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The "Sound of Silence" at Unicamp: from conception to conclusion

Construction was completed exceeding sound insulation expectations

Abstract: The construction of Unicamp's Critical Listening Room (SEC), presented in this journal in 2021, was completed, exceeding all sound insulation expectations. With the use of a floating floor and double walls, the SEC achieved a residual noise of just 1 dB(A), ensuring an ideal environment for high-precision audio research and evaluation.

O "Som do Silêncio" na Unicamp: da concepção à realização

Resumo: A construção da Sala de Escuta Crítica (SEC) da Unicamp, apresentada nesta revista em 2021, foi concluída, superando todas as expectativas quanto ao isolamento sonoro. Com o uso de um piso flutuante e paredes duplas, a SEC atingiu um ruído residual de apenas 1 dB(A), garantindo um ambiente ideal para pesquisas e avaliações de áudio de alta precisão.

1. Introduction

In 2021, I presented the design of a Critical Listening Room (or *Sala de Escuta Crítica*, SEC) at the University of Campinas (Unicamp), conceived as a unique space in which silence is as important as sound [1]. In this Insert, I am proud to report that construction has now been completed, as shown in Figure 1, and that the results have exceeded all expectations. The SEC not only met, but also surpassed stringent airborne sound insulation requirements, providing an environment in which the residual noise is virtually imperceptible.

Figure 1: Photograph of the Critical Listening Room after completion of the construction.

2. The project

The SEC was designed as a "room-within-a-room" (the so-called *box-in-a-box* concept), consisting of an internal structure fully decoupled from the external envelope. This was achieved through the use of three distinct technical solutions.

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The first solution was the use of a floating floor, consisting of a reinforced concrete slab supported by elastomeric isolators (see Figure 2 (b)), which decouple the room from ground-borne vibrations and from the building structure. The second solution was the adoption of double walls, comprising an external wall made of filled concrete blocks (see Figure 2 (a)) and an internal drywall partition mounted on a light steel frame (LSF), filled with 100 mm-thick mineral wool and installed on top of the floating floor (see Figure 2 (c)). The third solution was the installation of acoustical doors manufactured with double panels lined with mineral wool and equipped with perimeter rubber seals. The goal was to ensure that external noise sources — such as electrical transformers, road traffic, and other environmental contributors — would not interfere with the audio measurements and listening evaluations conducted inside the room.

(a) **(b)**

(c)

Figure 2: (a) Photograph during the measurement of the internal noise level with the external wall already completed; (b) Photograph during the measurement with the external wall completed and the floating floor slab newly cast; and (c) Photograph of the construction of the internal walls, in which the self-supporting LSF structure can be seen, filled with glass wool and covered with three layers of drywall.

3. The evolution of silence

During construction, the residual noise at the center of the room was measured at several stages, as shown in Figure 3. Initially, with only the side walls built, the residual noise had already decreased by approximately 6 dB. After the concrete slab was installed, an even more substantial reduction of about 10 dB was observed. The construction of the floating floor did not affect the residual noise measured inside the room. The construction of the internal walls further reduced the noise by approximately 3 dB.

Finally, the installation of the acoustical doors eliminated any airborne transmission paths between the interior and the exterior of the SEC, resulting in a very low residual noise level inside the room.

During the measurements, one of the main challenges was the self-noise of the microphones used. Initially, a Behringer ECM8000 microphone was employed, with a self-noise of approximately 22 dB(A). As the room's residual noise decreased, microphone self-noise began to dominate the measurements, particularly at higher frequencies. To address this limitation, more sensitive microphones were used: first, a PCB 378B02 microphone, with a self-noise of 15.5 dB(A), and later a low-noise B&K 4955 microphone, with a self-noise of 5.5 dB(A). It is observed that, even with this lower-noise model, the residual-noise measurement reached the electrical-noise floor at frequencies above 1 kHz.

