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Big halls for music in Argentine

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Abstract

In recent decades several large rooms for music have been built or reconditioned in Argentine. Among them is the well-known *Teatro Colon* of Buenos Aires, the *Teatro Argentino* of La Plata, the *Usina del Arte* Symphony Hall, the *Blue Whale Auditorium* of the CCK in Buenos Aires and el *Centro del Conocimiento* in Posadas, Misiones. And there are under construction or in its development stage some more, such as the *Teatro del Bicentenario* of San Juan and the *Polo Cultural Ambiental de Arte* of Tierra del Fuego. This paper describes briefly their physical, architectural and acoustic features. In each case it is highlighted the particular needs of each project and the strategies developed for their acoustical design.

Keywords: acoustics, music, big halls

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1 Introduction

In this work we will briefly analyze the big halls for music performances built and/or restored in the last 25 years in Argentina. In each of them, the acoustic consultancy applied technical criteria upheld throughout the development of each project and the subsequent Project Management practiced in every one of them.

There was total harmony among design Architects, structure Engineers and Consultants of various specialists in Engineering and Architecture and also among musicians who, with their experience and criterion, collaborated with the objective of creating rooms appropriate for music performances showing in every case the love for music. This introduction is also a well-earned homage to the Engineer Federico G. Malvárez, master in science and the art of acoustics, and a pioneer in this specialty in our country. Four of these great acoustics works will be described below.

2 Teatro Argentino of La Plata

The new building of the Teatro Argentino of La Plata, built after the fire in 1977, was inaugurated in 1999.

Figure 1: Opera Hall of the *Teatro Argentino* of La Plata

In the project of the opera hall “Alberto Ginastera”, we applied geometric frameworks, statistic calculations and a model 1:50 mirrored inwardly to observe reflections. Some researches were carried out simultaneously in England at Cambridge University, based on a physical scale model, to analyze the different acoustic parameters and behaviors. The trials in Cambridge were interrupted by the Malvinas Islands conflict of public knowledge. With the results of all these trials, the project was completed and the construction of the work began.

Figure 1: Excavation during the construction of the complex

During the construction, which was interrupted for fourteen years, all the materials added to the hall were analyzed acoustically based on trials in external and in situ laboratories [1].

The Opera Hall was inaugurated on 12th October 1999 with a Symphonic Choral programme. The following year, once the complete stage equipment was added, an opening opera was performed. From then on, the Ginastera Hall, with a capacity for 2300 spectators, has become a landmark for the music activity in the city of La Plata and in the country.

In the references cited at the end of this work, you can find the results of the acoustic measurements, laboratory trials and tests done with musicians. You can also read the comments by the specialized press after the first opera performances.

Architects: E. Bares, R. Germani, I. Rubio,T. García, C. Ucar, A. Sbarra.

Acoustic Consultants: Eng. F. Malvarez, Eng. R. Sánchez Quintana.
Uses: Opera, Concerts, Ballet and Recitals.
Capacity: 2,300 seats.
Dimensions: 20.5 m height, 27 m wide, 37 m long.
Volume: 15,030 m^3.

3 Usina del arte

The *Usina del Arte*, built in the premises of a former electric power plant, was inaugurated in 2011. To transform the industrial unit of the former Usina into a modern concert hall for symphonic music, the acoustic strategy considered accomplishing two complementary objectives and of similar importance.

The first of these objectives was to make the background noise inside the hall reach levels compatible with its function of non-amplified symphonic music. Here the challenge was huge since the building is located a few meters away from the Motorway La Plata-Buenos Aires, an environment of high noise pollution.

Source: G. Basso (2009)

Figure 1: Double insulation of the roof

To isolate the venue appropriately from the exterior noise, different strategies were used: perimeter partition walls were built and reinforced with high mass materials (concrete, solid bricks, etc.); a second roof acoustically reinforced was built a few meters away from the existing one and the room between them coated with absorbent acoustic material; the entrances for the public and artists were designed with double line doors; the windows to the outside in the spaces adjacent to the hall were made of double glazing mounted in double metal structural work with space between them.

The air-conditioning system was carefully set out so as not to produce noise levels above the permissible level when working fully. The final result was satisfactory and music performances without amplification as well as high quality digital recordings can take place in the hall.

The second objective was aimed at getting an adequate acoustic field inside the hall. The reverberation time chosen was of mid frequencies of 1.9 seconds, which is considered ideal for symphonic auditoriums by the specialized literature. This value was based on the balance between the interior cubic volume and the absorbent acoustic material, among which were included the seats as well as the spectators, the face brick walls and the wooden elements placed on the walls [2].

Source: G. Basso (2011)

Figure 1: Interior of the *Usina del Arte* of Buenos Aires

For the audience to experience a feeling of surround sound, we maximized the amount of lateral energy that is reflected on the different interior surfaces. The general geometry –including ramps behind the stage and two lines of lateral catwalks– as well as the interior coating were laid out according to this criterion. Finally, the hall has a big acoustic reflector over the stage whose location can be adjusted according to the characteristics of the musical group performing, be it a large orchestra, chamber orchestra or chamber concert.

