The Largest Musical Studio in Russia

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THE LARGEST MUSICAL STUDIO IN RUSSIA

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ABSTRACT

Studio 5 in the State House of Radio Broadcasting and Sound Recording was built in 1967. The area of the studio is 600 m^2 and its volume is equal to 7736 m^3. Up to now it is the largest musical studio in Russia. The acoustic design of the studio based on scale model research was not successful, and a lot of work was done in order to obtain good acoustic conditions. The history of the acoustic design of the studio is given as well as the results of the acoustic measurement that were made after the recent renovation. The subjective estimation of the sound quality is also presented.

O. INTRODUCTION

The State House of Radio Broadcasting and Sound Recording (GDRZ) was the first complex in Russia that was specially designed and built for the professional activity in sound recording. It was decided to locate this complex in a 6-storey building at Malaja Nikitskaja Street in the central part of Moscow. The design and the construction of the building began in the thirtieth years. The leading part in this work belongs to prof. I.Goron who later became the first director of GDRZ. Many of the well known Russian specialists in room and building acoustics took part in the design of the studios and their tuning. Among them should be mentioned the names of S.Rjevkin, G.Goldberg, S.Ter-Osipiantz, I.Dreizen and A.Kacherovitch.

Three musical studios, several talk studios and lot of different control rooms were included in the building. Reverberation and anechoic chambers for the acoustic laboratory were located in the basement. All three musical studios were on the ground floor of the building and had a double wall construction. They were: studio 1 (V=4800 m^3, S=420 m^2) studio 2 (V=2330 m^3, S=236 m^2) and studio 3 (V=879 m^3, S=119 m^2). Studios 2 and 3 were ready in 1938. The construction of studio 1 was finished after the World War II. Not all the decisions of the primary acoustic design considered to be successful. and some additional works were done during the acoustic tuning of the studios. As a result of that work done mainly by the acoustic laboratory of GDRZ it was managed to get a good sound quality in all three studios. It's no doubt that studios in GDRZ greatly influenced upon the development of the studio acoustics in Russia. The description of these studios was published in many student's books for the studies in technical acoustics and radio broadcasting. From the end of the fortieth the complex of GDRZ was conceded to be the main sample for the design of studios all over the former USSR.

In the beginning of the sixtieth it became clear that additional studios should be built in Moscow. So it was decided to enlarge the existing complex of GDRZ and to build a new large house in immediate contact with the primary one. This new building was finished in 1967. Musical studio 5 (V=7736 m^3, S=600 m^2), two drama studios and several control rooms were located in it. Studio 5 was designed mainly for the records of a symphony orchestra and a large choir. From that time an up to nowadays studio 5 remains the largest musical studio in Russia.

It should be mentioned that studio 5 is well known for the majority of the professional Russian musicians. Many foreign musicians, orchestras and choirs were recorded in this studio as well. But no detailed data on the acoustics of studio 5 was published. Only 2 papers should be mentioned [1,2]. Both of them deal mainly with the investigation of the measurement procedures in room acoustics and very limited data on the acoustics of studio 5 is given. The aim of this paper is to fill in the existing drawback. It has the following structure. The description of studio 5 is presented in part 1. The review of the works on the acoustic tuning of the studio that were done during several years is given as well. While presenting the material of this part there were used the unpublished report [3] and the archive of the acoustic laboratory of GDRZ. Some remarks on the subjective estimation of the sound quality in studio 5 are given in part 2. The last part 3 deals with the results of the acoustic measurement that were done in studio 5 after the recent renovation.

1. ACOUSTIC TUNING OF STUDIO 5

Studio 5 was designed for the records of a large symphonic orchestra with a possible presence of a choir and an audience up to 150 persons. The studio had a very simple plan 28.5 (L) x 21.0 (W) m with a flat ceiling 13.5 m high. The plan and the view of one lateral wall are shown in fig. 1,2. It can be seen that Studio 5 may be divided into 3 zones that are intended for the choir, for the orchestra and for the audience. The slope with 9 steps made of concrete is located in the zone for the choir. The orchestra is placed on a flat parquet floor in the central part of the studio. Five rows of chairs for the audience are installed in the last zone that include 6 steps made of concrete.

