeg føler jeg endrer spillemåte på...
Markér bare én oval.

- [x] En positiv måte
- [ ] En negativ måte
- [ ] Vet ikke
- [ ] Jeg endret ikke spillemåte...

28.
Jeg føler at rommet forandrer klangfargen til instrumentet mitt.
Markér bare én oval.

- [x] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

29.
Jeg føler at klangfargen til instrumentet ble forandret på...
Markér bare én oval.

- [ ] En positiv måte
- [x] En negativ måte
- [ ] Vet ikke
- [ ] Den ble ikke forandret...

30.
Lyden i rommet er skarp/skingrende.
Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

Lyden i rommet er "boomy"/buldrende/drønnende.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

32.
Lyden i rommet er metallisk.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

33.
Rommet gir meg mulighet til å gjenskape lyden jeg ser for meg i hodet mitt.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

34.
Jeg vil komme tilbake hit for å øve så ofte som mulig.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

Vurder i hvilken grad de følgende egenskapene var viktige for svaret ditt på spørsmålet over.
For hver egenskap, vurder hvor viktig den er for deg når du avgjør om du ønsker å øve i dette rommet.
Markér bare én oval per rad

	Svært viktig	Ganske viktig	Middels viktig	Noe viktig	Ikke viktig i det hele tatt	Vet ikke
Romklang	✓					
Klangfarge		✓				
Tydelighet				✓		
Balanse mellom mørke og lyse toner			✓			
Balanse mellom instrument og romklang		✓				
Om rommet bærer lyden godt					✓	
Hører detaljer som intonasjon og rytmikk				✓		
Motiverende å spille her			✓			
Forskjell i lyd avhengig av plassering og retning					✓	

Rom 2

Denne delen repeteres for hvert rom.
Spørsmålene nedenfor er utformet som en påstand. Velg hvor enig du er i påstanden når du vurderer rommets akustikk i lys av øvingsforhold for deg personlig. Velg det alternativet som kommer nærest ditt syn på rommet.

36. **Hvilket rom er dette?**

9

37. **Jeg synes generelt at akustikken er god.**
Markér bare én oval.

- ✓ Helt enig
- ○ Delvis enig
- ○ Nøytral
- ○ Delvis uenig
- ○ Helt uenig
- ○ Vet ikke

38. **Rommet hjelper meg med å spille.**
Markér bare én oval.

- ○ Helt enig
- ○ Delvis enig
- ○ Nøytral
- ✓ Delvis uenig
- ○ Helt uenig
- ○ Vet ikke

39. **Jeg føler jeg endrer hvordan jeg spiller stykket basert på hvordan stykket høres ut i rommet.**
Markér bare én oval.

- ○ Helt enig
- ○ Delvis enig
- ✓ Nøytral
- ○ Delvis uenig
- ○ Helt uenig
- ○ Vet ikke

Jeg føler jeg endrer spillemåte på...
Markér bare én oval.

- En positiv måte
- En negativ måte
- Vet ikke
- Jeg endret ikke spillemåte...

41. **Jeg føler at rommet forandrer klangfargen til instrumentet mitt.**
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

42. **Jeg føler at klangfargen til instrumentet ble forandret på...**
Markér bare én oval.

- En positiv måte
- En negativ måte
- Vet ikke
- Den ble ikke forandret...

43. **Lyden i rommet er skarp/skingrende.**
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

44. **Lyden i rommet er "boomy"/buldrende/drønnende.**
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

45. **Lyden i rommet er metallisk.**
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

Rommet gir meg mulighet til å gjenskape lyden jeg ser for meg i hodet mitt.
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [x] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

47.
Jeg vil komme tilbake hit for å øve så ofte som mulig.
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [x] Helt uenig
- [ ] Vet ikke

48.
Vurder i hvilken grad de følgende egenskapene var viktige for svaret ditt på spørsmålet over.
For hver egenskap, vurder hvor viktig den er for deg når du avgjør om du ønsker å øve i dette rommet.
Markér bare én oval per rad.

	Svært viktig	Ganske viktig	Middels viktig	Noe viktig	Ikke viktig i det hele tatt	Vet ikke
Romklang	✓					
Klangfarge		✓				
Tydelighet				✓		
Balanse mellom mørke og lyse toner		✓				
Balanse mellom instrument og romklang			✓			
Om rommet bærer lyden godt					✓	
Hører detaljer som intonasjon og rytmikk			✓			
Motiverende å spille her			✓			
Forskjell i lyd avhengig av plassering og retning						✓

Rom 3

Denne delen repeteres for hvert rom.
Spørsmålene nedenfor er utformet som en påstand. Velg hvor enig du er i påstanden når du vurderer rommets akustikk i lys av øvingsforhold for deg personlig. Velg det alternativet som kommer nærest ditt syn på rommet.

49.
Hvilket rom er dette?

7

50.
Jeg synes generelt at akustikken er god.
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [x] Helt uenig
- [ ] Vet ikke

Rommet hjelper meg med å spille.

Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [x] Helt uenig
- [ ] Vet ikke

52.

Jeg føler jeg endrer hvordan jeg spiller stykket basert på hvordan stykket høres ut i rommet.

Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

53.

Jeg føler jeg endrer spillemåte på...

Markér bare én oval.

- [ ] En positiv måte
- [x] En negativ måte
- [ ] Vet ikke
- [ ] Jeg endret ikke spillemåte...

54.

Jeg føler at rommet forandrer klangfargen til instrumentet mitt.

Markér bare én oval.

- [x] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

55.

Jeg føler at klangfargen til instrumentet ble forandret på...

Markér bare én oval.

- [ ] En positiv måte
- [x] En negativ måte
- [ ] Vet ikke
- [ ] Den ble ikke forandret...

56.

Lyden i rommet er skarp/skingrende.

Markér bare én oval.

- [x] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

Lyden i rommet er "boomy"/buldrende/drønnende.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

58.
Lyden i rommet er metallisk.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

59.
Rommet gir meg mulighet til å gjenskape lyden jeg ser for meg i hodet mitt.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

60.
Jeg vil komme tilbake hit for å øve så ofte som mulig.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

Vurder i hvilken grad de følgende egenskapene var viktige for svaret ditt på spørsmålet over.

For hver egenskap, vurder hvor viktig den er for deg når du avgjør om du ønsker å øve i dette rommet.

Markér bare én oval per rad

	Svært viktig	Ganske viktig	Middels viktig	Noe viktig	Ikke viktig i det hele tatt	Vet ikke
Romklang	✓					
Klangfarge		✓				
Tydelighet				✓		
Balanse mellom mørke og lyse toner		✓				
Balanse mellom instrument og romklang					✓	
Om rommet bærer lyden godt					✓	
Hører detaljer som intonasjon og rytmikk				✓		
Motiverende å spille her			✓			
Forskjell i lyd avhengig av plassering og retning						✓

Rom 4

Denne delen repeteres for hvert rom.

Spørsmålene nedenfor er utformet som en påstand. Velg hvor enig du er i påstanden når du vurderer rommets akustikk i lys av øvingsforhold for deg personlig. Velg det alternativet som kommer nærest ditt syn på rommet.

62.

Hvilket rom er dette?

3

63.

Jeg synes generelt at akustikken er god.

Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

64.

Rommet hjelper meg med å spille.

Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

65.

Jeg føler jeg endrer hvordan jeg spiller stykket basert på hvordan stykket høres ut i rommet.

Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [x] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

Jeg føler jeg endrer spillemåte på...
Markér bare én oval.

- [ ] En positiv måte
- [ ] En negativ måte
- [ ] Vet ikke
- [x] Jeg endret ikke spillemåte...

67.
Jeg føler at rommet forandrer klangfargen til instrumentet mitt.
Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

68.
Jeg føler at klangfargen til instrumentet ble forandret på...
Markér bare én oval.

- [x] En positiv måte
- [ ] En negativ måte
- [ ] Vet ikke
- [ ] Den ble ikke forandret...

69.
Lyden i rommet er skarp/skingrende.
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [x] Helt uenig
- [ ] Vet ikke

70.
Lyden i rommet er "boomy"/buldrende/drønnende.
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [x] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

71.
Lyden i rommet er metallisk.
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [x] Helt uenig
- [ ] Vet ikke

Rommet gir meg mulighet til å gjenskape lyden jeg ser for meg i hodet mitt.

Markér bare én oval.

- ( ) Helt enig
- ( ) Delvis enig
- (✓) Nøytral
- ( ) Delvis uenig
- ( ) Helt uenig
- ( ) Vet ikke

73. **Jeg vil komme tilbake hit for å øve så ofte som mulig.**

Markér bare én oval.

- ( ) Helt enig
- ( ) Delvis enig
- ( ) Nøytral
- ( ) Delvis uenig
- (✓) Helt uenig
- ( ) Vet ikke

74. **Vurder i hvilken grad de følgende egenskapene var viktige for svaret ditt på spørsmålet over.**

For hver egenskap, vurder hvor viktig den er for deg når du avgjør om du ønsker å øve i dette rommet.
Markér bare én oval per rad.

