LOST IN TRANSLATION: A STUDY OF MUSICAL LANGUAGE AND ENGINEERING DESIGN

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1. INTRODUCTION

The success of any project truly depends on how the unique challenges associated with the project are managed and dealt with. When dealing with a client with a musical background, the acoustic engineer is then faced with the challenge of translating the subjective metrics as described to them by the client to the objective metrics needed to proceed with the design of a treatment regime.

1.1 Musical Language

The term "Musical language" is used in this paper not refer to a language based on musical sounds such as Solresol[1], but refers to the language used by individuals to describe various traits or characteristics of music or sound. This language has also been described as "The Language of Musical Acoustics"[2].The variance in terms used is partly due to our own unique perception of sound and our own experience. Our interpretation of what we hear is described in words that relate to the sound, and since these words are based on our own experience, they are therefore subjective by nature; pertaining to the experience of the individual.

Terms like "dry" and "dead" may essentially describe the same characteristic, but is that characteristic what the client intends to communicate? There are other terms that are commonly used but much less descriptive, but if one was without experience with a sound containing these characteristics, there would be an inherent difficulty to understand descriptions that make use of these terms. Moreover, even if one does have experience, it may not be how that individual would describe the characteristic of interest. It has been said that a picture is worth a thousand words, but it could it not be said that a sound can be worth the same amount of words or more?

1.2. Engineering Design

Before we actually perceive a sound, it is just pressure fluctuations about a mean atmospheric pressure, which oscillate in frequencies that change over time. We may describe a sound differently, but in the end, it is still the same sound. If a specific sound is measured by a device such as a sound level meter, we would see that the same sound measured would always produce the same results, the same amplitude, and would have the same frequency response.

During the course of the design process, it is essential for an engineer to have quantifiable values, targets or objective metrics to use to guide them on the path towards a design solution. For the case of the client with a musical background, the subjective metrics can be somewhat abstract, but one needs concrete objective metrics to facilitate problem analysis and solution design. The language used in engineering is much more concrete in nature. Words like "Parameters", "dimensions" and "requirements" are used in the design process and more often than not, these words are followed by quantities, with units, making them measureable. The key to overcoming this language gap, and arriving at a solution, is the translation of the subjective metrics to objective metrics.

1.2. Example Project

This paper makes use of a project in which a room that has been re-purposed for musical rehearsal is assessed and a treatment regime is designed. The room is comprised of 4 parallel walls and one angular wall with a total volume of 507 m^3. The walls are treated with high frequency absorption (HF) panels; the ceiling is treated with angular diffusers, while the floor is linoleum on concrete. The band consisting of 15 to 27 musicians is comprised of brass, wind and percussion instruments are situated in a tiered fashion.

2. REQUIREMENTS

The general reports from the client and the band members was that the room was described as too "dry", too "live", "Muddy and too loud. The general consensus from the band and the conductor was that they all had trouble hearing instruments located further away from them and subsequently had difficulty playing in tune with each other. As design metrics the solution would have to decrease the muddiness of the room, increase blend and tonality, decrease loudness and increase ensemble. These metrics are completely un-achievable without more information.

3. METHOD

The initial assessment was conducted using accepted equipment and methods. The reverberation measurements were taken from 5 source positions per each of 6 receiver positions at 3 decays each. Erroneous measurements were completely discarded and the remaining results were averaged to obtain the reverberation time RT60 of the room.

Terms used by the client and the users of the room to describe issues with the room were researched to gain some understanding of their meaning. The existing treatment regime was examined for its effect on the room characteristic and the shape of the curve generated from the RT60 times at each full octave band was compared to the subjective metrics given by the client and the users of the room.

4. RESULTS AND DISCUSSION

As even the interpretation of both the subjective metrics given by the client and the interpretation of the results of the assessment is the opinion of this paper's author, they are themselves subjective, but are based on research and experience of the author. The reverb times for the room are shown in Figure 1.