The design of studio 5 was made by the Moscow institute GIPROKINOPOLIGRAF. Due to the primary design the ceiling of the studio is flat and covered with plaster. Panels of plywood (1200 x 1200 mm) were placed on the walls. A part of these panels was perforated and mineral wool was placed behind them. Three very large wooden boards were suspended to the ceiling, and 8 such boards were installed on the lateral walls (4 boards on the each wall). These boards were installed with the different sloping according to the surfaces of the ceiling and the walls. The angles of the sloping were estimated by the measurements done in the scale model (1:40) of studio 5. The main purpose of the estimated slope of the wooden boards was to provide the high-level sound reflections in the central zone of the studio. The sound absorbing material was placed on the back surface of 3 boards suspended to the ceiling. No sound scattering constructions were proposed for the studio according to the primary design.

The listening tests were done in the finished studio with the participation of the skilful sound masters and musicians. The results of these tests showed that the sound quality in the studio was poor and no professional sound records can be done in it. It was estimated: (1) the reverberation time is too short: (2) the musical balance is not proper, the string instruments sound too softly comparatively with the wind instruments; (3) the sound at low frequencies is chaotic and disunited: (4) The localisation of the different musical instruments is poor.

The authors of the primary design refused to do the acoustic tuning of the studio. So this work was done by the acoustic laboratory of GDRZ headed by V.Rudnic in co-operation with prof. I.Dreizen. A step by step procedure was used. After each stage of work the acoustic measurements were done and listening tests were provided during the rehearsals of the orchestra. It took a lot of time to do this work. As a result the following changes of the studio's interior were done:

- It was estimated that 3 wooden boards suspended at the ceiling with the different slopes had a poor effect on the sound quality. Experiments with the different slopes of these boards gave no positive result. So all these boards were raised to the ceiling and suspended practically in parallel to it's surface. Only very small slope of 3° was chosen in order to eliminate the flutter between the boards and the flat parquet floor in the central part of the studio. The sound absorbing material on the back surfaces of the boards was taken away in order to enlarge the reverberation time.
- Sound reflecting boards on the longitudinal walls of the studio were installed in parallel to the wall's surfaces (see fig. 1). Experiments with the different slopes of these boards also lead to no positive effect. Only one board opposite the string group of instruments was bent a little, and 11 sound scattering constructions were placed on the surface of this board (see fig. 2). All these constructions were made of plywood and had a form of half a cylinder surface. This measure was found to be extremely useful for the proper music balance of the string instruments.
- A new barrier 1.2 m high was installed between the orchestra and the choir (see fig 1,2). It was covered with perforated plywood panels. Behind the brass wind instruments the mineral wool was placed into the frame of the barrier.
- Two types of sound scattering constructions were suspended above the wind instruments (see fig 1). The first type had a form of half a cylinder surface and was similar to the constructions installed at the surface of the lateral wooden board opposite the string instruments. The second type had a conical form with a vertex orientated to the floor of the studio. The enlarged plan of these suspended constructions that were made mainly of plywood is shown in fig. 3.

2. SUBJECTIVE RATING OF THE STUDIO ACOUSTICS

A good sound quality was estimated in the studio after the mentioned acoustic tuning. A high acoustic rating of studio 5 remained up to nowadays. At the end of the eightieth acoustic laboratory of the Research Institute for TV and Radio started a program dealing with the subjective estimation of the sound quality in musical studios. A lot of studios in various cities (Kishinev, Erevan, Tallinn, ect.) were investigated. Studio 5 was among them. Some results of this research made by a questionnaire method will be presented.

Special forms were fulfilled by 60 musicians. All of them had a long practice of playing in studio 5. Four main criteria were proposed:

1. Audibility of the own instrument and the other groups of instruments;
2. Duration of the sound decay (reverberation);
3. Disturbing factors (echo, intensive sound reflections, etc.);
4. Total acoustical impression (TAI).

The 5 point scales were used for all the criteria. The details are given in the table below.

Table 1.