	Svært viktig	Ganske viktig	Middels viktig	Noe viktig	Ikke viktig i det hele tatt	Vet ikke
Romklang		✓				
Klangfarge	✓					
Tydelighet				✓		
Balanse mellom mørke og lyse toner		✓				
Balanse mellom instrument og romklang			✓			
Om rommet bærer lyden godt					✓	
Hører detaljer som intonasjon og rytmikk		✓				
Motiverende å spille her				✓		
Forskjell i lyd avhengig av plassering og retning						✓

Helt til slutt

75. **Jeg blir svært påvirket av akustikken i et rom når jeg spiller på instrumentet mitt.**

Markér bare én oval.

- (✓) Helt enig
- ( ) Delvis enig
- ( ) Nøytral
- ( ) Delvis uenig
- ( ) Helt uenig
- ( ) Vet ikke

Hva er viktig for deg med et godt øvingsrom?

Godt med demping av lyd, men alikevell ballansert mellom høye og lave frekvenser.

77.
Hvilket rom likte du best? Ranger rommene i rekkefølge fra likte best øverst til likte dårligst nederst.

9
3
10
7

78.
Har du noen ekstra kommentarer?

Akkustiske pianoer farger klangen i noen rom.
Hadde kun en plassering i alle rom.

Tusen takk!

Spørreundersøkelse

Under denne undersøkelsen skal du spille det samme musikkstykket i 5 forskjellige rom og gjøre en lyttetest der du produserer lyden. Det første rommet er et testrom for at du skal bli kjent med metoden og spørreskjemaet. Fokuser på opplevelsen av rommet og samspillet med instrumentet ditt når du spiller, og prøv å ikke fokusere på spørsmålene som skal besvares. Etter du har spilt i et rom, fyller du ut skjemaet. Det er ett skjema per rom.

1. **Deltakeridentifikasjon (velg fire bokstaver eller tall)**

   TE59

2. **Alder**

   58

3. **Kjønn**

   Mann

4. **Har du normal hørsel?**

   Markér bare én oval.

   - [x] Ja
   - [ ] Nei

5. **Hvilket instrument underviser du i?**

   Klarinett

6. **Hvor lenge har du spilt dette instrumentet?**

   51 år

7. **Hvor lenge har du undervist i disse lokalene?**

   18 mnd.

8. **Hvilke(t) øvingsrom bruker du regelmessig?**

   Merk av for alt som passer

   - [x] Rom 1: Klarinett/sax
   - [x] Rom 2: Fløyte
   - [ ] Rom 3: Messing
   - [ ] Rom 4: Gitar
   - [ ] Rom 5: Gitar
   - [ ] Rom 6: Slagverk
   - [ ] Rom 7: Sang
   - [ ] Rom 8: Fiolin/cello
   - [ ] Rom 9: Piano
   - [ ] Rom 10: Piano

Hvor ofte spiller du i omgivelser med svært ulik akustikk?
Markér bare én oval.

- [x] Svært ofte
- [ ] Ofte
- [ ] Noen ganger
- [ ] Sjeldent
- [ ] Svært sjeldent
- [ ] Vet ikke

Testrom

Denne delen repeteres for hvert rom.
Spørsmålene nedenfor er utformet som en påstand. Velg hvor enig du er i påstanden når du vurderer rommets akustikk i lys av øvingsforhold for deg personlig. Velg det alternativet som kommer nærest ditt syn på rommet.

10.
Hvilket rom er dette?

8

11.
Jeg synes generelt at akustikken er god.
Markér bare én oval.

- [x] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

12.
Rommet hjelper meg med å spille.
Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

13.
Jeg føler jeg endrer hvordan jeg spiller stykket basert på hvordan stykket høres ut i rommet.
Markér bare én oval.

- [x] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

14.
Jeg føler jeg endrer spillemåte på...
Markér bare én oval.

- [x] En positiv måte
- [ ] En negativ måte
- [ ] Vet ikke
- [ ] Jeg endret ikke spillemåte...

Jeg føler at rommet forandrer klangfargen til instrumentet mitt.
Markér bare én oval.

- [x] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

16.
Jeg føler at klangfargen til instrumentet ble forandret på...
Markér bare én oval.

- [ ] En positiv måte
- [x] En negativ måte
- [ ] Vet ikke
- [ ] Den ble ikke forandret...

17.
Lyden i rommet er skarp/skingrende.
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [x] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

18.
Lyden i rommet er "boomy"/buldrende/drønnende.
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [x] Helt uenig
- [ ] Vet ikke

19.
Lyden i rommet er metallisk.
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [x] Helt uenig
- [ ] Vet ikke

Rommet gir meg mulighet til å gjenskape lyden jeg ser for meg i hodet mitt.
Markér bare én oval.

- ( ) Helt enig
- (X) Delvis enig
- ( ) Nøytral
- ( ) Delvis uenig
- ( ) Helt uenig
- ( ) Vet ikke

21.
Jeg vil komme tilbake hit for å øve så ofte som mulig.
Markér bare én oval.

- ( ) Helt enig
- (X) Delvis enig
- ( ) Nøytral
- ( ) Delvis uenig
- ( ) Helt uenig
- ( ) Vet ikke

22.
Vurder i hvilken grad de følgende egenskapene var viktige for svaret ditt på spørsmålet over.
For hver egenskap, vurder hvor viktig den er for deg når du avgjør om du ønsker å øve i dette rommet.
Markér bare én oval per rad

	Svært viktig	Ganske viktig	Middels viktig	Noe viktig	Ikke viktig i det hele tatt	Vet ikke
Romklang	X					
Klangfarge	X					
Tydelighet		X				
Balanse mellom mørke og lyse toner	X					
Balanse mellom instrument og romklang	X					
Om rommet bærer lyden godt	X					
Hører detaljer som intonasjon og rytmikk	X					
Motiverende å spille her	X					
Forskjell i lyd avhengig av plassering og retning		X				

Rom 1

Denne delen repeteres for hvert rom.
Spørsmålene nedenfor er utformet som en påstand. Velg hvor enig du er i påstanden når du vurderer rommets akustikk i lys av øvingsforhold for deg personlig. Velg det alternativet som kommer nærest ditt syn på rommet.

23.
Hvilket rom er dette?

G

24.
Jeg synes generelt at akustikken er god.
Markér bare én oval.

- (X) Helt enig
- ( ) Delvis enig
- ( ) Nøytral
- ( ) Delvis uenig
- ( ) Helt uenig
- ( ) Vet ikke

Rommet hjelper meg med å spille.
Markér bare én oval.

- [x] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

26.
Jeg føler jeg endrer hvordan jeg spiller stykket basert på hvordan stykket høres ut i rommet.
Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

27.
Jeg føler jeg endrer spillemåte på...
Markér bare én oval.

- [x] En positiv måte
- [ ] En negativ måte
- [ ] Vet ikke
- [ ] Jeg endret ikke spillemåte...

28.
Jeg føler at rommet forandrer klangfargen til instrumentet mitt.
Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

29.
Jeg føler at klangfargen til instrumentet ble forandret på...
Markér bare én oval.

- [x] En positiv måte
- [ ] En negativ måte
- [ ] Vet ikke
- [ ] Den ble ikke forandret...

30.
Lyden i rommet er skarp/skingrende.
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [x] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

Lyden i rommet er "boomy"/buldrende/drønnende.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- [x] Helt uenig
- Vet ikke

32.
Lyden i rommet er metallisk.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- [x] Helt uenig
- Vet ikke

33.
Rommet gir meg mulighet til å gjenskape lyden jeg ser for meg i hodet mitt.
Markér bare én oval.

- [x] Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

34.
Jeg vil komme tilbake hit for å øve så ofte som mulig.
Markér bare én oval.

- Helt enig
- [x] Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

Vurder i hvilken grad de følgende egenskapene var viktige for svaret ditt på spørsmålet over.
For hver egenskap, vurder hvor viktig den er for deg når du avgjør om du ønsker å øve i dette rommet.
Markér bare én oval per rad

	Svært viktig	Ganske viktig	Middels viktig	Noe viktig	Ikke viktig i det hele tatt	Vet ikke
Romklang	X					
Klangfarge	X					
Tydelighet		X				
Balanse mellom mørke og lyse toner	X					
Balanse mellom instrument og romklang	X					
Om rommet bærer lyden godt	X					
Hører detaljer som intonasjon og rytmikk	X					
Motiverende å spille her	X					
Forskjell i lyd avhengig av plassering og retning	X	X				

Rom 2

Denne delen repeteres for hvert rom.
Spørsmålene nedenfor er utformet som en påstand. Velg hvor enig du er i påstanden når du vurderer rommets akustikk i lys av øvingsforhold for deg personlig. Velg det alternativet som kommer nærest ditt syn på rommet.

