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Rehearsal rooms in the context of norwegian standard NS 8178:2014

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Abstract

Music school students spend much more time rehearsing than performing in concert halls. Individual and small ensemble exercises are a major part of daily practice. The aim of the article is to verify whether the areas of rehearsal rooms given in functional programs attached to architectural contests for music schools, are sufficient to provide required acoustic conditions inside the chamber such as sound power level (SPL) and reverberation time (RT) which is preferred by musicians. The Norwegian Standard NS 8178:2014 was used to calculate the sound level generated by instruments. In this paper, the author will focus on small rehearsal rooms dedicated to individual practice and small practice groups of two or three members.

Keywords: sound level, music school, rehearsal room

1. Introduction

Several architectural contests for music schools have been organised in recent years in Poland. One of the necessary guidelines for the participants was a functional program. It had to be included in the concept project. The aim of the article is to verify whether the areas of rehearsal rooms provided in functional programs are sufficient to obtain required acoustic comfort inside the chamber.

By receiving "required acoustic comfort" during intended use, the author means to reduce sound level in the room to a value which is safe for hearing and to provide reverberation time that is preferred by musicians. To calculate the sound level generated by instruments, the Norwegian Standard was used (NS 8178:2014). The reverberation time was based on the attainable scientific literature. In this paper, the author focuses on small rehearsal rooms dedicated to individual practice and small practice groups of two or three members.

1.1. Why are small practice rooms so important in music schools?

First of all, students spend much more time rehearsing than performing in concert halls. Individual and small ensemble exercises are a major part of daily practice. According to a survey conducted among students from the Greensboro School of Music, the average time spent on individual exercises is three hours per day (Phillips, Mace, 2008) In addition to this, they practise in ensembles and perform in orchestras at least once a week. The investigation showed that the students receive on average from 59.5% (string instruments) to 180% (brass instruments) of the daily allowed dose of noise exposure during three hours of individual practice (Phillips, Mace, 2008). The maximum dose allowed for one day (100%) is defined as the exposure of 85 dB(A) for eight hours according to (NIOSH, 1998) and (Directive 2003/10/EC). Another reason why those spaces are so significant is the size issue. Rehearsal rooms are normally smaller than performance halls which can increase sound levels. The researches revealed that the sound power levels (SPL) of individual practices are often 6-20 times higher (in dB) than the levels during group rehearsals and performance (Phillips, Mace, 2008). Music school students are young. They link their future lives with music. However, they are at the beginning of their career path. Their hearing should be particularly taken care of. Furthermore, inappropriate room acoustic makes it impossible for a teacher to assess the propriety of a student´s exercise (Osman, 2010). It can adversely affect the development of basic musical skills of a student.

1.2. Why NS 8178:2014?

The Norwegian Standard "Acoustic criteria for rooms and spaces for music rehearsal and performance" (NS 8178:2014) was created especially for music practice rooms. It raises the complexity of the problem of receiving the required acoustic comfort in the practice space. This standard enables a designer to precisely establish the net volume of the rehearsal rooms during the concept stage. The introduction to this standard states that it is not possible to achieve appropriate acoustic conditions for all music types and speech communication in a single room. It is necessary to determine the accurate function of the space by defining the music type, the number of musicians and the users' preferred reverberation time. The standard can be used in the planning of new buildings as well as in refurbishment and assessment of the existing structures.

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2. The Method and the Results

Functional programs were analysed relating to:

- architectural contest for rebuilding the Public Music School in Konin (2012),
- architectural contest for concept design of Music School in Poznań (2014),

In order to calculate the sound level of the ensemble or single practicing musician, the following NS' equation was used:

$$L_p = G + 59 + 10\log\sum n_i k_i \,(dB) \tag{1}$$

where:

G – the sound strength of the space *(dB)*, as a variation depending on reverberation time and net volume of the space (from standard's Figure A.1);
n_i – the number of instruments of type *i,;*
k_i – the power factor for an instrument of type *i* at forte.

