The acoustics of rooms for music rehearsal and performance – the Norwegian approach

Presentation at the 3rd joint meeting Acoustics'17 in Boston (Acoustical Society of America and the European Acoustics Association), July 26th 2017.

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My name is Jon G. Olsen and I have been working together with acoustician Jens Holger Rindel from Multiconsult Norway in preparing this presentation.

I represent the musicians, the persons **singing or playing** in the rooms that you design as acousticians.

The council for Music Organizations in Norway is an association of more or less all nationwide music organizations in Norway, covering choirs, orchestras, jazz groups, wind bands, folk music, etc. and we also cover concert arranging organizations and the Union of Musicians. One of our main focus points is to work with t improving the rehearsal and concert rooms used throughout Norway.

Norway is a relatively small country, with 5,2 million people – but we have a very rich and widespread music life. In almost all local communities there are several choirs, often more than one wind orchestra and/or brass band, and several other music ensembles and groups. Most of them are amateurs, some have very high musical standard.

Surveys from our national statistical bureau and our own figures show that about 500.000 people are playing, singing, or arranging local concerts every week.

Many rooms are used for music

And we use MANY rooms. More than 10.000 rooms are used for music purposes every week. Most of these rooms are not mainly designed for music use, but they are used because they are available and there are no other options. Most of our rehearsal rooms are in school buildings.

We work continously and consistent to improve the acoustics in as many of the 10.000 rooms as possible. A part of this is to advice the music ensembles which group should use which room.

From our point of view music is important for many many pepole, and working with good rehearsal and concert rooms is a way to improve life quality for hundreds of thousand people in Norway – and for the society and the local communities. Figures from the European Choral Association show that more than **40 million people** in Europe go to choir rehearsals every week. Our work is therefore not just a minor detail, but a part of the planning of «good standard of living». The last 5 years we have done room acoustic measurements in more than 600 or these rooms.

The reports conclude that 85% of the rooms are not suited for the music use they in fact are used for!

The importance of suitable rehearsal rooms

From a musician's point of view, the rehearsal room is the most important room. That's where we spend most of our time. For a choir or an orchestra, the rehearsal room is the «home ground», where we learn to play or sing together with the other musicians. We adapt our musical skills to the acoustical situation in the rehearsal room, and if this is not ok we learn to play in an unbalanced way, or to develop poor sound quality and timbre.

THE most important factor is to be able to at the same time hear myself and the other musicians. It turns out that this not always is the case.

As a musician, I need an acoustic situation in the room that are suited to my instrument, to my kind of activity. A choir cannot use the same room as a concert band, or a rock group. YOU know that, but the politicians in Norway do not – or DID not.

The amateurs **enjoy** their music – that's the reason they play or sing. If it's not enjoyable, they quit and might start with other activities. Hence it might be even MORE important for an amateur group to have a good rehearsal room than for professionals.

Figures from our national music competitions show clearly that better acoustical rehearsal rooms improve the quality of the group significantly.

The importance of suitable concert rooms

The concerts are where we «show off». That's when we want to present ourselves at best, for the audience and the local community. In many ways, our concerts are also our pay-back to the society. That's a part of our way of making the local community a better place to live.

The concerts are also a recruitment arena for our music ensembles. If a music group sounds good, people would want to join and to be a member of that group.

Our succes criterion no 1:
A close longterm relationship between the users, the owners and acoustic consultants

We cooperate closely with top acoustic consultants.

Our target is to explain to **the decision-makers,** the local governments and municipalities the most important factors when they build rooms or refurbish rooms for music use.

While there are well-established requirements for rooms devoted to various kinds of sport, the requirements for music rooms have up to now been very weak, or fully missing. We try to explain complex acoustical criteria and context into easy-to-understand descriptions. And, **very** important, to prioritize between the options in each situation. This is one of the main backgrounds for the Norwegian standard ***NS 8178 – Acoustucal critera for rooms and spaces for music rehearsal and performance.***

We also try to explain to the music community how to adapt to various acoustic conditions, and how to find a suitable room for their type of ensemble. The musicians themselves are all too seldom aware of the impact the acoustic situation in the room has for the music development of the ensemble.

- Over the last 5 years, we have made 600 room acoustical measurement reports, all over the country.
- Our 13 regional offices use a standardized method. The last version measures reverberation time (RT), background noise level, clarity (C80), early decay time (EDT) and room strength (G).
- Each regional office has bought professional acoustic measurement systems for analysis based on Sinus Sweep.
- All reports are registered in a Google map for download.
- We are also working on a light version, where we hope to include as many rooms as possible within a few years.

Norwegian Standard NS8178:2014
«Acoustic criteria for rooms and spaces for music rehearsal and performance»

Target groups

Now, let's take a look at our NS and the results of our room acoustic measurements.