36.
Hvilket rom er dette?

3

37.
Jeg synes generelt at akustikken er god.
Markér bare én oval

- [x] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

38.
Rommet hjelper meg med å spille.
Markér bare én oval

- [x] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

39.
Jeg føler jeg endrer hvordan jeg spiller stykket basert på hvordan stykket høres ut i rommet.
Markér bare én oval

- [ ] Helt enig
- [ ] Delvis enig
- [x] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

Jeg føler jeg endrer spillemåte på...
Markér bare én oval.

- [ ] En positiv måte
- [ ] En negativ måte
- [ ] Vet ikke
- [x] Jeg endret ikke spillemåte...

41. **Jeg føler at rommet forandrer klangfargen til instrumentet mitt.**
Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

42. **Jeg føler at klangfargen til instrumentet ble forandret på...**
Markér bare én oval.

- [x] En positiv måte
- [ ] En negativ måte
- [ ] Vet ikke
- [ ] Den ble ikke forandret...

43. **Lyden i rommet er skarp/skingrende.**
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [x] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

44. **Lyden i rommet er "boomy"/buldrende/drønnende.**
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [x] Helt uenig
- [ ] Vet ikke

45. **Lyden i rommet er metallisk.**
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [x] Helt uenig
- [ ] Vet ikke

Rommet gir meg mulighet til å gjenskape lyden jeg ser for meg i hodet mitt.
Markér bare én oval.

- [x] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

47.
Jeg vil komme tilbake hit for å øve så ofte som mulig.
Markér bare én oval.

- [x] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

48.
Vurder i hvilken grad de følgende egenskapene var viktige for svaret ditt på spørsmålet over.
For hver egenskap, vurder hvor viktig den er for deg når du avgjør om du ønsker å øve i dette rommet.
Markér bare én oval per rad.

	Svært viktig	Ganske viktig	Middels viktig	Noe viktig	Ikke viktig i det hele tatt	Vet ikke
Romklang	X					
Klangfarge	X					
Tydelighet		X				
Balanse mellom mørke og lyse toner	X					
Balanse mellom instrument og romklang	X					
Om rommet bærer lyden godt	X					
Hører detaljer som intonasjon og rytmikk	X					
Motiverende å spille her	X					
Forskjell i lyd avhengig av plassering og retning		X				

Rom 3

Denne delen repeteres for hvert rom.
Spørsmålene nedenfor er utformet som en påstand. Velg hvor enig du er i påstanden når du vurderer rommets akustikk i lys av øvingsforhold for deg personlig. Velg det alternativet som kommer nærest ditt syn på rommet.

49.
Hvilket rom er dette?

10

50.
Jeg synes generelt at akustikken er god.
Markér bare én oval.

- [x] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

Rommet hjelper meg med å spille.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

52.
Jeg føler jeg endrer hvordan jeg spiller stykket basert på hvordan stykket høres ut i rommet.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

53.
Jeg føler jeg endrer spillemåte på...
Markér bare én oval.

- En positiv måte
- En negativ måte
- Vet ikke
- Jeg endret ikke spillemåte...

54.
Jeg føler at rommet forandrer klangfargen til instrumentet mitt.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

55.
Jeg føler at klangfargen til instrumentet ble forandret på...
Markér bare én oval.

- En positiv måte
- En negativ måte
- Vet ikke
- Den ble ikke forandret...

56.
Lyden i rommet er skarp/skingrende.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

Lyden i rommet er "boomy"/buldrende/drønnende.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

58.
Lyden i rommet er metallisk.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

59.
Rommet gir meg mulighet til å gjenskape lyden jeg ser for meg i hodet mitt.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

60.
Jeg vil komme tilbake hit for å øve så ofte som mulig.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

Vurder i hvilken grad de følgende egenskapene var viktige for svaret ditt på spørsmålet over.
For hver egenskap, vurder hvor viktig den er for deg når du avgjør om du ønsker å øve i dette rommet.
Markér bare én oval per rad

	Svært viktig	Ganske viktig	Middels viktig	Noe viktig	Ikke viktig i det hele tatt	Vet ikke
Romklang	X					
Klangfarge	X					
Tydelighet		X				
Balanse mellom mørke og lyse toner	X					
Balanse mellom instrument og romklang	X					
Om rommet bærer lyden godt	X					
Hører detaljer som intonasjon og rytmikk	X					
Motiverende å spille her	X					
Forskjell i lyd avhengig av plassering og retning		X				

Rom 4

Denne delen repeteres for hvert rom.
Spørsmålene nedenfor er utformet som en påstand. Velg hvor enig du er i påstanden når du vurderer rommets akustikk i lys av øvingsforhold for deg personlig. Velg det alternativet som kommer nærest ditt syn på rommet.

62.
Hvilket rom er dette?

7

63.
Jeg synes generelt at akustikken er god.
Markér bare én oval.

- ( ) Helt enig
- (X) Delvis enig
- ( ) Nøytral
- ( ) Delvis uenig
- ( ) Helt uenig
- ( ) Vet ikke

64.
Rommet hjelper meg med å spille.
Markér bare én oval.

- ( ) Helt enig
- (X) Delvis enig
- ( ) Nøytral
- ( ) Delvis uenig
- ( ) Helt uenig
- ( ) Vet ikke

65.
Jeg føler jeg endrer hvordan jeg spiller stykket basert på hvordan stykket høres ut i rommet.
Markér bare én oval.

- ( ) Helt enig
- (X) Delvis enig
- ( ) Nøytral
- ( ) Delvis uenig
- ( ) Helt uenig
- ( ) Vet ikke

Jeg føler jeg endrer spillemåte på...
Markér bare én oval.

- En positiv måte
- En negativ måte
- Vet ikke
- Jeg endret ikke spillemåte...

67.
Jeg føler at rommet forandrer klangfargen til instrumentet mitt.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

68.
Jeg føler at klangfargen til instrumentet ble forandret på...
Markér bare én oval.

- En positiv måte
- En negativ måte
- Vet ikke
- Den ble ikke forandret...

69.
Lyden i rommet er skarp/skingrende.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

70.
Lyden i rommet er "boomy"/buldrende/drønnende.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

71.
Lyden i rommet er metallisk.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

Rommet gir meg mulighet til å gjenskape lyden jeg ser for meg i hodet mitt.
Markér bare én oval.

- [x] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

73.
Jeg vil komme tilbake hit for å øve så ofte som mulig.
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [x] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

74.
Vurder i hvilken grad de følgende egenskapene var viktige for svaret ditt på spørsmålet over.
For hver egenskap, vurder hvor viktig den er for deg når du avgjør om du ønsker å øve i dette rommet.
Markér bare én oval per rad.

	Svært viktig	Ganske viktig	Middels viktig	Noe viktig	Ikke viktig i det hele tatt	Vet ikke
Romklang	X					
Klangfarge	X					
Tydelighet		X				
Balanse mellom mørke og lyse toner						
Balanse mellom instrument og romklang	X					
Om rommet bærer lyden godt	X					
Hører detaljer som intonasjon og rytmikk	X					
Motiverende å spille her	X					
Forskjell i lyd avhengig av plassering og retning		X				

Helt til slutt

75.
Jeg blir svært påvirket av akustikken i et rom når jeg spiller på instrumentet mitt.
Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

Hva er viktig for deg med et godt øvingsrom?

God akustikk
~~Estetikk~~ Respons fra rommet
Temperatur
Farger
Gode lysforhold

77.
Hvilket rom likte du best? Ranger rommene i rekkefølge fra likte best øverst til likte dårligst nederst.

3
9
10
7

78.
Har du noen ekstra kommentarer?

Generelt veldig gode rom
Overtoner i klaver kan
virke litt forstyrrende

Tusen takk!

Drevet av
Google Forms

Spørreundersøkelse

Under denne undersøkelsen skal du spille det samme musikkstykket i 5 forskjellige rom og gjøre en lyttetest der du produserer lyden. Det første rommet er et testrom for at du skal bli kjent med metoden og spørreskjemaet. Fokuser på opplevelsen av rommet og samspillet med instrumentet ditt når du spiller, og prøv å ikke fokusere på spørsmålene som skal besvares. Etter du har spilt i et rom, fyller du ut skjemaet. Det er ett skjema per rom.

1. **Deltakeridentifikasjon (velg fire bokstaver eller tall)**

   KARI

2. **Alder**

   35

3. **Kjønn**

   KVINNE

4. **Har du normal hørsel?**

   Markér bare én oval.

   - [x] Ja
   - [ ] Nei

5. **Hvilket instrument underviser du i?**

   FløYTE

6. **Hvor lenge har du spilt dette instrumentet?**

   28år

7. **Hvor lenge har du undervist i disse lokalene?**

   2år? 1½?