Criteria	Scale				
1.Mutual audibility.	Too little	Little	Optimal	Large	Too Large
2.Reverberation	--	-	0	+	++
3.Disturbing factors	Not audible	Audible, but doesn't disturb	Disturbs a little	Disturbs	Disturbs very much
	+++++	++++	+++	++	+
4.TAI	Very poor	Poor	With audible faults	Acceptable	Without any reproofs
	+	++	+++	++++	+++++

Most of the musicians noticed that the mutual audibility of the different groups of instruments in the studio is close to optimal. It means that the proper musical balance was obtained in the studio during it's acoustical tuning. The results for the other 3 criteria are shown in fig. 4. It can be seen from fig.4a that 56% of the musicians considered the reverberation time in the studio to be optimal. Only 9% of musicians marked that reverberation is small and 27% considered the reverberation to be large. It should be mentioned that the orchestra used studio 5 as a rehearsal hall for a long time. It's known that many musicians prefer to play in more "dry" rooms during the rehearsals then during the concerts. That may be the reason why 27% of musicians prefer to have the shorter reverberation time in the studio. Most of the sound masters considered the reverberation time to be optimal.

The majority (84%) of musicians marked that disturbing factors are not audible at all (58%) or audible but don't disturb (26%). This leads to the conclusion that there are no high-level sound reflections that may damage the sound quality. The estimation of TAI in the studio is high also. Most of the musicians (56%) marked that TAI is acceptable and 18% did not noticed any acoustical faults at all.

3. RESULTS OF ACOUSTIC MEASUREMENTS

In summer 1998 some renovation of studio 5 including the installation of a new parquet floor was done. The detailed acoustic measurements were provided after that. They were done in an empty studio with 170 upholstered chairs for the musicians, 70 music stands, 2 grand pianos and other musical instruments. MLSSA system from DRA was used. It was connected with the sound source and the measurement microphone type 4133 from Bruel&Kjer. The sound source was placed in 10 points. Three of them were in the placement of choir and the other among the orchestra area. The impulse responses was measured for every sound source - microphone position and several acoustic criteria (RT60, EDT, C80, TS, etc.) were calculated from them.

The measured values of RT60 are given in table 2. The results of the old measurements are also shown in this table. The measured results are close to the recommended values for the music studios of the corresponding volume [4]. It can be seen that the values of RT60 were not greatly changed during the last 17 years.

Table 2.

	Octave bands, Hz					
	125	250	500	1000	2000	4000
RT60, s (measured in 1981)	1.55	1.75	1.95	2.00	1.90	1.70
RT60, s (measured in 1998)	1.65	1.85	2.00	2.10	1.95	1.65

The detailed analysis of the measured impulse responses leads to the conclusion of the proper structure of sound reflections in the studio. Two examples in the form of EDC are shown in fig. 5. They correspond to the case when the microphone was placed behind the conductor. The measured values of C80 in middle frequencies (500-2000 Hz) are close to +(2-4) dB for the sound source positions in the choir area. The larger values of C80=+(3-9) dB were estimated when the sound source was moved to the orchestra area. In this case the direct sound dominates due to the small distances between the sound source and the receiver, and the measured values of C80 seemed to be acceptable.

4. CONCLUSION

Of course acoustic solution of studio 5 seems to be old fashioned while taking into account the modern achievements of architectural acoustics. The studio was designed many years ago when methods of computer simulation were not used. The "digital" sound scattering constructions proposed by M.Schroeder [5] that nowadays are produced as ready to use products were not also known. No doubt that the use of such construction would be very useful and gave the chance to avoid many mistakes at the stage of the design. Nevertheless the experience of the acoustic tuning of studio 5 may appear to be useful. It leads to the conclusion that even old methods allow to get good results in studio acoustics.