$G(dB)$ is a variation depending on reverberation time and net volume of the space. The value is determined by using the figure in the standard. The areas of the rooms were defined according to functional programs. A rectangular shape plan was assumed as the most popular. The net room height was assumed to be 3.3 m. According to the current Polish regulation (Dz.U. 2002 Nr 75, poz. 690) this is the minimum height for working and learning spaces where harmful or onerous factors present. Reverberation time was defined as shown in Table 1.

Table 1. Musicians' preferred reverberation times (Gade, 2014), (Osman, 2010)

Type of instruments	Preferred *RT [s]*	Average *RT* assumed in calculations *[s]*
Percussion Instruments	0,3 - 0,5	0,4
String Instruments	0,6 - 0,9	0,75
Woodwind and Brass Instruments	0,4 - 0,7	0,55
Grand Pianos	0,56 - 0,7	0,6

The results of the analysis are presented in the Tables 2-4. If the sound level L_p ranges from 85 dB to 90 dB at forte, it means that the volume of the rehearsal room is correctly designed and well suited to its function (NS 8178:2014). A sound level at forte higher than 90 dB may entail a risk of hearing damage. If sound level at forte is lower than 85 dB, it means that the intension and intimacy of music is insufficient. However, there are musicians who prefer lower reverberation time during practicing. So the limit of 85 dB as a minimum is rather an assumption than a restriction.

Table 2. Sound levels generated by a single instrument or a group of instruments in different types of rehearsal rooms

Type of the room	Instrument(s)	Sound level at forte L_p [dB]	Room's area in functional programs[1] [m²]	Required area [m²]
Piano Room	Two Grand Pianos	87.5	25	-
Percussion Practice Room	Percussion/ Snare Drum	**92.5**	15	27
	Cymbals	89.5	15	-
	Xylophone	80.5	15	-
Percussion Practice Room II	Percussion/ Snare Drum	**91.5**	20	27
	Cymbals	88.5	20	-
	Xylophone	79.5	20	-

Type of the room	Instrument(s)	Sound level at forte L_p [dB]	Room's area in functional programs[1] [m²]	Required area [m²]
Main Percussion Hall	Timpani/ Percussion/ Snare Drum	88.5	40	-
	Bass Drum	89.5	40	-
	Cymbals	85.5	40	-
	Xylophone	76.5	40	-
	Percussion + Snare Drum	**91.5**	40	50
	Timpani + Snare Drum	**91.5**	40	50
	Percussion + Bass Drum + Snare Drum	**93.6**	40	76
Organ Hall	Organ + Grand Piano	**92**	40	60

[1] Room's areas according to functional program of Music School in Poznań. Areas of Piano Room, Percussion Practice Room and Percussion Practice Room II are related to both functional programs (Music School in Poznań and Public Music School in Konin).

Table 3. Sound levels generated by a single instrument in individual practice rooms

Type of instrument	Instrument	Sound level at forte L_p [dB]	Room's area in functional program[2] [m²]	Required area [m²]
Woodwind Instruments	Flute	84.6	15	-
	Clarinet/ Bassoon/ Oboe	86.5	15	-
	Saxophone	**91.5**	15	21
Brass Instruments	Cornet/ Trumpet	**94.5**	15	40
	Trombone/ Tuba	**97.5**	15	73
	Bass Trombone/ Euphonium	**98.5**	15	91
String Instruments	Violin	84	15	-
	Viola	82	15	-
	Cello	85	15	-
	Double Bass/ Harp	87	15	-
	Acoustic Guitar	81	15	-

[2] Room's areas according to functional program of Music School in Poznań.