8. **Hvilke(t) øvingsrom bruker du regelmessig?**

   Merk av for alt som passer

   - [ ] Rom 1: Klarinett/sax
   - [x] Rom 2: Fløyte
   - [ ] Rom 3: Messing
   - [ ] Rom 4: Gitar
   - [ ] Rom 5: Gitar
   - [ ] Rom 6: Slagverk
   - [ ] Rom 7: Sang
   - [ ] Rom 8: Fiolin/cello
   - [ ] Rom 9: Piano
   - [ ] Rom 10: Piano

Hvor ofte spiller du i omgivelser med svært ulik akustikk?
Markér bare én oval.

- [x] Svært ofte
- [ ] Ofte
- [ ] Noen ganger
- [ ] Sjeldent
- [ ] Svært sjeldent
- [ ] Vet ikke

Testrom

Denne delen repeteres for hvert rom.
Spørsmålene nedenfor er utformet som en påstand. Velg hvor enig du er i påstanden når du vurderer rommets akustikk i lys av øvingsforhold for deg personlig. Velg det alternativet som kommer nærest ditt syn på rommet.

10\. **Hvilket rom er dette?**

8

11\. **Jeg synes generelt at akustikken er god.**
Markér bare én oval.

- [x] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

12\. **Rommet hjelper meg med å spille.**
Markér bare én oval.

- [x] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

13\. **Jeg føler jeg endrer hvordan jeg spiller stykket basert på hvordan stykket høres ut i rommet.**
Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

14\. **Jeg føler jeg endrer spillemåte på...**
Markér bare én oval.

- [x] En positiv måte
- [ ] En negativ måte
- [ ] Vet ikke
- [ ] Jeg endret ikke spillemåte...

Jeg føler at rommet forandrer klangfargen til instrumentet mitt.

Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

16.
Jeg føler at klangfargen til instrumentet ble forandret på...

Markér bare én oval.

- En positiv måte
- En negativ måte
- Vet ikke
- Den ble ikke forandret...

17.
Lyden i rommet er skarp/skingrende.

Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

18.
Lyden i rommet er "boomy"/buldrende/drønnende.

Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

19.
Lyden i rommet er metallisk.

Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

Rommet gir meg mulighet til å gjenskape lyden jeg ser for meg i hodet mitt.
Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

21.
Jeg vil komme tilbake hit for å øve så ofte som mulig.
Markér bare én oval.

- [x] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

22.
Vurder i hvilken grad de følgende egenskapene var viktige for svaret ditt på spørsmålet over.
For hver egenskap, vurder hvor viktig den er for deg når du avgjør om du ønsker å øve i dette rommet.
Markér bare én oval per rad.

	Svært viktig	Ganske viktig	Middels viktig	Noe viktig	Ikke viktig i det hele tatt	Vet ikke
Romklang		X				
Klangfarge		X				
Tydelighet	X					
Balanse mellom mørke og lyse toner	X	X				
Balanse mellom instrument og romklang			X			
Om rommet bærer lyden godt			X			
Hører detaljer som intonasjon og rytmikk	X					
Motiverende å spille her	X					
Forskjell i lyd avhengig av plassering og retning				X		

Rom 1

Denne delen repeteres for hvert rom.
Spørsmålene nedenfor er utformet som en påstand. Velg hvor enig du er i påstanden når du vurderer rommets akustikk i lys av øvingsforhold for deg personlig. Velg det alternativet som kommer nærest ditt syn på rommet.

23.
Hvilket rom er dette?

7

24.
Jeg synes generelt at akustikken er god.
Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

Rommet hjelper meg med å spille.
Markér bare én oval.

- Helt enig
- [X] Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

26.
Jeg føler jeg endrer hvordan jeg spiller stykket basert på hvordan stykket høres ut i rommet.
Markér bare én oval.

- [X] Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

27.
Jeg føler jeg endrer spillemåte på...
Markér bare én oval.

- En positiv måte
- [X] En negativ måte ~~I forhold til testrommet.~~
- Vet ikke
- Jeg endret ikke spillemåte...

28.
Jeg føler at rommet forandrer klangfargen til instrumentet mitt.
Markér bare én oval.

- Helt enig
- [X] Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

29.
Jeg føler at klangfargen til instrumentet ble forandret på...
Markér bare én oval.

- En positiv måte
- [X] En negativ måte I forhold til testrommet.
- Vet ikke
- Den ble ikke forandret...

30.
Lyden i rommet er skarp/skingrende.
Markér bare én oval.

- [X] Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

Lyden i rommet er "boomy"/buldrende/drønnende.

Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

32.

Lyden i rommet er metallisk.

Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

33.

Rommet gir meg mulighet til å gjenskape lyden jeg ser for meg i hodet mitt.

Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

34.

Jeg vil komme tilbake hit for å øve så ofte som mulig.

Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [x] Helt uenig
- [ ] Vet ikke

Dette rommet "buldrer" mer enn testrommet.
Mer etterklang.
Føles bedre hvis jeg beveger meg i rommet mens jeg spiller

Vurder i hvilken grad de følgende egenskapene var viktige for svaret ditt på spørsmålet over.
For hver egenskap, vurder hvor viktig den er for deg når du avgjør om du ønsker å øve i dette rommet.
Markér bare én oval per rad

	Svært viktig	Ganske viktig	Middels viktig	Noe viktig	Ikke viktig i det hele tatt	Vet ikke
Romklang	X					
Klangfarge			X			
Tydelighet	X					
Balanse mellom mørke og lyse toner	X					
Balanse mellom instrument og romklang	X					
Om rommet bærer lyden godt			X			
Hører detaljer som intonasjon og rytmikk	X					
Motiverende å spille her	X					
Forskjell i lyd avhengig av plassering og retning	X					

Rom 2

Denne delen repeteres for hvert rom.
Spørsmålene nedenfor er utformet som en påstand. Velg hvor enig du er i påstanden når du vurderer rommets akustikk i lys av øvingsforhold for deg personlig. Velg det alternativet som kommer nærest ditt syn på rommet.

36. **Hvilket rom er dette?**

10

37. **Jeg synes generelt at akustikken er god.**
Markér bare én oval

- [x] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

38. **Rommet hjelper meg med å spille.**
Markér bare én oval

- [x] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

39. **Jeg føler jeg endrer hvordan jeg spiller stykket basert på hvordan stykket høres ut i rommet.**
Markér bare én oval

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

Jeg føler jeg endrer spillemåte på...
Markér bare én oval.

- En positiv måte
- En negativ måte
- Vet ikke
- Jeg endret ikke spillemåte...

41. **Jeg føler at rommet forandrer klangfargen til instrumentet mitt.**
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

42. **Jeg føler at klangfargen til instrumentet ble forandret på...**
Markér bare én oval.

- En positiv måte
- En negativ måte
- Vet ikke
- Den ble ikke forandret...

43. **Lyden i rommet er skarp/skingrende.**
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

44. **Lyden i rommet er "boomy"/buldrende/drønnende.**
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

45. **Lyden i rommet er metallisk.**
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

Rommet gir meg mulighet til å gjenskape lyden jeg ser for meg i hodet mitt.
Markér bare én oval.

- ( ) Helt enig
- (X) Delvis enig
- ( ) Nøytral
- ( ) Delvis uenig
- ( ) Helt uenig
- ( ) Vet ikke

47.
Jeg vil komme tilbake hit for å øve så ofte som mulig.
Markér bare én oval.

- ( ) Helt enig
- ( ) Delvis enig
- (X) Nøytral
- ( ) Delvis uenig
- ( ) Helt uenig
- ( ) Vet ikke

Dette rommet tåler en del lyd.

48.
Vurder i hvilken grad de følgende egenskapene var viktige for svaret ditt på spørsmålet over.
For hver egenskap, vurder hvor viktig den er for deg når du avgjør om du ønsker å øve i dette rommet.
Markér bare én oval per rad.

	Svært viktig	Ganske viktig	Middels viktig	Noe viktig	Ikke viktig i det hele tatt	Vet ikke
Romklang	X					
Klangfarge	X					
Tydelighet	X					
Balanse mellom mørke og lyse toner	X					
Balanse mellom instrument og romklang	X					
Om rommet bærer lyden godt	X					
Hører detaljer som intonasjon og rytmikk	X					
Motiverende å spille her	X					
Forskjell i lyd avhengig av plassering og retning			X			

Rom 3

Denne delen repeteres for hvert rom.
Spørsmålene nedenfor er utformet som en påstand. Velg hvor enig du er i påstanden når du vurderer rommets akustikk i lys av øvingsforhold for deg personlig. Velg det alternativet som kommer nærest ditt syn på rommet.

49.
Hvilket rom er dette?

3

50.
Jeg synes generelt at akustikken er god.
Markér bare én oval.

- (X) Helt enig
- ( ) Delvis enig
- ( ) Nøytral
- ( ) Delvis uenig
- ( ) Helt uenig
- ( ) Vet ikke

Rommet hjelper meg med å spille.
Markér bare én oval.

- [x] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

52.
Jeg føler jeg endrer hvordan jeg spiller stykket basert på hvordan stykket høres ut i rommet.
Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

53.
Jeg føler jeg endrer spillemåte på...
Markér bare én oval.

- [x] En positiv måte
- [ ] En negativ måte
- [ ] Vet ikke
- [ ] Jeg endret ikke spillemåte...