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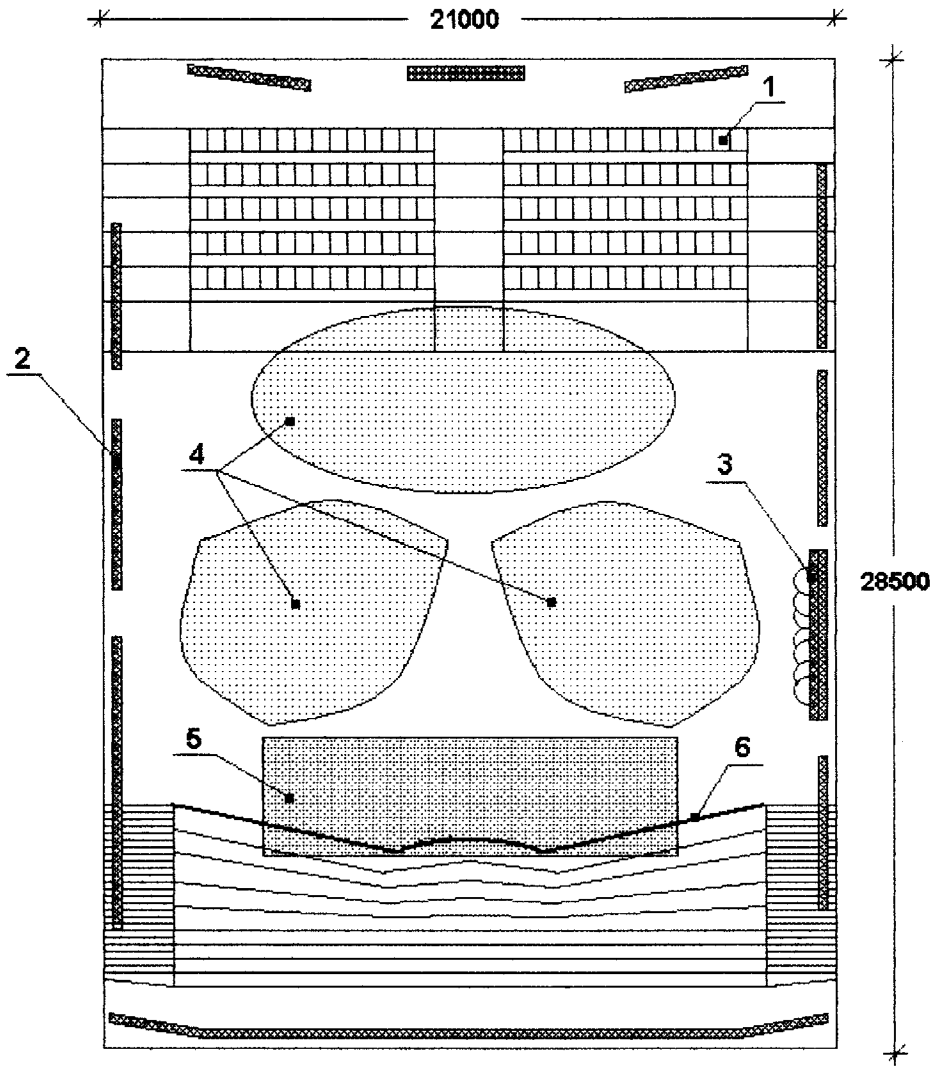


Fig.1. Plan of studio 5.
1 - Chairs for the audience.
2 - Wooden boards installed along the walls.
3 - Wooden board with the sound scattering constructions.
4 - Position of 3 wooden boards that are suspended to the ceiling.
5 - Area of the sound scattering constructions that are suspended 7 m above the wind instruments (see the enlarge view in fig.3).
6 - Barrier behind the orchestra.