Table 4. Sound levels generated by an instrument with a grand piano accompaniment in individual practice rooms

Type of instrument	Grand Piano + Instrument	Sound level at forte L_p [dB]	Room's area in functional program[3] [m²]	Required area [m²]
Woodwind Instruments	Flute	88.2	20	-
	Clarinet/ Bassoon/ Oboe	89	20	-
	Saxophone	**92.2**	20	27
Brass Instruments	Cornet/ Trumpet	**94.6**	20	55
	Trombone/ Tuba	**97.3**	20	85
	Bass Trombone/ Euphonium	**98.3**	20	106
String Instruments	Violin	87.5	20	-
	Viola	87	20	-
	Cello	87.8	20	-
	Double Bass/ Harp	88.6	20	-
	Acoustic Guitar	86.8	20	-

[3] Room's areas according to functional program of Music School in Poznań.

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3. Discussion

The presented results of the analysis suggest the need to segregate the individual practice rooms in accordance with the types of instruments. It is necessary to divide off rooms dedicated to saxophones and brass instruments. In case of those instruments, an area of fifteen square metres is definitely too small. The space should be around 30 square metres in area (Table 3). When it comes to instruments such as the trombone, tube or euphonium, the required area is even greater. However, bearing in mind economic issues, sharing other spacious rehearsal rooms, like the Main Percussion Hall, would be reasonable solution. Designing adequate sound insulation between spaces dedicated to brass instruments is another question - but it is not the subject of this paper.

The results of individual practice rooms with a grand piano accompaniment look similar (Table 4). There is a need to separate and to enlarge the spaces for saxophones and brass instruments.

The areas of analysed rehearsal rooms are suitable for string instruments. Too low values of the sound level can be noted (Table 3) but it has to be remarked that the students playing string instruments often exercise in pairs or as trio. In such situations, the sound level ranges from 84 dB to 87 dB (in the case of two players) or to 90 dB (in the case of a trio) which is the required sound level. So the same space can be used by one, two or even three string instrumentalists.

Percussion practice rooms should be enlarged to 27 square meters in area due to the higher sound levels from the percussion and snare drum (Table 2). In the case of the Main Percussion Hall, sound level values were increased during playing two and more percussion instruments together. However, in comparison to values from brass instruments in individual practice rooms (Tables 3 and 4), differences are not so crucial.

It should be emphasised that the values of the required room areas can-not be regarded as being set in stone – it is rather an approximation. The calculations were conducted on the assumption that the net room height is 3.3 m. This is the minimum height for spaces like music school rehearsal rooms and is often applied to architectural projects. If the height was assumed to be 4 m, percussion practice rooms and areas for saxophones would be sufficient. The net room volume is the decisive factor, not the room's area.

4. Conclusions

There are many issues to be considered during the design of music school rehearsal rooms. The results of analysis revealed that the individual practice rooms should be divided in accordance with the types of instruments. It is necessary to enlarge the spaces dedicated to saxophones and brass instruments.

The Norwegian Standard (NS 8178:2014) takes into account many factors affecting the acoustic comfort inside the chamber. It enables an architect to establish in a simple way, the net volume of the rehearsal rooms. However, it has to be remarked that the standard can-not replace the cooperation between the architect, the acoustician and the musicians at every stage of the design process.

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Sale do prób muzycznych w kontekście norweskiej normy NS 8178:2014

Streszczenie

Uczniowie szkół muzycznych znacznie więcej czasu spędzają, ćwicząc w salach do prób niż występując w salach koncertowych. Duża część zajęć praktycznych to zajęcia indywidualne lub w 2–3 osobowych grupach. Celem artykułu jest sprawdzenie, czy powierzchnie sal ćwiczeniowych, narzucone w programach funkcjonalnych szkół muzycznych, są wystarczające do uzyskania odpowiednich warunków akustycznych rozumianych jako poziom dźwięku w pomieszczeniu oraz preferowany przez muzyków czas pogłosu. Do obliczenia poziomu dźwięku generowanego przez instrumenty muzyczne wykorzystano norweską normę NS 8178:2014. W niniejszym artykule skupiono się na małych salach do prób, przeznaczonych do zajęć indywidualnych lub ćwiczeń w grupach 2–3 osobowych.

Słowa kluczowe: poziom dźwięku, szkoła muzyczna, sala do prób muzycznych