54.
Jeg føler at rommet forandrer klangfargen til instrumentet mitt.
Markér bare én oval.

- [x] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

55.
Jeg føler at klangfargen til instrumentet ble forandret på...
Markér bare én oval.

- [x] En positiv måte
- [ ] En negativ måte
- [ ] Vet ikke
- [ ] Den ble ikke forandret...

En bedre "overklang", ikke så "buldrende", men lettere å holde ut over tid.

56.
Lyden i rommet er skarp/skingrende.
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [x] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

Lyden i rommet er "boomy"/buldrende/drønnende.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- [X] Delvis uenig
- Helt uenig
- Vet ikke

58.
Lyden i rommet er metallisk.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- [X] Delvis uenig
- Helt uenig
- Vet ikke

59.
Rommet gir meg mulighet til å gjenskape lyden jeg ser for meg i hodet mitt.
Markér bare én oval.

- Helt enig
- [X] Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

60.
Jeg vil komme tilbake hit for å øve så ofte som mulig.
Markér bare én oval.

- Helt enig
- [X] Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

Vurder i hvilken grad de følgende egenskapene var viktige for svaret ditt på spørsmålet over.
For hver egenskap, vurder hvor viktig den er for deg når du avgjør om du ønsker å øve i dette rommet.
Markér bare én oval per rad

	Svært viktig	Ganske viktig	Middels viktig	Noe viktig	Ikke viktig i det hele tatt	Vet ikke
Romklang	X					
Klangfarge		X				
Tydelighet	X					
Balanse mellom mørke og lyse toner	X					
Balanse mellom instrument og romklang	X					
Om rommet bærer lyden godt		X				
Hører detaljer som intonasjon og rytmikk	X					
Motiverende å spille her	X					
Forskjell i lyd avhengig av plassering og retning			X			

Rom 4

Denne delen repeteres for hvert rom.
Spørsmålene nedenfor er utformet som en påstand. Velg hvor enig du er i påstanden når du vurderer rommets akustikk i lys av øvingsforhold for deg personlig. Velg det alternativet som kommer nærest ditt syn på rommet.

62.
Hvilket rom er dette?

9

63.
Jeg synes generelt at akustikken er god.
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [x] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

64.
Rommet hjelper meg med å spille.
Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

65.
Jeg føler jeg endrer hvordan jeg spiller stykket basert på hvordan stykket høres ut i rommet.
Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

Jeg føler jeg endrer spillemåte på...
Markér bare én oval.

- En positiv måte
- En negativ måte
- Vet ikke
- Jeg endret ikke spillemåte...

67\. **Jeg føler at rommet forandrer klangfargen til instrumentet mitt.**
Markér bare én oval.

- Helt enig
- [X] Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

68\. **Jeg føler at klangfargen til instrumentet ble forandret på...**
Markér bare én oval.

- [X] En positiv måte
- En negativ måte
- Vet ikke
- Den ble ikke forandret...

69\. **Lyden i rommet er skarp/skingrende.**
Markér bare én oval.

- Helt enig
- [X] Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

70\. **Lyden i rommet er "boomy"/buldrende/drønnende.**
Markér bare én oval.

- Helt enig
- [X] Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

71\. **Lyden i rommet er metallisk.**
Markér bare én oval.

- Helt enig
- Delvis enig
- [X] Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

Rommet gir meg mulighet til å gjenskape lyden jeg ser for meg i hodet mitt.
Markér bare én oval.

- Helt enig
- [x] Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

73.
Jeg vil komme tilbake hit for å øve så ofte som mulig.
Markér bare én oval.

- Helt enig
- [x] Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

74.
Vurder i hvilken grad de følgende egenskapene var viktige for svaret ditt på spørsmålet over.
For hver egenskap, vurder hvor viktig den er for deg når du avgjør om du ønsker å øve i dette rommet.
Markér bare én oval per rad

	Svært viktig	Ganske viktig	Middels viktig	Noe viktig	Ikke viktig i det hele tatt	Vet ikke
Romklang	X					
Klangfarge	X					
Tydelighet	X					
Balanse mellom mørke og lyse toner	X					
Balanse mellom instrument og romklang	X					
Om rommet bærer lyden godt		X				
Hører detaljer som intonasjon og rytmikk	X					
Motiverende å spille her	X					
Forskjell i lyd avhengig av plassering og retning			X			

Helt til slutt

75.
Jeg blir svært påvirket av akustikken i et rom når jeg spiller på instrumentet mitt.
Markér bare én oval.

- [x] Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

Hva er viktig for deg med et godt øvingsrom?

At det er godt å øve der ~~ø~~ lenge. Rommene som var "tørre", som tålte mye lyd ~~ø~~ var fine for å øve i høyden. Følte mye klarhet i spillet. Rommene med mest klang gir større mulighet for å variere klangfarge ~~-~~ og få respons med en gang.

77. **Hvilket rom likte du best? Ranger rommene i rekkefølge fra likte best øverst til likte dårligst nederst.**

~~7, 3, 10, 8, 9~~

8, 3, 10, 7, 9

Jeg skal bli flinkere til å bytte rom mer bevisst!

78. **Har du noen ekstra kommentarer?**

Det hadde vært veldig interessant å ~~ta~~ gjøre denne undersøkelsen med undervisning i rommet. Men gir også en pekepinn på hva som gjør mitt rom og min lydhverdag som den er

Tusen takk!

Drevet av
Google Forms

E.4 Norwegian Questionnaire Used at Blindern

The Norwegian versions of the questionnaire with answers for the experiment at Blindern campus are shown in their entirety below.

Spørreundersøkelse Blindern

Under denne undersøkelsen skal du spille det samme musikkstykket i 3 forskjellige rom og gjøre en lyttetest der du produserer lyden. Det første rommet er et testrom for at du skal bli kjent med metoden og spørreskjemaet. Fokuser på opplevelsen av rommet og samspillet med instrumentet ditt når du spiller, og prøv å ikke fokusere på spørsmålene som skal besvares. Etter du har spilt i et rom, fyller du ut skjemaet. Det er ett skjema per rom.

1. **Deltakeridentifikasjon (velg fire bokstaver eller tall)**

   84JU

2. **Alder**

   33

3. **Kjønn**

   Mann

4. **Har du normal hørsel?**

   Markér bare én oval.

   - [x] Ja
   - [ ] Nei

5. **Hvilket instrument spiller du?**

   Saksofon (tenor)

6. **Hvor lenge har du spilt dette instrumentet?**

   25 år

7. **Hvor eller i hvilket rom pleier du å øve?**

   Øverom på Skolen

8.

Hvor ofte spiller du i omgivelser med svært ulik akustikk?

Markér bare én oval.

- [ ] Svært ofte
- [x] Ofte
- [ ] Noen ganger
- [ ] Sjeldent
- [ ] Svært sjeldent
- [ ] Vet ikke

Testrom

Denne delen repeteres for hvert rom.
Spørsmålene nedenfor er utformet som en påstand. Velg hvor enig du er i påstanden når du vurderer rommets akustikk i lys av øvingsforhold for deg personlig. Velg det alternativet som kommer nærest ditt syn på rommet.

9.

Hvilket rom er dette?

432

10.

Jeg synes generelt at akustikken er god.

Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [x] Vet ikke

11.

Rommet hjelper meg med å spille.

Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

12.

Jeg føler jeg endrer hvordan jeg spiller stykket basert på hvordan stykket høres ut i rommet.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

13.

Jeg føler jeg endrer spillemåte på...
Markér bare én oval.

- En positiv måte
- En negativ måte
- Vet ikke
- Jeg endret ikke spillemåte...

14.

Jeg føler at rommet forandrer klangfargen til instrumentet mitt.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

15.

Jeg føler at klangfargen til instrumentet ble forandret på...
Markér bare én oval.

- En positiv måte
- En negativ måte
- Vet ikke
- Den ble ikke forandret...

16.

Lyden i rommet er skarp/skingrende.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

17.
Lyden i rommet er "boomy"/buldrende/drønnende.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

18.
Lyden i rommet er metallisk.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

19.
Rommet gir meg mulighet til å gjenskape lyden jeg ser for meg i hodet mitt.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

20.
Jeg vil komme tilbake hit for å øve så ofte som mulig.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

21.

Vurder i hvilken grad de følgende egenskapene var viktige for svaret ditt på spørsmålet over.
For hver egenskap, vurder hvor viktig den er for deg når du avgjør om du ønsker å øve i dette rommet.
Markér bare én oval per rad

	Svært viktig	Ganske viktig	Middels viktig	Noe viktig	Ikke viktig i det hele tatt	Vet ikke
Romklang		X				
Klangfarge		X				
Tydelighet	X					
Balanse mellom mørke og lyse toner	X					
Balanse mellom instrument og romklang		X				
Om rommet bærer lyden godt		X				
Hører detaljer som intonasjon og rytmikk	X					
Motiverende å spille her	X					
Forskjell i lyd avhengig av plassering og retning	X					

Rom 1

Denne delen repeteres for hvert rom.
Spørsmålene nedenfor er utformet som en påstand. Velg hvor enig du er i påstanden når du vurderer rommets akustikk i lys av øvingsforhold for deg personlig. Velg det alternativet som kommer nærest ditt syn på rommet.