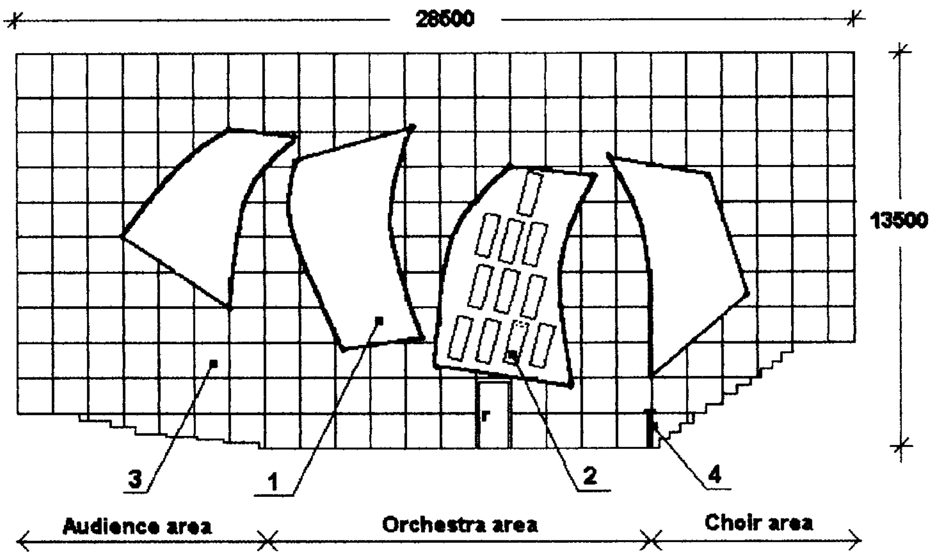


Fig. 2. View of the lateral wall.
1 - Wooden boards installed along the walls.
2 - Wooden board with the sound scattering constructions.
3 – Plywood panels (1200 x 1200 mm).
4 - Barrier behind the orchestra.

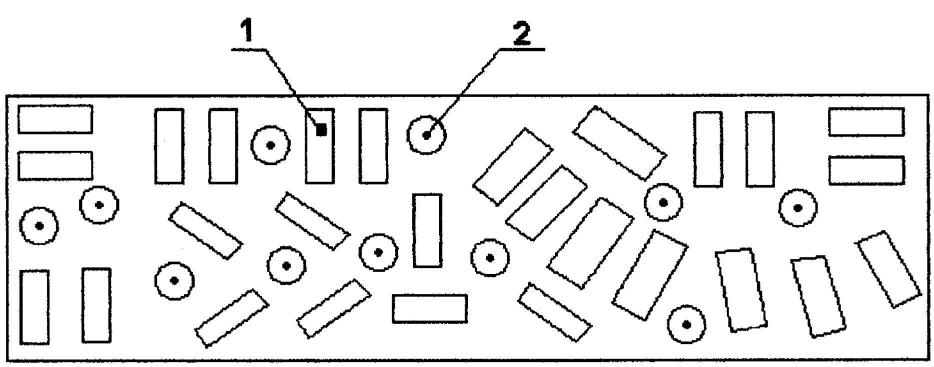


Fig. 3. Plan of the sound scattering constructions suspended above the wind instruments (see fig. 1). 1-Constructions in the form of half a cylinder.
2-Constructions in the form of a cone.