Architect: Alvaro Arrese.
Acoustic Consultants: Eng. R. Sánchez Quintana, Eng. G. Basso.
Uses: Concerts, Chamber music and Recitals.
Capacity: 1,200 seats.
Dimensions: 19 m height, 22 m wide, 42 m long.
Volume: 14,000 m^3.

4 Restoration of the Teatro Colón of Buenos Aires

The Teatro Colón of Buenos Aires was inaugurated in 1908 so it was decided to enhance the building on the occasion of its hundredth year anniversary. When we received the offer to start the work, we felt the great responsibility it implied, regardless of the affection and admiration the hall filled us with.

Source: http://festivales.buenosaires.gob.ar/2015/fiba/es/noticias/6760/mas-de-55-mil-personas-en-el-10-fiba

Figure 1: Interior of the *Teatro Colón* of Buenos Aires

In an article by Leo Beranek of 2000 [3] the hall had been regarded, based on a survey carried out among orchestra conductors and music critics, as the one with the best acoustics of all opera theatres. This survey positioned the theatre well ahead prestigious halls, which motivated us to call the intervention “Programme for the preservation of the acoustics of the Teatro Colón”. In 2003, another survey conducted by Beranek [3] showed the Teatro Colón in third place among the halls for symphonic concerts, behind the one in Vienna and in Boston.

Every single change inside the hall and stage had to be reversible, that is to say, in case they may have affected the acoustic conditions it had to be possible to go back to the original conditions. In order to provide the elements to be restored with the appropriate fire-proof characteristics, they had to be examined in the laboratory to assess the absorption characteristics. The replaced elements should have similar characteristics with a high level of approximation determined by the limits of human auditory perception once installed in the hall.

The programmed measurements in the hall were performed according to ISO 3382 standards, whereas for the laboratory measurements the relevant ISO and IRAM standards were applied. The tools used were always the same as well as the people who carried out the measurements so as to lessen the errors due to the operators. We requested the IRAM Institute [2] to certify the

tools and environmental conditions throughout the trials so that they meet the standards requirements.

We decided to disassemble the hall in a certain sequence and every piece taken off was sent to a laboratory. Every important removal led us to another measurement in the hall. The measurements of dismantling of the hall were the following:

Three initial measurements: reverberation time in initial state, without people, with the hall in an 'empty' occupancy state and a normal cover with the fire resistant curtain brought down and having removed the stage curtain.

Measurements 4, 5 and 6 similar to the previous ones removing successively the stage curtain, stall seats and stall carpets.

Measurements 7, 8, 9, 10 and 11 successively without seats in the three upper floors, without chairs and benches in the boxes, without box curtains, box carpets, entrance curtains and paradise carpets.

Source: G. Basso (2009)

Figure 1: Empty hall, without seats, carpets or curtains

The measurements sequence when reassembling the hall was spectacular with respect to the disassembling. The 20th measurement, with a full hall, was equivalent to the 1st and the acoustic objective was to reproduce the same parameters. The advantage of this paired method was that we could make control comparisons in every stage. Only when the values fell within set guidelines, the next stage was allowed.

4.1 Textiles.

The textile removed from the hall was analyzed in a laboratory to determine its absorption rate. Two methods were applied: measurement in reverberation chamber and in Kundt's tube. The first one is the most accurate and the only one that ensures an appropriate result based on ISO 354 standard. However, as measurements of textile in reverberation chamber requires as a rule 10 m^2 of fabric, we also used an approximation method by means of the Kundt's tube, suitable for the first selection because of the comparative nature of the trial. Nevertheless, once one or more samples were collected through this method, another trial was carried out in the reverberation chamber. This method was very effective for the seats since the standard requires 20 seats to be upholstered for every trial. For example, we kept the filling material of the seats and replaced only the fabric of the upholstery [4].

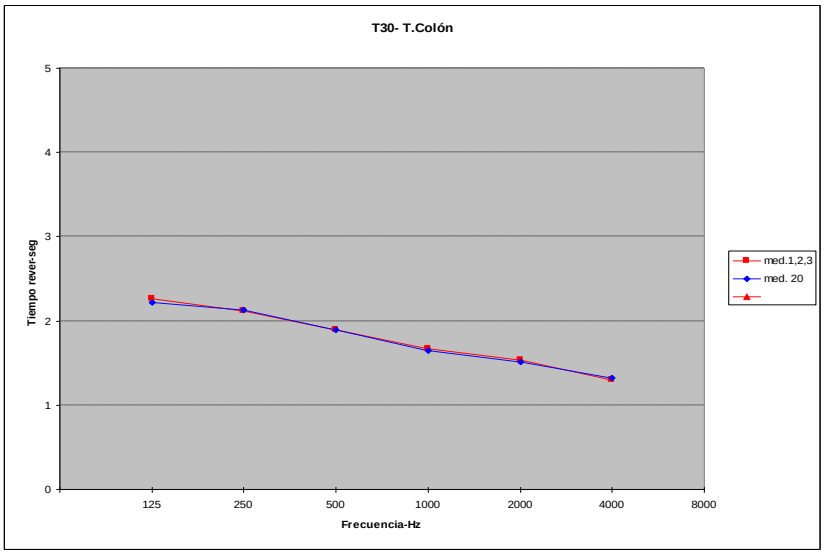

Figure 1: Comparison between the first (before the restoration) and the last measurements (after the restoration) of T30