22.

Hvilket rom er dette?

435

23.

Jeg synes generelt at akustikken er god.
Markér bare én oval.

- [x] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

24.

Rommet hjelper meg med å spille.
Markér bare én oval.

- [x] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

25.
Jeg føler jeg endrer hvordan jeg spiller stykket basert på hvordan stykket høres ut i rommet.
Markér bare én oval.

- [x] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

26.
Jeg føler jeg endrer spillemåte på...
Markér bare én oval.

- [x] En positiv måte
- [ ] En negativ måte
- [ ] Vet ikke
- [ ] Jeg endret ikke spillemåte...

27.
Jeg føler at rommet forandrer klangfargen til instrumentet mitt.
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [x] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

28.
Jeg føler at klangfargen til instrumentet ble forandret på...
Markér bare én oval.

- [ ] En positiv måte
- [ ] En negativ måte
- [ ] Vet ikke
- [x] Den ble ikke forandret...

29.
Lyden i rommet er skarp/skingrende.
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [x] Helt uenig
- [ ] Vet ikke

30.

Lyden i rommet er "boomy"/buldrende/drønnende.

Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

31.

Lyden i rommet er metallisk.

Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

32.

Rommet gir meg mulighet til å gjenskape lyden jeg ser for meg i hodet mitt.

Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

33.

Jeg vil komme tilbake hit for å øve så ofte som mulig.

Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

34.
Vurder i hvilken grad de følgende egenskapene var viktige for svaret ditt på spørsmålet over.
For hver egenskap, vurder hvor viktig den er for deg når du avgjør om du ønsker å øve i dette rommet.
Markér bare én oval per rad

	Svært viktig	Ganske viktig	Middels viktig	Noe viktig	Ikke viktig i det hele tatt	Vet ikke
Romklang	X					
Klangfarge	X					
Tydelighet	X					
Balanse mellom mørke og lyse toner			X			
Balanse mellom instrument og romklang		X				
Om rommet bærer lyden godt				X		
Hører detaljer som intonasjon og rytmikk			X			
Motiverende å spille her	X					
Forskjell i lyd avhengig av plassering og retning					X	

Rom 2

Denne delen repeteres for hvert rom.
Spørsmålene nedenfor er utformet som en påstand. Velg hvor enig du er i påstanden når du vurderer rommets akustikk i lys av øvingsforhold for deg personlig. Velg det alternativet som kommer nærest ditt syn på rommet.

35.
Hvilket rom er dette?

431

36.
Jeg synes generelt at akustikken er god.
Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

37.
Rommet hjelper meg med å spille.
Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

38.

Jeg føler jeg endrer hvordan jeg spiller stykket basert på hvordan stykket høres ut i rommet.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

39.

Jeg føler jeg endrer spillemåte på...
Markér bare én oval.

- En positiv måte
- En negativ måte
- Vet ikke
- Jeg endret ikke spillemåte...

40.

Jeg føler at rommet forandrer klangfargen til instrumentet mitt.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

41.

Jeg føler at klangfargen til instrumentet ble forandret på...
Markér bare én oval.

- En positiv måte
- En negativ måte
- Vet ikke
- Den ble ikke forandret...

42.

Lyden i rommet er skarp/skingrende.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

43.
Lyden i rommet er "boomy"/buldrende/drønnende.
Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

44.
Lyden i rommet er metallisk.
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [x] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

45.
Rommet gir meg mulighet til å gjenskape lyden jeg ser for meg i hodet mitt.
Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

46.
Jeg vil komme tilbake hit for å øve så ofte som mulig.
Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

47.

Vurder i hvilken grad de følgende egenskapene var viktige for svaret ditt på spørsmålet over.
For hver egenskap, vurder hvor viktig den er for deg når du avgjør om du ønsker å øve i dette rommet.
Markér bare én oval per rad

	Svært viktig	Ganske viktig	Middels viktig	Noe viktig	Ikke viktig i det hele tatt	Vet ikke
Romklang	X					
Klangfarge	X					
Tydelighet		X				
Balanse mellom mørke og lyse toner			X			
Balanse mellom instrument og romklang		X				
Om rommet bærer lyden godt	X					
Hører detaljer som intonasjon og rytmikk	X					
Motiverende å spille her	X					
Forskjell i lyd avhengig av plassering og retning					X	

Helt til slutt

48.

Jeg blir svært påvirket av akustikken i et rom når jeg spiller på instrumentet mitt.
Markér bare én oval.

- ☐ Helt enig
- ☒ Delvis enig
- ☐ Nøytral
- ☐ Delvis uenig
- ☐ Helt uenig
- ☐ Vet ikke

49.

Hva er viktig for deg med et godt øvingsrom?

At jeg ikke blir for sliten av dårlig lyd og luft. Nøytral lydgjengivelse.

50.

Hvilket rom likte du best? Ranger rommene i rekkefølge fra likte best øverst til likte dårligst nederst.

435
431
432

51.
Har du noen ekstra kommentarer?

Vanskelig å høre nøyaktigheten i akustikken grunnet piano som tar opp mye lyd.

Tusen takk!

Spørreundersøkelse Blindern

Under denne undersøkelsen skal du spille det samme musikkstykket i 3 forskjellige rom og gjøre en lyttetest der du produserer lyden. Det første rommet er et testrom for at du skal bli kjent med metoden og spørreskjemaet. Fokuser på opplevelsen av rommet og samspillet med instrumentet ditt når du spiller, og prøv å ikke fokusere på spørsmålene som skal besvares. Etter du har spilt i et rom, fyller du ut skjemaet. Det er ett skjema per rom.

1. **Deltakeridentifikasjon (velg fire bokstaver eller tall)**

   J47Q

2. **Alder**

   19

3. **Kjønn**

   Mann

4. **Har du normal hørsel?**

   Markér bare én oval.

   - [x] Ja
   - [ ] Nei

5. **Hvilket instrument spiller du?**

   Gitar

6. **Hvor lenge har du spilt dette instrumentet?**

   9 år

7. **Hvor eller i hvilket rom pleier du å øve?**

   på skolen i kjellern

8.
Hvor ofte spiller du i omgivelser med svært ulik akustikk?
Markér bare én oval.

- ( ) Svært ofte
- ( ) Ofte
- (X) Noen ganger
- ( ) Sjeldent
- ( ) Svært sjeldent
- ( ) Vet ikke

Testrom

Denne delen repeteres for hvert rom.
Spørsmålene nedenfor er utformet som en påstand. Velg hvor enig du er i påstanden når du vurderer rommets akustikk i lys av øvingsforhold for deg personlig. Velg det alternativet som kommer nærest ditt syn på rommet.

9.
Hvilket rom er dette?

432

10.
Jeg synes generelt at akustikken er god.
Markér bare én oval.

- (X) Helt enig
- ( ) Delvis enig
- ( ) Nøytral
- ( ) Delvis uenig
- ( ) Helt uenig
- ( ) Vet ikke

11.
Rommet hjelper meg med å spille.
Markér bare én oval.

- ( ) Helt enig
- (X) Delvis enig
- ( ) Nøytral
- ( ) Delvis uenig
- ( ) Helt uenig
- ( ) Vet ikke

12.
Jeg føler jeg endrer hvordan jeg spiller stykket basert på hvordan stykket høres ut i rommet.
Markér bare én oval.

- ( ) Helt enig
- ( ) Delvis enig
- ( ) Nøytral
- (X) Delvis uenig
- ( ) Helt uenig
- ( ) Vet ikke

13.
Jeg føler jeg endrer spillemåte på...
Markér bare én oval.

- ( ) En positiv måte
- ( ) En negativ måte
- ( ) Vet ikke
- (X) Jeg endret ikke spillemåte...

14.
Jeg føler at rommet forandrer klangfargen til instrumentet mitt.
Markér bare én oval.

- ( ) Helt enig
- ( ) Delvis enig
- ( ) Nøytral
- (X) Delvis uenig
- ( ) Helt uenig
- ( ) Vet ikke

15.
Jeg føler at klangfargen til instrumentet ble forandret på...
Markér bare én oval.

- (X) En positiv måte
- ( ) En negativ måte
- ( ) Vet ikke
- ( ) Den ble ikke forandret...

