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Room- and electro-acoustic design for a club size performance space

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Traditionally performance of acoustic music has required a somewhat large volume to achieve appropriate acoustic conditions. Therefore it has been difficult to make a concept with an intimate club, with audience at tables etc., for both acoustic and reinforced music. When the Finnish Musicians' Union decided to invest in a club venue in Helsinki, the requirement was that the venue should provide excellent acoustics for everything from chamber music to reinforced music. This paper describes the functionality planning as well as the acoustic and electro acoustic design of the venue as well as some background for the design of electro acoustic enhancement systems.

1 Introduction

The G-Livelab in the center of Helsinki, is a live club or event center, built on the ground floor of an existing building.

The club is owned by The Finnish Musicians' Union and hosts music events as well as other cultural events, such as film screenings and conferences.

The space is used for both acoustic and reinforced music, essentially everything from classical music and jazz to rock and electronic music. In other words, acoustic conditions of the space must be very adaptable, so it was decided from the beginning of the process, that an electronic enhancement system would be necessary.

Furthermore, the G-Livelab is located next to a rather busy street with both trams and heavy lorry traffic. This, combined with the fact that there are apartments right across the street, made sound isolation a vital part of the design.

The performance area of the club is about 190 m^2 and the total area of the venue is about 265 m^2.

Akukon was responsible for both the acoustic as well as the performance systems design. This paper will focus on the acoustic design of the venue.

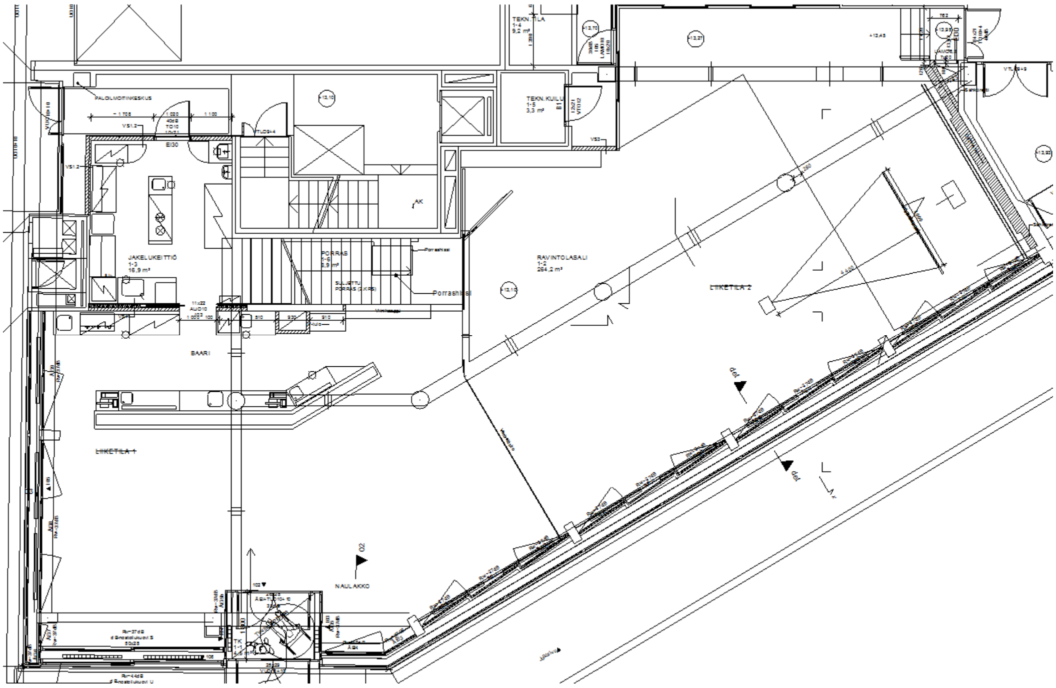

Figure 1: Basic layout of the club

2 Acoustic design of the G-Livelab

2.1 Starting point and goals

The wide range of the intended use of the G-Livelab as well as the limitations of the space, set significant challenges for the acoustic design. The principle dimensions of the space are 21 m long, 11 m wide and height of about 3 m. Also, as can be seen from figure 1, the space is very asymmetrical. From the start all surfaces except for the facade window, was concrete.