4.2 Additional works done

We also replaced the exterior zinc sheets and we put a plastic designed to have ventilation on both sides of the sheets. To check its effectiveness, we asked the fire brigade to throw water on the roof and assess the rain noise level produced on the stage. In the hall this noise is blocked by the air gap belonging to the mansard roof.

The stage windows that open in the façade in Cerrito Street were acoustically reinforced.

In order that the noise level produced by the machines room did not affect the performances, the equipment was acoustically protected and mounted on elastic systems.

Architects: Francesco Tamburini, Vittorio Meano, Jules Dormal.
Acoustic Consultants during the restoration: Eng. R. Sánchez Quintana, Eng. G. Basso.

Uses: Opera, Concerts, Ballet and Recitals.
Capacity: 2,487 seats.
Dimensions: 26.5 m height, 24.4 m wide, 43 m long.
Volume: 20,570 m^3.

5 Cultural Center CCK –ex Central Post Office

The “Ballena Azul” Auditorium of the CCK was built in a huge building where the Central Post Office used to operate and where all the mechanisms to direct and deliver the mail had become obsolete. It was decided to assign the building another use, and next to a palatial part of great historical value, a space of 50 x 50 was available for the symphonic auditorium. The international call of bids also included a hall for chamber music, six medium-sized auditoriums, rehearsal rooms and a glazed room in the Dome. The process started in 2006 and the Centre was inaugurated in 2015.

Source: G. Basso (2015)

Figure 1: Interior of the *Ballena Azul* Auditorium of Buenos Aires

As the historical building is a monument legally protected, it was decided that the project should not alter the external appearance. In the industrial part of the building, the roofing was removed and the interior storeys were emptied. The excavation reached up to the third basement where the bases for the future auditorium were set which were mounted elastically on natural rubber blocks to avoid traffic vibrations and those coming from the two subway lines nearby.

The main hall of the auditorium has an ovoid/rectangular storey 40 meters long, 26 meters wide and an average height of 20 meters, giving a volume of 21,500 m^3. The distance between boxes of the lateral upper circles ensures reflections with proper delays. The ceiling is a network of iron beams covered in wooden slats, acoustically transparent which continue in the sides of the hall to have a particular aesthetic result. Over the stage, a multiple acoustic reflector was installed with variable height and inclination, which is necessary to redirect the sound waves towards the hall and adjust it for different types of performances.

The lateral walls are covered with wooden acoustic diffusers with different designs in order to have a good diffusion of the acoustic energy in different frequency bands. Folding drapery was set up allowing the reverberation adjustment according to the musical programme to be held. This drapery is useful if, for example, amplified instruments are used.

The stage is very versatile due to the mechanized lifts and it can be used flat or stepped by sectors to make all the different sections of an orchestra radiate the sound towards the audience appropriately.

The audience is located on a stepped ramp on the stall in two frontal circles and in three levels of boxes with two rows of spectators each. These sidelines with their ledges and depth contribute to create the necessary sound diffusion in the hall. The audience can access to the lateral boxes, for acoustics reasons, through lateral circulations outside the hall to bring the lateral walls closer avoiding cross-echoes coming from the sides.

The hall is equipped with a concert hall organ of 56 registers manufactured by the German company Klais Orgel.

Architects: E. Bares, F. Bares, N. Bares, D. Becker, C. Ferrari, F. Schnack.
Acoustic Consultants: Eng. R. Sánchez Quintana, Eng. G. Basso.
Uses: Concerts, Chamber Music and Recitals.
Capacity: 1,900 seats.
Dimensions: 24 m height, 26 m wide, 40 m long.
Volume: 21,521 m^3.

References

[1] Sanchez Quintana, R. Diseño de la sala de Opera del Teatro Argentino de La Plata, *Memorias del II Congreso Ibero Americano de Acústica*, Madrid, 2000, in CD-ROM.

[2] Basso, G; Sanchez Quintana, R. Una arquitectura para la música. *La Usina del Arte. Puesta en valor y reciclaje*. Ed. Ministerio de Desarrollo Urbano, GCBA, Buenos Aires, 2014.

[3] Basso, G; Sanchez Quintana, R. La acústica. *Teatro Colón. Puesta en valor y actualización tecnológica*. Ed. FADU-GCBA, Buenos Aires, 2012.

[4] Basso, G; Sanchez Quintana, R. Acústica. *El gran libro del Teatro Colón.* Ed. Clarín, Buenos Aires, 2010.