16.
Lyden i rommet er skarp/skingrende.
Markér bare én oval.

- ( ) Helt enig
- ( ) Delvis enig
- ( ) Nøytral
- (X) Delvis uenig
- ( ) Helt uenig
- ( ) Vet ikke

17.
Lyden i rommet er "boomy"/buldrende/drønnende.
Markér bare én oval.

- ( ) Helt enig
- ( ) Delvis enig
- ( ) Nøytral
- ( ) Delvis uenig
- (X) Helt uenig
- ( ) Vet ikke

18.
Lyden i rommet er metallisk.
Markér bare én oval.

- ( ) Helt enig
- ( ) Delvis enig
- ( ) Nøytral
- (X) Delvis uenig
- ( ) Helt uenig
- ( ) Vet ikke

19.
Rommet gir meg mulighet til å gjenskape lyden jeg ser for meg i hodet mitt.
Markér bare én oval.

- ( ) Helt enig
- (X) Delvis enig
- ( ) Nøytral
- ( ) Delvis uenig
- ( ) Helt uenig
- ( ) Vet ikke

20.
Jeg vil komme tilbake hit for å øve så ofte som mulig.
Markér bare én oval.

- ( ) Helt enig
- ( ) Delvis enig
- (X) Nøytral
- ( ) Delvis uenig
- ( ) Helt uenig
- ( ) Vet ikke

21.

Vurder i hvilken grad de følgende egenskapene var viktige for svaret ditt på spørsmålet over.
For hver egenskap, vurder hvor viktig den er for deg når du avgjør om du ønsker å øve i dette rommet.
Markér bare én oval per rad

	Svært viktig	Ganske viktig	Middels viktig	Noe viktig	Ikke viktig i det hele tatt	Vet ikke
Romklang	X					
Klangfarge				X		
Tydelighet		X				
Balanse mellom mørke og lyse toner	X					
Balanse mellom instrument og romklang				X		
Om rommet bærer lyden godt					X	
Hører detaljer som intonasjon og rytmikk	X					
Motiverende å spille her		X				
Forskjell i lyd avhengig av plassering og retning			X			

Rom 1

Denne delen repeteres for hvert rom.
Spørsmålene nedenfor er utformet som en påstand. Velg hvor enig du er i påstanden når du vurderer rommets akustikk i lys av øvingsforhold for deg personlig. Velg det alternativet som kommer nærest ditt syn på rommet.

22.

Hvilket rom er dette?

4135

23.

Jeg synes generelt at akustikken er god.
Markér bare én oval.

- ☒ Helt enig
- ☐ Delvis enig
- ☐ Nøytral
- ☐ Delvis uenig
- ☐ Helt uenig
- ☐ Vet ikke

24.

Rommet hjelper meg med å spille.
Markér bare én oval.

- ☐ Helt enig
- ☒ Delvis enig
- ☐ Nøytral
- ☐ Delvis uenig
- ☐ Helt uenig
- ☐ Vet ikke

25.
Jeg føler jeg endrer hvordan jeg spiller stykket basert på hvordan stykket høres ut i rommet.
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [x] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

26.
Jeg føler jeg endrer spillemåte på...
Markér bare én oval.

- [x] En positiv måte
- [ ] En negativ måte
- [ ] Vet ikke
- [ ] Jeg endret ikke spillemåte...

27.
Jeg føler at rommet forandrer klangfargen til instrumentet mitt.
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [x] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

28.
Jeg føler at klangfargen til instrumentet ble forandret på...
Markér bare én oval.

- [x] En positiv måte
- [ ] En negativ måte
- [ ] Vet ikke
- [ ] Den ble ikke forandret...

29.
Lyden i rommet er skarp/skingrende.
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [x] Helt uenig
- [ ] Vet ikke

30.

Lyden i rommet er "boomy"/buldrende/drønnende.

Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- X Helt uenig
- Vet ikke

31.

Lyden i rommet er metallisk.

Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- X Helt uenig
- Vet ikke

32.

Rommet gir meg mulighet til å gjenskape lyden jeg ser for meg i hodet mitt.

Markér bare én oval.

- Helt enig
- X Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

33.

Jeg vil komme tilbake hit for å øve så ofte som mulig.

Markér bare én oval.

- Helt enig
- X Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

34.
Vurder i hvilken grad de følgende egenskapene var viktige for svaret ditt på spørsmålet over.
For hver egenskap, vurder hvor viktig den er for deg når du avgjør om du ønsker å øve i dette rommet.
Markér bare én oval per rad

	Svært viktig	Ganske viktig	Middels viktig	Noe viktig	Ikke viktig i det hele tatt	Vet ikke
Romklang	X					
Klangfarge				X		
Tydelighet		X				
Balanse mellom mørke og lyse toner	X					
Balanse mellom instrument og romklang				X		
Om rommet bærer lyden godt					X	
Hører detaljer som intonasjon og rytmikk	X					
Motiverende å spille her		X				
Forskjell i lyd avhengig av plassering og retning			X			

Rom 2

Denne delen repeteres for hvert rom.
Spørsmålene nedenfor er utformet som en påstand. Velg hvor enig du er i påstanden når du vurderer rommets akustikk i lys av øvingsforhold for deg personlig. Velg det alternativet som kommer nærest ditt syn på rommet.

35.
Hvilket rom er dette?

431

36.
Jeg synes generelt at akustikken er god.
Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

37.
Rommet hjelper meg med å spille.
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [x] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

38.
Jeg føler jeg endrer hvordan jeg spiller stykket basert på hvordan stykket høres ut i rommet.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- X Helt uenig
- Vet ikke

39.
Jeg føler jeg endrer spillemåte på...
Markér bare én oval.

- En positiv måte
- En negativ måte
- X Vet ikke
- Jeg endret ikke spillemåte...

40.
Jeg føler at rommet forandrer klangfargen til instrumentet mitt.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- X Delvis uenig
- Helt uenig
- Vet ikke

41.
Jeg føler at klangfargen til instrumentet ble forandret på...
Markér bare én oval.

- X En positiv måte
- En negativ måte
- Vet ikke
- Den ble ikke forandret...

42.
Lyden i rommet er skarp/skingrende.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- X Delvis uenig
- Helt uenig
- Vet ikke

43.

Lyden i rommet er "boomy"/buldrende/drønnende.

Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [x] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

44.

Lyden i rommet er metallisk.

Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [x] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

45.

Rommet gir meg mulighet til å gjenskape lyden jeg ser for meg i hodet mitt.

Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

46.

Jeg vil komme tilbake hit for å øve så ofte som mulig.

Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [x] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

47.

Vurder i hvilken grad de følgende egenskapene var viktige for svaret ditt på spørsmålet over.

For hver egenskap, vurder hvor viktig den er for deg når du avgjør om du ønsker å øve i dette rommet.

Markér bare én oval per rad

	Svært viktig	Ganske viktig	Middels viktig	Noe viktig	Ikke viktig i det hele tatt	Vet ikke
Romklang	X					
Klangfarge			X			
Tydelighet		X				
Balanse mellom mørke og lyse toner	X					
Balanse mellom instrument og romklang		X				
Om rommet bærer lyden godt					X	
Hører detaljer som intonasjon og rytmikk	X					
Motiverende å spille her		X				
Forskjell i lyd avhengig av plassering og retning		X				

Helt til slutt

48.

Jeg blir svært påvirket av akustikken i et rom når jeg spiller på instrumentet mitt.

Markér bare én oval.

- ◯ Helt enig
- ◯ Delvis enig
- ◯ Nøytral
- ⊗ Delvis uenig
- ◯ Helt uenig
- ◯ Vet ikke

49.

Hva er viktig for deg med et godt øvingsrom?

God luft

ingen romklang/helt tørt

lyst og åpent

50.

Hvilket rom likte du best? Ranger rommene i rekkefølge fra likte best øverst til likte dårligst nederst.

435

431

51. **Har du noen ekstra kommentarer?**

Jeg lånte en gitar
som var litt dårlig
både med tanke på lyd
og spillekomfor

Tusen takk!

Spørreundersøkelse Blindern

Under denne undersøkelsen skal du spille det samme musikkstykket i 3 forskjellige rom og gjøre en lyttetest der du produserer lyden. Det første rommet er et testrom for at du skal bli kjent med metoden og spørreskjemaet. Fokuser på opplevelsen av rommet og samspillet med instrumentet ditt når du spiller, og prøv å ikke fokusere på spørsmålene som skal besvares. Etter du har spilt i et rom, fyller du ut skjemaet. Det er ett skjema per rom.

1. **Deltakeridentifikasjon (velg fire bokstaver eller tall)**

   4254

2. **Alder**

   22

3. **Kjønn**

   MANN

4. **Har du normal hørsel?**

   Markér bare én oval.

   - [x] Ja
   - [ ] Nei

5. **Hvilket instrument spiller du?**

   GITAR

6. **Hvor lenge har du spilt dette instrumentet?**

   10 ÅR

7. **Hvor eller i hvilket rom pleier du å øve?**

   Hjemme eller IMV kjeller

8.

Hvor ofte spiller du i omgivelser med svært ulik akustikk?

Markér bare én oval.