The space as such is not ideal for essentially any sort of performance. It is too low to achieve any sensible natural acoustics and too long and asymmetrical for a traditional sound reinforcement system. For this reason, it was decided from the beginning to design the space with an acoustic enhancement system and a distributed sound system layout. Hence, the main goal for the room acoustic design was to ensure that the reverberation time (and thus gain) was sufficiently short.

Sound isolation was yet another issue to be dealt with from both the airborne and structure borne perspectives. For example, there is an apartment in the building across the street and the Finnish legislations for noise caused by music etc. are quite strict. Also, the tram traffic on the street outside presented a challenge. It was clear from the beginning that it was not possible to do anything to any potential structure borne noise, but the façade had to be designed to minimize the airborne noise. As it turned out, the structure borne noise was not problematic since the rest of the building are offices, so sound isolation inside the building was not that critical, however, to enable daytime use some measures had to be taken.

2.2 Room acoustics simulations

The space was modeled using the Odeon software [1] to check out the different interior design solutions and different layout possibilities.

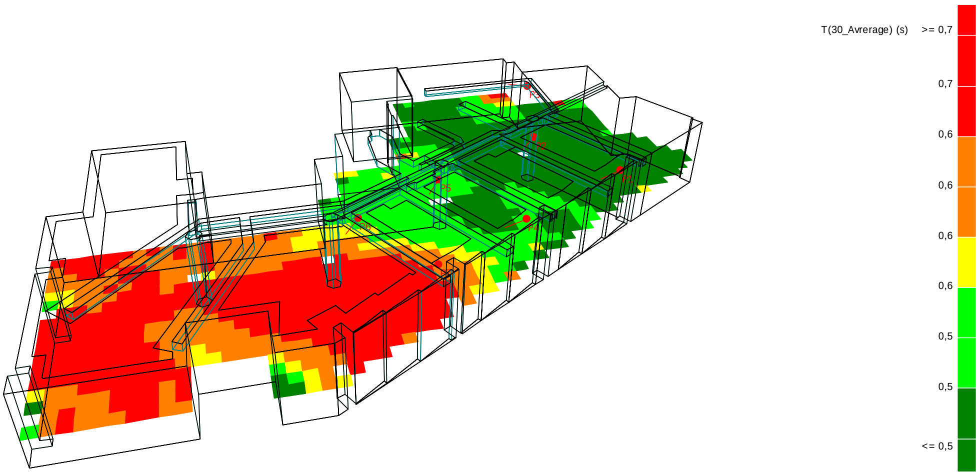

Figure 2. Calculated reverberation time in the empty club with the window curtains open. The reverberation time variates between 0,5 – 0,7 s between the stage area and bar area.

2.3 Room acoustic design

As mentioned earlier, the space needed to be well damped to optimize the acoustics for the electronic enhancement system as well as for normal reinforced music performances. As the height of the space is not very large and most of the acoustic absorption would have to be placed on the ceiling, avoiding flutter echoes and similar effect which can create localization problems in a highly absorptive room, was also some significant design criteria.

The main part of the absorption is placed on the ceiling. This was designed to be as broadband as possible, within the limitation of the height and the amount of HVAC and other installations. Furthermore, heavy curtains were designed along the façade windows and around the stage area. This was to enable some optimization of the acoustic conditions on the stage in accordance to the different bands.

The reverberation time of the space can be slightly enlarged by removing the curtains. The wall and window surfaces are designed slightly diffusing to avoid flutters etc. Furthermore, the stage rear wall is designed as a slightly diffusing brick structure and the ventilation units was also chosen to give some diffusion.