First of all – why a «National Standard» (NS8178)?

We see an official Standard as «Good for the community». A standard secures that certain main quality criteria are considered and will be used when building new rooms that will be used for music or refurbishing rooms for music. A Standard does not have the same power as a law, but if we can make the decision makers aware of the Standard, they will probably use it as a basis when ordering new buildings that might be used for music purposes.

The Council for Music Organizations in Norway and all our regional and local units have been working to promote the Standard since it was established in 2014. We have had an extra focus in working with schools, as school buildings are the buildings most used in Norway for music rehearsal and also for small local concerts. Three years after the Standard was established, we now see that more and more local governments use the Standard as a base when working with new buildings. And we also see that when using the Standard, the rooms planned for music use are better suited than when the Standard is not used. This tells us that the Standard is a good tool as useful in the real world.

The main target groups are

- Municipalities and local governments
- Architects and advisors
- Construction companies
- Acoustic consultants
- Music organizations, conductors and concert organizers
- Amateurs and professional musicians

The most important maybe that an official standard forces the owner to decide the primary use for each room and to specify their use

From small rehearsal room to 500 seats concert

The rooms covered in the standard are from the small individual practice rooms to rehearsal rooms for large ensembles

The performance rooms are up to 500 seats, or 1000 persons in standing audience. The standard is not intended to be applied to large specialized concert halls, opera venues and similar spaces.

It is meant to be used in all kind of buildings, as long as the room is used for music.

The standard can also be used to assess the suitability of existing spaces for different music purposes.

Overview

According to the MUSIC GENRE and ENSEMBLE SIZE there are specific demands for

- ROOM VOLUME, DIMENSIONS AND GEOMETRY
- ACOUSTC TREATMENT of the room surfaces (walls/ceiling)
- REVERBERATION TIME
- BACKGROUND NOISE LEVEL
- STRENGTH (G) is also discussed, I'll come back to that later

The standard categorizes the rooms into 3 genres and 5 different room categories:

- Common soft music («quiet groups») -Singing, choir, string, guitars etc
- Common loud music - Wind ensembles, concert bands, brass, percussion, big bands etc. and opera
- Amplified music - All kind of music being played through a PA system, via loudspeakers

And for each of the ensemble type we have 5 different categories of rooms/ensemble sizes

- Individual practice room (1-2 musicians practicing)
- Small ensemble room (3-6 musicians, teaching rooms)
- Medium size ensemble room (up to 20 musicians/singers)
- Large group ensemble room
- Performance rooms, divided in 4 type of rooms
    - Amplified club scenes (Small jazz, pop, singer/songwriter, club scenes)
    - Amplified music concert room (Pop/Rock/Jazz concert rooms)
    - Acoustic loud music concert room

- Acoustic soft music concert rom

The most important criteria

Room volume

ROOM VOLUME is **the** most important criterion. This corresponds well with our measurement reports.

The main problems we find in large rehearsal rooms for soft ensembles (choirs) and for loud ensembles (wind bands).

We also see problems in music schools where the teaching rooms and studios are too small.

For soft music the Standard gives a minimum of 700 m3 for a choir – and minimum 5 m room height.

For loud music the Standard gives a minimum of 1000 m3 for a wind concert band – and minimum 5 m room height.

For teaching rooms in music schools etc the rooms should be 45m3 for soft and 60 m3 for loud music instruments.

The individual practice rooms can be smaller, but a survey with professional wind musicians show that also many of the professional individual practice rooms are too small.

Here we see the result of a survey made by the choir organization Norsk Sangerforum, and as we see,

- 54% of the rehearsal rooms are way too small, less than half the size they should have been
- 22% are too small
- 24 % have more or less sufficient volume

Here you see the volumes defined by the standard as minimum.

This corresponds well with our practical references, both from our measurements and from talking to conductors, musicians and singers.

Here we have the concert volumes. As you see, the standard sets 12 m^3/person for acoustic soft and 10 m^3/person for acoustic loud music (as long as the lower limit of 2000m^3 is fulfilled).

Room geometry and dimensions

Criterion 2 is Room geometry and dimensions

a) Sufficient dimensions h– room length, width and height
   Especially room heigt is important
   This is not as problematic as one might expect, the main problem turns out to be choirs rehearsing in rooms with all too low room height
b) Sufficient room geometry
   Not too long/narrow rooms – avoid arches and curved surfaces

We see that some rooms are too long and narrow - not giving enough space for the musicians to the closest wall (reflecting surface)

c) ABSOLUTLY NO «NARROW THEATRE STAGE OPENING», which we see all too often in Norway

Reverberation time

Our 600 measurements show a variety of different problems, and many types of problems are frequent. The good news however is that If criteria 1+2 is ok, it's often not too expensive to fix the conditions in rehearsal rooms.