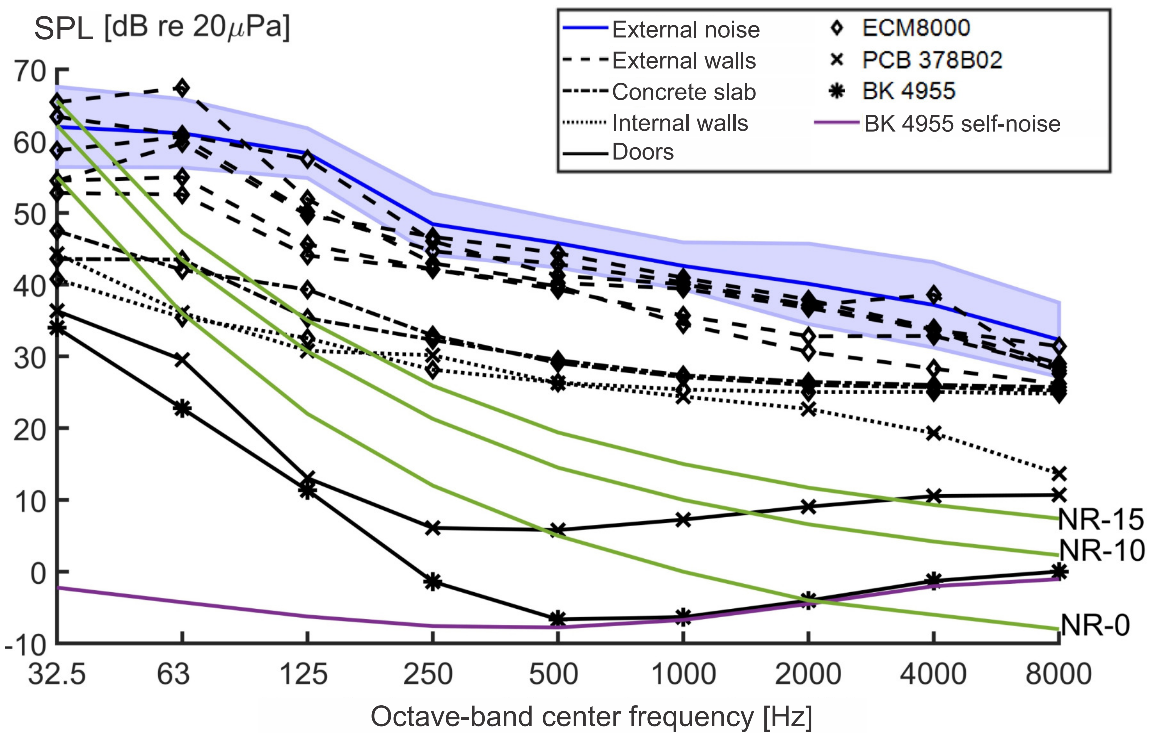

Figure 3: Residual noise measured throughout the construction of the SEC using three different measurement systems. For reference, the NR-15, NR-10, and NR-0 noise rating curves are shown [2].

4. The "Sound of Silence"

The residual noise measured in the SEC with the low self-noise microphone was only 5.7 dB(A), an exceptionally low value. For comparison, the sound of a leaf falling to the floor in a quiet room can reach approximately 10 dB(A). However, after accounting for the noise generated by the measurement system itself, we estimate that the true residual noise in the room is close to 0.8 dB(A), a level that is nearly imperceptible to the human ear.

These results indicate that the residual noise inside the SEC is below the NR-10 noise rating curve and, therefore, meets the recommendations of ITU-R BS.1116-3 (an international standard for critical listening rooms) [3]. Disregarding microphone self-noise, it is possible to state that the residual noise inside the SEC is below the NR-0 curve. In other words, the residual noise inside the SEC is below the threshold of human hearing, making it an ideal environment for precise audio evaluations and acoustical research.

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5. Conclusion

The SEC represents a milestone for acoustics research in Brazil. The room exceeded the technical requirements for sound insulation and residual noise level, providing an environment of near-absolute silence. This “sound of silence” is essential for advanced audio/acoustics research and for the evaluation of sound reproduction systems, ensuring that every nuance of sound can be perceived and analyzed with accuracy and precision.

Now that the SEC is complete, our focus turns to the next step: internal acoustic treatment, which will adjust the reverberation time and make the room even more versatile. In the near future, Unicamp’s SEC will be ready to become a national reference for acoustics research and development, providing an environment in which silence speaks louder.

5.1 Funding

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