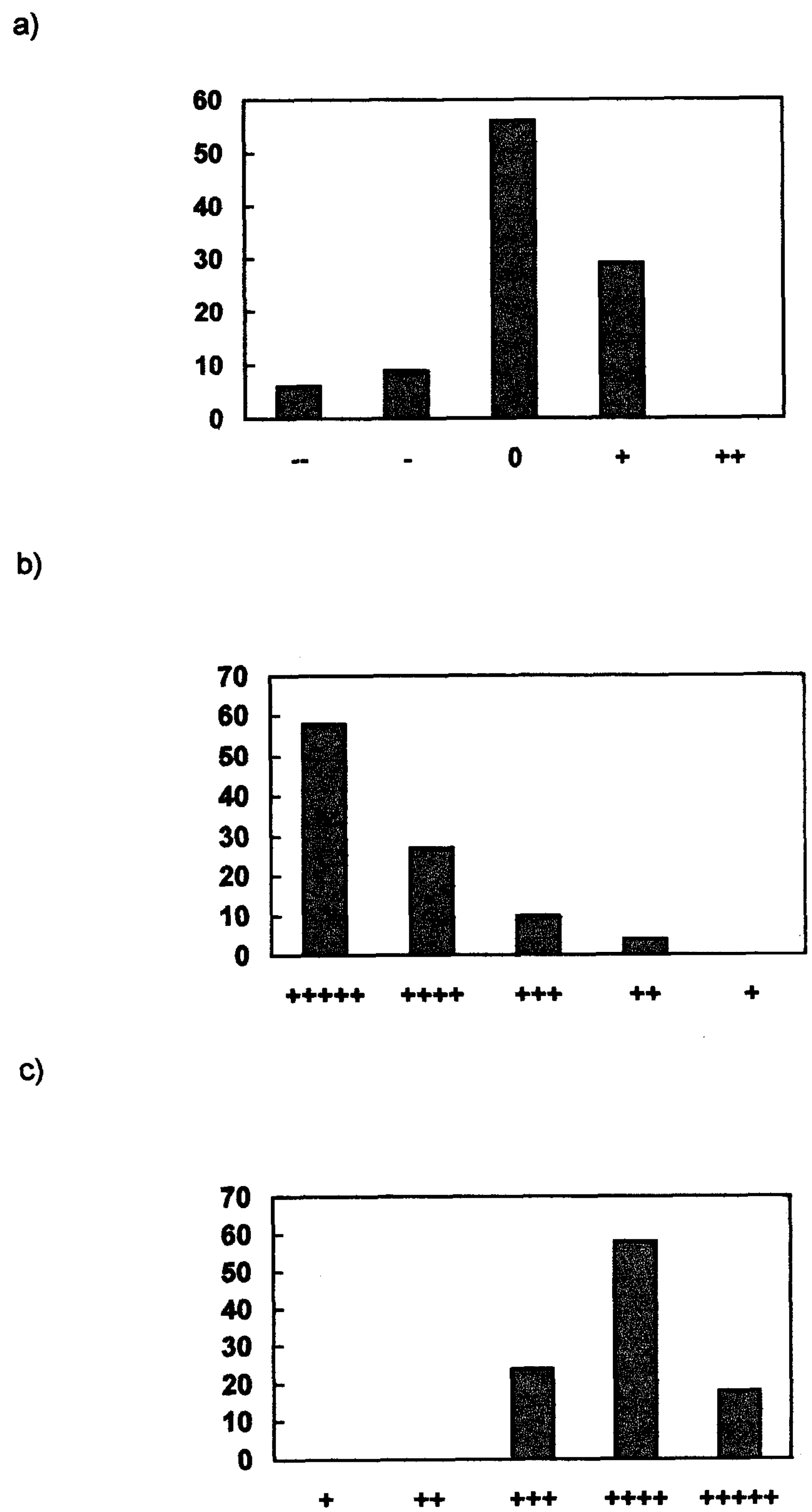
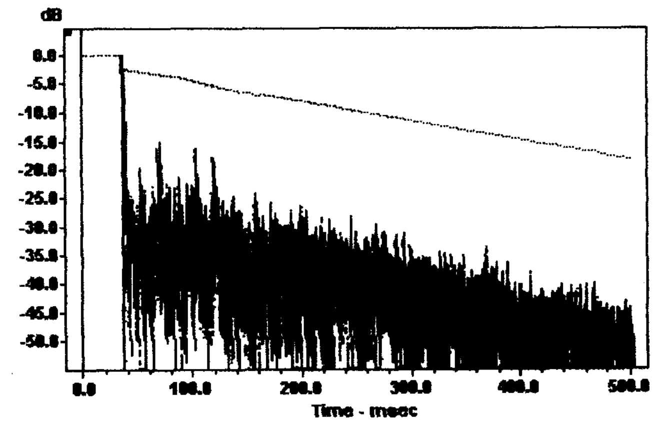


Fig. 4. Estimation of the sound quality (percent). a – duration of the sound decay; b – disturbing factors; c – total acoustic impression. The scales are given in table 1.

a)



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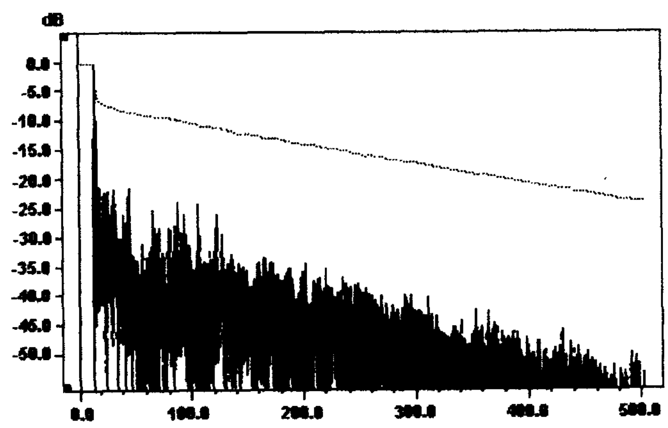

Fig. 5. Two examples of the measured EDC for the sound source position (a) in the choir area and (b) in the orchestra area. The microphone is behind the conductor.