In rehearsal rooms (and also in concert rooms), we see very often very uneven reverberation profile, the reverberation times in the 63 Hz and 125 Hz octaves surprisingly often more than 50% shorter or longer than the 500Hz+1000Hz-octaves. We are astonished to see how often the average reverberation time is **not** representative for the 63 Hz-4000Hz span, and in many cases this average reverberation time is in real misleading as a valuable expression for the acoustical quality of the room.

We also find big differences around the room (not enough diffusion and/or unevenly positions of reflecting and absorbing surfaces). This is especially harmful in rehearsal rooms, since it might lead the ensemble using the room every week to train for poor internal music balance in the group – and that the musical quality gradually weakens instead of improving!

The main challenge for concert rooms is to PRIORTIZE ONE main use. It's difficult for the local authorities **not to** wish to have one and the same room to suit all kind of music use – and also be able to use the room for theatre, conference, even cinema and other events. The political desire to build one multipurpose room for every music use seems efficient and smart – but the result is often a room not at all acoustically suited for acoustical soft music as singing or choirs, too small for normal size or large wind bands and either not suited for loud amplified music.

Reverberation time – mid frequencies - is one of the main diagrams in the standard, showing the reverberation time related to the room volume – for each of the three different music genres and for the concert/rehearsal situation. Remember that the standard is a minimum standard, so we have focused on reverberation time. In the next revision (due in 2019), we might consider other criteria, such as C80 and/or strength.

Regarding strength, the standard has an interesting appendix about strength in rehearsal rooms.

Room strength turns out to contribute very much to a good acoustic description of music rooms – as well in rehearsal rooms as in concert rooms

«How much louder is the sound in the room related to the sound level outdoor»

The strength depends on net volume, reverberation time, medium absorption factor and absorption surface area

And is important especially for

- LOUD music – where the room strength should not be **too high** room –
- and for SOFT music - where the room strength should be **enough**

Our measurements now include calibrated G in all rooms for acoustic music/ensembles

Ex: Typically, many school wind bands use rooms with a G of 15-20 dB, giving very high sound pressure levels, and/or training the musicians to play only in piano to mezzopiano, maybe mezzoforte, and NOT developing a good quality of sound/timbre.

One of our worst cases is the brass band rehearsing in a room with a strength of 23 dB (room volume of under 400 m3).

Regarding the room strength, «The aim is to find the volume and reverberation time that corresponds to a sound level at *forte* between 85 and 90 dB." (JHR)

- For a string quartet, it is found that *G* should be between 21 and 26 dB.
- For a boys choir of 24 singers, the G should be between 14 and 19 dB.
- For a brass quintet, the *G* should be between 6 and 11 dB.
- For a 40 musicians wind band, the *G* should be between 0 and 5 dB. (If the room has a strength of 20 dB, the sound level turns out to be >110 dB, which of course is impossible and forces the band not to play forte at all…..)

Acoustical adaption

Criterion nr 4 is acoustical adaptation. Our measurements show that many rooms have too little diffusion, the newer rooms built today have substantially more diffusion than older rooms. There are some echoeffects in quite a number of rooms, but they are seldom very bothersome.

One special situation happens in some rooms with retractable seats. When the seats are retracted, the acoustics in the room changes significantly, often giving strong echoes and unwanted longer reverberation time.

Background noise

The last – but not least – criterion is the background noise. In Norway, this is related to another Norwegian standard, NS8175 which covers all kind of buildings and rooms.

NS 8178 relates to the «music education room» standard

In short, the limits are

- 25 dBA for concert purposes
- 30 dBA for rehearsal purposes
- No single-tone noise

Summary

The *Council for Music Organizations in Norway* have completed 600 room acoustic measurement reports from rooms that are used for music rehearsals and/or concerts. This, combined with the National Norwegian Standard NS 8178:2014 «Acoustic criteria for rooms and spaces for music rehearsal and performance» has lead to a bigger and improved focus on the acoustical conditions in music rooms and spaces in Norway – based on the main principles in the Standard:

3 wide different music genres:

- Acoustically soft music
  voice and relatively quiet instruments string instruments, guitars, small woodwind groups
- Acoustically loud music
  brass and percussion instruments, brass bands, concert b ands, symphony orchestras and opera
- Amplified music
  pop/rock bands, amplified jazz groups etc.

5 types of room:

- Individual practice room (1-2 musicians)
- Small ensemble room (3-6 musicians)
- Medium size ensemble room (up to 20 musicians)
- Large ensemble room (more than 20-25 musicians)
- Performance rooms

5 most important criteria

- Enough volume
- Suitable room geometry and dimensions
- Reverberation time
- Acoustic treatment of the room
- Background noise level

As a combination of criteria 1-4 the room gain (G) is discussed, and is very important for the music use of the rehearsal and concert rooms.