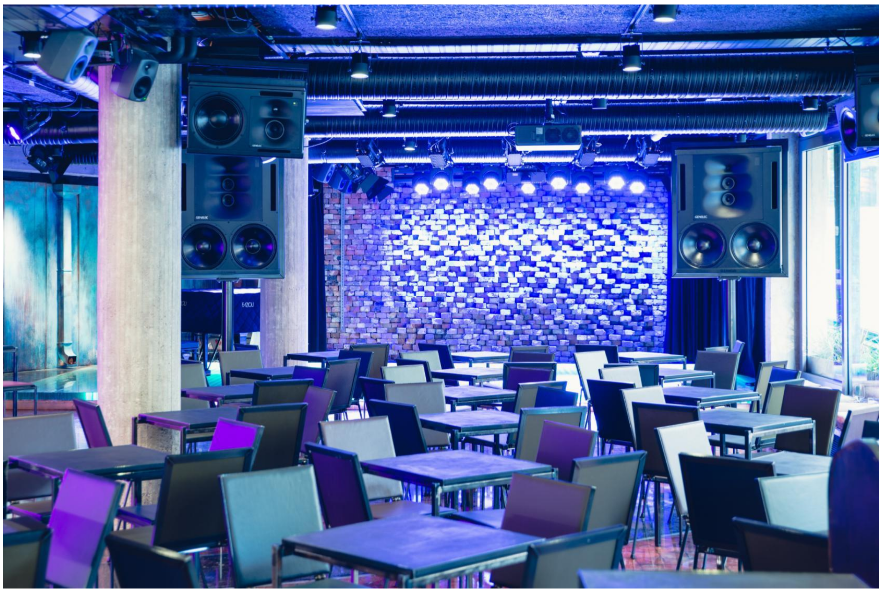

Figure 3: View towards the stage, with brick rear wall (Photo by Genelec)

2.4 Sound isolation planning

To preserve the visual impact of the space, the shop-style window towards the street was preserved. To ensure sufficient sound isolation, both from the club to the neighbors and from the traffic (the trams) to the club, a heavy laminated glass was added on the inside of the existing glass. As the void had to be ventilated, it was possible to use plants etc. as absorption between the inner and outer glass.

Because of the limited height of the space, the sound isolating ceiling structure had to be done with minimal height vibration isolators. The sound isolation to other spaces in the building was also improved by installing heavy doors and all shafts were closed with concrete.

Figure 4: View from the back with façade window and “absorption plants”

2.5 Sound systems design

The basic concept for the sound system design is a distributed loudspeaker system, provided by Genelec.

The main loudspeakers are two Genelec 1236A-loudspeakers and seven Genelec 1237A delay- and fill-loudspeakers. A separate surround system is done with 6 Genelec 1237A-loudspeakers. The electronic enhancement system is done using 42 pcs Genelec 8430A loudspeakers.

The sound system is mainly digitally distributed but also contains a possibility for an analog split. The Musicians Union also operates Radio Helsinki, which has its studios a few floors above the club, and thus this means that it is very simple to make live broadcast for the club.

There is an infrared system for hearing impaired, which can also be used for conferences etc.

2.6 Electroacoustic enhancement system

It was decided from the very beginning of the design that the only sensible way to provide appropriate acoustic conditions for the wide spectrum of performances planned for the club, was to use an electronic enhancement system.

It was also decided to use a custom or proprietary system, based on the work done at the Aalto University and Genelec speakers.

As mentioned above, the reproduction system consists of 42 loudspeakers. The sound input to the system is picked up 6 DPA microphones above the stage.

The reverberation is produced by a network feedback delay network (FDN) which consists of delay line and all pass-filter units. In this installation a total of 64 delay lines are used.

Within the system of reverberation, the reverberant level as well as tonal balance of the reverberation can be adjusted. The system is fed both by the microphones above the stage but can also be fed from the mixing console, making it possible to make “artistic virtual acoustics”. This has been used surprisingly often by bands using electronic reinforcement.

Fixed setting is provided for acoustic pop/jazz music, classical music and reinforced music. The sound engineer can however change the settings, also in real time during a performance.

3 Conclusion

Overall the club has received very good reviews and has become very popular both with musicians and the audience. The acoustic enhancement system is used for nearly every performance, either as a stand-alone system or as an extension of the reinforcement system.

The sound isolation structure has worked as designed, there has been no complaints from any neighbors and when in the club, you can see the trams but not really hear them.

Currently a similar club is being planned in Tampere in Finland and interest for the concept has also shown from other countries.

It is worth noticing that using a proprietary enhancement system has some challenges, concerning maintenances etc. which should be considered before starting such project.

References

[1] Odeon A/S. Odeon Room Acoustics Software. URL: http://www.odeon.dk/

[2] Lokki, T. and Hiipakka, J., "A Time-Variant Reverberation Algorithm For Reverberation Enhancement Systems," In *COST-G6 Conference on Digital Audio Effects (DAFx-01)*, pp. 28-32, Limerick, Ireland, December 6-8, 2001.

[3] Max 7, Cycling ’74, https://cycling74.com/products/max