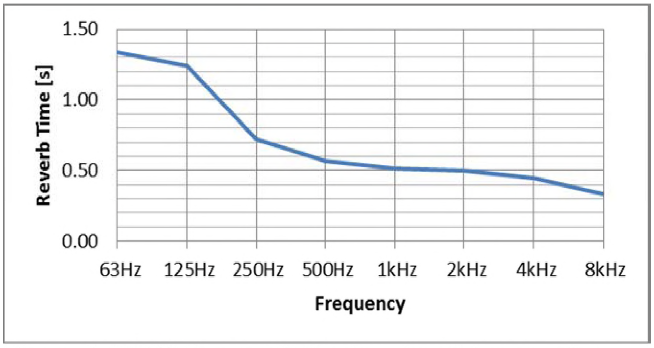

Figure 1. RT60 times at full octave band frequencies

4.1. Metric: Decrease "Muddiness"

Muddiness can be interpreted as the excess reverberation of the frequencies below 500 Hz when compared to those above 500 Hz, and therefore by this interpretation, it is clear from figure 1 that the room is indeed muddy as the low frequencies are over emphasized by the character of the room. To remedy this, HF panels would need to be removed and replaced with low frequency absorption (LF) panels as there are none currently in the room.

4.2. Metric: Increase "Ensemble"

Ensemble can be described as the ability of the performer's to play together as a cohesive unit[2]. This of course would depend on the ability of the musician to hear each other play. This interpretation is applicable as again the over treatment of the room with HF panels has removed the early sound, essential for the musician to hear each other as well as themselves. A proposed solution would be to remove more of the HF panels to increase the early sound so that the musicians could hear themselves more easily.

4.3. Metric: Increase "Blend"

Blend can be described as the mixing of sound produced by the different instruments so that they sound harmonious[2]. It could be said the lack of blend in this room is primarily a result of the lack of balance in the reverb decay times of the low frequencies vs. those of the high frequencies as shown in Figure 1. This lack of balance would be remedied by the solution proposed in section 4.2, allowing a more even reverb response in the room, increasing balance.

4.4. Metric: Increase "Tonality"

Tonality or tonal quality has been described as the accurate transmission of the sounds produced by the instruments[2]. The lack of tonality in this room can be interpreted as a direct result of the imbalance shown in Figure 1, and again would be remedied by the solution proposed in section 4.2.

4.5. Metric: Decrease "Loudness"

One interpretation is that the loudness or strength of sound in the room depends on the strength of the early sound, and the strength of the reverberant sound. As the walls were heavily treated with HF panels, it can be said that by the previous interpretation of loudness, the excess loudness is not a result of early sound, nor is it a result of reverberant sound when taking into account the results displayed in Figure 1. It would seem that the loudness was unfortunately a result of a large band, in a small room, but the solution proposed in 4.1 should also assist in lowering the overall level in the room.

4.6. Metrics: "Dryness and Liveliness"

To shed some light on the use of the clearly contradicting comments of the room being too live and too dead, the seating positions of the specific members were explored. The comment of the room being "dry" was given by a member seated next to a wall heavily treated with HF panels, and the comment of the room being too "live" was given by a member seated near the middle of the room. These reports were then seen to be a function of the seating position and the existing treatment regime, not a function of the room's overall characteristic.

5. CONCLUSION

This project presented unique challenges; the client was of a musical background and presented subjective metrics as requirements. These subjective metrics were compared to results of an RT60 assessment of the room and by using an understanding of the effect of different acoustic treatments, were converted into objective metrics to be used in the design of a treatment regime. This process allowed the client's requirements to be supported by experimentally determined objective metrics and ensured that the client's requirements were not lost in translation.

REFERENCES

1. François Sudre, 1827
2. Beranek L. (2004). "Concert Halls and Opera Houses, Music Acoustics and Architecture" 2nd Ed. Springer.

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