- [ ] Svært ofte
- [x] Ofte
- [ ] Noen ganger
- [ ] Sjeldent
- [ ] Svært sjeldent
- [ ] Vet ikke

Testrom

Denne delen repeteres for hvert rom.
Spørsmålene nedenfor er utformet som en påstand. Velg hvor enig du er i påstanden når du vurderer rommets akustikk i lys av øvingsforhold for deg personlig. Velg det alternativet som kommer nærest ditt syn på rommet.

9.

Hvilket rom er dette?

432

10.

Jeg synes generelt at akustikken er god.

Markér bare én oval.

- [x] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

11.

Rommet hjelper meg med å spille.

Markér bare én oval.

- [x] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

12.
Jeg føler jeg endrer hvordan jeg spiller stykket basert på hvordan stykket høres ut i rommet.
Markér bare én oval.

- [x] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

13.
Jeg føler jeg endrer spillemåte på...
Markér bare én oval.

- [ ] En positiv måte
- [ ] En negativ måte
- [ ] Vet ikke
- [ ] Jeg endret ikke spillemåte...

SLO HARDERE PÅ BASSTRENGene.
Lydbalanse i rommet.
Ikke positivt eller negativt.

14.
Jeg føler at rommet forandrer klangfargen til instrumentet mitt.
Markér bare én oval.

- [x] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

15.
Jeg føler at klangfargen til instrumentet ble forandret på...
Markér bare én oval.

- [x] En positiv måte
- [ ] En negativ måte
- [ ] Vet ikke
- [ ] Den ble ikke forandret...

16.
Lyden i rommet er skarp/skingrende.
Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

17.
Lyden i rommet er "boomy"/buldrende/drønnende.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

18.
Lyden i rommet er metallisk.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

19.
Rommet gir meg mulighet til å gjenskape lyden jeg ser for meg i hodet mitt.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

20.
Jeg vil komme tilbake hit for å øve så ofte som mulig.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

21.

Vurder i hvilken grad de følgende egenskapene var viktige for svaret ditt på spørsmålet over.
For hver egenskap, vurder hvor viktig den er for deg når du avgjør om du ønsker å øve i dette rommet.
Markér bare én oval per rad

	Svært viktig	Ganske viktig	Middels viktig	Noe viktig	Ikke viktig i det hele tatt	Vet ikke
Romklang	X					
Klangfarge	X					
Tydelighet	X					
Balanse mellom mørke og lyse toner	X					
Balanse mellom instrument og romklang	X					
Om rommet bærer lyden godt		X				
Hører detaljer som intonasjon og rytmikk	X					
Motiverende å spille her		X				
Forskjell i lyd avhengig av plassering og retning		X				

Rom 1

Denne delen repeteres for hvert rom.
Spørsmålene nedenfor er utformet som en påstand. Velg hvor enig du er i påstanden når du vurderer rommets akustikk i lys av øvingsforhold for deg personlig. Velg det alternativet som kommer nærest ditt syn på rommet.

22.

Hvilket rom er dette?

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23.

Jeg synes generelt at akustikken er god.
Markér bare én oval.

- (X) Helt enig
- ( ) Delvis enig
- ( ) Nøytral
- ( ) Delvis uenig
- ( ) Helt uenig
- ( ) Vet ikke

24.

Rommet hjelper meg med å spille.
Markér bare én oval.

- (X) Helt enig
- ( ) Delvis enig
- ( ) Nøytral
- ( ) Delvis uenig
- ( ) Helt uenig
- ( ) Vet ikke

25.
Jeg føler jeg endrer hvordan jeg spiller stykket basert på hvordan stykket høres ut i rommet.
Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

26.
Jeg føler jeg endrer spillemåte på...
Markér bare én oval.

- [ ] En positiv måte
- [ ] En negativ måte
- [ ] Vet ikke
- [ ] Jeg endret ikke spillemåte...

27.
Jeg føler at rommet forandrer klangfargen til instrumentet mitt.
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [x] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

Frembringer de positive egen skapene.

28.
Jeg føler at klangfargen til instrumentet ble forandret på...
Markér bare én oval.

- [x] En positiv måte
- [ ] En negativ måte
- [ ] Vet ikke
- [ ] Den ble ikke forandret...

29.
Lyden i rommet er skarp/skingrende.
Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

30.
Lyden i rommet er "boomy"/buldrende/drønnende.
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [x] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

31.
Lyden i rommet er metallisk.
Markér bare én oval.

- [ ] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [x] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

32.
Rommet gir meg mulighet til å gjenskape lyden jeg ser for meg i hodet mitt.
Markér bare én oval.

- [x] Helt enig
- [ ] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

33.
Jeg vil komme tilbake hit for å øve så ofte som mulig.
Markér bare én oval.

- [ ] Helt enig
- [x] Delvis enig
- [ ] Nøytral
- [ ] Delvis uenig
- [ ] Helt uenig
- [ ] Vet ikke

34.
Vurder i hvilken grad de følgende egenskapene var viktige for svaret ditt på spørsmålet over.
For hver egenskap, vurder hvor viktig den er for deg når du avgjør om du ønsker å øve i dette rommet.
Markér bare én oval per rad

	Svært viktig	Ganske viktig	Middels viktig	Noe viktig	Ikke viktig i det hele tatt	Vet ikke
Romklang	X					
Klangfarge	X					
Tydelighet	X					
Balanse mellom mørke og lyse toner	X					
Balanse mellom instrument og romklang	X					
Om rommet bærer lyden godt		X				
Hører detaljer som intonasjon og rytmikk	X					
Motiverende å spille her		X				
Forskjell i lyd avhengig av plassering og retning		X				

Rom 2

Denne delen repeteres for hvert rom.
Spørsmålene nedenfor er utformet som en påstand. Velg hvor enig du er i påstanden når du vurderer rommets akustikk i lys av øvingsforhold for deg personlig. Velg det alternativet som kommer nærest ditt syn på rommet.

35.
Hvilket rom er dette?

431

36.
Jeg synes generelt at akustikken er god.
Markér bare én oval.

- ( ) Helt enig
- (X) Delvis enig
- ( ) Nøytral
- ( ) Delvis uenig
- ( ) Helt uenig
- ( ) Vet ikke

37.
Rommet hjelper meg med å spille.
Markér bare én oval.

- ( ) Helt enig
- (X) Delvis enig
- ( ) Nøytral
- ( ) Delvis uenig
- ( ) Helt uenig
- ( ) Vet ikke

38.
Jeg føler jeg endrer hvordan jeg spiller stykket basert på hvordan stykket høres ut i rommet.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

39.
Jeg føler jeg endrer spillemåte på...
Markér bare én oval.

- En positiv måte
- En negativ måte
- Vet ikke
- Jeg endret ikke spillemåte...

40.
Jeg føler at rommet forandrer klangfargen til instrumentet mitt.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

41.
Jeg føler at klangfargen til instrumentet ble forandret på...
Markér bare én oval.

- En positiv måte Men ikke like fint som forrige.
- En negativ måte
- Vet ikke
- Den ble ikke forandret...

42.
Lyden i rommet er skarp/skingrende.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

43.
Lyden i rommet er "boomy"/buldrende/drønnende.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

44.
Lyden i rommet er metallisk.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

45.
Rommet gir meg mulighet til å gjenskape lyden jeg ser for meg i hodet mitt.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

46.
Jeg vil komme tilbake hit for å øve så ofte som mulig.
Markér bare én oval.

- Helt enig
- Delvis enig
- Nøytral
- Delvis uenig
- Helt uenig
- Vet ikke

47.
Vurder i hvilken grad de følgende egenskapene var viktige for svaret ditt på spørsmålet over.
For hver egenskap, vurder hvor viktig den er for deg når du avgjør om du ønsker å øve i dette rommet.
Markér bare én oval per rad

	Svært viktig	Ganske viktig	Middels viktig	Noe viktig	Ikke viktig i det hele tatt	Vet ikke
Romklang	X					
Klangfarge	X					
Tydelighet	X					
Balanse mellom mørke og lyse toner	X					
Balanse mellom instrument og romklang	X					
Om rommet bærer lyden godt		X				
Hører detaljer som intonasjon og rytmikk	X					
Motiverende å spille her		X				
Forskjell i lyd avhengig av plassering og retning		X				

Helt til slutt

48.
Jeg blir svært påvirket av akustikken i et rom når jeg spiller på instrumentet mitt.
Markér bare én oval.

- ◯ Helt enig
- ☒ Delvis enig
- ◯ Nøytral
- ◯ Delvis uenig
- ◯ Helt uenig
- ◯ Vet ikke

Avhenger mest av størrelse.

49.
Hva er viktig for deg med et godt øvingsrom?

Belysning, utstyr ~~og~~ god romklang og frekvens balanse.

50.
Hvilket rom likte du best? Ranger rommene i rekkefølge fra likte best øverst til likte dårligst nederst.

435
432
431

51. Har du noen ekstra kommentarer?

Forbehold for mentalt bias basert på øvelsene gått gjennom i forkant.

Tusen takk!